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2nd Organic Animal Husbandry Conference
Hamburg, Trenthorst, 12-14 September, 2012

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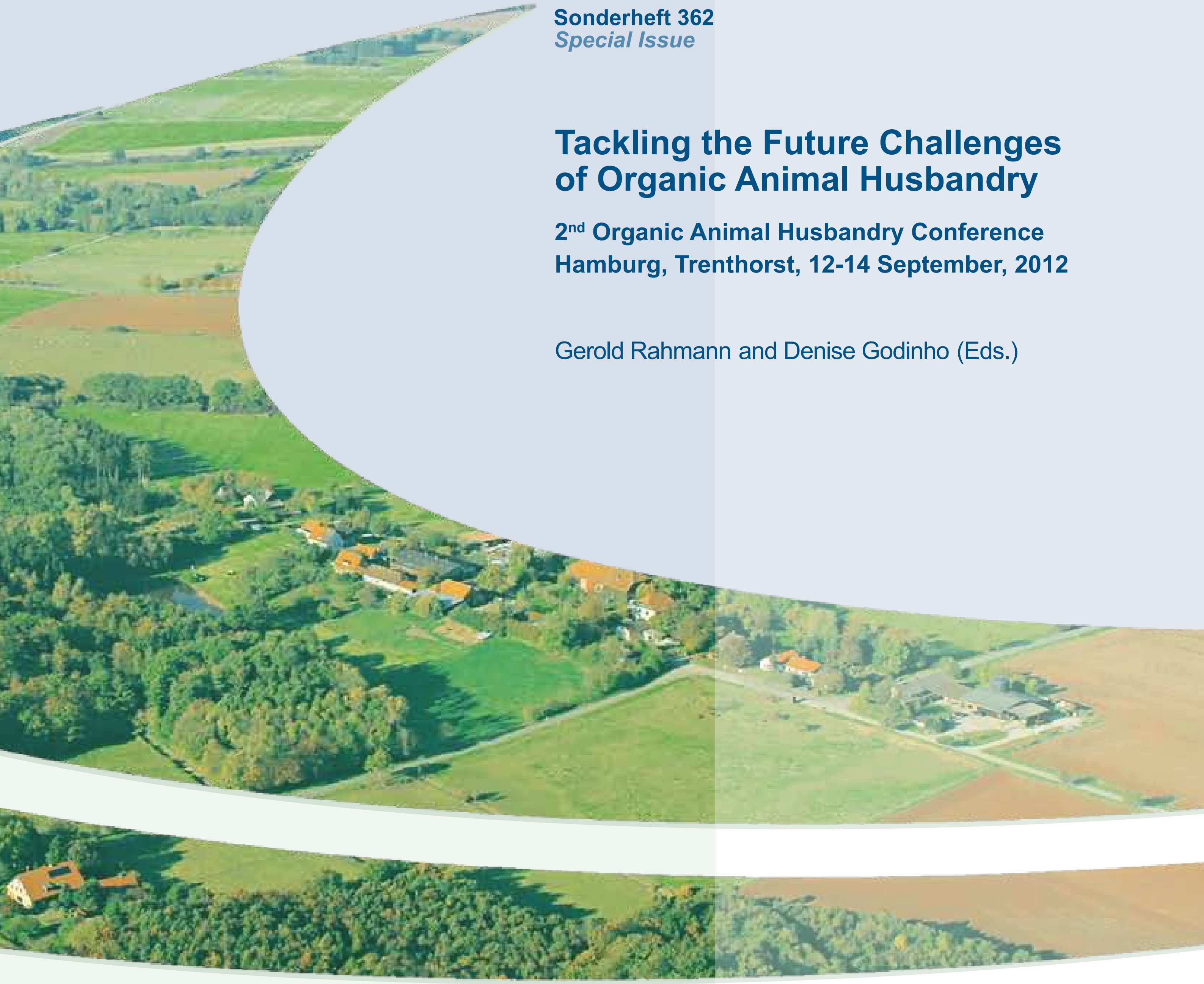

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Gerold Rahmann[1] and Denise Godinho[2] (Eds.)

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‘Tackling the Future Challenges of Organic Animal Husbandry’

GEROLD RAHMANN AND DENISE GODINHO
(EDITORS)

2nd Organic Animal Husbandry Conference

Hamburg, Trenthorst, 12-14 September, 2012

Foreword

Organic animal husbandry still needs a lot of scientific support

Organic farming is based on the idea of an environmentally-friendly food production system with high animal welfare standards. Nevertheless, reality shows many problems in reaching these goals. There are many problems in animal health and welfare that remain unresolved and present a challenge for individual producers and the industry as a whole. These include: achieving balanced, 100%-organic, feed rations that produce adequate growth rates and high product quality, animal-friendly transport and slaughtering, sustainable use of local resources and, last but not least, profitability and efficient use of resources.

Beside these internal issues organic farming is increasingly being asked to give answers to the main challenges facing humanity: food security and safety for an ever-increasing world population, climate change, increasing pressure on non-renewable resources (energy and crude fertilizer like rock phosphate), losses in agricultural and natural biodiversity and last but not least development of rural areas.

Organic Animal Husbandry does not always fulfil its promises

Animal welfare is a central objective of organic farming and one of the most important reasons why consumers purchase organic products. In 1980 IFOAM set out its objective of "providing farm animals with living conditions based on animal welfare and an ethical basis" This subsequently became incorporated into the European organic farming standards (as defined in 834/2007/EC). The reality, however, often differs from this aim.

- Hybrid poultry - bred for cages and intensive keeping – are kept on organic farms and often show severe difficulties in behaviour (including feather pecking and cannibalism) and health problems. Male chicks from laying hen populations are still killed instead of fattened. No farm-reared breeds of poultry or double purpose breeds are used because they do not fulfil the performance and production requirements of farmers. Poultry is still kept in large flocks, with several thousand animals in one barn.
- In pig production, the castration of piglets is an unsolved problem. Conventional pig production has forced the abolition of castration but this is causing problems in organic pig farming as it has an impact on farming practice (i.e. the keeping, feeding and housing of boars), the environment (i.e., the climatic impact of anaesthesia), profitability (i.e. production cost advantages, marketing sacrifices) and meat quality (i.e. odour, tenderness, juiciness, low intramuscular fat content). Another problem in this sector is the mortality rate of piglets, which is higher in organic than in conventional systems.
- Last but not least the organic dairy sector also experiences problems. The removal of horns from beef cattle is still widely practiced on organic farms. The life expectancy of organic dairy cows is no higher than in conventional dairy systems and the use of animal medications is not significantly less (although more natural medications are used). The tethering of cows is still permitted on small organic farms (with less than 35 cows) and is widely practiced. Milk production is still heavily reliant on the use of cereals, the organic ration can contain up to 40% concentrates: 50% in the high lactation phase and in practice even more.

Feeding livestock is one of the most difficult problems. As a consequence of the BSE crisis, omnivores, such as pigs and poultry, have been turned into „vegetarians/vegans" yet are still expected to maintain rapid daily weight gains (and therefore need a high level feed quality to ensure sufficient essential amino acids in the diet).

While conventional animal husbandry permits the use of synthetic essential amino acids, these are not allowed in organic agriculture. But plant based organic feeds have not closed this protein gap for fast-growing young animals like piglets and broilers as well as high yield animals like sows and laying hens. The "vegan" diets for these animals does not contain sufficient essential amino acids. However from the start of 2012, 100% organic feeding will be required by law in the EU, although the problem of how to close this gap has not yet been solved.

In can be concluded from the numberous status qou analysis in the last decade (mainly in Europe), that on many organic farms animal husbandry is unsatisfactory in terms of both animal welfare and production yields. This creates both an economic and an image risk.

How can science help?

Scientific support of organic husbandry has already achieved much in the past ten years. Animal research is a long and complex business. The organic animal husbandry research agenda should focus on the following issues

- Reducing the negative environmental impacts (CO_2 emissions, dust, smells, nitrates) from organic animal husbandry.
- Increasing the efficiency of the use of on-farm and local resources.
- Improving animal health and longevity
- Increasing product quality and production output per animal.
- Guaranteeing and securing competiveness on global markets.

The 2nd International Conference on Organic Animal Husbandry, held in September 2012 in Hamburg and Trenthorst (Germany) and organized by IFOAM, ISOFAR, Thuenen-Institut, and Senat Ressortforschung, is the following up of the 1st Conference in 2006 in St. Pauls (USA). This conference has discussed the future challenges of Organic Animal Husbandry and made suggestions for future development of a sustainable, profitable and animal friendly organic production of livestock products. This is a challenge. Solutions can only be found in an interdisciplinary system approach, together with scientists, farmers and consumers.

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On behalf of the Scientific and Organizing Committee:
Prof. Dr. agr. habil. GEROLD RAHMANN
DENISE GODINHO
Trenthorst/Bonn, September 12th, 2012

The 2nd OAHC: Background and Invitation

Building on the first IFOAM conference in the US in 2006, farmers and scientists had once again have the opportunity to exchange information and build new partnerships at the 2nd IFOAM International Organic Animal Husbandry. Although organic livestock production has made significant advances over the last few decades, navigating complex regulatory frameworks and dealing with other challenges facing the sector, organic livestock systems will benefit from an exchange at the international level. Key figures from around the world have been presented the diversity of organic livestock systems, including opportunities and challenges on the horizon.

The result of the discussions wants to recommend development paths for the future development of Organic Animal Husbandry in the context of the challenges of growing population, changing attitudes and expectations, limited resources and climate change.

The conference was organized by

(IFOAM: www.ifoam.org)

(ISOFAR: www.isofar.org)

(Federal Research in the BMELV:
www. http://www.bmelv-forschung.de)

(Thuenen-Institute: www.vti.bund.de)

2nd International Organic Animal Husbandry Conference, Hamburg / Trenthorst Sep 2012

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Keynote speaker:

• Fritz Schneider	Swiss College of Agriculture, CH
• Alan Savory	Savory Institute, US
• Alexander Müller	FAO, IT
• Andre Leu	IFOAM, AU

Content

Cattle and climate

(Foto BLE 2004)

Animal Husbandry and Climate Change in Organic Production Systems

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Introduction

The methane output from animal husbandry systems is considered a major contributor to global greenhouse gases (GHGs) emissions. The science on soil methane and soil organic matter is still in its infancy, with many unanswered questions due to the lack of research. This paper will look at some of the emerging areas of research that question the current models used to assess animal husbandry systems and show that extensive organic pasture based systems have the ability to be net sequesters of GHGs rather than net emitters.

Methane Emissions and Degradation

Historically, apart from a few exceptional events during geological time periods, the amount of methane in the atmosphere from the enormous herds of grazing animals on the prairies, savannahs and steppes, and from the decay of organic matter in the vast forests and wetlands of the planet was relatively stable until human activities over the last 200 years disrupted the natural cycles of methane production and degradation (Heimann, 2011, Murat A et al, 2011).

Studies by Hellebrand and Herppich (2000) and Levine et al. (2011) showed that a significant amount of methane is biodegraded in soils, and that this has been underestimated due to lack of research. A study by van Groenigen et al.(2011) shows an increase in methane output from soils when the temperature increases, however the Hellebrand and Herppich studies show that the increase in temperature will drive up the rate of biological degradation of methane by methylotropic bacteria and other methanotrophic micro-organisms. This could explain why historical atmospheric methane levels have been relatively stable, and also why naturally produced atmospheric methane levels may not increase as the climate gets warmer.

Many studies of methane production only calculate the methane produced by the systems as a one-way output into the atmosphere. This can be correct for some production systems, such as confined animal feed lots and garbage sent to land fill; however, it is not correct for most natural productions systems, such as animal grazing on grasslands, crop production on biologically active soils, orchards and forests, as these systems are based on cycles that also degrade methane. This oversight of the amount of methane that can be biodegraded by the soil or the oceans is a major flaw that needs to be rectified.

Until the decay cycles are properly identified, measured and modelled, the amounts of methane that are given out by animal husbandry systems are not an accurate measure of these systems methane's contribution to total GHGs.

The Need for Good Soil Management Practices to Reduce Methane Emissions

A study by Fuu Ming Kai et al. (2011) suggests that the recent reductions in methane output are due to changes in farming practices. This study adds to the data showing that there is good evidence of the potential to reduce the amount of methane in the atmosphere through good soil management practices.

Understanding these cycles and the biological conditions needed to biodegrade methane will give scientists and landholders a major tool to manage one of the most important GHGs.

Soils as a Carbon Sink

Carbon dioxide (CO_2) accounts for around 80 per cent of anthropogenic GHGs. Soils are the greatest carbon sink after the oceans. According to Professor Rattan Lal of Ohio State University there are over 2,700 Gt of carbon is stored in soils worldwide. This is considerably more than the combined total of 780 Gt in the atmosphere and the 575 Gt in biomass. (Lal, 2008) Despite the fact that soil has the potential to sequester more CO_2 than biomass, neither soil nor agriculture is incorporated in any formal agreement of the United Nations Framework Convention on Climate Change.

Grazing Systems

The majority (68.7%) of the world's 4,883,697,000 hectares of agricultural lands are used for grazing (FAO, 2010). There is an emerging body of published evidence showing that pastures and permanent ground cover swards in perennial horticulture build up soil organic carbon faster than any other agricultural system and with correct management this is stored deeper in the soil. (Fliessbach et al, 1999, Sanderman et al, 2010) According to Gattinger and colleagues (2011:16): '*Researchers working of the long term comparison trials between organic and convention farming systems in Switzerland (the DOK trials), found that when rotation phases that contained two years of deep-rooting grass-clover leys, that 64 percent of the total SOC* [Soil Organic Carbon] *stocks are deposited between 20–80 cm soil depths (Fliessbach et al, 1999)'*.

One of the significant reasons for pasture based systems being more effective in sequestering CO_2 is the higher proportion of plants that use the C4 pathway of photo synthesis. This makes them more efficient at collecting CO_2 from the atmosphere, especially in warmer and drier climates. According to Osborne and Beerling (2006:173): *'Plants with the C4 photosynthetic pathway dominate today's tropical savannahs and grasslands, and account for some 30% of global terrestrial carbon fixation. Their success stems from a physiological CO_2-concentrating pump, which leads to high photosynthetic efficiency in warm climates and low atmospheric CO_2 concentrations.'*

This knowledge is now being applied in innovative ways such as holistic stock management, evergreen farming, agro forestry in pastures and pasture cropping and has the potential to turn organic grazing systems into net sequesters of GHGs rather than net emitters.

Integrating Animal Husbandry into Farming Systems

In organic systems it is important to integrate animals into the cropping cycles, especially in broadacre systems where it is desirable to have a pasture phase in crop rotation cycles. This is starting to lead to innovative methods to integrate the pasture and cropping phases to ensure minimal soil disturbance and the maximum area of permanent ground covers. One of the best examples of this is pasture cropping.

Pasture Cropping

Pasture Cropping is where the annual crop is planted into a perennial pasture instead of planting it into a plowed field. This was first developed by Colin Seis in Australia. The principle is based on a sound ecological fact. Annual plants grow in perennial systems. The key is to adapt this principle to the appropriate management systems for the specific crops and climates. In Seis's system the pasture is first grazed with sheep using holistic management to ensure that it is very short. This adds organic matter in the form of manure, cut grass and shed roots and significantly reduces the competition from the pasture when the cash crop is seeded and germinates. The crop is directly planted into the living pasture, rather than the pasture being eliminated through extensive plowing or killed with herbicides.

Research by Dr Christine Jones at Colin Seis's property shows that 168.5 t/ha of CO_2 was sequestered over 10 years. The sequestration rate for last two of the ten years (2009 and 2010) was 33 tons of CO_2/ha/yr (Jones, 2011). This system can be and is being successfully used in both arable and pastures systems including horticulture. If this was applied around the world, it could potentially sequester 82 Gt of CO_2 annually. (4,883,697,000 ha X 16.85 tonnes = 82 Gt)

This significantly more than the world's GHG emissions of 49 Gt and would help reverse climate change. The increase is soil carbon will also significantly improve the production and adaption capacities of global grazing systems. One of the very significant sections of the data sets that are emerging from the research into this system has been the impressive increase in soil fertility with only a minimal input of a small amount of phosphorus. There has been no need to add large amounts of synthetic fertilizers to achieve good yields. The following increases in soil mineral fertility have occurred in 10 years: calcium 277%, magnesium 138%, potassium 146%, sulphur 157%, phosphorus 151%, zinc 186%, iron 122%, copper 202%, boron 156%, molybdenum 151%, cobalt 179% and selenium 117% (Jones 2011).

The crop yields from this system are equal to the district conventional farming averages with the added advantages of extra income from grazing as well as significantly lower costs in preparing the ground for cropping, savings from not using synthetic fertilizers and herbicides and the cost of not having to re-sow the field for pasture.

Conclusion - The Urgent Need for More Peer Reviewed Research

The current models for analyzing the GHG output of animal husbandry systems, especially extensive grazing systems need to be seriously questioned in the light of the new research on soil methane degradation and soil carbon sequestration.

It is unfair and also unscientific to start introducing mitigation schemes that reduce stock numbers or tax the emissions from livestock until the science has been properly researched. The critical issue here is that urgent peer reviewed research is needed to understand how and why these systems sequester significant levels of CO_2 and biodegrade methane and then look at how to apply the findings for scaling-up on a global level in order to achieve a significant level of GHG mitigation. The potential of these agricultural methods is enormous, considering that these data are based on current practices.

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Using Workhorses in agriculture: Farming of yesterday or of tomorrow?

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Abstract

Using of draft animals in agriculture is in the first world a kind of "out of fashion", because using of tractors is faster. Is this the true? No, said the results of some new current results: A tractor compact soil 40 % more then workhorse, even the tractor is lighter (Strüber 2010). The harvest is on a horse managed field 15% higher as on a tractor managed field. The use of workhorses help to reduced the consumption of diesel up to over 50%. The efficiency of workhorses in comparison with other renewable resource such as those plants like corn or canola is on a higher level. (Bender & Jackson 1982, Zimmermann 1992).

The problem: In countries with high – level labour costs, the use of animals can be more expensive as a tractor. Using of animals is more designed to a small farm as to big farms.

The use of animals is not "out of fashion", but the problems need to be founding answers. The challenge is the economic situation. Small farms are better designed as big farms for the horse power system and it's difficult to earn enough money from a small farm. The CSA system is a possibility for small farms, but eventually not enough to run a farm only by horse. Complete new ideas like a "Co²-Certificate" can help to bring more horsepower as today on the farms. If this happened, the soil quality is getting better by less fuel consumption. This is a goal which is worthwhile, for us and our children.

We have decided on our farm, that we try this way.

Introduction

Organic farming needs a balance between ecology and economy. Some of the main challenge on the ecological side is energy and soil pressure. Here have workhorse's good aspects:

- The soil pressure by using workhorses in vegetable production is less as using tractors.
- The following energy aspects are good. We produce 1, 5 ha vegetable only powered by two horses.

The main challenge in using of horses is the fact, that we need more manpower as with tractor using. On little land dimensions, is it ok, but with bigger fields, it's virtually impossible to use horses: The cost of labour are high.

Germany is a land with a high level for cost of labour and the price for food is low. Making money by farming means big farms, also in organic farm systems. If we want to bring the key benefits of working horses into the agriculture of Germany and central Europe, we need small farms.

To create an economic proper situation for organic small farming powered by workhorse is here the necessary goal.

Results

Large scale changes of soil

A long term research (Cooperating partner for this research: University of Kiel, Germany, Prof. Dr. Horn) over 6 years on our farm shows, that "horse land" over 40% more air spaces have as "tractor land". Therefore we use exclusive horse in vegetable production on 1, 5 ha since 2006 and the soil is getting better. The same research shows average 15% more crop on "horse land". On our farm with 600 mm rain in a year we need no soil irrigation for the vegetables, because the water-holding capacity is good by using horse.

Figure 1. Different yields of crops in potatoes (*Solanum tuberosum*) (deci tons)

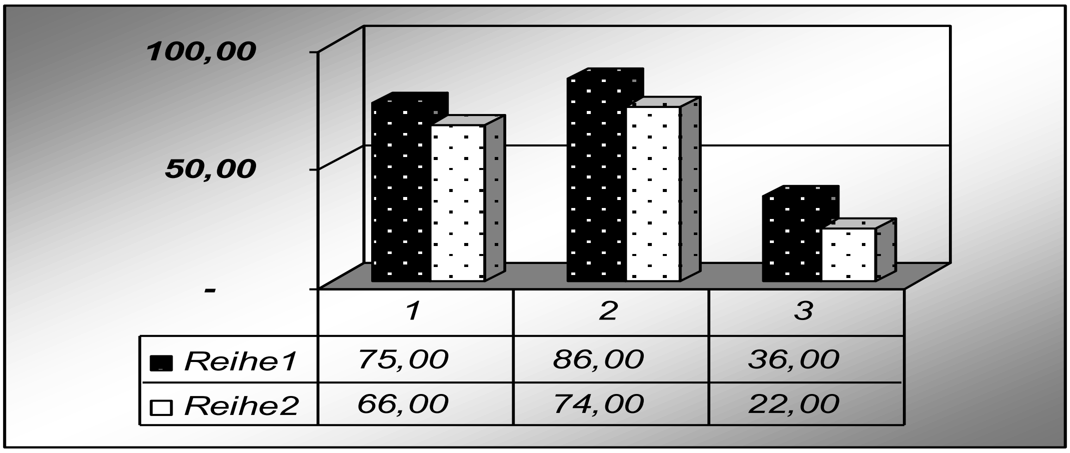
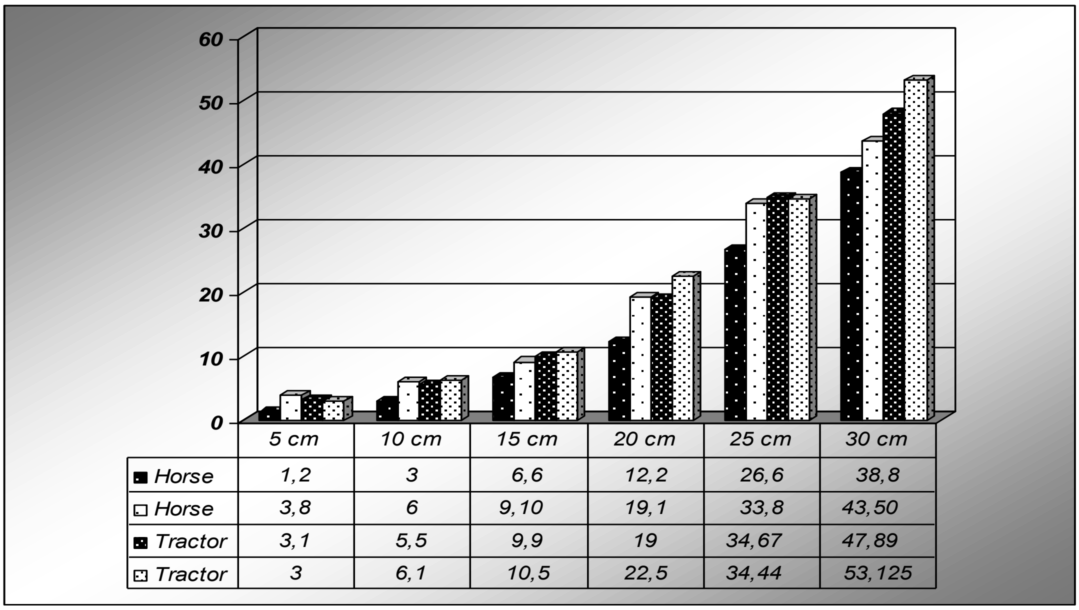


Figure 2. Different soil pressure situations



After 6 years using of horses for vegetable production we see on our farm a good development of the soil.

Energy capability

Our farm has 22, 5 ha land, both pasture and arable farm land. A part of 1, 5 ha are for vegetables, and this land is managed only by horse, without any fuel. The rest of the farm needs in 2005 (without horses, only with tractor) round about 2000 l fuel in a year. Now, when 60% of the field work is done by horse instead of tractor, we need more then 50% less fuel as 2005. We can't use more horsepower, because the cost of labour for the essential manpower is too high. Horses can help to reduce fuel consumption in organic farming.

Economic challenge

As we see, in countries with high – level labour costs like Germany, the use of animals can be more expensive as a tractor, item after drawback costs for diesel and capital investment for a tractor.

Using of animals is more designed to a small farm as to big farms. In countries with much tractor input in agriculture it's difficult to established a horse powered farm. How we can design economic situations for small farms?

Worldwide situation

"One of biggest advantages of animal power is that it reduces the drudgery and increases the productivity of poor, smallholder farmers. It is extremely important to focus on poor people and how they could benefit from animal power in a realistic timescale. Unfortunately, the poverty focus is often lost as animal power is widely perceived as old-fashioned and outmoded. As countries urbanise and industrialise, national figures and even provincial politicians fail to see the value to local people of using work animals. Politicians, advisors, government officials, NGOs and aid donors can all gain popularity by offering modernisation and tractorisation." (Citation by: P. Starkey, 2010).

Economic approaches

Using workhorses in agriculture have essential ecological assets. It is therefore a system create for the future of our planet. But which economic models are right for the workhorse (and all other draft animals)? Here is one answer, which already are reality on our and other farm.

Community Supported Agriculture (CSA) is a system that allowed a prise fixing for food between the farmer and his farm consumer. On our farm we discuss all the challenges of horsepower farming with our consumers and find a price, which help us to realize a big part of our visions. But we can't set too much financial pressure only on the consumer. The financial power of CSA-projects alone is not strong enough to run our farm only with horses. Here is another answer, not today realize, but a future project.

The use of horses helps to reduce carbon dioxide, CO_2. The CSA system too, because the consumers of CSA –projects need less package and the farm products were transported only on short distances. A model of a "CO_2-Certificate" can be an opportunity to bring new proceeds for eco-friendly farms. This idea is not ready discuss, but we think, it's one of the ideas with a great potential.

Horses are multifunctional. Among farming they can logged in the forest, transport people and material and much more. The big scale of benefits allows also additional funds; depend on the special situation from the singular farm. On our farm we discuss horse logging in the winter time.

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Emissions of greenhouse gases from dairy farms – a case study using the German agricultural emission model GAS-EM

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Abstract

The model GAS-EM was used to calculate the greenhouse gas (GHG) emissions from the dairy cattle husbandry of four organic and two conventional farms in northern and southern Germany. Emissions from enteric fermentation, manure management and grazing were included. Results lie between 3779 and 5060 kg $CO_{2\text{-}eq}$ *cow*$^{-1}$ *a*$^{-1}$ *or 0.54 and 0.96 kg* $CO_{2\text{-}eq}$ *kg ECM*$^{-1}$*. GAS-EM can be used to calculate GHG-emissions of single farms, but a refined methodology would be desirable so that all data available at the farm level (e.g., share of concentrates) could be included. At the moment the algorithms of GAS-EM cause in some cases substantial differences between the survey and model in the share of concentrates. The adequate modeling of feed flows and qualities is fundamental for a realistic calculation of dairy farm GHG-balances. The modular structure of GAS-EM, due to the aims of the model and the specifications of the IPCC (1996), makes it difficult to calculate a comprehensive GHG-balance of a dairy farm.*

Key words: GHG-emissions, dairy farms, farm comparison, model, GAS-EM

Introduction

GHG-emissions associated with dairy cows form a large part of agricultural GHG-emissions. By modeling the GHG-emissions of single farms, farm-specific potentials for the reduction of emissions can be explored. The model GAS-EM was developed to calculate agricultural GHG-emissions at the national and regional level for the German National Emission Inventory. The aim of our study was to examine the suitability of GAS-EM for the calculation of GHG-emissions from single dairy farms and to investigate farm differences in GHG-emissions.

Material and methodology

In the project „Climate effects and sustainability of organic and conventional farming systems" 20 conventional and 25 organic dairy farms in four different regions of Germany were studied in the years 2008 to 2010. On each farm samples of feed stuffs and manure were collected and analysed. Extensive data on feeding, housing, herd management and manure management were collected in interviews with the farmers. Milk production data were taken from the monthly milk recording. Six farms were chosen from the 45 project farms: two extensive and two intensive organic farms and two intensive conventional dairy farms. The GHG-emissions were calculated for the years 2009 and 2010 for these farms with the dairy module of GAS-EM, so the emission sources enteric fermentation, housing, grazing and manure management could be included. Additionally the mean GHG-emission values of the respective districts for the year 2009 were compared with the farm values. Characteristics of the six farms are given in Table 1. The main manure on all farms, apart from Farm 11, was slurry, which was stored mainly in open tanks and spread by broadcasting.

Table 1. Characteristics of the six studied farms

Farm System region[1]	10 Org B	11 Org B	13 Org B	20 Conv B	73 Org N	85 Conv N
Farm size [ha]	43	55	36	59	1299	153
Herd size [cows]	42	18	44	57	234	77
Breed[2]	Si	HF	Si	Si	HF	RH
Milk yield [kg ECM a^{-1}]	4243	5156	6937	8000	8598	8610
Prod. herd life [a]	3.33	4.90	3.26	1.69	2.26	2.35
Grazing summer	half-day	half-day	night	none	whole day	half-day
Share of concentrates [% in DM]	12	5	16	27	34	30
Housing[3]	FS	DL	FS	FS	FS	FS

[1] B: Bavaria, N: Northern Germany (Baltic Sea) [2] Si: Simmental, HF: Holstein Friesian, RH: Red Holstein [3] FS: Free stall with slatted floor, DL: Deep litter

The model GAS-EM has a modular structure. Emissions are calculated in defined categories in compliance with the specifications of the IPCC (1996), that is according to animal groups (e.g., dairy cows, other cattle) and not as per farm branch or product. A detailed description of the calculation procedures is given in Haenel et al. (2010) and Roesemann et al. (2011). The amounts of feed consumed are calculated based on animal performance and energy contents of the feedstuffs. Due to the design of the model for national calculations (and the limited data availability at this level), data on amounts of feed or share of concentrates that are collected on farm can not be included directly; these values are modeled by GAS-EM.

Results

The modeled amount of concentrates lies in most cases below the input data (Table 2). In half of the farm years the difference is no more than 0.5 kg DM cow^{-1} d^{-1}, in the other cases it amounts to up to 2.4 kg DM cow^{-1} d^{-1}. The modeled amount of forage is usually lower than the input value, up to 5.9 kg DM cow^{-1} d^{-1}.

Table 2. Mean energy content and daily amount of feed, comparison of the input and output data of the model GAS-EM

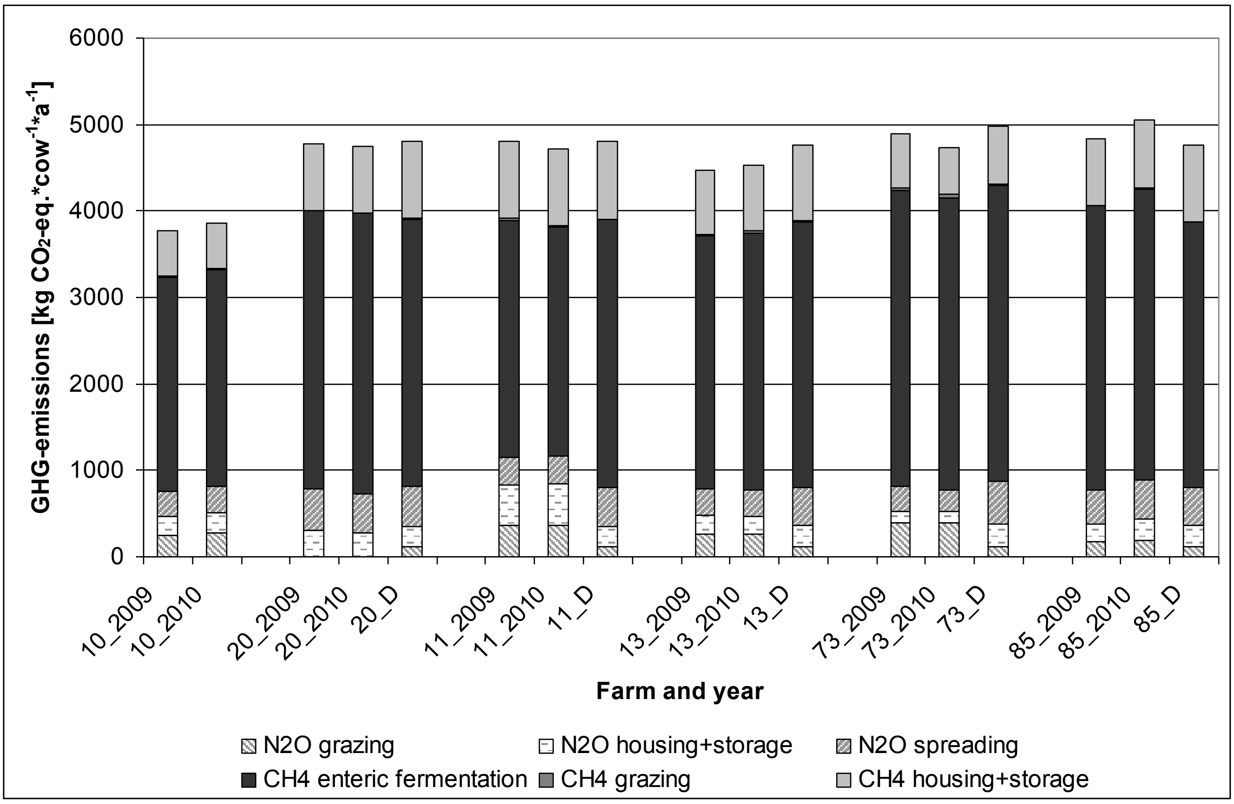
	Energy content[1] [MJ NEL kg DM^{-1}]		Amount[1] [kg DM cow^{-1} d^{-1}] of concentrates		forage		Share [% DM] concentrates	
Farm_year	conc.	forage	I[2]	G[3]	I[2]	G[3]	I[2]	G[3]
10_2009: org	8.1	6.4	0.7	0.2	14.2	13.6	4.9	1.4
10_2010: org	8.1	6.4	2.5	0.4	12.5	13.5	16.7	3.0
11_2009: org	8.5	6.1	1.1	1.1	17.2	14.0	5.8	7.1
11_2010: org	8.8	6.1	0.8	0.4	17.4	14.1	4.4	2.5
13_2009: org	8.5	6.3	2.8	2.9	19.4	13.5	12.5	17.8
13_2010: org	8.5	6.6	3.1	2.2	19.1	14.4	14.0	13.3
20_2009: conv	7.9	6.3	6.1	5.0	14.5	12.7	29.5	28.4
20_2010: conv	8.1	6.3	5.8	5.0	12.9	12.8	30.9	28.0
73_2009: org	7.8	6.5	5.7	4.6	14.1	13.9	28.7	24.9
73_2010: org	8.1	6.6	7.0	4.6	10.4	14.0	40.2	24.8
85_2009: conv	7.9	6.5	5.4	5.1	14.2	12.7	27.5	28.4
85_2010: conv	7.6	6.5	5.3	5.6	13.4	12.8	28.3	30.5

[1] NEL: Net Energy Lactation, DM: dry matter [2] I: Input data for GAS-EM [3] G: Output data of GAS-EM

This reduction of feed amounts by the model can be explained by the more precise inclusion of animal requirements in GAS-EM than was possible during the plausibility check (comparison of feed ration and milk yield), which was conducted after the on-farm data collection. The changes in the feed amounts modeled in GAS-EM lead sometimes to conside-rable differences between input and model values in the share of concentrates.

The per cow GHG-emissions of the Intensive Dairy Farms 13 to 85 and the Extensive Deep Litter Farm 11 are on the same level, between 4531 (13_2009) and 5060 (85_2009) kg $CO_{2\text{-eq}}$ cow^{-1} a^{-1}, and differ by no more than 13 % (Figure 1).

The other extensive farm (Farm 10) shows clearly lower per-cow GHG-emissions. Reason for the higher values of the Extensive Farm 11 are the higher GHG-emissions from its deep litter system compared to the slurry systems of the other five farms. GHG-emissions in relation to milk yield range from 0.54 (73_2010) to 0.96 kg (11_2010) $CO_{2\text{-eq}}$ kg ECM^{-1}. These results agree with the findings of other studies (de Vries et al., 2010), but are on a lower level, as some emission sources are not included in the dairy module of GAS-EM. The farms with higher milk yields have lower GHG-emissions per kg ECM than low yielding farms when regarding solely the emissions from manure and enteric fermentation.



D: mean value for the respective district for the year 2009; the farms 10 and 20 are located in the same district, so the district value is given only once

Figure 1. GHG-emissions from selected sources of six dairy farms calculated with the model GAS-EM

Discussion

GAS-EM can be used to calculate GHG-emissions of single dairy farms. But to do so the model should be refined, so data (e.g., share of concentrates) which are available on farm can be incorporated directly into the model. The sometimes large deviance in the share of concentrates between model and survey is problematic when detailed equations based on feed properties are used to calculate emissions from enteric fermentation.

Besides, the modular design of GAS-EM makes it difficult to calculate a comprehensive GHG-balance of a dairy farm. Important emission sources belonging to dairy cows indirectly (e.g., replacement animals, feed production on- and off-farm) are not part of the dairy module and can be included only with difficulty or not at all.

A comparison of the studied farms shows the importance of the level of milk yield, as the basis for the calculation of feed intake, and thus emissions from enteric fermentation and the amount of manure produced, for the GHG-emissions per cow.

Suggestions to tackle the future challenges of organic animal husbandry

To realistically and comprehensively estimate GHG-emissions from dairy farms, models should incorporate all relevant emission sources, including feed production off-farm, land use change and carbon sequestration. This is of special importance for organic farms, as they might have advantages in these areas. The adequate modeling of feed flows and qualities is fundamental for a realistic calculation of dairy farm GHG-balances. Calculation procedures with smaller uncertainties are desirable.

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Shades of green – Global implicatons of choises for dairy systems in the United States

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Key words: Dairy, Greenhouse Gas Emissions, Comparative Studies, Integrated Farming Systems, Methane.

Introduction

Conventional dairy production in the United States has intensified rapidly since the introduction of recombinant bovine somatatropin (rbST), corn-based Total Mixed Rations (TMRs) and the concentration of animals in freestall barns. These changes have been coupled with heavy reliance on drug-based therapies to combat disease and improve the efficacy of artificial insemination-based breeding programs, as well as the movement of cattle into facilities allowing little or no access to pasture. Over the same period, the demand for organic milk has grown rapidly in response to concerns related to the animal health and environmental impacts caused by intensified dairy production.

Studies have either directly measured or projected the environmental footprint of dairy farms. A controversial 2008 study concluded that high-production, input-intensive dairy farm management systems release fewer GHGs than organic dairy farms (Capper et al., 2008). Other studies concluded that organic dairy farms have smaller environmental footprint than conventional ones (Benbrook et al., 2010; Haas et al., 2001; Arsenault et al., 2009). Still other studies consider the differences in emissions by the two farming systems insignificant and inconclusive (Olesen et al., 2006).

The different results reached by past efforts to model environmental performance result from the assumptions made, factors and variables specified, the data used and how the results are reported. One major concern over the life cycle of the animals is their production of greenhouse gas (GHG) emissions. The GHG of greatest concern is methane (CH_4). Methane is 25-times more potent than CO_2 in terms of global warming potential. Cows emit methane directly through digestive processes (enteric) and indirectly by excretion (manure). Enteric methane accounts for most of the CH_4 emitted by grazing-based dairy farms, while manure methane can approach one-half of total methane on farms where manure is managed using daily flushes and anaerobic lagoons.

Methods and materials

The Shades Of Green (SOG) calculator is an Excel spreadsheet-based simulation model that projects the impacts of management practices on several indicators of dairy farm performance: milk and meat production, feedstuffs required, crop production inputs, cow health and longevity, several measures of milk production, environmental performance, and gross revenues. It is designed to compare the environmental footprint of dairy operations under scenarios that differ in one, a few or many parameters.

Unlike other models and studies, SOG takes into account the many impacts of dairy farm management on animal health, reproductive performance, and cow longevity, as well as financial performance. The structure and equations in the SOG calculator are fully explained and referenced in a user-manual document (Benbrook et al., 2010).

Four different farms were used to model the methane release caused by dairy production. Two were grass-based organic dairy farms, one was a hypothetical dairy farm designed and managed to minimize methane emissions per unit of milk produced, one reflected a typical high-production conventional dairy operation. Key characteristics of each farm are described below and summarized in Table 1.

Table 1. Key Variables of Four Scenarios

	Scenario 1 -- Double J Jerseys	Scenario 2 -- CA Cloverleaf Farms	Scenario 3 -- Reduce Methane Emissions	Scenario 4 -- Typical High-Production Conventional
Breed	Jersey	Crossbreed	Crossbreed	Holstein
Involuntary Cull Rate	9%	10%	6.5%	32%
Voluntary Cull Rate	17%	15%	20%	5%
Death + Downer Rate	2.7%	3%	2.5%	9.2%
Replacement Rate	28.7%	28%	29%	46.2%
Number of Lactations	6.3	3.7	6.8	1.85
Average Lifespan (years)	8.5	5.6	8.8	4.3
Unadjusted Milk Production (kg/cow)	18.4	18.8	29.5	34.0
Energy Corrected Milk (ECM)* (kg/cow)	22.6	21.5	31.8	33.5
Length of Lactation (days)	330.7	319.5	320.4	413.3

Full details on the four scenarios are accessible via the "Bansen-Burroughs SOG Application" on The Organic Center's website www.organic-center.org/SOG.

Scenario 1 reflects the 2010 production year on the Double J Jerseys Inc. farm in Monmouth, Oregon, an organic farm managed by the Bansen family. The herd is composed of Jersey cows that producing an unadjusted average of 18.4 kg per day over lactations spanning an average of 330.7 days. The farm makes heavy use of high-quality pasture and forages year round. The cows are fed limited grain in the summer months (6% of "Dry Matter Intake," or DMI), rising to 10% of DMI in the winter.

Table 2 Average Annual Methane Excretions per Lactating Cow

	Scenario 1 -- Double J Jerseys	Scenario 2 -- CA Cloverleaf Farms	Scenario 3 -- Reduce Methane Emissions	Scenario 4 -- Typical High-Production Conventional
Enteric Methane (kg/day)	0.34	0.27	0.44	0.47
Manure Methane (kg/day)	0.21	0.13	0.04	0.57
Total Methane (kg/day)	0.55	0.40	0.48	1.04
Total Methane kg per 100 kg of unadjusted milk production	3.01	2.10	1.64	3.05
Total Methane kg per 100 kg of ECM	2.45	1.84	1.52	3.09
Total Methane kg per year of productive life	277	190	228	585

Scenario 2 models the 2010 performance of the California Cloverleaf Farm (CCF), another grazing-based operation that milks mostly crossbred and Jersey cattle seasonally, drying the cows off during the winter months. Unadjusted milk production is 18.8 pounds per day, over lactations lasting 319.5 days. Grain accounts for 16% to 22% of DMI, with forages accounting for most of the rest of the animal's rations. Seasonal milking is reflected in the performance and age structure of the herd. Both organic farms maintain herd health through grazing and high-quality forage based feeds.

Scenario 3 represents a hypothetical farm designed and managed to minimize methane emissions per unit of milk production. Crossbred cattle are raised annually and are heavily reliant on high quality forages, but not to the degree present on the two pasture-based farms (Scenarios 1 and 2). Grain accounts for 14% to 19% of DMI, and concentrates add another 3% to 4%. The greater reliance on energy-dense feedstuffs supports a higher level of unadjusted milk production – 29.5 kg per day over lactations averaging 320.4 days. Solid manure is collected and composted, prior to field application, a management method that minimizes manure-methane emissions.

Scenario 4 captures the performance of a typical, high-production, conventional dairy farm with Holstein cows, a manure lagoon, and a nutrition program based on feeding a Total Mixed Ration (TMR) and corn silage year-round. Unadjusted average daily milk production is 34 kg per cow over lactations lasting 413 days on average. The hormone rbST is administered to sustain relatively high levels of milk production over extended lactations. Use of rbST is correlated with greater frequency of embryonic losses and spontaneous abortions, more frequent re-breeding, and higher involuntary cull and death rates than on the lower-production, pasture-based farms. Conventional dairy's annual culling rates run between 30 and 35% and are primarily involuntary (Knapp, 2010).

Pasture-based systems lead to higher quality milk. The study compares Energy Corrected Milk (ECM) as well as unadjusted milk production. ECM is a measure that adjusts milk production by accounting for the nutritional quality, based on variable levels of fat and protein in milk. By taking into account the nutritional value of milk, ECM offers a more objective way to compare the quality of different production systems, especially when comparing farms milking different breeds of cattle.

Enteric methane emissions from dairy cattle are projected based on milk production, DMI, forage amount in the diet, and measures of energy intake. The energy intake method recommended in the EPA's most recent national inventory of GHG emissions from agriculture (U.S. EPA, 2007).

Results and Conclusions

Table 2 shows that the organic farms used in the study have lower enteric, manure and total methane than conventional confinement systems. While the unadjusted emissions per unadjusted kg of milk are only about 4 g per 100 kg apart between Scenarios 1 and 4, there is over a half a kg per 100 kg difference when using ECM. The results suggest that CH4 emissions can be reduced by selecting breeds that have greater forage conversion efficiencies, and produce higher quality milk. While average daily production per cow will be markedly lower, so too will feed inputs and the wastes generated per cow. More research is needed to improve rumen performance, forage quality and nutrient balance needed to reduce enteric CH_4 emissions.

The model suggests replacing liquid manure systems with grazing and manure composting can cut manure methane as much as 10-fold. Farms that graze and manage dry manure most of the year can cut total methane per unit of milk production at least in half. Manure deposited directly on fields by cows essentially eliminates manure-methane losses. While some pasture-based organic dairies cut manure methane emissions by 90% compared to emissions with an anaerobic lagoon system, the average organic dairy likely reduces manure-methane emissions by around 50%.

Management practices to reduce stress, improve cow comfort, and permit natural behavior can result in better animal health and greater longevity. Reducing the involuntary cull, death and downer rates has the potential to cut the number of replacement cows needed by about one-half, from 50% or more, to around 25%. Each replacement animal will emit methane for two years prior first freshening. Greater longevity reduces CH_4 emissions over the life of the animal.

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An LCA based comparison of two different dairy breeds in an organic farm

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Abstract

In the experimental station of the Thünen-Institute of Organic Farming the dairy breeds Black Holstein (BH) and Red Holstein double usage (DU) are kept in separate herds under identical conditions. By means of a material flow FARM-Model, designed with the life cycle assessment (LCA) and material flow software Umberto, an assessment from cradle to farm gate of standard environmental impact categories was undertaken. As the model reflects real farming conditions the effects of changes in animal husbandry such as varying milk yield and herd structure can be assessed. But also the effects of changes in the crop yields or even crop failures can be shown in respect to their product related environmental impact. Therefore it is possible to express the environmental impact of a product as a range of the variable farming conditions and practices. For the three assessed years product related climate impacts vary as much as 11% which is more than the difference between the two breeds. Under identical management milk from BH, the breed which has the higher milk production potential, showed a preferable environmental performance in all studied impact categories.

Key words: milk production, farm-model, emissions, environmental performance

Introduction

Efficiency in terms of nutrients and production methods is one key aspect in reducing the environmental burdens associated with organic farming systems. Higher efficiency on the farm itself may however lead to offsetting mechanisms along the production chain, for example by the production of concentrate feed in other parts of the world or by increased energy demand. Therefore tools are needed to analyze the efficiency of farming practices and their off-site effects to evaluate change and development in farming conditions on a farm specific level.

In order to improve existing agricultural systems they must be analyzed in regard to their overall performance as well as to the individual performance of the different farm parts. Via a LCA-FARM-Model developed at the Thünen-Institute of Organic Farming the environmental burdens associated with the production of sellable products such as milk and also the environmental performance of e. g. self-produced fodder on the local level can be assessed.

Material and methodology

The FARM-Model is based on the flow-software Umberto, structured hierarchically and controlled by parameters. These input parameters are data that can easily be obtained in real farming conditions such as crop yields, crop rotation schemes, manure management practices and additional inputs with a market value like mineral fodder, fuel and electricity or special materials for silage making. The parameters for the animal husbandry include the herd size and structure, milk yields and feeding regime.

In order to evaluate emissions from farming practices common assessment schemes from published sources have been used. Green house gas emissions have been calculated according to the rules in IPCC (2006) and Rösemann et al. (2011). Emissions from manure management have been calculated with the formulas published by Amon et al. (2006). Emissions from the combustion of fuels were calculated based on the GEMIS database (Fritsche, 1999). To assess processes upstream the production chain datasets from the ecoinvent database v2.2 (Hischier et al., 2010) have been used. Effects on common impact categories are addressed by e. g. global warming potential (GWP), photochemical ozone creation potential (POCP), euthrophication potential (EP) and acidification potential (AP). The methodology of the assessment is based on the requirements and guidelines of the international standards ISO 14040 and ISO 14044 (ISO, 2006a, ISO, 2006b).

Table 1. Crop yields in the experimental station of the Thünen-Institute of Organic Farming in the dairy cattle section [t ha-1, cerals 86 % DM, forage crops ~35% DM)

Crop	2008	2009	2010
Pea/Spring barley	3.01	-	-
Oat/Bean	2.24	1.66	1.4
Clover/Grass (1st & 2nd year)	32.1	35.6	28.2
Maize	-	18.1	11.7
Triticale	2.6	3.09	1.83
Wheat	3.1	1.65	2.83

The experimental station of the Thünen-Institute of Organic Farming is located in Schleswig-Holstein, North Germany. The dairy breeds Black Holstein (BH) and Red Holstein double usage (DU) are kept in two separate herds under identical conditions. The fodder production is conducted in the experimental station on the same acreage with a 6-year crop rotation scheme that was changed in the crop year 2009. Table 1 shows the crop yields for the years 2008-2010. Fluctuating low yields are apparent.

Table 2. Milk yields and compounds and herd structure for the dairy breeds in the experimental station of the Thuenen-Institute of Organic Farming for the years 2009-2011

	DU			BH		
	2009	2010	2011	2009	2010	2011
Milk yield [kg]	6157	5639	6364	7621	6992	6833
Fat [%]	4.52	4.42	4.42	4.35	4.32	4.26
Protein [%]	3.31	3.28	3.38	3.07	2.99	3.07
Avg. Calves	22.72	25.66	18.83	23.00	23.64	23.11
Avg. Heifers	21.51	15.65	8.04	15.85	17.59	11.53
Avg. Cows	40.83	43.80	39.32	46.15	43.18	42.69

In order to reflect the feed flow in real farming conditions each crop year was combined with the following milk year. Table 2 presents the yearly herd size and structure for both dairy breeds as well as the respective milk yields and compounds. The reduction in herd size over time is due to experimental management decisions. Any surplus fodder from the dairy cattle section is not included in the environmental impact assessment of the milk production.

Results

In a product related assessment, in order to produce 1 kg energy-corrected milk (ECM), the BH herd performs better in all assessed impact categories in all years under study. The difference between the herds is highest in the year with the highest environmental impact in milk production (Figure 1). The crop year 2010, shown in Figure 1 for the milk year 2011, was also the year with the highest indicator values for environmental performance. However, as the crop yield from 2010 is fed in 2011 the aggravation in crop performance does not necessarily lead to an aggravation in overall performance in the environmental impact categories under study.

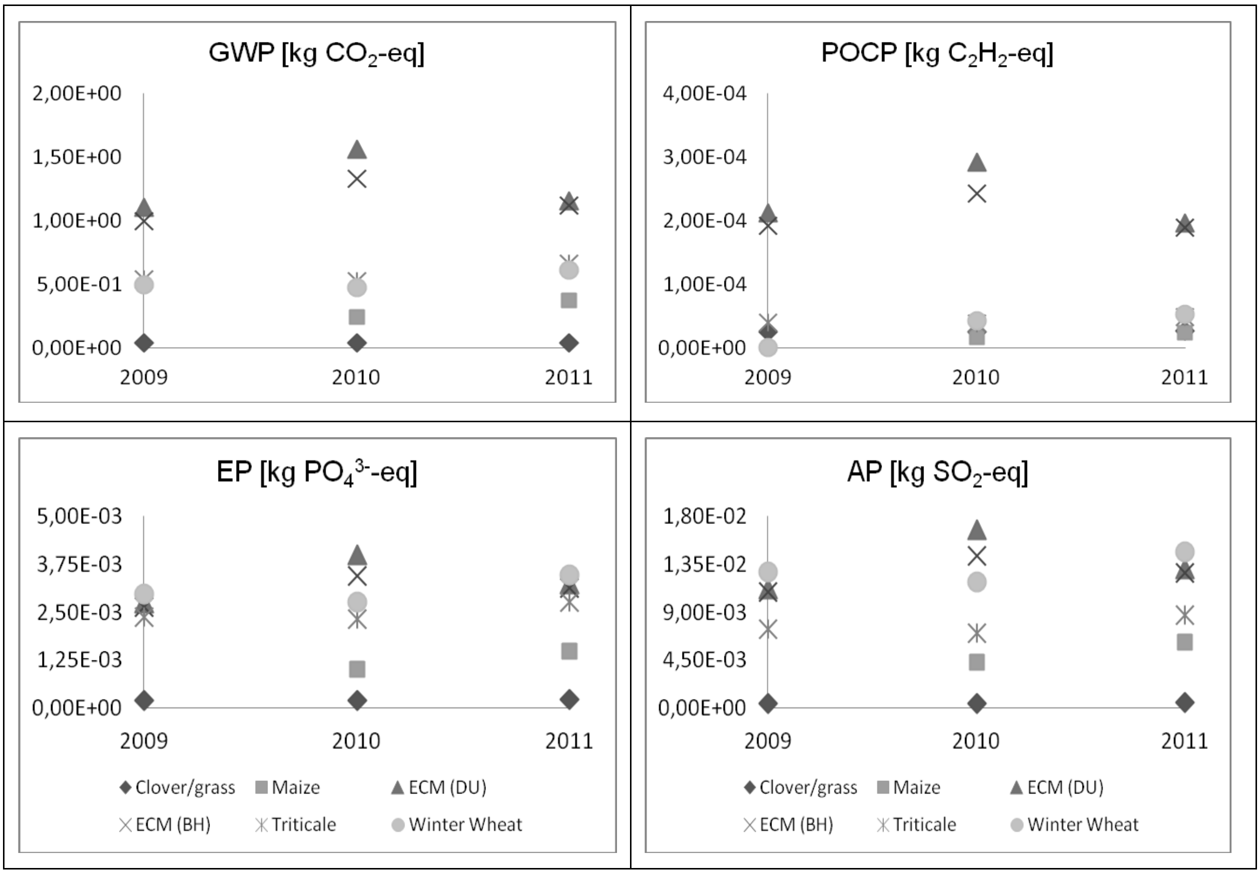

Figure 1. Associated environmental impacts of milk production of two different dairy breeds per kg ECM and of intermediate products per kg DM in selected impact categories in the cradle-to-gate assessment in the experimental station of the Thuenen-Institute of Organic Farming, 2009-2011.

In all impact categories the milk year 2010 performs worst. The variation in different milk years is higher than the difference between the two dairy breeds.

In regard to the crop production wheat and triticale show the highest environmental product related impact potential in all categories. This is due to the significantly lower yields compared to maize and clover/grass.

Discussion

Using the FARM-Model to analyze the dairy section of the Thünen-Institute of Organic Farming over three consecutive years showed a high variation of the potential environmental impacts of farm products and intermediate products. As changes in environmental burdens associated with yield fluctuations of intermediate products did not affect the performance of the milk production as much as anticipated it is probable that a change in herd structure masked this. Herd management may be one starting point for improvement. Further research on the local environmental performance in the different farm parts is needed as management practices towards sustainability and efficiency are developed. For the use of LCA to analyze and communicate the environmental performance of agricultural products, the volatility of the results as an inherent property of farming must be addressed.

Suggestions to tackle the future challenges of organic animal husbandry

Process and life cycle analyses of farming systems must be undertaken to get a complete view on global and local environmental burdens of their products and the related socio-economical effects of agricultural production lines. Due to its intensity animal husbandry has inherent energy demands in forage crop production and competes for cropland. Especially in dairy farming it is possible to rely on local feed and material flows and to minimize competition of human and animal nutrition by the use of permanent pastureland and forage legumes that are indispensable in organic crop rotations. In organic dairy systems environmental burdens can probably be reduced further by the minimization of the use of energy intensive forage crops as well as by upholding and improving proper herd management and forage quality. Breed differences in milk yield are determining the product related environmental burdens to a large extent and should be considered in future development of farms.

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Sustainability Indicators for Low Carbon Farming

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Abstract

This study with northeastern USA dairy farmers developed a self-assessment for indicators of sustainable practices. Farms involved used these indicators to guide management decisions, made significant improvements in stewardship practices which reduce environmental impacts.

The average size of the farms was 343 acres with 188 milking cows, represented approximately 12,690 acres, and managed a total of 11,400 head. Results showed a wide range of improved sustainable production practices in the areas of animal husbandry, biodiversity, community health, energy efficiency, farm financials, nutrient management, pest management, soil health, and water management. This work continues as an applied collaborative initiative being implemented by the "Caring Dairy" project in the USA and The Netherlands.

Significantly measureable changes observed included an increase use of cover crops and conservation practices; reduced enery consumption; water management and improvement in health status.

Key words: indicators, sustainable, dairy farms, conservation practices

Introduction

To be sustainable, practices must enhance the natural environment and herd health, support profitability and improve the quality of life for farmers and their communities.

The Dairy Stewardship Alliance (Alliance) Self-Assessment researched measurable indicators for continuous improvement in farming practices across ten areas. The Alliance was a 4 year collaborative effort between dairy farmers, the University of Vermont, Ben & Jerry's Inc., St. Albans Coop and Vermont's Agency of Agriculture.

For the farms involved, there have been significant improvements in stewardship practices. Support is provided for farmers to develop a better understanding of their production practices, explore alternatives and implement changes to improve the sustainability of their farm operations.

The opportunity of using these indicators to develop baseline measurements for carbon credits is leading to a new focus for further research. In the USA there is an industry wide effort to identify ways to reduce Green House Gas (GHG) emissions throughout the dairy production and distribution system.

Material and methodology

The self-assessment tool has 10 modules encompassing social, environmental and economic indicators which include:

- **Animal Husbandry:** Focuses on areas such as: herd nutrition, overall health, health of incoming and outgoing animals, milk quality, lactation management and cull rates, housing and handling areas, stalls, pasturing and milking equipment, parlor, and calf raising conditions.

- **Biodiversity:** Refers to all plants, animals, and microorganisms existing and interacting within an ecosystem. In an agriculture setting, this can be viewed in layers: microorganism living in the soil; native plants, crops, and trees growing on top of the soil; and insects, birds, and animals inhabiting the plants, crops, and trees.
- **Community Health:** Community health is defined as the strength of the community in which a farmer operates and their participation. Strong community relations and respect for agriculture can lead to a better quality of life for farmers. Research shows that the support received from a community can significantly impact a farmer's job satisfaction. Consequently, this module evaluates a farmer's working environment through two main criteria: community relations and protection of labor supply.
- **Energy:** Use of renewable and non-renewable energy are examined in this module. Non-renewable energy is an energy resource that is not replaced or is replaced only very slowly by natural processes. Primary examples of non-renewable energy resources are the fossil fuels—oil, natural gas, and coal. Renewable energy includes energy resources that are naturally regenerated over a short time scale and derived either directly or indirectly from the sun, or from other natural movements and mechanisms of the environment, such as: thermal, photochemical, photoelectric, wind, hydropower, photosynthetic, geothermal and tidal energy. This module provides iinformation on how the dairy farmer can benefit from managing their energy use.
- **Farm Financials:** Farm Financials is a module designed to assess the financial performance of a farm enterprise. Through the use of key ratios, this section describes the merits of monitoring financial performance of the farms. Monitoring financial performance can help farmers control their costs for managing their businesses.
- **Nutrient Management:** Adopting best practices for nutrient management is important to maintaining ground water that is safe for drinking and surface waters that can support healthy aquatic ecosystems, function as industrial and commercial water supplies, and provide recreational enjoyment.
- **Organics:** Note: This module is not used in the ranking and provides information and a summary of the regulations rather than certification questions. Both organic and conventionally non-organic dairies were included in this research. Organic farms were those certified under the USDA National Organic Program. The USDA National Organic Program is defined in the U. S. Federal code and is the only legally recognized standard for organic products in the United States.
- **Pest Management:** After WW II, chemical pesticides such as herbicides, insecticides, fungicides, rodenticides, and plant growth regulators became a dominant approach to controlling and eliminating pests. Farmers are concerned regarding the use of pesticides as they have the potential to cause harm to humans, animals, or the environment because they are designed to kill or otherwise adversely affect living organisms. These concerns led to an approach called Integrated Pest Management (IPM), a strategy which focuses on long-term prevention or suppression of pest problems through a combination of techniques such as monitoring for pest presence and establishing pest threshold levels, using non-chemical practices to make the habitat less conducive to pest development, improving sanitation, and employing mechanical and physical controls. Elements of the IPM are integrated into this module.
- **Soil Health:** This module focuses on best management practices to maximize soil quality and health in order to improve production and minimize erosion and pollution to water or air. Recommended areas of management include monitoring overall quality, minimizing erosion, maximizing organic content and preventing soil compaction.
- **Water Management:** This module focuses on sustainable practices dairy farmers can use to minimize and prevent water pollution and, to a lesser extent, to promote appropriate water use.

General areas to be covered include preventing pollution from livestock yards, storage areas and milk house waste, general land management strategies and management of water use.

- **Rank Scoring:** After completing the first assessment, farmers each received a report with detailed charts showing how they scored in each of the different topic areas of the modules. Their first chart showed their individual farm results and the second chart presented their scores in comparison to the overall averages for all farms for each module area. In this way the farmer can see how they've scored in relation to all the other farms completing the self assessment.

The scoring was done reflecting the amount of sustainable practices are being used, with an evaluation and recommendations for practices in need of improvements to be more sustainable overall. The organic module is included for informational purposes as farms with a wide variety of farming practices were included.

Design and Process: Assessments gauging a variety of indicator criteria related to sustainability were conducted on dairy farms throughout the state. During this time, fifty-five (55) farms volunteered to become involved in the research being conducted by the Dairy Stewardship Alliance. Fifty-one (51) farms successfully completed a ten module self assessment inventory composed of 67 ranked questions on sustainability of their farming practices. Farmers then received a report ranking their results, identifying and providing a comparison of their results against all other farms completing the assessment. Seventy-two percent (72%) or 37 of those farms identified changes or improvements in their farming practices.

These farms then documented the changes made by completing the self assessment a second time. Farmers were provided a final report identifying the results of their first assessment versus their 2nd assessment for all modules, as well as a report of their ranked scores and changes compared to all farms completing the final assessment.

The initial time a farm filled out the assessment it was referred to by researchers as 'assessment one' or the 'Pre assessment' and correspondingly, the second time a farm fill out the assessment, the document was referred to by researchers as 'assessment two' or 'Post- assessment'. With a time gap of 12-24 months between the 1st and 2nd assessment, researchers were able to document a number of changed conditions/practices being reported on these farms. When taken in sum, an analysis of these findings indicates an increase in sustainability related practices/indicators has occurred during the project period. Data from these assessments tell an interesting story about practices on dairy farms and selected findings are presented below.

The assessment tool contained nine distinct modules (or categories) to be ranked as indicators, plus a tenth information module on organic farming practices to consider. Each module contained a series of 6-9 questions related to the module theme. Some questions were quantitative in nature and others qualitative. When assessments were collected from farms, answers to each of the 67 questions were ranked and assigned a quantitative value then weighted. When added together the values of these answers helped to create Module Index Scores (MIS) for each farm. A more comprehensive indicator score, Total Index Score (TIS) was created for each farm which consisted of the sum of a farm's nine individual MIS scores.

Post-test Results: Interpreting the values from the 2nd Assessments

When added together the value of the scores from each question within an individual DSA Module determines the module score. The value of these answers helped to create Module Index Scores (MIS) for each farm, which was shared with each farmer so they could see how they ranked themselves. As a more comprehensive indicator score, the Total Index Score (TIS) was created for each farm which consisted of the sum of a farm's nine individual MIS scores, allowing them to compare their overall results with those of all other farms involved.

Results

Overall, there were measureable positive changes in the scores for all modules between the pre and post-tests. Providing up to date information and education on sustainable practices for dairy farms was a secondary, underlining objective when designing the Diary Stewardship Self Assessment. It was extremely encouraging to see positive change over time in all areas of the assessment.
Across the farms making changes and completing the second assessment, researchers saw a 12.2 average increase/improvement in TIS between the 1st and 2nd assessment (186.5 and 198.7 respectively). The average total MIS for all farms increased by 1.35, however the level of change did deviate between different farms and across different modules. When looking at the average MIS, all of the modules except the Farm Financial module showed an increase. Farmers were more reluctant to share the specifics of their farm financial information. Therefore, the final edit of assessment changed the format of the Financial module to include a series of positive or negative responses to their record-keeping and financial analysis, rather than asking for specific financial indicators.
The most significant changes in conditions/practices were all quantitatively positive and were seen in the Animal Husbandry (+2.59), Water Management (+1.86), Soil Health (+1.81) , and Community Health (+1.71) modules.

Discussion

While the greatest change in conservation practices observed was found within the Soil Health Module, specifically an increase use of cover crops on farms, the process of self assesssment was, in itself, the most significant impact of this research on developing sustainable indicators for dairy farms. All of the farms involved are paying greater effort in observing conservation practices designed to reduce their carbon footprint and improve overall health of their animals. Researchers detected an increased use of, adherence to, and documentation of nutrient management plans.

Suggestions to tackle the future challenges of organic animal husbandry

1. Develop a matrix of low carbon farming practices with specific measurements of the sustainable practices being implemented and their relationship to reduced GHG emissions and increased carbon sequestration.
2. Develop information for module for indicating “carbon footprint”
3. Engage other University and Corporate Researchers in the use of Sustainability Indicators to reduce carbon footprint of livestock farming by emphasizing ecologically responsibility across the entire “value chain” from production to distribution to consumption and waste processing.

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Cows are not climate killers! The undervalued potentials of grass and grazers for nutrition

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Abstract

The Agricultural science and teaching is still based on a perception of growth, productivity *and* efficiency *which is externalizing social, ecological and economical costs. Industrial livestock production exacerbates the global food situation, since arable land is being used to cultivate animal feed rather than food for people: 40 percent of the world's grain harvest is fed to livestock, while one sixth of the world's population goes hungry. Nitrous oxide (N2O) is the largest agricultural threat to the climate - especially through intensive fertilization for cultivating concentrated feed. On average, 2-5% of nitrogen fertilizer is converted into N2O which damages the atmosphere 296-fold than CO2 (methane 25-fold). 75% of the total N2O emissions (and 90% of all ammonia emissions - NH3) in Europe are caused by livestock farming. But if ruminants graze on land that is not suitable for cultivation, they turn grass, hay and silage into milk, meat and draught power and increase the carbon-rich topsoil.*

Key words: sustainability, grazing management, soil fertility, protein resource, food security, climate change, land use change

Introduction

In the public debate, it has even become common to compare cattle with cars, to bash the first ones as climate killers. Cows burp methane into the atmosphere day after day. And methane, which is 25 times more harmful to the climate than CO2. But we need to distinguish between different agricultural systems: from eco-friendly and sustainable resource use and energy intensive industrial approaches.

The scientific and in the following the public view is limited to just one greenhouse gas – methane – and omits the much more important nitrous oxide, which is emitted through the nitrogen fertilization used for the intensive production of concentrated feed. So an agricultural climate assessment should include not only the negative effects (emissions) but also the positive ones: the storage of greenhouse gases is an intrinsic potential of sustainable land use.

This becomes only apparent when the carbon and nitrogen cycles are taken into full consideration. The decisive factor is whether the soil and, in particular, permanent grasslands are used sustainably.

It is rather short sighted to limit the discussion to the methane that comes from the rumen of cows and other ruminants Nitrous oxide (N_2O), not methane, is the largest agricultural threat to the climate. 75% of the total N_2O emissions (and 90% of all ammonia emissions -NH3) in Europe are caused by livestock farming – especially through intensive fertilization for cultivating concentrated feed.

Methane is 25 times more harmful to the climate than CO_2, but nitrous oxide, which is primarily released through nitrogen fertilization, damages the atmosphere 296-fold. On average, 2-4% of nitrogen fertilizer is converted into N_2O. The authors of the recently published 600 page European Nitrogen Assessment (ENA) argue that the role of NH3 (an indirectly operating GHG) needs to be taken much more seriously.

The differences in the intensity of livestock breeding systems are most evident in feeding: industrial livestock production demands more concentrated feed and this requires intensive fertilization which damages the climate. This further exacerbates the global food situation, since arable land is being used to cultivate animal feed rather than food for people: 40 percent of the world's grain harvest is fed to livestock, while one sixth of the world's population goes hungry. This diversion of soy, grain and maize to produce concentrated feed is what makes it possible to have such enormously high numbers of animals: nearly 1.5 billion bovine (including domestic buffalo), nearly 1 billion pigs and around 15 billion poultry. More than two-thirds of the protein-rich feed crops for livestock in the EU are imported: the damage to ecosystems and the climate not only occur where the animals are kept, but affects South America in particular, where much of the fodder is produced and rainforests are still being cut down, eventually to make way for arable land.

When intensively fed, cows and ruminants compete with humans for food. But this is not the case when they left are to graze using land that is not suitable for cultivation (or grass and clover from crop rotation). On the contrary, they turn grass, hay and silage into milk, meat and draught power.

Results

The positive climatic effects of sustainable grazing systems and particularly the contribution that grazing ruminants can make to the production of carbon-rich topsoil is entirely ignored. As most people are unaware that cattle can contribute to climate relief, my counter-thesis may be even more surprising: millions of cattle have the potential to act as environmentalists.

Discussion

Provided that grazing is sustainably managed, cattle also help maintain the biodiversity of the countryside. They keep these grasslands, grazing lands and steppe lands, which account for approximately 40% of the global land area, intact. Because of its vast scale, permanent grassland is the largest terrestrial carbon sink on the planet. The carbon is not only stored on the surface in visible gramineous plants, but also (and primarily) in the soil. From a climatic and soil fertility viewpoint it is not only important to maintain a dense and durable coverage of perennial grasses, which protect the soil from erosion.

Sustainable grazing management promotes biological activity (photosynthesis) so that through root development the amount of topsoil (which consists of more than 50 percent carbon) ultimately increases.

Suggestions to tackle the future challenges of organic animal husbandry

Cows, sheep and buffalo have a great capacity to convert pasture forage into milk and meat (and draught power) in symbiosis with the micro-organisms in their rumens. From this point of view, they are ingenious users of feed. They should be particularly pastured on areas that are not suitable for crops, such as pastures and grasslands, which can be protected from erosion through sustainable grazing.

The milk and meat from intensive production only appears to be cheap. The bill comes later. The loss of biological diversity, the ploughed grasslands and the associated CO2 emissions, as well as the cutting-down of rainforests for fodder production are all part of this bill.

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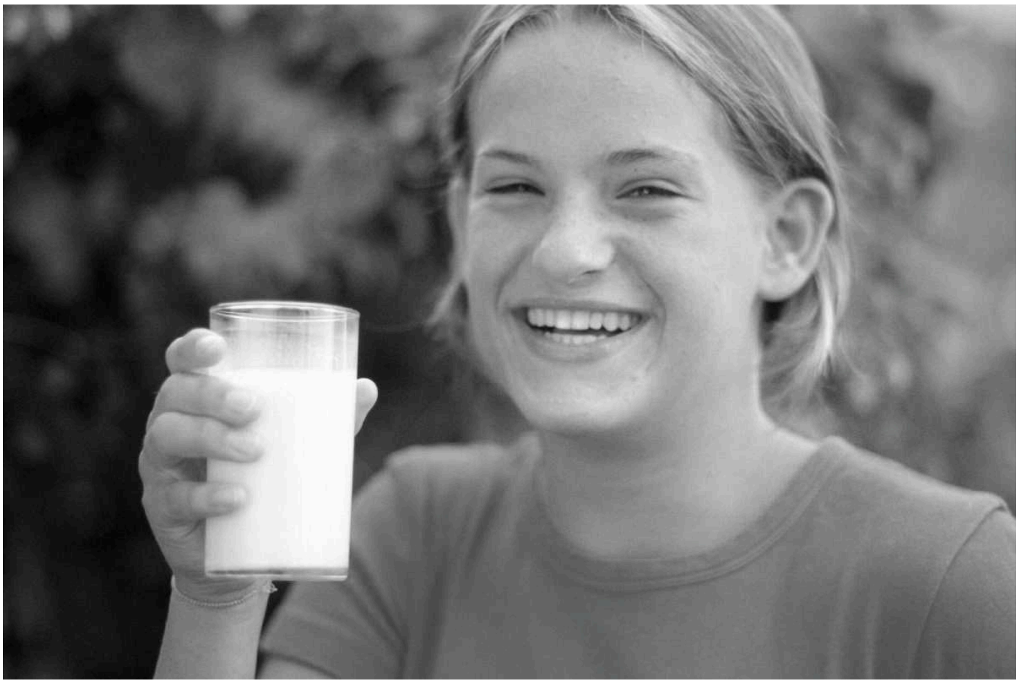
Future markets for organic livestock products



(Foto BLE 2004)

Food (meat) consumption and socio-econoic context of EU on PC versus alternative approach – PAHU

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Abstract

While the world population has doubled in the past century, its appetite for meat quadrupled reaching more than 225 million t. The presentation aims implementing developed PAHU method (Copyright©1989) to revaluating demographic structure, consumer and organic meat consumption projections of EU27, candidate states, its safety-efficacy as needed for the period of 1999/2010/2020. Also, the aim involves systematic attempts to create awareness of error inherent to PC (19.4 percentage unit). This includes food, other goods consumption, consumer evaluations and their impacts on society. The view is set on identifying the areas of scientific harmonization, qualitative and quantitative development including family-household evaluations of EU. Even if the focus is on projects, programs, food policies, organic meat consumption and production, it is important to understand their nutritional impact and their socio-economic relations. Factors affecting organic meat consumption are also discussed.

Key words: Per Capita (PC), Per Adult Human Unit (PAHU), Consumer, Demographic structure, Anthropometry

Introduction

Worldwide, PC meat consumption in 2010 was 41.9 kg; in developing world 32 kg and developed 80 kg respectively. Natural and organic meat production was only 1.1% of total meat production (Gossard 2003; EUROSTAT 2008). Past and future meat consumption cannot be accurately evaluated by using PC projections because it doesn't address detailed anthropometric criteria (Young/old and gender) differences. Last fifty years EU population has been in a demographic transition. These changes have implications for many facets of EU's economic life: food (meat), other goods consumption and services, workforce structure, retirement etc. Findings indicate that the consistency problems exist among EU states and its institutions due to different definitions and method assessments. Aiming to reduce the magnitude of errors inherent in PC meat consumption projections, developed PAHU method was used to eliminate the error bound "one-size-fits-all-accept or reject" approach of PC consumption evaluations.

Material and methodology

The demographic change is a future challenge to which the European economy does not appear to be adequately prepared and where significantly increased research and transfer of knowledge is required. EC (2008) reported that EU beef production for 2008 was 7.4 million tons and 619,000 tons was imported. One of the world's largest internal retail meat markets require EU action because it remains fragmented along national lines, forming 27 different minimarkets instead. EU's real consumer potentials have not been accurately determined. Thus, it is time to develop a new society-wide single composite indicator that describes welfare in more sophisticated way than old primitive economic measures in evaluating the meat consumption.

Concept and key innovations and method development criteria: When data are presented on the basis of PC-Defined - (Equal to each individual, per unit of population and/or for each person) for production and consumption of commodities (Including foodstuffs/meat).

The assumption is that 0-19-year old, (e.g. 6-month old baby) and 66 to 75+ year-old will produce and consume meat as much as a mature person (20-65-year old) man and/or woman. The use of PC to evaluate food produce, meat consumption predictions has rarely been directly challenged. The above assumption will lead to faulty conclusions in the kind of actions that are required by both developed and developing countries, (Hasimoglu 1984; 1989; 2000; 2010 and Prskawetz et al. 2007).

1. **Nutrition and Energy Expenditure for Human Productivity:** Method deals primarily with energy obtained from foodstuffs and may not be able to fix the total energy requirement for a standard reference individual. On the other hand minimal standard energy, called metabolic body rate (MBR), basal metabolic body size (BMS) or energy (BME) can be determined and calculated for each age group (5-year intervals) are selected as one of the method criteria.
2. **Age and Gender Structure of a Population:** Method design selected correlates to deviant anthropometry that includes defined age and sex structure and other factors (Body weight, height, body frame, environmental temperature etc.) affecting BMR are also considered and included in calculations. Anthropometric indices are essential for the interpretation of measurements: e.g., a value for body weight alone has no meaning unless it is related to an individual age, height and energy requirement.
3. **Scientific Findings and Calculation Procedure of PAHU:** BMR is the criteria used to calculate the PAHU conversion factors (Table 1.) for the different age and gender groups to standardize a population or a target group under one standardized unit, because BMR or metabolic energy is an essential part of human vitality and productivity. The formula and calculations were based on the long-term research findings and the mathematical equation representing the internationally well accepted model: BMR kcal) = 70 (W kg)0.75
4. **Selected Anthropometric Criteria:** In order to serve the purpose, age groups and their live weights are recalculated according to their heights for males and females from the values and tables given by different scientists. These values serve as guidance for calculating the energy needs for the age groups on their BMRs. An age group of 20-24 is chosen as a standard adult age group (Per Adult Human Unit or Reference Person) for both male and female because, up to this age, the growth based on bone and muscle, whereas weight increases after that age almost always represent fat. The calculated BMR values, 1694 kcal/d for males and 1319.3 kcal/d females, averaging 1528.7 kcal/d are very close to the values given by the literature. BMR calculated values are presented in Table 1. for selected each age group.

Results

Through the expansion of EU to 27 members where each member is evaluated individually over ten years, (Addition of 106 million PC and 89.5 million PAHU), its population increased to 480 million PC and 406 million PAHU in 2010. With the expansion of EU to 29 [EU-27 plus Croatia and (Turkey-if accepted until 2020)], PC and PAHU numbers will reach to 561 million and 469 million in the year 2020 respectively. EU27 is one of the largest meat/organic meat consumer markets of the world after China and India.

In addition, the calculation of the PAHU of the German population indicates that consuming and/or producing 81.1 and 81.4 million PC populations for the years 2010 and 2020 respectively, would be reduced down to standardized 69.2 and 68.3 million PAHU populations with a difference of 17.2 and 19.1 percentage unit from PAHU respectively, indicating an increase in ageing population and reduction in the birth rate. The methodology underlying the PC estimate is an indirect procedure of arriving at a conclusion by disregarding not only the young but also the older proportion of a population with energy intakes above their requirements. Further graphic analysis made by using Table 1. BMR kcal requirement values against age groups, clearly illustrated faulty and deleterious assessments. These deleterious assessments are not less than 7.6 percentage units for the age group less than 20 and 11.8 percentage unit for the age group 25 and over respectively, totaling not less than 19.4 percentage units for each PC as compared to PAHU. Germany's meat consumption for the year 2007 on PC was 84.2 kg., (EC 2008). However further graphic analysis made by using BMR kcal requirement values for the age groups showed faulty and deleterious assessments (7.6 <age 20 + 11.8 > age 25 =19.4 percentage unit), so PAHU meat consumption value calculated to be 100.5 kg /PAHU.

Table 1. Calculated Conversion Factors of the Age Groups

Age Groups	Calculated average BME[3] requirements kcal / day	PAHU	Conversion	Factors
		Male	Female	$\bar{X}$
0-4	438.9	0.262	0.317	0.287
5-9	781.4	0.461	0.572	0.511
10-14	1147.4	0.672	0.848	0.751
15-19	1492.5	0.974	1.091	0.976
20-24[1]	**1528.7**	**1.000**	**1.000**	**1.000**
25-34	1494.5	0.979	0.979	0.980
35-44	1452.0	0.950	0.950	0.950
45-54	1406.3	0.920	0.920	0.920
55-59	1354.2	0.870	0.906	0.886
60-64	1354.2	0.870	0.905	0.886
65-74	1222.6	0.800	0.800	0.800
75+	1095.3	0.719	0.713	0.716

[1] Standard PAHU (Age 20-24) for male and female BMR requirements are 1694 and 1363.36 kcal/d respectively, averaging 1528.7 kcal/d. [2]PAHU Calculation = Population of the age group x Age group's conversion factor. [3]BMR is the minimum energy cost of body process, that represents the excess of endothermic over exothermic reactions in the body.

Discussion

The EU currently has to cope with demographic decline, low natural growth and the ageing of its population. Gossard (2003) indicated that social structure influences on meat consumption. During the last decades, scientists have indicated that demography indeed matters but the implicit assumption of a constant age distribution of the population must be abandoned. Actions for stimulating organic agriculture and livestock production and controlling meat market volatility in both developed and developing countries are essential, but not sufficient. Evaluations should not be made on error bound PC basis to achieve food security in the increasingly complex EU and the international economic context because "Errors can not be corrected with the same error source." Building a mutually accepted sustainable and resilient evaluation thus using suggested PAHU as policy innovation may be essential for achieving and even eliminating hunger.

Suggestions to tackle the future challenges of organic animal husbandry

EU27 must be open to rethinking on how accurately the current methods (PC, Adult Equivalent, Consumer Unit, equivoque estimates) represent the true gender differences, the age structure of the real consuming population and must be open to monitoring. The economic crisis of EU started in 2008 and its economic growth evaluated on PC does not measure the quality of life and prosperity of population especially when the family and the household food (meat) consumption values are analyzed.

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Spanish organic livestock: Evolution from 2001 to 2010

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Abstract

Spanish organic animal production situation and its evolution have been studied. Using official data from the Ministerio de Agricultura (Agriculture Department), trends from 2001 until 2010 in number of farms, different livestock species and product orientation, pastures and forage surfaces have been analyzed. There is an important increase in number of organic farms (283%) and in pastures and forage area (316%). Regional distribution of production has been also analyzed, and some regions have a high importance in organic ruminant production. However, it depends on the product, and often each zone is important in products that are similar to traditional ones. We can conclude that organic production is increasing, and it is doing it in a sound way: to traditional way of farming. In a context of economic crisis, when organic products may have more difficulty to be sold, it is a very good tendency. Perhaps this is yet to be seen in the coming years, but it has had no effect until now.

Key words: organic, livestock, Spain, traditional farming

Introduction

Spain is the first country in European Union if organic agriculture area and number of farms are considered (Agence Bio, 2011). More than a half of surface is pastures and forage: 829.273 ha in 2010, 50% of 1.650.866 ha in organic agriculture (Ministerio de Agricultura, 2012).

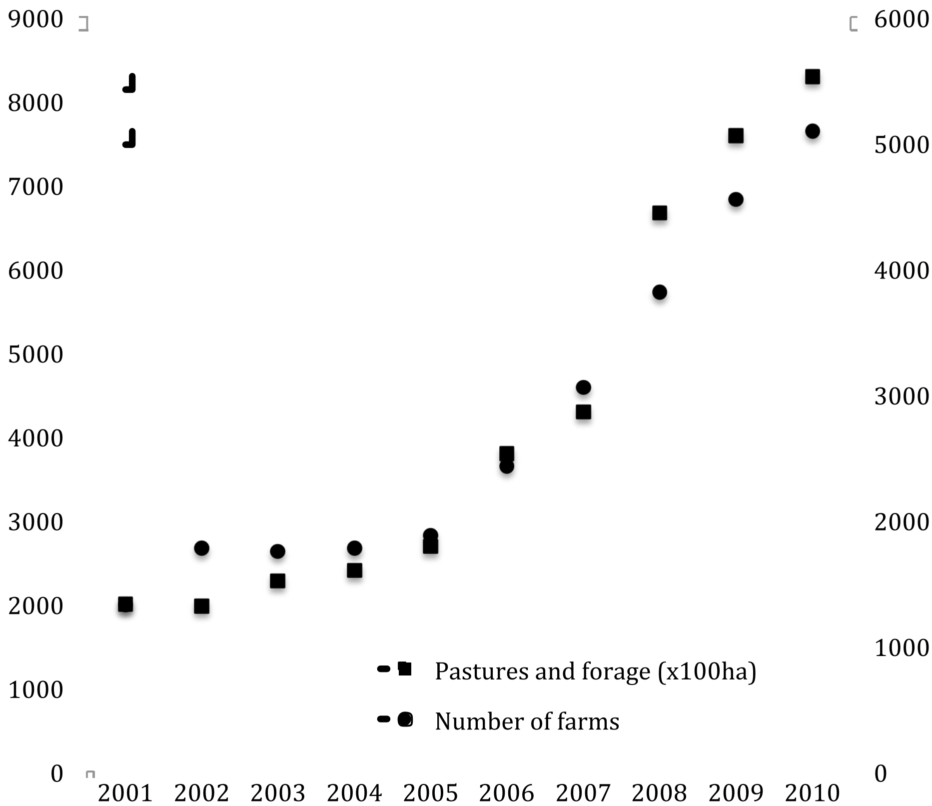
Traditionally, extensive livestock has occupied important areas of Spain, especially central and western Spain (dehesa system: pastures and *Quercus* trees for grazing) and in the north of Spain, where a most humid climate allows a higher pasture production. Agricultural areas have also been used for small ruminants in traditional farming. These areas and these systems may develop organic systems and give quality products.

Methods and materials

Official data from the Ministerio de Agricultura (Agricultural Department) from 2001 to 2010 have been used: number of farms and of heads in every species and product orientation, surface of pastures and forage, and regional distribution.

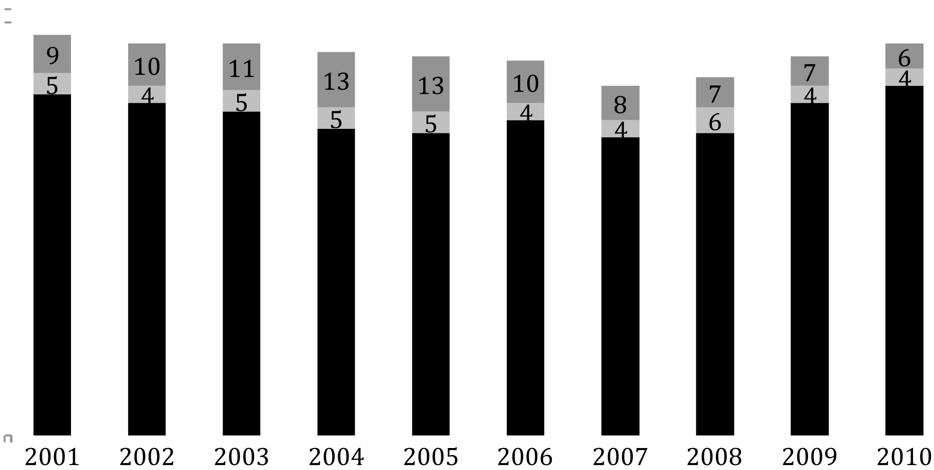
Results

The number of organic farms has increased by 283% in last 10 years, and pastures and forage surface has also increased by 316%. However, both have grown especially in second half of this period of time.



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Pastures and forage (x100ha)	1993	1977	2275	2399	2682	3788	4291	6660	7588	8293
Number of farms	1327	1776	1751	1777	1879	2428	3053	3813	4547	5091

Figure 1. Number of farms and pasture and forage surface evolution.



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Pigs and poultry	9	10	11	13	13	10	8	7	7	6
Dairy ruminants	5	4	5	5	5	4	4	6	4	4
Meat ruminants	80	78	76	72	71	74	70	71	78	82

Figure 2. Number of farms in different product orientation

The most important increase in number of farms (Table 1) has been in meat ruminants: beef cattle 252%; meat sheep 311%; meat goats, 672%. Besides, meat ruminants are the most important part in spanish organic livestock (figure 2): 80% of farms in 2001 and 82% in 2010 (47% beef cattle, 27% meat sheep and 8% meat goats). Dairy livestock is much less important but milk ewes had an important rise (also in census, Table 1). Perhaps due to extensive way of farming in meat ruminant in Spain (at least for reproductive females) pastures and forage area has increased in a very similar pattern.

Poultry has a high importance in neighboring countries, like France (Guémené *et al*. 2009) but not in Spain, as we can see in Table 1. There are small farms and census between 2004 and 2010 only increased in 110% in meat poultry and 38% in egg poultry. Pig census has decreased.

Table 1. Census in different product orientation

	2004		2010		Total heads
	Total heads	Heads per farm	Total heads	Heads per farm	Increase 2004-2010 (%)
Beef cattle	51350	72	138613	57	170
Dairy cattle	2338	54	4426	60	89
Meat sheep	142457	314	426788	315	200
Dairy sheep	4216	211	16314	371	287
Meat goats	10918	98	34881	85	219
Dairy goats	6774	226	14249	223	110
Pigs	8455	83	5900	48	-30
Meat poultry	38393	1097	80802	1594	110
Egg poultry	56548	577	78082	605	38

First region in organic animal production in 2010 is Andalucía (57% of farms); there, an important rise had place, and an important public support in the last years may be the explanation. Besides, we can see an important concentration of organic production (Tables 2 and 3): 88 to 100% of organic livestock heads is in 5 regions (different if we consider different species and product orientation), and only egg poultry have 73% of census in the first five regions.

We can observe, as far as regional distribution is concerned, that organic production is located in the traditional areas of each kind of livestock: beef cattle is in *dehesa*, our traditional pasture system with *Quercus* trees linked to extensive farming, and also in the north of Spain; dairy cattle is located in traditional places of northern Spain and near big consumption centers; milk ewes are located in Castilla y León, Castilla-La Mancha, Navarra and País Vasco, leader regions in this production, and where large agricultural areas have been used used by small ruminants after crops. We think this is an important advantage of spanish organic animal production: if it is in traditional places, it may be a sound way of growing, linked to natural basis.

Only some regions where public support has been very important, as Baleares Islands, have more importance than expected due to its surface.

Conclusions

Organic animal production in Spain is growing, in spite of economic crisis. Meat ruminants predominate, and this may be related to the fact that more than a half of organic agriculture surface in Spain is devoted to livestock (pastures or forage). Production is concentrated in some regions, and they have been traditional products in these areas. We can conclude that organic production is growing in a sound way, and is expected to keep.

Table 2. Regional distribution of number of heads in 2010 (percentage in first 5 regions) in meat ruminants

Beef cattle	Meat sheep	Meat goats
Andalucía 54%	Andalucía 60%	Andalucía 62%
Cataluña 16%	Asturias 15%	Castilla-La Mancha 17%
Asturias 8%	Castilla-La Mancha 12%	Cataluña 9%
Extremadura 8%	Baleares 5%	Asturias 5%
Galicia 4%	Cataluña 5%	Galicia 3%
Total 90%	Total 97%	Total 96%

Table 3. Regional distribution of number of heads in 2010 (percentage in first 5 regions) in dairy ruminants

Dairy cattle	Milk sheep	Milk goats
Galicia 49%	Castilla-La Mancha 44%	Andalucía 45%
Asturias 15%	Castilla y León 24%	Castilla-La Mancha 22%
Madrid 14%	País Vasco 10%	Murcia 10%
Cantabria 9%	Andalucía 10%	Castilla y León 6%
Cataluña 5%	Navarra 6%	Madrid 5%
Total 92%	Total 94%	Total 88%

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Dairy value chain analysis in Arsi zone, Ethopia

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Abstract

A cross-sectional study was conducted from July 2010 to May 2011 with the objectives of assessing dairy husbandry practices, characterizing milk marketing system and identifying constraints and prospects of the dairy sector. Data were collected by way of questionnaire interview, visits to production units' sites and discussion to key informants. A total of 220 smallholders were interviewed using semi-structured questionnaire. The five study districts showed similarities in herd composition and husbandry practices. Milk yield from local breeds of cattle varied among the study districts but this variation was statistically insignificant (p>0.05). However, milk yield from crossbred animals, age at first calving (AFC) and calving interval (CI) showed significant differences (p<0.05). Informal milk marketing represented the major (79.09%) share of milk marketing channel. In the study areas, milk price and demand were affected, primarily, by season, access to market and fasting season. Constraints cited more frequently by the respondents were feed, animal disease, AI, veterinary and extension services accessibility. Although there were differences in the number of citations, the similarities between districts in cited constraints may show the seriousness of the problem and needs action in terms feed supply, market access, veterinary, AI and other extension services.

Key words: Arsi, dairy, husbandry and milk marketing

Introduction

In cattle population, Ethiopia ranked first in Africa for decades. The dairy sector, however is not developed even as compared to east African countries like Kenya, Uganda and Tanzania. The national milk production remains among the lowest in the world (Zegeye 2003). Dairy marketing in Ethiopia appears less developed than neighboring countries with similar agro-climate conditions, like Kenya and Uganda. Smallholders dominate dairy production in all the three countries, Kenya, Uganda, and Ethiopia. Similarly, all the three countries have parallel formal and informal milk marketing system where the proportion of milk production marketed in the formal market constitutes a very small portion of the total milk produced. The proportion of milk sold in the form al market is 15% in Kenya, 5% percent in Uganda (Muriuki and Thorpe 2001) and only 2% in Ethiopia (Van der Valk and Abebe 2010).

Reports on husbandry practices, milk production and marketing systems and constraints and prospects of dairy sector are scanty, in the particular study area. Therefore, this research were undertaken with the objectives of assessing dairy husbandry practices, characterize milk marketing system and identify constraints and opportunities of the dairy sector in Arsi zone, Ethiopia.

Material and methods

Description of the study area

The study was conducted in five districts located at a distance of 167 to 257 Km from the capital Addis Ababa, in the south east direction. The districts were composed of highlands with a reliable rainfall and drought-prone areas with many small-scale irrigation schemes (FAO 2006).

Sample size and sampling procedure

Multi-stage sampling procedure was followed at four different stages. In the first stage, a primary sampling unit represented by two broad categories of producers; the rural (mixed crop-livestock) production system and urban dairy production system was selected in each of the study districts. In secondary stage, following randomization (proportional allocation), a total of nine peasant associations from mixed crop-livestock production system and five groups of "kebeles" from urban dairy production system were selected. In the tertiary stage, individual households having dairy cows of any breed and size were identified and listed and in the final or quaternary stage, a total of 220 households were randomly selected from the list.

Data collection methods

Semi-structured questionnaire with close and open ended questions were the major tools used during the survey. Household heads were the ones deciding on the production and sale of the product, and thus were the interviewees in each household. A one time farm visit was conducted at the same time with the questionnaire interview, and variables inspected during the visit were the housing conditions and some of the routine dairy activities.

Data management and analysis

Quantitative data was edited, coded and entered in Microsoft Excel (2003) and the Statistical Package for Social Science (SPSS) software version 15.0 (SPSS 2005) spread sheets was used for the analysis. Descriptive statistics were run to give means, standard deviations and frequencies. Analysis of variance (ANOVA) was also used to test variability on AFC, CI and volume of milk produced across the study districts. Qualitative data derived from direct observations and key informants were examined and presented in form of discussions.

Results

Dairy cattle husbandry practices

The feeding systems in use, in the study areas, were grazing on a natural pasture and supplementing with crop residues (39.55%), stall feeding (33.18%) and using a mixture of both systems (27.27%). More than half of the smallholders (55.91%) used river water while 35.91% and 8.18% used wells and pipe water, respectively. Animals were/are watered on *ad libitum* basis, once, twice and thrice per day, respectively in 53.18%, 42.27% and 4.09% of the farms.

Milking is predominantly done by women (85%) while the involvement of men children and all household members were found to be 5, 4 and 6%, respectively. Most of the smallholders (98%) practiced twice per day milking. Once and trice per day milking were also mentioned by few respondents in local and crossbreed cows, respectively. Washing hands before milking was practiced by all dairy producers. Moreover, 84% of the producers wash udder of cow before milking. Some, 40% of the respondents also indicated that they use towel for whipping the teats of milking cows. Large proportion of smallholders (76%) use plastic vessels as milk container. Earthen pots and metallic utensils are used by 22% and 2% of the respondents, respectively.

Most of the households in the rural (mixed crop-livestock) production system kept their cattle within their own residence compound, while considerable proportions used open barn/shed. By contrast, in urban dairy production systems, most of the dairy producers had a separate shelter for their animals.

Out of the total study participants, 68.6% use artificial insemination while the rest use natural service as a breeding method. Short AFC (39.1 months) and CI (15.6 months) were recorded from Tiyo district while the longest AFC (45.4 months)and CI (19.7 months) were recorded from Munesa district and these variations were statistically significant (p<0.05) (Table 1).

Table 1. Age at first calving and calving interval of the study districts

Districts	N	Reproductive performance traits (Mean ± SD)	
		AFC[a] (months)*	CI[b] (months)*
LemunaBilbilo	62	41.6 ± 4.3	16.3 ± 5.1
DigelunaTijo	32	42.1 ± 5.2	19.7 ± 4.6
Tiyo	62	39.1 ± 4.1	15.6 ± 4.5
Munesa	32	45.4 ± 9.7	19.7 ± 5.3
Shirka	32	43.7 ± 10.9	18.4 ± 7.4
Total	220	41.8 ± 6.9	17.4 ± 5.5

[a] age at first calving, [b] calving interval
* Significant at p<0.05

Dairy producers encounter animal diseases of different origin. Parasitic infection was the most prevalent animal disease (50%), followed by black leg (26.4%), mastitis (10%), hypocalcaemia (7.3%) and reproductive disorder (6.36%). Most of the respondents (75%) can get access to veterinary services either from government or private veterinary clinics and out of the interviewed dairy producers, 28.6% and 33% received limited training on animal husbandry and clean milk production, respectively. Record keeping was almost non-existent in rural mixed crop-livestock production system and only 6% of the urban dairy producers keep some production and reproduction information in an unstructured way on note books.

Milk production and marketing

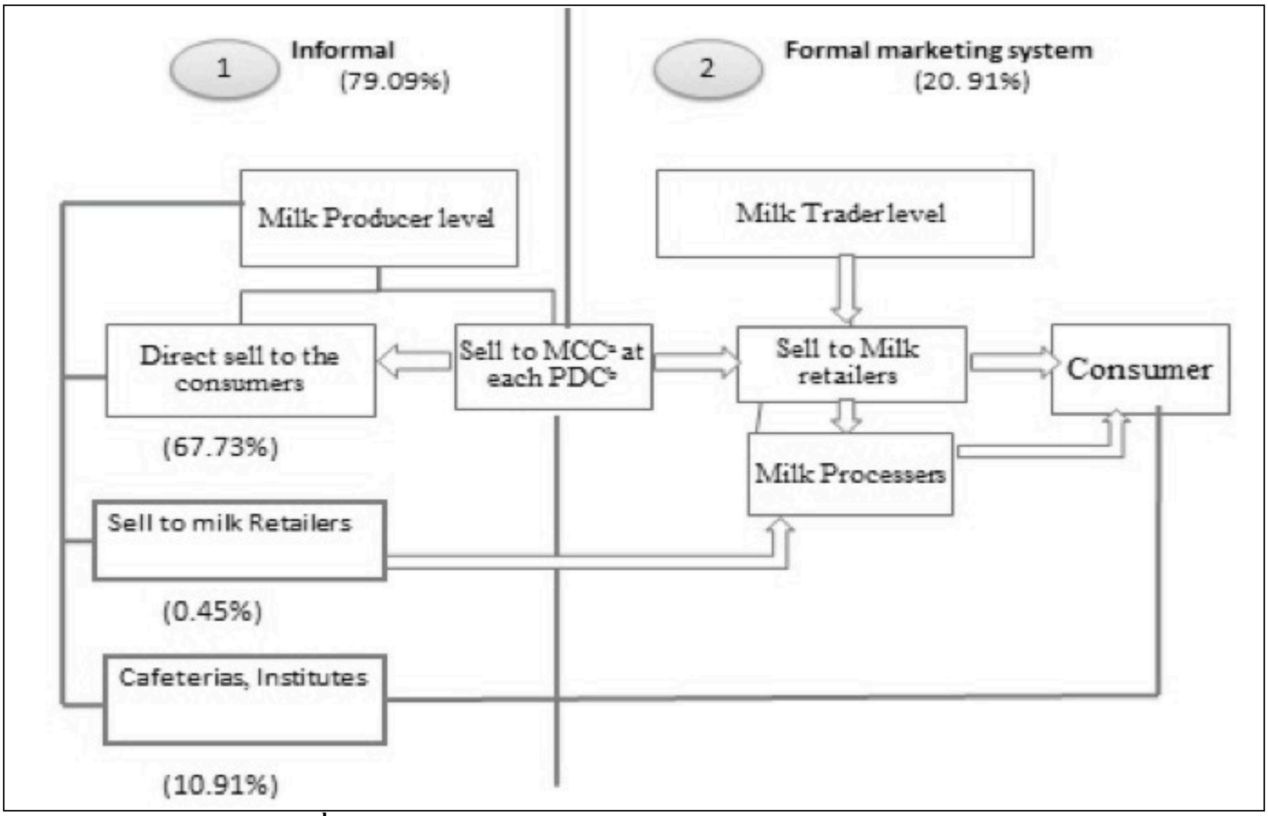
Average milk production for local dairy cattle ranged from 2.0 to 2.9 liters/day in Shirka and Lemuna Bilbilo districts, respectively. However, these variations in milk production across the study districts were statistically insignificant (p>0.05). On the other hand, average milk production for crossbred dairy cattle ranged from 8.6 to 12.5 liters/day in Shirka andTiyo districts, respectively and this variation was statistically significant (p<0.05) (Table 2).

Table 2. Average milk production of local and cross breed dairy cattle

Districts	Average milk production (Mean ± SD)			
	N	Local (liters/day)	N	Cross (liters/day) *
LemunaBilbilo	34	2.9 ± 1.0	56	10.4 ± 3.5
DigelunaTijo	14	2.5 ± 0.7	27	9.2 ± 3.3
Tiyo	18	2.6 ± 0.8	54	12.5 ± 4.9
Munesa	30	2.5 ± 0.9	10	9.8 ± 2.9
Shirka	14	2.0 ± 0.6	21	8.6 ± 3.4
Total	110	2.6 ± 0.9	168	10.6 ± 4.2

* Significant at p<0.05

The dairy producers were involved both on formal and informal milk marketing system. Milk producer, milk collector, retailers and processors were the main actors' involved before it reaches to the end consumer. However in the case of informal milk marketing channel, the chain is too short and there were fewer actor involvement.Most of dairy producers (79.1%) were involved in informal dairy marketing and sell their milk either directly to the consumers (67.7%), retailers (0.50%) or hotels and institutes (10.91%). By contrast, 20.91% of the respondents represent the formal supply chain and sell thier milk only to the MCC or PDCs (Figure 1).



[a] Milk collection center, [b] Primary dairy cooperative

Figure 1. Milk marketing system in Arsi Zone

The determinant factors that influence the sell milk by the producers were/are better price and presence of consistent demand (97.7%), transportation availability (1.4%) and proximity of the market point (0.9%). The major factors affecting the price and demand of milk and products in the studied areas were/are season (dry and wet seasons), access to market (proximity to urban consumers), fasting and non-fasting days (followers of the Orthodox Christian religion), holidays and festivals, quantity of dairy supply vs. purchasing ability of the urban dwellers. The price and demand for milk and products, especially butter, are highly vulnerable to the mentioned factors. The price of milk varied across different points of the value chain; the primary dairy cooperatives (PDC) or milk collection centers (MCC) buy one liter of milk at a price of four birr and fifty cents form their own members and sell to milk retailers at a price of four birr and seventy five cents per liter. Milk processers buy one liter of milk at a price of five birr and fifty cents from milk retailers and liquid milk processing plant process and change to products (pasteurized milk, yoghurt, cheese, butter and cream) (Figure 2).

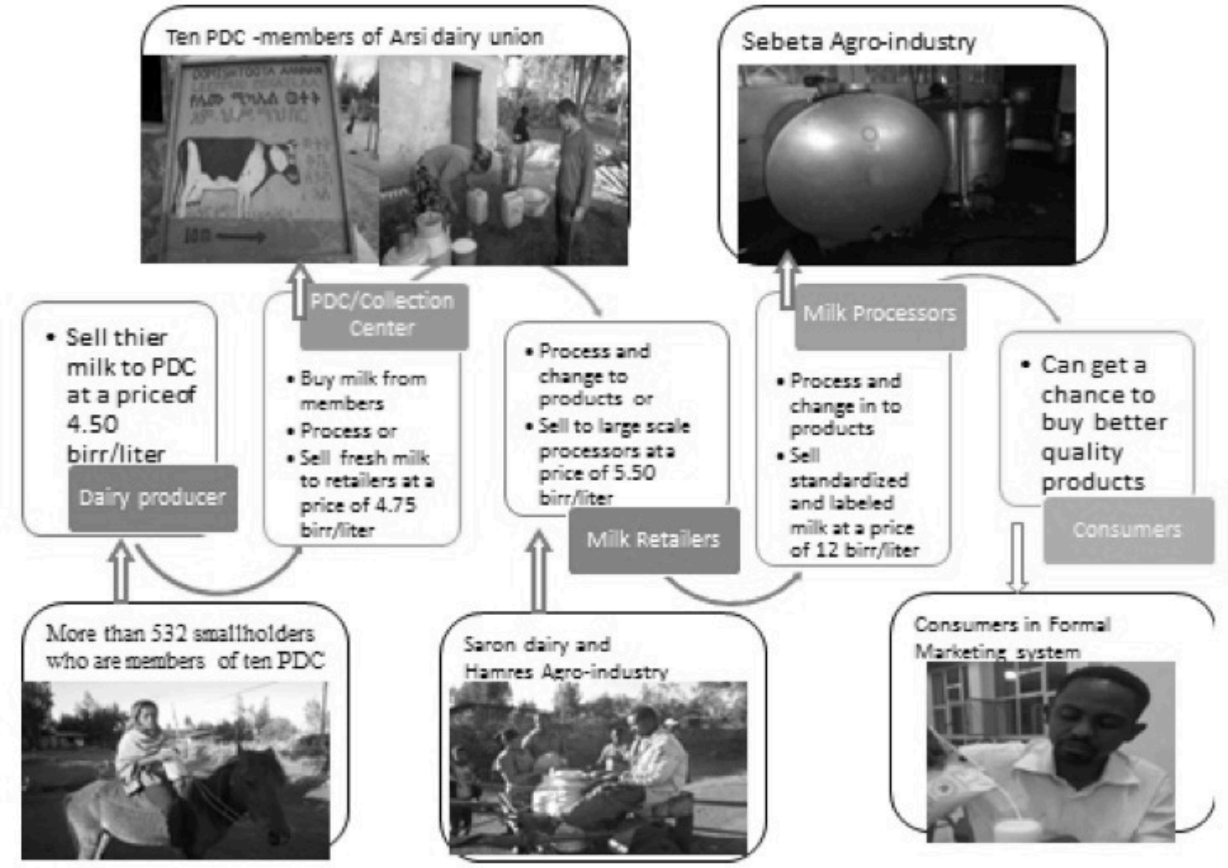


Figure 2. Main actors on formal milk marketing system and their role in milk transaction

Constraints of the dairy sector

Dairy producers in the study areas were constrained by different problems and ranked them as follows: availability and costs of feeds (33.9%), poor veterinary services (13.8%), discouraging seasonal milk marketing systems (13.4%), poor artificial insemination service (12.9%), water scarcity (8%), shortage of supply of genetically superior dairy animals (6.4%), animal diseases and reproductive disorders (5.8%), limitations of land for sustainable dairy development and problems related to waste disposal (for urban producers) (5.8%). The extent and significance of the problems and constraints differed between and within the different production systems and/or study areas.

Although there were/are potential constraints that hinders the development of the dairy sector in the study areas, the dairy producers willingness to be member of dairy cooperatives and participate in the formal milk marketing channel, their willingness to work in cooperation with the coming and existing small and large sized dairy processing plants, the commitment of extension service providers and input suppliers (improved genetic material, feeds, AI, drugs) in the study areas is expected to give the dairy sector a better future.

Discussion

The use of crop residues as a main feed resource by dairy producers in the present study areas is similar practice with most of mixed crop-livestock production systems of Ethiopia. The water source and frequency of watering in the present study agreed with the reports of Sintayehu et al. (2008) as the majority of the households in the mixed crop livestock production system obtained water from rivers. Availability and frequency of watering varied from one production system to another, which was affected by season of the year, accessibility, performance and/or breed of the cow and type of predominant feed and feeding systems.

Milking activity, primarily done by women in the study areas, is in agreement with the reports of other studies conducted in different parts of Ethiopia (Belete 2006). Twice per day milking in the present study is higher compared to the report of Yitaye (2008) in the North western highlands. The present study also agrees with the report of Alehegne (2004) in which, most farms do not use towel for wiping of cows udder. The large proportion of respondents used plastic milk utensils, corroborates with the report of Sintayehu et al. (2008). Types of utensils, frequency and methods of cleaning of milking utensils are the key components for implementing proper milk handling practice prior to consumption, marketing and/or further processing purposes.

Record keeping is a prerequisite for any decision making and control over certain production and reproduction performance of dairy cattle and to measure the profit of any market-oriented farms. Despite this basic principle, record keeping in inexistent in the present study area, most likely due to lack of adequate experience and/or awareness of its benefits.

The present study corroborates with the reports of Sintayehu et al. (2008) regarding the housing conditions of dairy cattle. Most smallholders in rural mixed crop-livestock production system share the same house with their animals while the urban dairy producers keep their animals in a separate shelter. Sheltering cattle, not only protects animals from extreme environmental hazards, but also ease some other husbandry practices. Therefore, cow sheds must be designed in such a way that routine activities like feeding, watering, milking, waste management and other activities can be easily and effectively handled.

Age at first calving and calving interval in the present study agreed with the reports of Mukasa-Mugerwa (1989). However, AFC from Tiyo district was slightly shorter than the other districts and this might be due to the highly influence of environmental factors, feed and health on the trait than heritability.

As reported by many researchers, animal diseases posed a major threat to cattle production in the present study area. However, the types and ranking of diseases occurred was differed from the previous reports. Higher numbers of respondents have got veterinary services over the report of Kedija (2007). Poor animal health service and lack of improved management were the major constraints for dairy development, resulted in poor performance across the production systems (Ibrahim and Olaloku 2002). The dairy producers who have got training on dairy cattle management were fewer compared to the report of Yitaye (2008) and artificial insemination service users in the present study were also fewer compared to the report of Kelay (2002).

Milk yield of local breeds was in agreement with the report of Sintayehu et al. (2008) while that of crossbreeds was lesser. Dairy producers which kept better performing dairy cows were able to benefit much more from dairying and provide good service to the community by providing milk to the urban population.

Formal dairy marketing in the present study area was established by producers, few cooperatives, retailers and processors and consumers. Similarly, Sintayehu (2003) reported, the presence of milk processing plants encouraged the emergence of formal marketing systems in the Addis Ababa milk shed. The present study also agrees with the report of Kurtu (2003) in which, differences in distance to milk market places in the Harar milk shed affect the price of milk. Milk is transported to towns on foot, by donkey, by horse or by public transport, and commands a higher price there than when sold in the neighborhood (Siegefreid and Berhanu 1991).

As reported by IPS (2000), major factors that determine selling outlets, demand and price of milk in the present study were poor infrastructure and poor logistics for collection, transport and sale of milk and milk products coupled with seasonal fluctuation of market prices due to relatively more supply and refrain in more people from taking milk and milk products during fasting period. Under difficult market conditions, processing of dairy products and selling in times of a greater seasonal demand is a promising option.

The frequently cited constraints of dairy sector in the present study are in agreement with the report of Yitaye (2008). A limited availability and high costs of feeds in connection with a shortage of farm land, poor access to waste disposal, poor market infrastructure and marketing systems, a lack of improved dairy cows, poor extension, training, artificial insemination and animal health services, a shortage of credit services and a general gap in the knowledge about improved dairy production, processing and marketing systems are pointed out as bottle necks for the development of the dairy sector.

Conclusion and Recommendations

Dairying, in the studied areas, is most likely to develop, if major constraints of smallholder dairy producers that encompass feed supply, access to land, good marketing systems, and management problems could be tackled. Provisions of veterinary, artificial insemination (AI), credit, extension, and training services at reasonable time and cost will have a very positive role to play in the development of the sector. Moreover, as market is the driving force to the production and productivity of dairying, encouraging private investors to establish dairy processing plants in the area may be an option as a permanent market outlet for both rural and urban dairy producers through an organized milk collection schemes.

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Road map for organic animal husbandry development in India

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Abstract

The increasing area, production and export revenues and ever increasing number of certified organic producers in India indicate that it has made significant progress in organic agriculture expansion globally. But, this progress has been limited to a few export oriented high value commercial crops like cotton, spices, tea, Basmati rice and honey. Whereas, India owns largest livestock population with species and breed diversity, as also the production practices of livestock farmers in India are closely compatible with the standards of organic livestock production. Thus, based on the analysis of the strengths, weaknesses, threats and opportunities (SWOT), a road map for organic livestock production in India has been drawn. India needs appropriate policy interventions, capacity building measures and marketing support, to develop organic animal husbandry, for domestic consumption initially, since, the strengths and opportunities for organic livestock production outweigh weaknesses and threats.

Key words: Problems, prospects, organic livestock, India

Introduction

India ranks 7th in the world, constituting 0.6% of total agricultural land (1.2 million ha organic land) with largest number (677,257) of organic producers. India exported 86 organic products worth US$ 100.40 Million during 2007-08 with 30% growth over years.

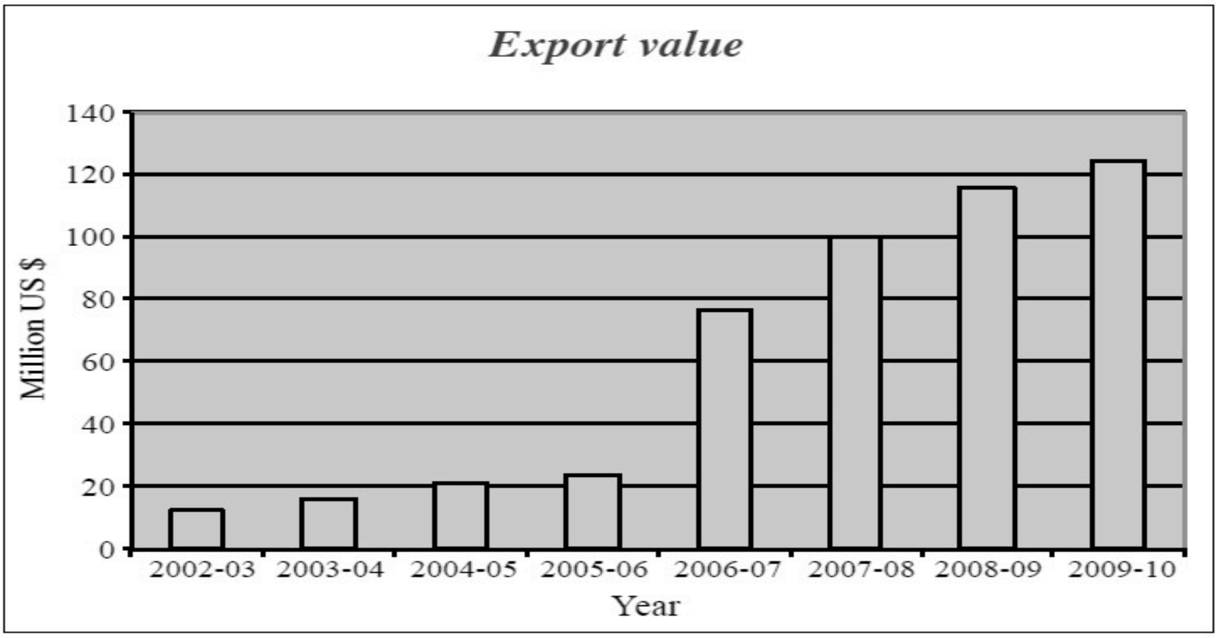

Figure 1. Growing export of certified organic agricultural products from India.

The export figures further rose to US$122 Million in 2009-10 (Figure 1). Also, the certified Indian organic products have compliance with the EU and NOP standards of USA making it important country in global agribusiness. This paper, thus, based on SWOT analysis explores the possibility of organic livestock production and shows a roadmap for development of organic animal husbandry in India.

To benefit from this emerging system of food production, producers in developing countries must build their capacity and take into account their natural advantages for organic livestock production (Chander et al 2011).

Material and methodology

A research project was undertaken by the authors during 2005-2011, to analyse the prospects of organic animal husbandry in India. Under this project, the data were collected from different categories of farmers in different agro-climatic regions of India through field surveys using an interview schedule which contained 40 questions concerning inputs like medicines, fertilizers, feeds, fodder, prevalence of diseases in livestock etc. Also, intensive case studies of registered organic farmers were conducted alongside personal interviews in the states where organic farming was being promoted through policy intervention by the government. Maximum respondents were from dryland states (1216) followed by hill/mountain states (229) and irrigated states (169). Considering the suitability of mountain regions for promotion and development of organic animal husbandry, a focused survey of 180 registered organic farmers (111 Male & 69 female) registered with Uttarakhand Organic Commodity Board (UOCB), was also undertaken, to know the compatibility of local livestock production practices with the Organic Animal Husbandry Standards (OAHS). Similar survey was also carried out in Mizoram state, where, 150 registered organic farmers and 50 officials involved with organic farming promotion were interviewed for SWOT analysis. These registered organic farmers were supported for organic crop production activities, but they were not involved with organic livestock production per se.

Results

The findings revealed:

1. Many farmers across India now produce and sell certified organic Basmati rice, spices, cotton, tea, coffee, fruits etc. with the assistance of the government agencies, NGOs, buyers and certification agencies. But the success stories on certified organic animal husbandry are not yet available, though most of the production practices of farmers were in consonance with the OAHS. The farmers of hill areas, dryland/rainfed conditions might switch to organic livestock farming, if they are properly oriented, trained and marketing support is avalable as in case of organic crop production in Uttarakhand and Mizoram in particular. The farmers see an opportunity in producing and selling certified organic livestock products alongside organic crop products, if they were provided training and supported in marketing of their organic livestock products like milk, butter oil, backyard poultry eggs and meat.
2. The government agencies have done appreciable work in setting up model organic villages, model organic farms, organic shops, along with substantial efforts made in marketing and capacity building of trainers and farmers in different aspects of certified organic crop production. The developments in the area of crops and composting may be seen as precursor to the organic animal husbandry development in the future, since most of the livestock and poultry rearing practices in these states were found to be very close to the organic production practices, though by default.
3. The domestic market is still very weak for organic products, even more weaker for organic livestock products.Nevertheless, some entrepreneurs have taken up organic production of milk and its products for local consumption and exports.

Discussion

Strengths

Integrated crop-livestock farming system predominant in India with well diversified livestock population in terms of species and breeds is ideal for organic livestock production. Besides, limited external input use including for animal production and maximum on- farm reliance brings it further closer to organic systems. The livstock production being largely extensive or semi-intensive, animal welfare too is not much compromised compared to factory type of animal production common in Western developed nations. The Indigenous Technical Knowledge (ITK) and ayurvedic medicines for health care are effective substitute for allopathic medicines, giving India an edge over western countries in the matters of organic livestock production. The National Accreditation Board has recently approved and notified long awaited- the Indian National standards for organic livestock and poultry production, bringing it under regulation- a welcome move which might boost organic livestock production.

Weaknesses

- **Feed and fodder:** The inadequate supply of required organic feed and fodder may be a limiting factor while promoting organic livestock farming, since under organic livestock systems, animals are expected to be fed species specific organic diet in sufficient quantities. Besides, the feed and fodder requirement has to be met on farm or locally and it has to be grown following organic crop production methods.
- **Sanitary conditions:** Prevention of diseases is paramount in organic systems, so that the medicine interventions like antibiotics etc are minimized to the extent possible. To minimize diseases, sanitation is important, for which the efforts are needed on massive scale to improve hygiene and sanitary conditions especially at production, processing and packaging stages.
- **Existence of diseases:** Among others, the prevalence of Foot & Mouth Disease (FMD) in various parts of India is one limiting factor for export of livestock products, so its control is number one priority for India. The Disease Free Zones (DFZs) may be created, where; organic livestock production may be encouraged.
- **Small farms:** In India, livestock production is mainstay of landless and small scale farmers. However, the landless animal husbandry is not allowed under the organic systems, unless they go for land leasing to raise livestock. Contract farming may be a potential solution where many small farmers may contract out their farms to companies, which may produce organic food products on consolidated holdings with required expertise and resources.
- **Traceability:** Unlike in Western countries, milk and meat is sourced from numerous small farmers in India making the traceability a difficult option. Nevertheless, appreciably, Indian goverenement has introduced a web-enabled application- Tracenet system for Organic Products being exported from India.
- **Lack of knowledge, training and certification facilities:** Easily accessible information in local languages, locally available training and certification facilities at an affordable cost to small farmers is not available in many parts of the country, restricting Indian farmers to switch over to organic production especially when there is weak domestic market and current poor prospects for exports in case of livestock products.

Opportunities

It is expensive for intensive livestock producers to convert to organic production, but converting extensive, pasture-based systems could become economically more attractive, if price premiums could be captured for organic meat and livestock products (Scialabba & Hattam 2002). India may follow experiences of developing countries like Argentina, Brazil & Namibia which could export organic livestock products. India exports certified organic honey, which may be extended initially to small ruminants, for organic textile/garments including the materials like hides, leather and wool. The ITK of farmers may provide effective option for veterinary care through proper validation, as also the negligible use of agro-chemicals especially in drylands and hilly regions, makes favourable environment for organic livestock production. Grass based extensive production systems prevalent in parts of India have good potential for conversion into organic animal husbandry. Moreover, Indian livestock breeds being less susceptible to diseases and stress, need less allopathic medicines/antibiotics. With rising literacy and the consumers‘ awareness and concern about animal welfare issues and health foods, domestic consumption of organic foods including of animal origin is likely to get a boost.

Threats

The international trade in organic livestock products from the developing world is considered a risky business due to poor sanitary conditions, existence of diseases, traceability problems as also the self sufficiency in importing countries, which might discourage producers in India too. But rich segments among the Indians might offer market niche for organic livestock products, which can be tapped.

Suggestions to tackle the future challenges of organic animal husbandry

The producers in India need to overcome the weaknesses and harness the strengths and opportunities, while developing their capacity in terms of knowledge, skills, infrastructure, animal feeding, hygiene, sanitation, disease control and assured certified supply chain required for organic livestock production. Large-scale commercial farms usually undertake most organic livestock production in industrialized countries; whereas, the small scale producers having limited resources and low risk bearing ability dominate Indian livestock sector. Nevertheless, they may cater to domestic consumers, if not exports currently. The emerging need of the quality conscious high end consumers in metros for organic quality animal products is required to be met locally. The local organic milk, meat and egg production may subsitute import if any, while generating employment, reducing foreign exchange demand, stimulating innovation, and making the country self-reliant in critical areas like food. Organic livestock production may be encouraged through research & development efforts including establishment of model organic livestock farms, processing units, traceability tools, and capacity building measures, besides consumer awareness on health foods. Consumers need to be told that the safe milk, meat, eggs and products their of that they are looking for is the one that is ‘certified organic‘, while farmers need to be made aware of this demand to enable them to translate it into the new market opportunity!

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Evaluation of livestock production in Colombia and experiences within an organic farm when using an associative model

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Abstract

Colombia has a cattle population of nearly 27 million, 2 % are dairy cows, 28 % are double purpose, and 70 % are beef cattle. Nearly 500 thousand properties in Colombia have livestock. Some livestock farms have high technique level, but the national averages on each production system show poor efficiency when compared to other countries. Ecological models integrate livestock and forestry with agriculture, to lessen dependency on external inputs with increased demand for labor, to promote of local resources. The organic livestock is still very small in Colombia, with just 40,000 hectares. The experience of an association of producers in a Colombian Andean municipality has been used to assess its impact on their environmental, economic and social development.

Key words: Organic production, livestock, sustainability, ecology, agroecology.

Introduction

In Colombia, organic animal production is in its beginning stages compared to organic agriculture. The MADR-CCI (2009) shows that Colombia dedicates 51 millions hectares to the agricultural sector, which is equivalent to 45 % of the whole national territory. Livestock activities are conducted in 77 % of this area (almost 39 millions ha). Additionally, environmental problems are high, according to IGAC (2002), which is considered appropriate for livestock activities in only 39% of the area (15 millions Has). The free trade agreements (FTA) signed by Colombia will create difficulties mainly for small and medium dairy producers. The country has an organic certified production of around 40,000 hectares while less than 1 % of the area is dedicated to livestock production. This paper presents the analysis of the livestock sector in Colombia and some experiences from the Ecological Association of Producers Ecoreal.

Results

The process experienced by a business association of small farmers in the Andean region of Colombia (Guayabal de Siquima Township) for certified organic farming, since 2002, has shown promising results for its environmental, social, and economic development. The association seeks to add value to their products through agro industrialization processes with own labor. It produces and sells organic coffee, fresh milk, chili sauces, vinegars, herbs, and other consumable products. The description of the subsystems, that comprise one of the livestock farms within the association, shows the integration activities (Table 1).

The farm makes use of family labor, generates two permanent jobs in the farm and at least four odd jobs for the harvesting and agriculture. The changes in farm management have allowed for progress on the production parameters that initially were close to national averages. The results are due to the interdisciplinary work of students and professionals from different institutions (Table 2).

Table 1. Description of an agro ecological farm in Guayabal de Síquima (Colombia)

General description	Agricultural Subsystem	Livestock Subsystem	Forest Subsystem
Area: 9 hectares	Crops of chili, onion, cilantro, herbs, and vegetables	Balanced diets based on pasture and supplementation cutting grass or forage from species of trees, shrubs and herbs.	Conservation of native forest strips as conservative elements of water and wildlife corridors.
Altitude: 1870 – 1935 o.l.s.	Fertilization with compost produced on the farm, and microbial broths.	Animal Welfare (shade, water will move, management). Milking facilities.	Planting forage, fruits and timber tree species in pastures and agrosilvopastoral systems
Rainfall: 2000 mm / year	Biological control of pests and diseases and use of allelopathy.	Preventive health care. No use of chemical parasiticides.	Handling of food plots with forage species of trees, and shrubs.
Environment: tropical wet forest high	Use cover crops and minimum tillage.	Records management and planning processes.	Using trees as living fences.
Soil: Clay	Marketing fresh and processed.	Marketing of fresh and processed milk as caramel.	The tree is a vital element for the system in the conservation of soil, water, air, wildlife, as a supplier of fodder, timber, food, and a rich landscape.

Table 2. Comparison of the dual purpose cattle production with an organic farm in Guayabal de Síquima (Colombia)

Parameter	National average	Farm average
Birth rate (%)	53	70
Daily gain weight (grs/day)	350	950
Birth weight (kg)	25	27
Weaning weight (kg)	130	170
Slaughter (months)	39	28
Carrying capacity (TLU/Ha)	0,6	4,0
Milk production in double-purpouse (lt/cow/day)	3	7

Discussion

Colombia has a cattle population of nearly 27 million, the third largest in South America after Brasil and Argentina, and 15th largest in the world. From this quantity, almost 2 % are dairy cows, 28 % are double purpose, and 70 % are beef cattle (MADR-CCI 2009). This sector could be producing 950,000 jobs, which would amount for 25 % of the rural and 7 % of the total employment. It has been calculated that milk production systems produce 7 or 8 jobs for every 100 animals, in double purpose 5 or 6 jobs, and in beef cattle breeding, growing and fattening only 2 or 3 jobs per 100 animals (Fedegán - FNG 2006). Figure 1 indicates the Colombian livestock structure.

Nearly 500 thousand properties in Colombia have livestock. In small properties, 58 % of the area is dedicated to livestock, in medium properties almost 65 %, and in large properties it is 90 % (IGAC 2002). Some livestock farms have high technique level, but the national averages on each production system show poor efficiency when compared to other countries. It is estimated that 9 % of farmers use irrigation for its grasslands, while only 15 % offer hay or silage, occasionally, and less than 4% make pasture renewal practices. Similarly, the workforce has a low level of schooling, with at least 15 % having not gone to school, and 33 % having studied some levels of basic education (Fedegán - FNG 2006).

The slaughter weight has been increased during the last 20 years reaching 420 kg. The daily weight gain was estimated at 350 grams, a very low number when compared to 450 grams in Brasil or 550 grams in Argentina. Milk production, according to Faostat and the agrocadenas observatory during 2005, was 4.4 liters per cow, almost the same production level as it was in 2000. Milk production increase is a big challenge to the sector when compared to Argentina or Uruguay, countries with production levels of around 13 liters/cow/day.

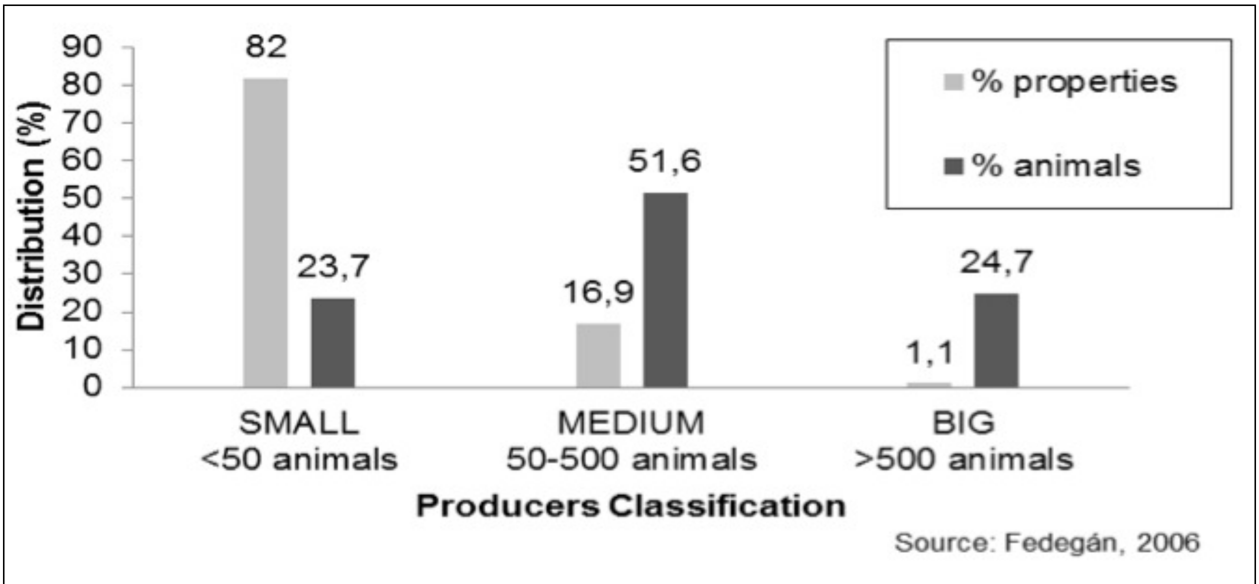

Figure 1. Colombian livestock structure

Colombia has 40 millions of hectares in forests that are harvested at a rate of 300,000 Ha. per year. A lot of these deforested areas are now used as livestock systems (Guevara 2002). The areas with poor technique level, where the carrying capacity is low, the infrastructure investment is small, and where the pastures have not had any fertilization or irrigation practices belong to an extensive livestock type. This production structure has not considered the agro ecological context and their consequences over ecosystems or biodiversity. These systems with 10 Has each scarcely generated employment for a person per year (Vergara 2010), with an average animal extraction index of 14 %, which is less than the world average of 21 % (Faostat 2008). This structure leads to questioning of the environmental and social sustainability of the system, though it has been a consequence of the rural problems in Colombia related to high concentration of land property in a few families and mistakes with the agriculture policies, poverty, violence, drugs, and the poor infrastructure.

In contrast, there are intensive livestock systems, which mostly correspond to dairy type systems of the green revolution with better technical parameters than the presented national averages, although questioned by some sectors regarding the environmental effects of residual pesticides, high intakes of water, and heavy dependence on oil. These systems currently have difficulties with the economic sustainability of the business as a result of reliance on external inputs such as fertilizers, concentrates, herbicides, and more, as well as the increase in international grain prices, high importing of materials for preparing raw food for animals, and the entry into force of the FTA with developed countries.

As an alternative to the productive systems mentioned previously, ecological models are used to integrate livestock and forestry with agriculture, to lessen dependency on external inputs with increased demand for labor, to promote of local resources, as sound management of soil, as consideration of nutrient cycling, and as an overall systemic approach to problem analysis.

Conclusions and suggestions

The high environmental cost generated by deforestation and low production efficiency from the activity also threaten the economic and social sustainability of the livestock industry. The entry into force of the FTAs raises the need to assess their sustainability and defensible alternatives, especially for certain farmers and producers of milk and beef that are highly vulnerable to the activity that generates food for subsistence and income. The ecological or organic farming can be an alternative for this sector. The organic livestock is still very small in Colombia, with just 0.21 % of the total certified area in 2010 (40,000 hectares) developing a local market that pays between 20-40 % premium prices for these products. The experience of an association of producers in a Colombian Andean municipality has been used to assess its impact on their environmental, economic and social development. The efficiency increase observed in the cattle production parameters in the association's farms can confirm that it is possible to have animal production with low use of products from chemical synthesis.

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Experienced benefits and risks perceived by organic farmers in conversion to livestock production

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Abstract

The registered organic farmers of Uttarakhand state in India are being benefitted individually as well as community levels in terms of socio-economic empowerment alongwith restoration of traditional values through organic agriculture and now aspire to venture into organic livestock production. However, these farmers might come across risks while converting livestock farming systems into organic with strict adherence to organic animal husbandry standards set by National Standards for Organic Production (NSOP), India which resemble IFOAM standards. Hence, a study in assessing the perceived risks and also the strategies to overcome the risks as suggested by organic farmers was carried out. The emerging rural institutions i.e. Organic Producer Groups (OPG) strengthened village communities with multiple tasks of organic agriculture production, management and marketing. The multiple factors like farm, market and institutional risks were perceived by farmers. Uncertainty about the product demand and consumer preferences followed by limited range of resources and options in organic production systems like feed, limited therapies along with lack of technical expertise including veterinary support were among the risks perceived by majority. Whereas, wider consumer awareness alongwith the development of national market information systems followed by production at the lowest cost possible, diversifying the farm research on testing the efficacy of Indigenous Technical Knowledge (ITK) and suitable alternate therapies were among the major risk managment strategies as suggested by most of the organic farmers. There is strong need to update and orient the livestock advisors i.e. veterinarians regarding the organic livestock production which is knowledge intensive. Farmers need to be encouraged through providing market support locally and also by validating and incorporating their traditional knowledge in organic production systems. However, the perceived risks and suggestions of farmers should be paid attention through focussed research and capacity building programmes towards better comprehension and adoption of organic livestock standards so that organic farmers with assured confidence can produce and market organic livestock products locally and globally.

Key words: conversion, organic livestock production, benefits, risks

Introduction

Uttarakhand, the Northern state of India where organic farming is being promoted in a systematic way, farmers could market organic crop produce and are interested to produce organic livestock products, where livestock are integrated with crop farming operations. Though farmers benefitted in organic crop production, there is no production of organic livestock products. The requirement of strict adherence to the organic animal husbandry standards set by National Standards for Organic Production (NSOP), India to get label and market the products as organic, farmers may come across certain risks in conversion process to organic livestock production. To encourage the farmers to continue the organic crop production and marketing, and also to pursue the conversion of livestock systems to organic production, the farmers have been studied in terms of the benefits they experienced in adopting the organic crop practices and the risks perceived in converting the livestock systems into organic production.

Material and methodology

Data were collected through personal interview among 180 registered organic farmers of Uttarakhand Organic Commodity Board (UOCB) using 'Likert scale of rating' and analysed with suitable statistical tools. Criteria to assess risks were framed in accordance with organic animal husbandry standards set by NSOP (India) which resemble IFOAM standards.

Results

Farmers were empowered and benefited at community level as well as individual level. Organic Producer Groups (OPG), the rural institutions with multiple tasks strengthened village communitites. Such organized efforts helped farmers in better cultivation, production, processing and marketing of produce with with market premiums. Capacity building programs and activities like linkage with micro-finance, training on packaging, labeling and storage specificities, encouraged farming activities. Rural tourism i.e. eco-tourism helping in restoration of traditional culture thereby helping the farmers to improve socio-cultural values along with economic status since the national as well as international tourists visit them. Farmers became proficient enough to prepare plan for conversion of conventional farm into certified organic farm and empowered in organic production techniques whereas, awareness on market linkage development reduced the dependence on the middlemen resulting in reduced financial and price risks. Fewer health risks due to change in working environment and improved social contacts resulted in self-confidence.

Risk perception and Risk Management strategies as perceived by Organic Farmers

There is a general belief that organic farming is more risky because it is vulnerable to different sources of risk. The perception of higher risk may be a potential barrier for switching to organic farming (Lampkin 1994). Sources of risks during conversion to organic livestock farming perceived by farmers provided a mixture of factors at different levels like farm, market and institutional. Uncertainty about the product demand and consumer preferences, limited range of resources and options in organic production systems like feed, limited permitted therapies and the animal epidemic diseases might be potential barriers for conversion as indicated by 90 per cent and 90.91 per cent of farmers, respectively. Whereas, factors like premiums and market stability, lack of technical support, cumbersome and costly certification procedures may create uncertainties in carrying out livestock farming activities were mentioned by many. However, skills of producer and animal welfare policies might not pose any risk to farming activities during conversion as mentioned by majority.

Management strategies to minimize or reduce risks as perceived by farmers

The most preferred risk management strategies seemed to be a mixture of market, institutional as well as farmer related factors. Among all the strategies, wider consumer awareness alongwith the development of national market information systems would be the most relevant risk management strategy as mentioned by majority (86.32%). Production at the lowest possible cost, technical support to enrich farmers' knowledge on risk reducing technologies as well as an effective organic livestock farm plans was also considered as relevant strategies as mentioned by 80.91; 79.09 per cent and 77.28 per cent of farmers, respectively.

Discussion

Consumers play very crucial role in marketing of any product, hence, farmers might have felt that if there was wider awareness about the quality of organic produce in terms of its taste and safety, there will be continuous demand for the organic farmers' produce. Reduction in cost of production will act as an effective management strategy by reducing the burden on the farmer irrespective of fluctuations in the market, as also observed by Lien et al (2003) in their study in Norway, that producing at lowest possible cost was the most important strategy to manage the risk by organic farmers. If the farmers were empowered with knowledge on risk reducing technologies and skilful enough to manage farm efficiently through well designed farm plans, then they might be confident enough to run their respective enterprises. Moreover, working in groups often leads to exchange of information and resources as well as other inputs which might be beneficial to the farmers involved. The Organic Producer Groups (OPGs), should be trained and encouraged in these lines by making them technologically sound as well as empowered with skill which greatly enhances the chances of success and reduction of risks. This might be the reason for farmers mentioning group certification as also one important risk management strategy during conversion to organic livestock farming. Group certification is a good opportunity for small holder developing country farmers to benefit from the opportunities offered in the main organic agriculture markets (Twarog 2006). Diversification provides a key opportunity to spreading out the risk for organic farmers. Reduced input costs, diversified production and improved local nutritional security were the risk management strategies as mentioned by Mathur (2007).

Suggestions to tackle the future challenges of organic animal husbandry

The ideology behind principles and standards of organic animal husbandry is not new to the Indian farming system, whose farming community insist upon the animal welfare and animal natural rearing systems since ancient times. Moreover, a country rich in indigenous animal genetic resources like India is very much suitable for adopting this innovative farming system. However, the livestock farmers need to be oriented and educated about the standards and how to overcome the risks they might face in adoption of organic livestock standards. The livestock advisors should be trained and skilled enough in providing the services in livestock management and permitted therapies in organic rearing systems. The research on the locally adaptable management and disease preventive measures need to be emphasized by the government, organic promoting agencies as well as NGOs, keeping in view the potential of Indian farmers who can meet the requirements of organic livestock product demand not only locally but also globally in the near future.

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Conversion potential of conventional cattle farms to organic production systems in the State of Tabasco, Mexico

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Key words: Organic livestock, Productive conversion, Tabasco.

Introduction

Beef cattle production is a strategic activity in Mexico owing to its high social and economic impact. Some 1,453,245 cattle production units occupy 68 % on the country's land area (INEGI 2007) However, this sub-sector policies, among other causes, have weakened some links in the production chain, a state of affairs which has worsened with a growth in imports of beef products since NAFTA's implementation, which set 0 % import duties for main beef products and a 20% duty to be reduced to 0 by 2004 for some byproducts (SARH 1993). This situation favored imports to such a degree that by 2010, the beef dependency (import) index rose to 35%, in accordance to Mexican official statistics (Informe de Gonierno 2011). However, this value increases to 40% in other sources, like those of export data provided by USDa (USDA 2012). Beef imported from the USA and Canada is produced in intensive systems in which animals are finished in feed lots with grain rich diets to which feed supplements and hormones are added, which result in more muscle in detriment of body fat; in addition, the volume of inputs, subsidies to grain producers and integration of the agribusiness chain allow for cost reduction and in a lower price. In Mexico, conditions are somewhat different, and therefore it is urgent for producers to look for other production alternatives which optimize available resources to be able to compete in price and quality with imports.

Organic production systems, based on grazing (Olivares 2003), free of additives and hormones, could be a valid alternative for the home market as a beginning (Gómez et al. 2010) Livestock organic production entails production of high nutritive quality foods, in which ethological characteristics of animals are respected. A transition period needed to change from conventional to organic production systems is needed, in order to certify production as organic. In Mexico, 5,371 ha in 26 farms and 10 States (Gómez et al. 2010) are already certified.

Instrumentation of this production system implies a better use of grazing resources, a lower dependency on outside inputs and also helps maintain the environment. Besides, a product having definite advantages for the consumer's health is obtained. In this paper this possibility was studied, through a methodology to determine an Index of Compliance with Organic Standards (ICOS) and also by setting a conversion potential from conventional to organic production systems.

Materials and Methods

ICOS set-up: The case of Tabasco.

This methodology is based in the study of livestock production from a complying with organic producers' regulations angle, in such a way those technical matters that must be taken into account when changing production methods from conventional to organic, are identified. To this end the Livestock Inventory of Tabasco database was made use of, which contains information on 1,718 records, of which 1,712 were employed. This database was used in other studies (De Luna, 2001).

Information in the livestock inventory provides basic and general data on Tabasco's beef cattle production and allows approaching production systems from an organic angle. To this end ICOS was created. This index was created ex profeso as part of a more complex study to obtain a preliminary rough estimate for identifying conversion potential in ranches that use conventional production systems to production units who comply with organic production regulations. This indicator compares nutritional, health and paddock management aspects with technical features taken into account by organic production rules.

Livestock inventory data was grouped is six criteria. No more criteria were considered owing to lack of additional information. Ideally, to grade the conversion potential of a given ranch, county, region or State would be to employ surveys based on organic production rules. At the beginning, to generate ICOS, a similar value was given to each criterion, so their sum would be equal to 1. However, taking into account technical and economic problems and the time it would take to convert a conventional farm to organic, each criterion's value was weighted in accordance with its importance and the complexity of its change. To this end, system management was awarded the higher score (0.30), followed by adequate resources use and preventive health management (0.20) and finally, use of fertilizers, weed control methods and cattle management (0.10). Scores awarded to these criteria can be seen in Table 1.

It is worth mentioning that organic livestock production implies production of highly nutritive foods, in respect of animals' ethological characters, which should be fed in accordance with their physiology with organic feed produced with preference in the farm. Besides, to keep animals healthy, a strong preventive program should be enforced, in accordance with organic rules. If an animal health problem surfaces in a certified organic farm, suspicious animals should be quarantined and treated with medicines. Animals thus cured, lose their organic status due to drug residues. Besides, animals can not be kept in confinement, except when quarantined.

Table 1. Criteria and assigned values for generating an Index of Compliance with Organic Standards*

Criteria	Assigned value	Criteria	Assigned value
Management system (MS)	0.30	Cattle management (CM)	0.10
Grazing	0.30	Supplements	0.05
		Has a set breeding season	0.05
Use of fertilizers (UF)[a]	0.10	Adequate resources use (ARU)	0.20
Yes	0.10	Stocking rate[b]	0.10
No	0.00	Improved forage species	0.05
		Paddock rotation	0.05
Weed control method (MCM)	0.10	Preventive health management (PHM)	0.20
By hand or mechanical	0.10	Vaccinates	0.05
Chemical	0.00	Controls external and internal parasites	0.05
		Performs parasite tests in feces	0.05
		Checks for brucellosis and TB	0.05

*ICOS = MS + UF + MCM + CM + ARU + PHM.
a From a standpoint of getting used to and possible later use of compost.
b < 1.2 AU ha^{-1}.

Cattlemen who obtained ICOS scores close to 1 (7.1%) need to make few changes to their farm management to achieve organic production status, in comparison to producers whose score is close to 0 (16.9%), who would have great difficulty to convert their production system. Most of the cattle producers (76.0%) are found in an intermediate phase.

Discussion and Results

Stratum 1 (ICOS < 0.55)

This segment, holding 290 producers (16.9%) is made up by those cattlemen with the lower ICOS scores, being those who would have to carry out the greater adjustments in management practices to become certified organic producers, a process which could take up more than four years. This time-frame is estimated taking into account infrastructure changes (number of paddocks, for example) and the time it will take for agrochemical residues to completely disappear from the whole ecosystem. Plots of producers in this layer are relatively small (20.1 ha on average). Of the land allotted to cattle, 54.1% is planted to improved grasses of better nutritive value than native species; however, the stocking rate (1.74 AU ha^{-1}) suggests the possibility of some kind of overexploitation of forage resources, because the recommended optimal stocking rate for the tropics is 1 AU ha^{-1}. On average, farms are divided in 3.2 paddocks, 84.8% of producers rotate their animals and the remainder let them loose without any constraints inside their production units. In weed control, a mixed system is used (96.9% of producers normally apply herbicides and mechanical mowing, 93.4%). This is one of the items most difficult to change when converting to organic production systems, because producers indiscriminately use highly toxic chemicals to control weeds. In this layer not only are found producers with less cattle (35.7 heads on average), but also those who apply less technified management and have poorer infrastructure. This can be seen in the following parameters, only 9.6% supplements cattle in some form (6.9% mineral salts and 3.4% feed). None uses artificial insemination and only 1.7% has a set breeding season. With reference to infrastructure, 96.6% have their perimeter fenced, 75% have internal fencing to divide paddocks and only 0.7% uses electric fences. Management pens are found in 73.9% of farms and only 2.8% have feed lots. Regarding animal health, 97.6% of producers at least vaccinates with one vaccine once a year, 97.9% worms periodically and only 0.3% use diagnostic methods for parasites in feces and tests for brucellosis and tuberculosis (TB). Preventive health management is a sine qua non requirement for being accepted as an organic livestock producer, therefore, use of tests to detect parasites or other health problems are a must.

Farmers in this stratum produce weaners (63.8%), half finished animals (17.2%) and only 2.1% complete the fattening process. The main marketing channels are resellers or intermediaries (41.4%), butchers (30%) and fatteners (21.4%).

Stratum 2 (ICOS 0.55 to 0.75)

This layer comprises the greater group of cattlemen (1,302) or 76.0% of the whole population. Their conversion to organic livestock producers would take between two and four years. This time-frame is considered because their management system does not need structural changes, they use less agrichemical than those in stratum 1, with fewer residues and also because their infrastructure is more adapted to ecological production. Farms are bigger (50.1 ha on average) than in stratum 1, with greater investment. In 58.7% of paddocks improved pastures are found. On average, each production unit has 5.2 paddocks and 64.8 heads. This greater number of paddocks allows a better management of pastures and cattle and therefore both soil and vegetable resources are in better shape. In general, these farms show a higher technification level, 89.9% of farms rotate animals, 8.4% apply fertilizers, 57.4% supplement, 2.7% use artificial insemination and 8.5% has a set breeding season.

When this layer is compared to stratum 1, we find that 58.4% of producers use herbicides, down from 96.9%, machinery use is greater (12.0%) and labor used in weed control is practically the same (91.9%). When inputs used in supplement are analyzed, cut forages show an increment (3.1%), which is important because successful experiences in the use of these species could favor an increase of planted area. This would provide a forage source in critical periods and therefore, to depend less on outside inputs, which would guarantee a production system used in input production. Besides, in this layer, supplementation with mineral salts is more generalized (51.8%) which should result in a more adequate nutrition. Regarding animal health, 98.2% of producers at least vaccinates with one vaccine once a year, 99.5% worms periodically and preventive management makes an appearance, as 12.5% use diagnostic methods for parasites in feces and 15.4% check their animals for brucellosis and TB.

Available infrastructure is greater than in the previous layer. Perimeter fencing is found in 97.6% of cases, dividing fences in 85.1%, 4.1% use electric fences, 85.4% have management pens and 8.2 % feed lots. The percentage of producers who sell weaners decreases, the same for half finished animals and producers who market finished animals increase to 6.7%. Producers who market their products directly to slaughterhouses show an increase, both in TIF (23.7%) and municipal (8.3 %).

Stratum 3 (ICOS > 0.75)

This layer is made up by 120 producers which represent 7.1% of available records. Conversion to organic production requires few changes in management system and could be completed in less than two years. This group of producers usually uses a management system more in compliance with organic production rules. Farms are bigger (152.7 ha on average), of which 140.4 ha or 91.9% are used for livestock production. Of this last area, 62.6% is planted with improved forage species, which allows a better stocking rate (1.05 AU ha-1). To show respect to the ethological individuality of animals is one of the pillars of organic livestock production. Therefore, when keeping an adequate relationship between number of animals and area, resources are neither underused nor degraded and established rules and regulations are observed.

In this layer, farms have been divided into 13.3 paddocks on average, which allows a better use of forages and control of cattle, combined to cattle rotation in 99.2 % of cases, and to an increase in fertilizer use (39.2%). Besides, weed control is done by hand in 80.0 % of cases and mechanically in 46.7%. Only 30.0% of producers in this stratum use herbicides. Average animal stock in these farms is 174 head.and cattle management is the most sophisticated of the three strata studied. Supplement is provided in 91.7% of farms (87.5% mineral salts, 49.2% molasses and 16.7% cut forage), 23.2% use artificial insemination and 49.2% have a set breeding season.

Preventive practices in animal health in this layer are more common. Vaccination is performed in 99.2% of farms and practically 100% worms periodically. Parasite diagnosis in feces is practiced in 69.2% of herds and 75% are checked for brucellosis and TB. Farms in this stratum have better infrastructure. Perimeter is fenced in 97.5% of them, 96.7% have internal fences, 25.0% use electric fencing, 96.7% have management pens and 24.2 % feed lots. It is worth mentioning that organic production rules say that when an animal is stabled, pens should contribute to animal's wellbeing, and for ruminants confinement is permissible but should not be permanent. Producers in this segment market their cattle mainly in TIF slaughterhouses (32.5%), and 15.0% complete the fattening process. Also an increase in half finished animals (27.5%) is observed, which are bought mainly by intermediaries (38.3%) and fatteners (29.2%).

Conclusions and Implications

There exists in Tabasco a potential for 7.1% of cattlemen to convert their conventional operations to organic within a two year timeframe, while for 76.0% of them this process could take up to four years provided some modifications are put into practice in their production units. Those producers that can adopt organic production systems faster own on average 152 ha and 174 heads, their farms are more technified, and have at their disposal more infrastructure and financial resources. From a technical standpoint, it is important to set research lines on specific problems for cattlemen, who wish to adopt organic production systems, because of crucial problems that limit production.

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Consumer perception and communication on welfare in organic laying hen farming

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Abstract

A major reason for increased societal popularity of organic production systems is the growing general discontent with intensive farming practices. However, urbanization leads to limited knowledge of farming and farm animal welfare. Consumers believe organic farming leads to better animal welfare, although most health and welfare issues seen in conventional systems are also found in organic poultry systems. The majority of consumers do not translate attitude and good intention into action, the actual purchase of organic products. Understanding this intention-behaviour gap may lead to increased sales of organic products. Effective communication and education can create trust, added additional values and credibility, and may lead to structured perceptions, convictions, values, norms, knowledge and interests and lead to better understanding of organic farming and farm animal welfare. Merchandising strategies can reduce barriers the consumer may encounter at the moment of decision making.

Key words: organic poultry, laying hen, animal welfare, consumer perception, theory of planned behaviour, intention-behaviour gap, consumer awareness

Organic egg production

Besides environmental awareness of farmers, the growing general discontent of consumers with conventional intensive farming practices is a major reason for increased societal popularity of organic production systems (Zeltner and Maurer, 2009). This growth of increased societal popularity can also be seen in organic egg production. Organic egg production generally accounts only for a relatively low proportion of overall egg production, but has substantially increased in the last years and already gained considerable significance in some European countries. For instance, between 1997 and 2004 organic poultry productions in Belgium showed 76,8% growth, thereby being one of the fastest growing organic sectors in the EU (Oliver et al., 2009; Pyfferoen et al., 2011). Still only 5,4% of all laying hen farms in Belgium were registered as organic laying hen farm in 2004. Halfway 2011 this number had more than doubled, listing 13,8% of all registered farms as organic. Nevertheless, only 2,4% of all registered hen places were registered as organic egg production (Pyfferoen et al., 2011). Organic egg production standards require free range systems of non beak-trimmed birds that allow outdoor access and lower stocking densities, preferential use of preventive measures against diseases and alternative treatment methods, and from 2012 onwards a 100% organic diet. These guidelines may be beneficial for various aspects of the welfare of the hens, on the other hand it may also expose the birds to various stressors or risks that may aggravate certain welfare problems (Zeltner and Maurer, 2009).Hen welfare is influenced by multiple animal-based factors such as disease, pest and parasite load, skeletal and foot health, inappropriate behaviour, stress, affective states, and genetics (Lay et al., 2011). Hen welfare is also influenced by environment-based factors such as management and housing system (e.g. group size, litter area, perch availability, nest availability and feeding) (Shimmura et al., 2011). Berg (2002) concluded in a review that most of the health and welfare issues seen in conventional free-range and loose housed systems are also found in organic poultry systems. The outdoor access exposes the birds to an increased risk of viral, bacterial and parasitic infections that not only pose a threat to the health and welfare of the birds, but may also be a zoonotic danger for food safety (e.g. Campylobacter spp. and Salmonella spp.)(Kijlstra and Eijck, 2006). Uneven and infrequent use of the outdoor pasture indicates that the environment provided is often not preferred habitat (Dawkins et al., 2003). For example, birds may not feel safe in the unroofed area of the outdoor pasture. Cover, trees, hedges and other structuring elements may increase use of the outdoor pasture and reduce mortality due to predation as well as decrease risk of feather pecking behaviour (Bestman and Wagenaar, 2003). Beak trimming is not allowed in organic farming and therefore feather pecking remains a severe problem on organic laying hen farms (Berg, 2002; Bestman and Wagenaar, 2003; Nicol et al., 2003).

Consumer concern and product perception

Consumers are concerned about animal welfare and farming standards as they often equate good animal welfare standards with high food quality standards (Harper and Henson, 2001). Evidence for increased interest in good animal welfare standards is the increasing demand for 'animal friendly' products, such as free-range eggs. Consequently, society shows an increase of product awareness in decision making when buying food products as consumers. For the livestock production sector this growing awareness is based on natural, ecological and socio-cultural aspects and perceptions when considering buying livestock products (Vanhonacker et al., 2008). Besides the important role of environmental issues and animal welfare, also creating more affinity towards organic products by social issues such as supporting local farmers and societal initiatives contribute to additional value and closer connection to organic products (Zander and Hamm, 2008). Consumers general perception of organic farming consists of the assumption that this farming practice should enhance food safety, be sustainable with low environmental impact, offers outdoor access for the animals and contributes to better animal welfare (Crandall et al., 2009; Hermansen, 2003). Te Velde et al. (2002) describes how generally perceptions are formed and influenced by convictions (opinions about the way things are), values (how things should be), norms (how things should be treated according to the values), knowledge (formed by what is known, experiences, facts, stories, and impressions) and interests (economic, social, moral, health). However, the consumers' knowledge of farming in general and the circumstances in which livestock are reared is much more limited due to urbanization and increasing dissociation from the farming practices.(Te Velde et al., 2002) This leads to vague concepts and perceptions of organic farming and farm animal welfare, and are strongly influenced by biased media coverage (Vanhonacker et al., 2008). The lack of belief in the ability of the consumer to make a difference when choosing for organic product is another barrier to buy organic products (Harper and Henson, 2001). Although most consumers claim to be concerned about animal welfare, the vast majority does not translate this opinion in actually consequently buying organic or animal-friendly products. Carrington et al. (2010) describes how from 30% of the consumers state they intent to purchase ethical products (e.g. organic products) only 3% actually do buy ethically. This is also known as the intention-behaviour gap (Vermeir and Verbeke 2006).

Consumer behavioural control and intention - behaviour

The theory of planned behaviour (TBP) is an accepted concept or theory that describes how behaviour can be predicted through conceptualizing, measuring and identifying factors that determine behaviour and intention (Azjen 1991; Vermeir and Verbeke 2008). This concept may explain why consumers with a specific mind set (e.g. I want to buy organic products because they offer better animal welfare) do or do not follow through with their intentions at the actual moment of purchase. The intention-behaviour gap is influenced by several factors that are also found in the TPB. Disparity between purchase intention and actual behaviour can be explained by i. implementation intentions, ii. actual behavioural control (ABC), and iii. situational context (Carrington et al. 2010). A consumers attitude does not necessarily lead to intentions. In its turn the purchase intentions does not automatically translate into purchase behaviour. The implementation intention specifies the plan to put this intention into action and is developed prior to the actual behaviour of purchase. When attitude is translated into intention, the purchase-intention and actual buying behaviour is influenced by environmental factors. These environmental factors are the individuals' interactions with the physical and social environment. The actual behavioural control is influenced by internal and external factors to either facilitate or inhibit the ability to perform the intended behaviour. The situational context explains how the consumer actual behaviour is under influence of encounters with an environment with external influencing factors. Such external factors can be unpredictable situations (e.g. sales of non-organic products), temporarily situations (e.g. product sold out), a moment in time, or a physical and social environment (e.g. the shopping mall). These factors may either facilitate or block the translation of intentions into behaviour (Carrington et al. 2010).

Consumer communication

When consumers trust the story behind organic farming and embrace the holistic approach of organic farming, the willingness to pay more will become stronger. This trust can be created by good communication strategies. The extent to which consumers believe that their personal efforts contribute to their ethical intention is defined as the perceived consumer effectiveness (Vermeir and Verbeke 2006). The TPB can provide a framework for conceptualizing and identifying factors that determine behaviour and behavioural intention. Thereby creating the opportunity to a systematic approach for information campaign development and communication strategies (Vermeir and Verbeke 2006). High credibility and reliability of organic farming can be formed by proof and certification of bodies such as consumer organizations, environmental organizations and certification of the organic producers and its products. Knowledge of the different consumer groups and profiling the consumers may provide tools on who and how to inform and convince the consumer (Vanhonacker and Verbeke, 2009; Zander and Hamm, 2008). Communicating strategies about animal welfare to construct a representative perception of organic farming should take into account the consumers' limited knowledge of farming. Therefore scientific definitions and research based findings should be translated in popular definitions (definable, recognizable, and explicit) when communicated to the public. Communication in an educational way will support constructive public debates (Vanhonacker et al., 2012). Effective communication and education, trust, additional values and credibility may reduce the earlier mentioned vagueness on which current perceptions, convictions, values, norms, knowledge and interests are based on and lead to better understanding of organic farming and farm animal welfare.

Discussion

Kijlstra et al. (2009) reviewed how information about organic food production is provided to the general public by both governmental bodies and nongovernmental organizations (NGO's). However, NGO's tend not to address public health problems and animal welfare issues associated with outdoor organic food production, either by not mentioning the issue or by disputing its validity. This emphasizes that honest and trustworthy communication may create ethically minded attitudes that might be translated into intentions. The formation of trust, added additional values and credibility, and structured perceptions, convictions, values, norms, knowledge and interests can lead to better understanding of organic farming and farm animal welfare. Understanding the TPB may decrease the intention-behaviour gap. Negative influences of the SC are often unforeseen and therefore difficult to shield off from consumers. However, well tactical merchandising strategies might decrease some of the influences.

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Animal, husbandry, women, husbands, family

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Introduction

Ecologically working smallholders in Southeast Nicaragua - as it happens in most farming families all over the country – are confronted with the fact of low female participation in agriculture itself and in organizing as farmers, with the only exception of farms which belong to a woman without husband. This has a series of different reasons, which the self organized group "Mujeres Emprendedoras[1] 15 de Octubre"[2] is trying to solve within the association Sano y Salvo - Safe and Sound, Primera Asociación Campesina de Cultura y Producción Ecológicas en la Región Autónoma del Atlántico Sur[3]. The traditional role in the Central American countryside is that the man does all the outside work and contacts and communication, his work generates the food and the money income, while the woman is responsible for maintaining the household, feeding the family and rising the children: a role of service, without producing money.

The normal smallholder did not send his children to school, but if he did so, girls were normally not included.

Methods and Materials

Education and Ecology

The solution for this given and widespread situation is based on a close together of education and ecology. Many efforts have been made to change the school education level of the rural poor, many of them just aiming at fighting illiteracy or - more recently - trying to put in practise the Millennium Development Goal of "primary school for all", which in the countryside means "low quality" education.

The association Sano y Salvo tries to widen this vision by different means: environmental education of the rural community is a permanent programme, accompanying the efforts of winning more farming families for ecological agriculture. In close cooperation and alliance with schools, among them a Montessori initiative, churches and NGOs Sano y Salvo tries to help motivating the public, the state and the private education sector to do more, to think of quality education, necessary to successfully tap the hidden potential of the rural youth.

Animal husbandry – more than "backyard economy"

From the very beginning the female engagement did not aim at the usual, limited "backyard economy", but participate seriously in ecological agriculture, marketing and organization. These are several challenges at once, which need also combined solutions and cannot be seen isolated. It must be

[1] Women Entrepreneurs – a group initiative helped to get started and running by Triodos Bank, The Netherlands, and SNKT, Enschede, The Netherlands.
[2] "*Día Mundial de la Mujer Rural*", as created by the World Summit of Women, Ginebra, Switzerland.
[3] "First Smallholders Association of Ecological Culture and Production in the Autonomous South Atlantic Region of Nicaragua", founded November 27. 1998.

mentioned that the animal husbandry is connected to an acre (or more) of diversified agroforestry under her management.

Animal husbandry – a women's project with the whole family ...

In the mere agricultural field Sano y Salvo's workshops like "The Family on the Organic Farm" aim to influence both genders in their attitudes, now tackling behaviour and customs of the whole peasant family. Role changes and what is connected to this is a transversal theme of most workshops and meetings. The experience showed that it is not just "making men gender sensitive", what brings us closer to sole urgent situations, but equally difficult was and is convincing rural women to accept this new task and role, which is contrary also to their conventional or traditional behaviour, still valid in the major part of the rural Latin American rural society, or to identify women, which have been ready "to start off". Women of course see the danger of another workload, when participating in extended animal husbandry, but when they begin to like the idea they help and contribute and fight to change their men ... (husbands and sons).

Quality and quantity: Organic!

The animals' fodder demand needs' planning and production in an organized and organic way, thinking of quality but - equally important – of sufficient quantities (which at the beginning is easily underestimated by the female "newcomers"). Veterinary problems are showing up, and not astonishingly most participants of our yearly repeated very practical workshop "Basic and Organic Veterinary" are women (including many young ones). Cost calculation of production, processing, sale etc. is often done by the young people, which have passed 5, 6 grades or more in school.

Results

Serious animal husbandry leads to family involvement

Keeping, caring for and producing a diverse game of animals in an organic setting are an agricultural practise, which needs the whole family's involvement. Producing ducks and geese and pigs and turkeys and chicken and sheep in our humid tropics demands diversified knowledge of the different species, fodder, shelter, health care, fencing, pasturing, pasture rotation, permanent supervision, book keeping, certain market analysis, protection against outside threats, organization with the other families; being responsible for an agroforestry plot at the same time helps the women and the family to understand the holistic nature of a family eco-farm, nutritional diversity needs and how to accomplish them and more.

Changing men

Some men of the association felt their power in danger; this was sometimes expressed directly, but more often indirectly like "Look, they do not achieve what they wanted, they have no knowledge, they belong into the house, they produce losses." But the majority of the husbands like the animal husbandry of their spouses and compañeras and are willing to accept the shift in roles and behaviour and help to get the young people into it, too. The educational components of the training workshops contribute a lot to this change, reinforced afterwards by practical experience and success of the activity.

Organic empowerment

The overall success is a real "empowerment" of women, but also of the whole family, and an acceptance of change of rules of the family, better nutrition, a clear improvement of income, controlled by the women and more. Our internal inspection scheme's people feel that the strengthened female participation also upgrades organic compliance of the whole membership; most women are more future oriented as men and feel more responsible for the long term well being of the family, which means in relation to being organic and being certified they do not risk easily this status by inadequate practise and violation of rules and norms and do help their husbands to follow the same honest way.

The women's sector is certified independently as organic by a recognized certification agency. This means in each of the participating member farms (right now around 15-20% of the membership) we do have two members of the association, with voice and vote. Before that, female membership and therewith organizational and executive influence in the association was very low, the possibility of being a full member was connected to – mainly male - ownership of the farm. Sano y Salvo redefined this: you can become a member with all rights, when "contributing directly to the agricultural production".

Victoria and Tomasa

As case examples the development of the animal husbandry - in the described way and with the described consequences - of the group members Victoria López Urbina, small farmer in Santa Isabel del Pajarito, and Tomasa Pérez, Buenavista (Punta Gorda), are documented with some numbers and photographic material, their production and market success so far and the challenges and temporary defeats as well. We do not do comparisons and calculations of costs, income, profit etc., because these ciphers are extremely influenced by local conditions, which moreover change permanently (season, weather, shortages etc.), and by national ups and downs of agricultural policies and day to day decisions of politicians.

Conclusions

Eco farming organizations may not turn down the female potential in their membership, because it would cut them off from a lot of possibilities to develop. The animal husbandry project autonomously done by the female membership of our eco farming families' association is an interesting and promising way to develop this potential and make it have an impact.

Active self-governed female participation in organic farming is very motivating and contributes to all the good things, organic agriculture stands for: environment protection, health, biodiversity, soil, water, self induced poverty eradication, climate care and mitigation.

Organic grazing systems in wet areas

(Foto: BLE 2004)

Effects of animal manure and harvest interval on the growth, dry matter yield and nutritive quality of three grasses at Abeokuta, Southwest Nigeria

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Abstract

A field experiment was conducted at the Organic Research Site, University of Agriculture Abeokuta, Nigeria between June 2010 and October 2011 to evaluate the effects of animal manure and harvest interval on the growth, dry matter yield and nutritive quality of three forage grasses. The experiment was a split-split-plot design with four animal manures namely: cattle, small ruminant, swine, poultry and control (no manure) as main plot; three grasses (Panicum maximum (Local), P. maximum (Ntchisi) and Pennisetum purpureum (Napier)) as sub-plot and four harvesting intervals (4, 8, 12 and 16 weeks) as sub-sub-plot. The grasses were evaluated for growth, proximate, fibre and mineral composition. The main effects of manure, harvest interval and species were significant for all the parameters evaluated. Dry matter (DM) yield was lowest ($P<0.05$) for the control treatments (12.96 t ha^{-1} versus 20.53, 25.87, 18.95 and 23.21 t ha^{-1} for cattle, swine, poultry and small ruminant manure respectively). Except for leaf proportion, swine manure produced higher ($P<0.05$) values for all other parameters evaluated than other manures. The interaction effects of manure type, grass species, harvest interval as well as that of species and harvest interval were significant. The DM, crude protein (CP) and ether extracts (EE) of the grasses were higher for cattle and lower for control ($P<0.05$) than other manure types. The CP, EE, ash and nitrogen free extracts (NFE) were higher ($P<0.05$) for Napier and harvesting at four weeks yielded higher values than longer intervals. The values for fiber components were higher for the control treatment than those that received manure and for Panicum species than Napier. Harvesting at 16 weeks resulted in higher ($P<0.05$) values than shorter intervals but the values for the mineral compositions did not follow clear trends even though the control treatment recorded higher values for phosphorus (3.33%) and calcium (10.41%).

Key words: Manure, Pasture, Panicum maximum, Pennisetum purpureum, Harvest interval

Introduction

In the developing countries of the tropics, ruminant animals depend mainly on forage as concentrate rations are expensive and unaffordable to most stockowners. The nutrition of animals in these countries is provided by the natural vegetation, commonly referred to as natural pastures, which for most of the year do not have sufficient nutrients and biomass to satisfy the needs of the animals (Mohammed-Saleem, 1994). One major factor militating against the adoption of sown pasture is the generally low nutrient status of tropical soils, especially of nitrogen and phosphorus (Martínez-Sánchez, 2005). Apart from the well known health and environmental hazards associated with prolonged and heavy use of inorganic fertilizers, their availability and affordability to livestock producers have also been major constraints to their use, especially for pasture production. In Southwest Nigeria, large quantities of manure of various animal species are generated daily (Osuhor *et al.*, 2002; Fasae *et al.*, 2009). The manure constitutes environmental hazards arising from pollution resulting from gas emissions as they decay, and in some cases through discharge of effluent into water bodies and underground water. The manure also sometimes builds up and occupies considerable spaces that could otherwise be profitably used. Some pilot studies (Onifade *et al*., 2005; Sodeinde *et al*., 2009) have shown that some of the manure can be profitably used for improved production of some forage grasses. Using the manure for increased pasture production may, in fact, be a means of recycling the waste for environmental sustainability and may, on the long run, revolutionize ruminant livestock production in Nigeria. The objective of the study was to evaluate the effects of various animal manure (Cattle, sheep/goat, swine, poultry and No manure - control) and cutting intervals (4, 8, 12 and 16weeks) on the dry matter productivity and nutritive quality of three forage grasses (*Panicum maximum* (Local), *P. maximum* (Ntchisi) and *Pennisetum purpureum*) in Abeokuta, Nigeria.

Materials and methods

The field experiment was conducted at the Organic Research farm, University of Agriculture, Abeokuta (UNAAB), Ogun State, Nigeria and laboratory analyses were carried out at the laboratory of the Institute of Subtropical Agriculture, Hunan, China. The land was cleared, ploughed and harrowed after two weeks, and the experimental land measuring 4,265m^2 was mapped out. Manure from four animal species namely: cattle, sheep/goat, swine and poultry were collected from the Teaching and Research Farm and used for the study. Sub-samples were taken from each manure type and analyzed prior to application to determine their nutrient composition. The crown splits of the *P. maximum* varieties and stem of *P. purpureum* were sourced from previously established plots on the Teaching and Research farm and planted at the spacing of 0.5m x 0.5m so that each plot had forty-eight grass stands. The study was a factorial experiment in a split-split-plot design with the main plot measuring 15m x 15m, sub plot 4m x 15m and the sub-sub-plot was 4m x 3m. The manure types were allotted to the main plot, the grass species to the sub plot while the harvesting intervals were allotted to the sub-sub plot. The three grasses (*P. maximum* (Local), *P. maximum* (Ntchisi), and *P. purpureum*); four harvesting intervals (4, 8, 12 and 16 weeks after planting) and four manure types plus control (i.e. cattle, sheep/goat, swine, poultry manure, and no manure) constitute the treatments totaling sixty (60) treatment-combinations with three replicates.

Results and discussion

The effect of manure type was significant ($P<0.05$) on the growth parameters and dry matter yield of the grasses (Table 1). The plant height ranged from 125.43 cm for unfertilized grasses to 179.53 cm for swine manure-fertilized grasses (SMFG). The height of the grasses fell within the range reported by Bilal *et al*. (2000) for *P. purpureum* to which nitrogen fertilizer and farmyard manure were applied but higher than those reported by Olanite *et al*. (2006) for *P. maximum* (Local) and *P. maximum* (Ntchisi) when inorganic fertilizer was applied at the rate of 40 kgN/ha. The leaf width ranged ($P<0.05$) from 3.37 to 4.03 cm for sheep manure-fertilized grasses (SMFG). Values for leaf length ranged from 92.14 cm for poultry manure-fertilized grasses (PMFG) to 103.97 cm for SMFG. The leaf widths were similar to those reported by Dele (2008) when an inorganic compound fertilizer was applied at 40 kgN/ha to two varieties of *P. maximum*. The range of values were however wider than those reported by Nyambati *et al.* (2010). The highest ($P<0.05$) value for tiller density (160.64 tiller/m^2) was recorded for SMFG while the control treatment (i.e. no manure) recorded the lowest value. The tiller density value recorded in SMFG was probably an indication of higher rate of nitrogen mineralization in swine manure compared to the other manure (Waskom, 1994; Olanite *et al*., 2010). Leaf proportion was higher for fertilized grasses (57.52 % for cattle manure fertilized grasses) than the unfertilized grasses (51.12% for control).

Table 1. Effects of manure type and age at harvest on the growth parameters, dry matter yield and fibre composition of the grasses

Factors	Plant Height (cm)	Leaf Width (cm)	Tiller Density (tiller/m²)	% Leaf	Dry Matter Yield (t/ha)	NFC	NDF	ADF
Manure type								
Cattle	157.06[b]	3.71[b]	111.33[cd]	57.52[a]	20.53[c]	128.74[b]	601.26[a]	337.51[a]
Swine	179.53[a]	4.03[a]	160.64[a]	54.49[b]	25.87[a]	129.72[b]	598.12[ab]	339.20[a]
Poultry	126.70[d]	3.96[ab]	119.85[c]	52.11[c]	18.95[c]	146.61[a]	597.52[ab]	321.93[b]
Sheep / goats	142.79[c]	3.37[c]	142.36[b]	54.55[b]	23.21[b]	142.13[ab]	586.51[b]	302.32[c]
Control	125.43[d]	3.74[ab]	97.38[d]	51.12[c]	12.96[d]	148.94[a]	603.04[a]	308.01[c]
SEM	10.2	0.1	10.0	2.3	1.4	6.2	8.8	3.2
Species								
P. maximum (Local)	166.56[a]	3.71[b]	125.57[b]	52.70[b]	17.52[c]	131.21[b]	620.65[a]	329.15[a]
P. maximum (Ntchisi)	132.59[c]	4.19[a]	162.56[a]	56.35[a]	20.32[b]	128.41[b]	622.53[a]	326.61[a]
P. purpureum	139.74[b]	3.38[c]	92.70[c]	52.84[b]	23.09[a]	157.95[a]	548.72[b]	309.61[b]
SEM	8.0	0.1	7.4	1.8	1.2	4.7	5.2	3.0
Age at harvest								
4	87.47[d]	3.22[b]	78.76[d]	71.94[a]	10.67[d]	132.34[b]	572.10[c]	312.70[c]
8	114.33[c]	3.92[a]	103.42[c]	59.81[b]	16.29[c]	137.41[ab]	581.14[c]	317.72[bc]
12	157.88[b]	4.08[a]	140.33[b]	46.35[c]	24.29[b]	146.21[a]	595.41[b]	322.91[b]
16	225.51[a]	3.81[a]	185.27[a]	37.75[d]	29.98[a]	140.82[ab]	640.54[a]	333.84[a]
SEM	5.6	0.1	7.8	0.7	0.9	5.7	6.8	3.5
P-value								
Manure	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	0.0028	0.0533	<0.0001
Species	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Age at harvest	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.1136	<0.0001	<0.0001
Manure * species	<0.0001	0.0742	0.0096	<0.0001	0.1402	0.0896	0.0048	<0.0001
Manure * age at harvest	<0.0001	0.0048	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0007
Species * age at harvest	<0.0001	<0.0001	0.4291	<0.0001	0.1096	0.0011	0.2716	0.6328
Manure * species * age at harvest	<0.0001	<0.0001	0.2814	<0.0001	0.9809	<0.0001	0.0002	0.1234

[a, b, c, d]: Means in same column with different superscripts are significantly (p<0.05) different
SEM = Standard Error of Mean; NFC = Non fibre carbohydrate; WAP= weeks after planting; NDF = Neutral detergent fibre; ADF = Acid detergent fibre; * = interaction

The dry matter yield ranged from 12.96 t/ha for unfertilized grasses to 25.87 t/ha for SMFG which was significantly (P<0.05) higher than others. The interaction effect of manure type x species, manure type x age at harvest, species x age at harvest and manure type x species x age at harvest were all significant (P<0.05). The non fibre carbohydrate (NFC) values were also within the range of 127-259 g/kg reported by Anele *et al.* (2009). This indicates that the NFC of the grasses can be easily degraded or fermented as NFC is a crude estimate of the carbohydrate pool that differ in digestibility from NDF. It has also been reported that NFC has a positive relationship with ammonia nitrogen (NH_3-N) utilization in the rumen (Tylutki *et al*., 2008). The NDF and ADF values were however lower than those reported by Olanite *et al*. (2006) for two Panicum varieties fertilized with inorganic nitrogen fertilizer (Table 1). The P values recorded were slightly higher than those reported by Ayano (2005) for *P. maximum* unimproved that was fertilized with different animal manures (Table 2). This might be due to different factors such as the soil fertility as well as the feed offered the animals that produced the manure used for fertilizing the grasses. However, the trend in the change in concentration of P with plant maturity is in line with the report of Minson (1990). The P contents however fell within the recommended (1-4.8 g/kg) range for different classes of ruminant animals as stated by McDowell (1992; 1997). The values recorded for Ca content of the grasses as influenced by the manure types in this study is in consonance with the report of Chang *et al.* (1994) in which the Ca content of zero-manured barley had higher concentration. This might be as a result of salinity associated with manure application (Chang *et al*., 1991), also chelating properties of manure could be responsible in which elements such as calcium are bond into a chelate with the soil colloids and are release gradually and this is one of the importance of manure as they are known for binding up mineral elements against being washed away during erosion. The requirement of different ruminant animals in terms of Ca concentration ranged between 1.8 to 8.2 g/kg as reported by McDowell (1992; 1997). The crude protein (CP) recorded for the grasses as affected by the animal manure were within the range of 82– 112.8 g/kg reported by Bilal *et al.* (2001) when farmyard manure was applied to *P. purpureum* (Table 2). The values were generally above the critical limit below which forage intake by ruminants and rumen microbial activity could be negatively affected (Van Soest, 1994). These values were also above the minimum range of 65–80 g/kg prescribed for optimum performance of tropical ruminant animals (Minson, 1981).

Table 2. Effects of manure type and age at harvest on the phosphorus (P) calcium (Ca) and crude protein (CP) composition of three grass species.

Factors	P	Ca	CP
Manure type			
Cattle	1.67^{d}	7.11^{d}	101.60^{a}
Swine	2.48^{b}	7.91^{c}	100.84^{a}
Poultry	3.33^{a}	9.51^{b}	88.95^{c}
Sheep and goats	1.90^{c}	9.76^{ab}	93.62^{b}
Control	1.89^{c}	10.41^{a}	84.94^{c}
SEM	0.2	0.4	2.9
Species			
P. maximum (Local)	1.80^{b}	8.19^{b}	92.52^{b}
P. maximum (Ntchisi)	1.75^{b}	10.01^{a}	91.33^{b}
P. purpureum	3.22^{a}	8.62^{b}	98.22^{a}
SEM	0.1	0.4	2.4
Age at harvest (WAP)			
4	2.24^{b}	9.19^{b}	110.60^{a}
8	2.53^{a}	10.15^{a}	101.54^{b}
12	2.59^{a}	8.65^{b}	90.52^{c}
16	1.66^{c}	7.78^{c}	73.32^{d}
SEM	0.2	0.4	1.9
P-value			
Manure	<0.0001	<0.0001	<0.0001
Species	<0.0001	<0.0001	<0.0001
Age at harvest	<0.0001	<0.0001	<0.0001
Manure x species	<0.0001	0.0031	<0.0001
Manure x age at harvest	0.0103	<0.0001	0.0015
Species x age at harvest	0.0551	0.0062	0.0676
Manure x species x age at harvest	0.0335	<0.0001	0.5432

[a, b, c, d]: Means in same column with different superscripts are significantly ($p<0.05$) different;
SEM = Standard Error of Mean; WAP = weeks after planting

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Production cost of organic beef cattle production system in Pantanal – Brazil

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Abstract

In most farms in the Pantanal region the cattle farming is an activity with a reduced supply of external inputs and that maximize the use of natural resources. In order to add value to their production, some ranchers have chosen to certify their properties as organics. A panel of local producers held in 2011 analyzed the cost of production and fattening of calves on a farm that is representative of the Pantanal organic beef cattle system. The total area of the representative farm was estimated at 13,204 hectares with total herd of 1,462 cattle heads, and annual production of 13,611.92 arrobas (15 kg) of certified meat. The most significant items in the effective operating cost (COE) were administrative costs (taxes, certifications, etc.), and mineral salt supplementation, 19.51% and 19.19% respectively. The COE was estimated at R$_601,767.92, and gross revenue at R$_1,610,217.85 (R$ 1.00 = US$ 1.67 in 2011). The total operational cost (TOC), which is the COE with the depreciation of buildings, machinery and pastures, was R$_860,514.64. The expansion of organic production systems in the Pantanal depends on adds higher value to the product, which can occur due to the importance of environmental conservation for the region.

Key words: panel, gross margin, net farm income

Introduction

Cattle ranching in the Pantanal are developed in extensive ranches with management features guided by the flooding system. In this system the animals are kept almost exclusively of extensive native pasture from the sandy plains in order to allow selective grazing and the watery use (Abreu et al., 2010). The good state of conservation of the Pantanal is directly related to how extensive the local livestock production is. However, the productive performance below the national average, the acute reduction in the area of the properties and the fall in profitability of the livestock industry has committed the economic efficiency. An alternative to the intensification of production is to add value to the product and in this sense the certified organic production has aroused the interest of producers in the region. However the transformation of conventional beef cattle production for organic production system should be performed cautiously. Preferably, it should be deployed in areas where there will be favorable conditions and will require some adjustments to the management system. Besides the need to assess the economic viability of the whole process (Euclides Filho, 2004). This study aimed to survey primary data via the panel system that allowed the definition of a representative ranch of the organic system in the Pantanal.

Material and methodology

In the Pantanal there are 13 certified organic farms which make a total of 92,981 hectares with 30,361 cattle, of which 11 farms in the Pantanal of Nhecolândia, a farm in the Pantanal of Nabileque and a farm in the Pantanal of Aquidauana. All properties are part of the Brazilian Association of Organic Farmers - ABPO. The primary data collection via the panel system allows the definition of representative properties. For studies of production units in rural areas, Plaxico &

Tweeten (1963) suggest the representative farm system as the ideal and practical. However, some definitions and assumptions should be adopted, the regional characteristics must be constantly revised and the production data often revised to reflect technological advances. The panel is a procedure for obtaining information less costly than the census or sample of farms. Another advantage is that it provides greater flexibility and versatility in the updating of data, without compromising quality. The technique consists of an assembly with a group of one or more researchers, a regional ~~T~~technician and five to ten producers (eight in average). Despite the difficulty of characterizing a single property of a production system that is representative of the locality under study, the method seeks, through the experience of participating producers; characterize the property that is most commonly found in the organic system in the Pantanal (Carvalho et al., 2008).

In 2011, with the participation of five producers and of the technician responsible for the deployment of the system on proprieties in the Pantanal, panel was performed according to the methodology described in Plaxico & Tweeten (1963).

Results

It was found that the modal property that develops organic production system has complete cycle (breeding, rearing) in the Pantanal and fattening on the plateau. The breeding and rearing of matrices are developed in the Pantanal in property of 12,000 hectares with 8,200 hectares being of native pastures and 1,800 hectares of cultivated pastures. The remaining area (2,000 hectares) ~~of~~ is for permanent preservation and improvements. The fattening system is held in properties in the highlands near the Pantanal on farms of 1,200 hectares with 1,000 hectares formed with cultivated pastures, of which 800 hectares of *Brachiaria decumbens* and 200 hectares of *Panicum*. The total herd in the Pantanal was 4.944 animals or 2,835.48 Animal Units (AU), with a stocking rate of 0.24 AU / ha, considering that each AU is equivalent to 450 kg live weight. The herd comprised male and female calves, heifers, bulls, pregnant and non-pregnant cows, as shown in Table 1.

Table 1. Structure of cattle herd in the Pantanal

Category	Male calves / young bulls	Bulls	Female calves	Heifers 12 to 24 months	Heifers 24 to 36 months	Pregnant cows (multi-parous)	Cows	Total Herd Animals
Number	1571	80	629	334	330	1300	700	4944
Average weight (kg)	238	550	135	190	265	350	340	

In the fattening, which is held on the plateau, the average age at slaughter of cattle is 42 months, and the herd that is fattening is basically composed of heifers and steers, as shown in Table 2.

Table 2. Structure of cattle herd for fattening in the Pantanal.

Category	Ox	Fat ox	Heifers	Fat heifers
Number	613	603	289	286
Average weight (kg)	285	395	135	190

In the cost analysis of the organic system developed in the Pantanal (Figure 1), the most significant spending is the mineral supplementation, responsible to approximately 30% of effective operational cost (EOC). This situation was expected due to the large number of animals which must be supplemented, and due the lack of minerals occurring in the Pantanal, which causes mineral mixtures become expensive due the need to use large amounts of phosphorus and calcium (Pott et al. 1987a; Pott et al., 1987b).

Figure 2 shows the COE of the fattening phase where there is a higher administrative cost, because in addition to normal spending on administration is there the cost of mandatory certification for the organic system, and more specialized manpower in the management of animals screened and certified. And the spending on the maintenance of pastures in order to prevent that degradation occurs, with consequent loss of efficiency throughout the process.

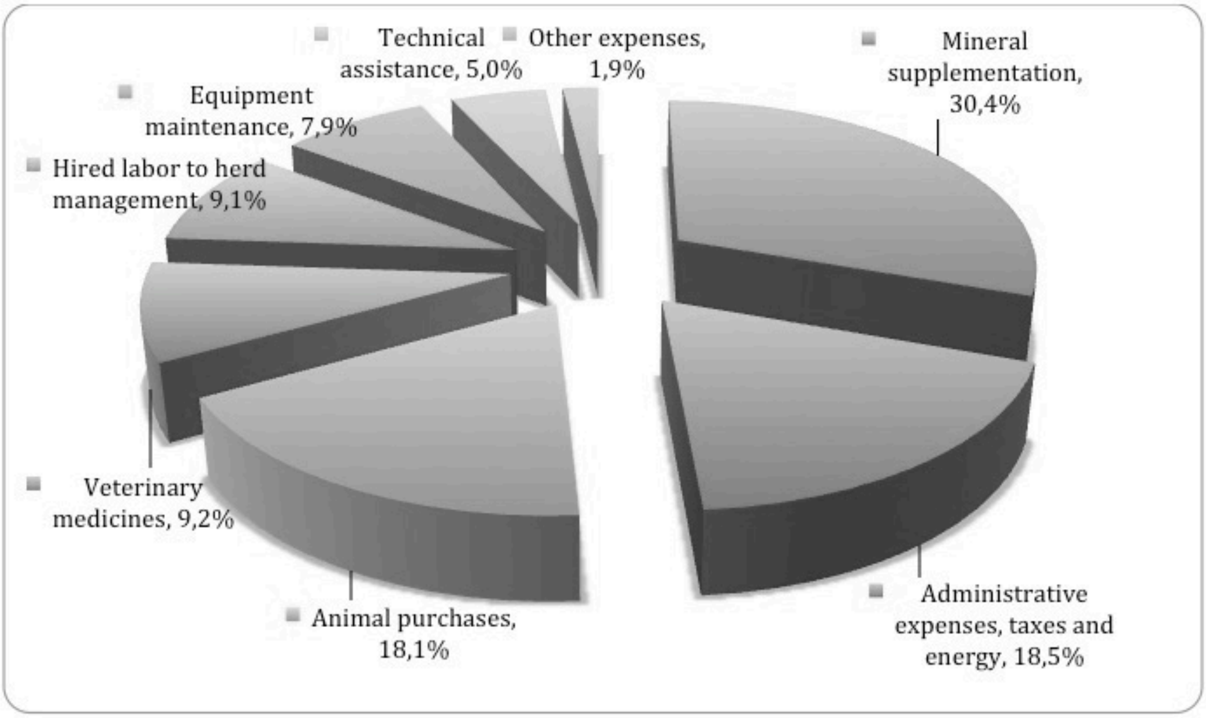

Figure 1. Weighting of the main inputs in the EOC of the rearing system in the organic production in the Pantanal.

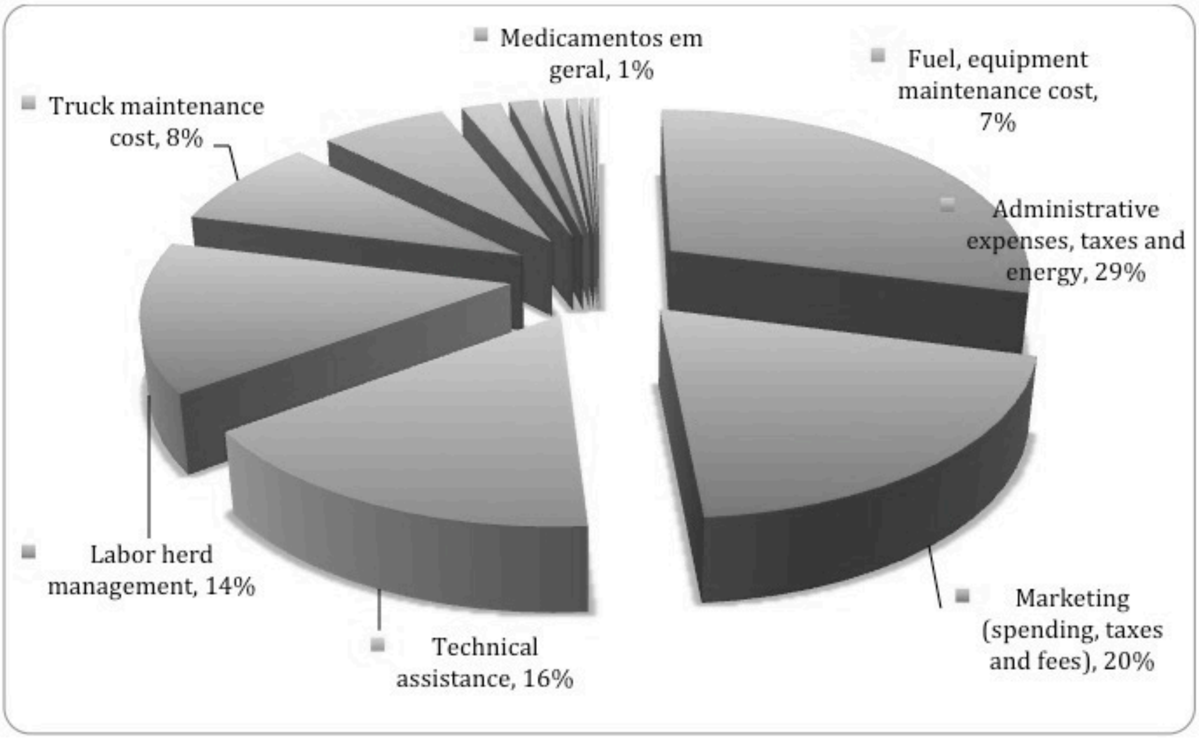

Figure 2. Weighting of the main inputs in the EOC of the fattening system in the organic production in the Pantanal.

In the analysis of administrative indices, the Gross Revenue (sale of animals), the COE, depreciation, and Total Operating Cost (TOC) were estimated at R$ 1,610,217.85; R$ 601,767.34, R$ 258,747.30 and R$ 860,514.64 respectively. That is, the organic system of the Pantanal had a Net Margin of R$ 749,703.21 in 2011.

However, when considering the entire invested capital (purchase of land, pasture establishment, improvements and animals) it was found the amount of R$ 19,857,251.87. Thus, it is possible to calculate the Opportunity Cost of Capital (COC), which represents 6% of total invested capital (i.e., income that would be obtained if the invested capital were applied in savings), which in the case was of R$ 1,414,297.43. Adding the TOC and COC result in a Total Cost (TC) of R$ 2,274,812.07. Finally, the Net Revenue found (difference between gross revenue and TC) was R$ - 664,594.22.

The effective operating profitability of beef cattle was R$ 65.17 per hectare of pasture per year. While the total operating profitability, which includes the cost of depreciation (TOC) was R$ 45.57/ha of pasture per year.

Discussion

The results of the study for the beef cattle organic system in the Pantanal region reveals that livestock revenue can cover the TOC and COE, is enough to cover the depreciation, but insufficient to cover the capital invested (IC) . This fact indicates that the activity is a sustainable and profitable investment in the short and medium term, but not at long term, as the producer cannot remunerate its invested capital. This was also been verified by Uematsu & Mishra (2012), who evaluated financially organic agricultural production systems and found no economic advantage to producers, what can be a barrier so that more producers invest in organic certification of their systems production.

Therefore the absorption of technologies, especially those that positively impact the reproductive rates of the breeding herd in the Pantanal is essential for the maintenance of the producer in activity in the long term. In addition to a policy of differentiated tax incentive for the producer of the Pantanal that to compromise to produce in a sustainable manner and contribute effectively to the conservation of this biome.

Suggestions to tackle the future challenges of organic animal husbandry

The importance of cultural constructions of "farmer conservationist" through good animal husbandry practices is great in Brazil, because in Brazil it is a new fact. Generally society does not know the work done by farmers. There is a need, through changes in concepts, enhance the human capital of the agricultural sector, and provide economic support to the studies of farmers in agri-environment schemes. One way to valorize this situation is to strengthen, by means of economic support, the ranchers that became organic, and study all the cultural, productive, economic and environmental conversion process.

Although certified ranchers with organic systems increased their revenue, also incur greater labor and expense as well. In particular, certified organic producers spend significantly more on marketing expenses, compared to conventional farmers. The results suggest that the lack of economic incentives can be an important barrier to conversion to organic farming.

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A rotational winter grazing system for beef cattle – production costs in relation to animal welfare, working environment and environmental impact

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Abstract

Keeping beef cattle outdoors during winter could be inexpensive. Our objective was to design a rotational grazing system that can fulfil the aims of low production costs, good animal welfare, good working environment and low environmental impact. The design produced was evaluated during two years with suckler cows (71 cows ha^{-1} month^{-1}) given access to a weather shelter, a new pen every month and a new feeding area every week. The system was set up in autumn and only manually portable equipment was moved during winter. Calculations included annual investment and labour costs for two design cases compared with indoor wintering. Annual costs in a 38-suckler cow herd were SEK 1500 and 1200 cow^{-1} for the two design cases, compared with SEK 3000 cow^{-1} for conventional indoor wintering. The rotational grazing design has the potential to achieve good animal welfare and a good working environment, but phosphorus surface runoff losses are too high.

Key words: design, investment, equipment, working hours

Introduction

Grazing cattle are needed in Sweden to preserve 450 000 hectares of semi-natural grasslands with high biodiversity, but declining economic margins for Swedish beef production and high costs of conventional indoor wintering of cattle make grazing economically unsustainable in many cases. Cheap outdoor wintering might improve the sustainability of beef production and grassland management (Kumm *et al.*, 2005). Keeping cattle outdoors improves animal health and allows them to express their natural behaviour (Keeling and Jensen, 2002). However, keeping cattle in permanent pens can have negative environmental effects, due to excessive accumulation of excreta increasing the risk of nutrient runoff during periods of high precipitation or snowmelt (Uusi-Kämppä, 2002). Rotating pens can reduce the risk of excretion point loads and runoff (Dahlin *et al.*, 2005). The working environment in beef cattle farming involves high risks concerning health and security (Stiernström *et al.*, 1998) which must also be minimised. Our objective was to design and test a flexible rotational grazing system for beef cattle during winter and evaluate the production costs.

Materials and methodology

The experimental design was tested and evaluated during two winter periods (November-April) on a commercial organic beef farm in western Sweden (59°20'N; 13°7'E). The site was chosen to represent extensive beef production in a forest district with less than 400 annual working hours per farm.

The experimental design aimed to imitate a rotational beef cattle system for winter rearing on arable land with clover/grass in the final winter before ploughing and subsequent reseeding. The experimental design also aimed to be flexible concerning herd size (5-50 cattle), arrangement of a weather shelter supporting a number of pens (1-4) and portability.

The study cattle, pregnant beef heifers of cross-breeds (suckler cows), were kept in a pen on an eight-year-old clover/grass ley for one month, at an animal density corresponding to 71 cows ha^{-1} $month^{-1}$. The pen area represented the forage requirement of the cattle during one month. The pen and weather shelter sites were prepared in advance in autumn by using a tractor to erect fencing and rising poles. The lying area under roof represented 4.5 m^2 $animal^{-1}$. The roof and wind-nets of the weather shelter and other loose equipment such as strip fences were moved manually during winter to equip new pens. Silage bales, corresponding to requirements for one month when the heifers had free access to forage, were placed within the pen by tractor in autumn. In winter the feed racks were moved manually to new silage bales in the expanded pen area every week. The insulated drinking facility was stationary. Straw litter corresponding to 5 kg $animal^{-1}$ day^{-1} was taken by tractor to the weather shelter once a week and spread manually. There was no machine traffic in the pen during the winter period in order to minimise soil compaction.

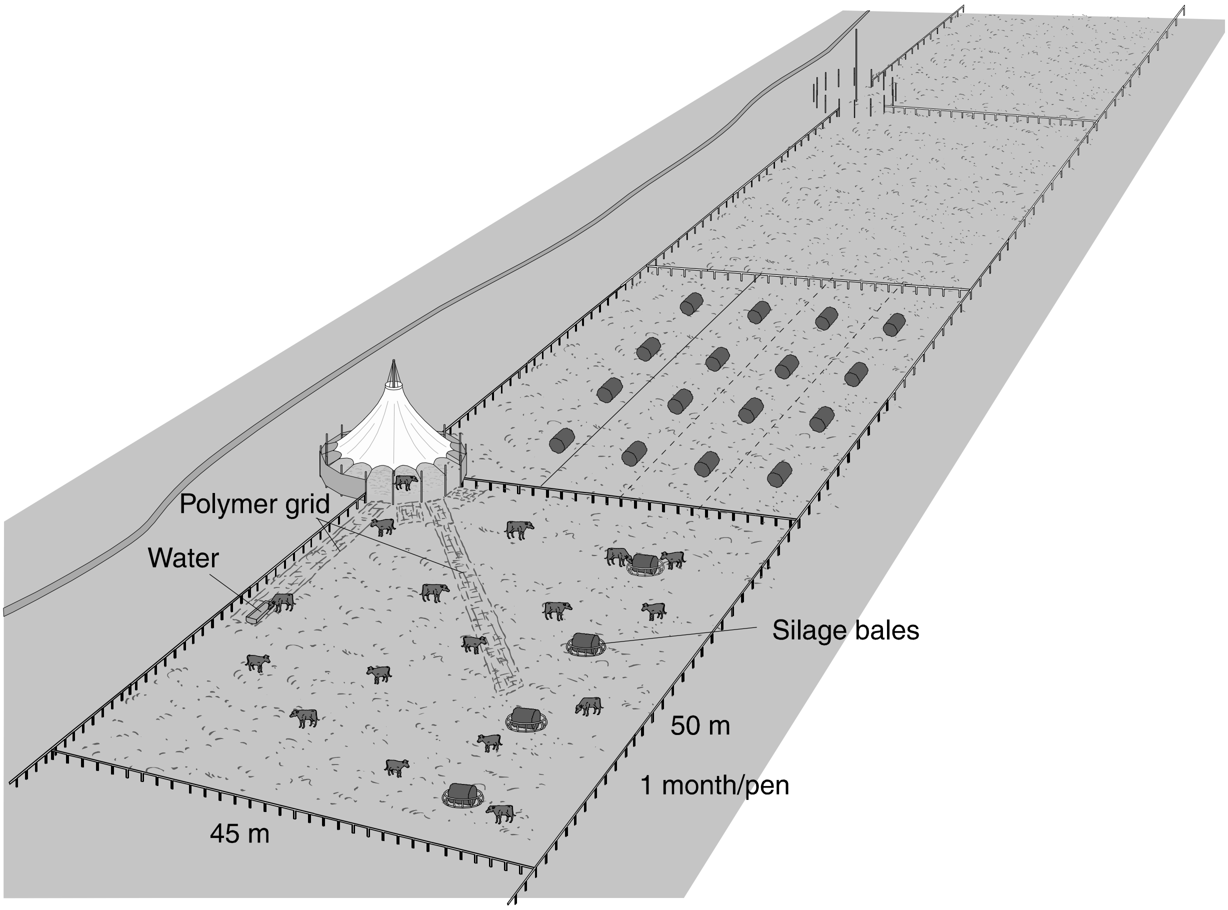

Figure 1. Diagram of the rotational outdoor winter grazing system.

The design was evaluated in terms of costs for investments in weather shelter, main fences, feed-racks, insulated water facilities, strip fences and wind-nets, with depreciation for wear and tear corresponding to 10 years and 5 years, respectively.

Labour costs during two winter periods included work hours for fencing, moving feed-racks once a week and erecting/dismantling and moving the weather shelter three times $winter^{-1}$, corresponding to 0.5 man-hours day^{-1}. Labour costs also included daily work on supervision of animals, straw application and adjusting feed-racks, which corresponded to 0.25 man-hours day^{-1}. The costs were also calculated for a simplified example of the design where the weather shelter was moved only once per year and placed in one large pen of permanent pasture (3 cows ha^{-1}). Moving feeding places was included in the simplified example. The annual costs of the complete and the simplified design were compared with the costs of conventional housing for indoor wintering of beef cattle on straw bedding. All calculations of costs were based on statistics from the database Agriwise (2010) and expressed in SEK (1 SEK=0.11 EUR).

Results

Based on a herd of 38 suckler cows, the annual costs of the simplified design were calculated to be SEK 1200 cow^{-1}, while those of the complete design including costs for housing sick animals and frostless water pipes were SEK 1500 cow^{-1}. The total annual cost of conventional housing for indoor wintering is about SEK 3000 suckler cow^{-1} in a 38-cow herd (Agriwise, 2010).

Discussion

Both the complete and the simplified design of rotational winter grazing system tested in this study halved the annual costs per suckler cow compared with a conventional cow house for indoor wintering. However, in smaller herds and where long water pipes are required the total cost per cow can be considerably higher. The working environment could be safe and healthy if some technical and management solutions are developed and used for moving feed-racks and the weather shelter and for feeding/watering. Working outdoors in a cold environment (around 0 ºC during this study) was not a serious problem (Geng and Salomon, 2010). The experimental design was capable of providing good animal health and welfare. All the heifers had unrestrained access to the weather shelter and feed and all were surprisingly clean due to their frequent use of the weather shelter for lying (Wahlund et al., 2010). The experimental design with rotational pens and weekly moving of feeding places could decrease the risk of point loads of excretion and continuous accumulation of N and P. However, a density of 71 suckler cows ha^{-1} seemed too high, as the N application with manure corresponded to 510 kg N ha^{-1}. A density of 24 heifers ha^{-1} would correspond better to EU Nitrate Directive requirements. The clay-silt soil at the site proved challenging during wet conditions and trampling by the heifers created heavy mud, destroying the soil structure completely. Concerning N and P losses, the cold, water-saturated soil conditions promoted low losses of NH_3 and N_2O (Salomon & Rodhe, 2011), while the wet and muddy conditions gave significant surface runoff. The P losses were about 10-fold higher than normally expected from arable land in Sweden (Salomon et al., 2012). To decrease the risk of N and P losses with surface runoff, a lower animal density and a site with a soil less sensitive to trampling are strongly recommended. Another approach is to develop nutrient management techniques for collecting or absorbing manure on sub-areas with a high load of nutrients.

Suggestions to tackle the future challenges of organic animal husbandry

In extensive beef cattle production the type of overwintering needs to be inexpensive and thus have low labour and investment costs. This must be combined with a good working environment, good animal health and welfare, and a low environmental impact. Access to the outdoors is a key requirement in organic animal production and there is therefore a need to develop innovative outdoor system designs with technology adapted to biological demands that promote all aspects of sustainability.

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A comparative analysis of the conventional beef export outputs from Subsaharan African countries and beef outputs from organic beef exporting developing countries.

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Key words: beef, conventional, organic, trade, sub-Saharan

Introduction

In the past decade there has been an increasing consumer preference for certified organic beef products or chemical- free beef products which can be detrimental to the health of consumers. Due to this trend, the trading partners of Subsaharan African countries and other developing countries' beef exporters have imposed stringent food safety measures on beef exports from these countries. The imposed stringent food safety measures such as stringent sanitary and phytosanitary measures imposed on beef exports from developing countries restrict market access of beef exports to their trading partners (Wilson, 1999).

Method

Time series data from year 2000 to 2009 for major Susaharan African countries (Kenya, Namibia and South Africa) beef exporters' annual income were obtained from FAOSTAT. Time series data were also obtained from FAOSTAT for three developing countries exporting certified organic beef exports in addition to conventional beef exports. The annual income growth rates and the average income growth rates for these countries were determined from 2000 to 2009. Utilizing descriptive analysis in form of bar charts, the average annual income growth rates for Subsaharan African countries and the developing countries exporting competitive value added certified organic beef products in addition to conventional beef products were analysed.

Results

The major exporters of conventional beef products in Subsaharan Africa are South Africa, Namibia and Kenya. These countries are not known to export certified organic beef products. In recent years there has been a haphazard increase in the annual income for beef exports from these Subsaharan African countries. Table 1 shows that the annual income for South Africa increased from $5,951,000 in 2000 to $9,484 ,000 in 2004 and declined to $6,655,000 in 2005. It declined to $4,755,000 in 2007 and rose in 2008 from $ 6,369,000 to $6,680,000 in 2009. This table also shows that Namibia's annual income for beef exports declined from $3,500.000 in 2000 to $ 649,000 in 2002. It rose from $1,413,000 in 2003 to $3,231,000 in 2006. It rose to $5,879,000 in 2007 and declined to $3,867,000 in 2008 and 2009. Also, in table 1, Kenya's annual income for beef exports rose from $48,000 in 2000 to $109,000 in 2001. The annual income for Kenyan beef exports declined to $93,000 in 2002 and rose to $181,000 and rose from $181,000 in 2003 to $1,515,000 in 2008. Kenya's annual income for beef exports declined to $1,056.000 in 2009.

Table 1: Beef exports for selected Subsaharan African countries from 2000 to 2009

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Kenya	48	109	93	181	205	512	574	1036	1515	1056
Namibia	3500	1603	649	1413	5038	7676	3231	5879	3867	3867
South Africa	5951	6503	6808	9200	9484	6655	4964	4755	6369	6680

Source, FAOstat 2012 (in 1,000 US-$)

The haphazard increase in the annual income of major Subsaharan African countries beef exporters limits expansion of annual income for these countries. A major contributor to this haphazard increase in the annual income for Subsaharan African countries beef exports is the imposition of stringent food safety measures such as sanitary and phytosanitary measures which distort trade, due to market access restrictions of beef exports from these countries to their trading partners (RASFF, 2010). A few developing countries which include Argentina, Uruguay and Brazil export competitive value added beef products such as certified organic beef products in addition to conventional beef exports to the export markets of their trading partners. This study aims at a comparative analysis of the annual conventional beef export outputs and the annual beef outputs from organic beef exporting developing countries.

Table 2: Annual income for major developing countries exporters of certified organic and conventional beef exports from 2000 to 2009 (1000 USD)

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Argentina	4,523	549	1,058	6,077	12,339	12,531	19,245	7,790	19,495	16,375
Brazil	391	603	463	577	1,601	2,049	4,959	6,081	11,498	6,841
Uruguay	38,918	19,226	2,723	6,392	4,636	6,603	10,331	10,953	17,049	10,169

Source: FAOSTAT 2012

Table 3: Annual income growth rates of beef exports for Subsaharan African countries beef exporters and developing countries certified organic and conventional beef exporters (%)

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Average
Argentina	-45.9	87.8	92.7	474.3	103.4	1.5	53.5	59.5	15.0	-16.0	66.6
Brazil	48.1	54.2	23.2	24.6	177.4	27.9	142.0	22.6	89.0	-40.5	52.2
Uruguay	10.9	50.5	85.8	134.7	-27.4	42.4	56.4	6.0	55.6	-40.3	10.1
South Af.	7.5	9.2	4.6	35.1	3.0	-29.8	-25.4	0.0	33.9	4.8	7.0
Namibia	116.8	-0.5	-59.5	117.7	256.5	52.3	0.5	81.9	-34.2	0.0	41.9
Kenya	-89.8	127.0	-14.6	94.6	113.2	149.7	12.1	8.5	46.2	30.2	41.6

Source: Author's Compilation from FAOSTAT

Table 4: Comparative analysis of average income growth rates for Subsaharan African countries beef exporters and developing countries certified organic beef exporters (%)

Subsaharan African Countries beef exporters	Developing Countries Organic Beef Exporters
41.9	66.6
41.6	52.2
7.0	10.1

Discussion

The results show the lowest growth rate as a double digit of 10% and the highest growth rate as a double digit of 66.6% for the average annual income growth rates for both conventional and certified organic beef exporting developing countries. The results show the lowest growth rate as single digit of 7% and highest as a double digit of 41.9% for the conventional beef exporting countries.

Conclusion.

Implementation of effective organic beef exports production policies in Subsaharan African countries in future will enhance growth of the annual income from beef exports.

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Performance and efficiency of organic low input pasture beef production

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Abstract

The main agricultural acreage of Switzerland is grassland and alpine pastures. 70% of the Swiss agricultural land is grass land 744'000ha + 536'000ha of alpine pastures (total of 1'280'000ha). That totals 31% of the surface of Switzerland (4'128'500ha). Grassland is not available as food for human beings. Ruminants transform grass into to food (milk and meat). Small and remote farms Switzerland produce beef. Our small grassland farm (5.7ha) uses crossbreed Aberdeen Angus with milk breeds (Brown Swiss, Holstein, Jersey, Simmental) suckler cows and a pure bread Limousin bull as the father for the calves. The cows, calves and beef animals are kept in a free stall for 150 days in winter (Nov.-March), 115 days on the home pastures (550m) and 100 days on alpine pasture (1500-2500m). They feed only on pasture grass during the vegetation period and grass silage and hey in winter. They do not get any corn or concentrated feed (feed no food).

Key words: Low input organic pasture beef, cross breed suckler cows, efficiency in pasture beef production, and quality of organic pasture beef

Introduction

Three years ago we could rent the small neighbor grassland farm (5.7ha). We yield about 10to of dry matter in grass, 4-5 cuts and 1400mm of rain spread well over the summer. We have no milk quota so we produce beef with suckler cows like many small and remote farms in Switzerland. Our aim is to produce a high quality organic pasture beef in a closed nutrient and animal cycle on the farm without any use of arable land, corn or other concentrated feed (feed no food).

Materials and methods

Our grassland farm uses crossbreed Aberdeen Angus (premature, polled, good intramuscular fat) with milk breeds Brown Swiss, Holstein Frisian, Jersey, Simmental (size, milk) for suckler cows. That is the base of the cow herd. These F1 cows are crossed with a pure bread French Limousin bull (good daily gain, nice carcass, good fat cover and good meat quality). The hybrid vigor is utilized two times, once for the cows and a second time for the calves. The aim is to produce as much high quality organic beef per ha grassland with the restriction of no corn or concentrated feed. In winter (Nov.-March, 150 days) the cows and beef animals for fattening are kept in a free stall with wooden boxes inside and an outside run and feeding place. The calves have a separate lying place on deep straw. During the vegetation period all animals feed on permanent intensive natural grassland pastures at home in spring and fall (115 days, 550m over sea) and 100 days on alpine pastures (2000m over sea) in Grison. The winter feed consist of 80% grass silage and 20% hey ad libitum in a covered hayrack. We feed absolutely no corn or concentrates.

Results and discussion

Tab. 1 shows that the quality (except for the E-carcasses) and daily gain of Meilibeef is better than the average of the Swiss organic pasture beef (OPB) sold by Migros. The results show, that if the genetics of the cows and bulls are carefully selected, the animals can feed ad libitum on good quality grass and conserved grass, the quality of the carcass and the daily gain can be very appealing. Swiss organic pasture beef (OPB) has no restrictions for corn or concentrated feed. The last survey in 2010 on 67 OPB farms showed, that 16% of the farms gave concentrated feed and only Ø of 90kg per animal.

Table 1

Quality of carcass	Meilibeef 18 animals	organic pasture beef (OPB) 2300 animals
Ø weight carcass kg	272	280
Ø age at slaughtering	453 days, 15.1 months	636 days, 21.2 months
Ø daily gain in gr. LW*	1074	780
Ø daily gain in gr. CW*	600	440
Ø taxation EUROP	28% R+, 55% U, 17% E	8% less than R, 9% R, 22% R+ 36% U, 25% E

*LW-life weight, *CW-carcass weight

Table 2

Efficiency of	Suckler cows with slaughtering at 10 months	Suckler cows with slaughtering at av. 14-21 m.	Organic Pasture beef av. 21
Carcass weight	220kg	280kg	280kg
Carcass weight/ha grassland	491	557	856

Tab. 2 shows that the most efficient way (most meat/ha) is to directly fatten beef crossbreed off-spring of dairy cows or weaned of suckler cow calves on the pasture. If suckler cows move around with the calves the efficiency drops very quickly.

Table 3.

Quality of meat	Meilibeef, 6 animals	average or aim in Switzerland
pH	5.49	over 5.9 DFD meat
Color	36.3	between 35-40
Drip after 48h	1.15%	aim less than 4.5%
Loss by cooking	13%	aim less than 25%
IMF	3.01%	Ø in CH 1.5-2%
Tenderness	25.5 N	under 31 N, very tender
Σ CLA 10	0.93%	CH 0.3-0.6%, more is good
Σ Ω3 FA	3.34%	CH 1.5%, more is good
Σ Ω6 FA	4.13%	CH 4-12%, less is good

Tab. 3 shows the quality of meat on the plate of the consumer. Meat quality has a lot to do with the sex of the beef (heifer/steer), slaughtering, cooling of the carcass, maturing of the carcass and the meat. If all the parameters are taken care of in an optimal way, the meat quality of organic pasture beef can be very good.

Conclusion

The small Meilibeef suckler cow herd shows, that if the entire production chain of breeding, animal husbandry, feeding, slaughtering, maturing is followed up by the aim on quality, the carcass and meat quality of organic pasture beef can be excellent even though the animals get absolutely no corn or concentrated feed. These animals are not in competition for the food of human beings. Feed no food and nevertheless enjoy high quality beef at its best.

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Organic grazing systems in dry areas

(Foto: Rahmann 2011)

The Ark of Livestock Biodiversity

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Introduction

As industrial modes of livestock production are spreading around the world, domestic animal diversity is in rapid decline. According to the FAO, one third of all livestock breeds have either perished or are threatened with extinction, due to intensive selection for high production by means of artificial insemination and embryo transfer and the spreading of a small number of genetically narrow high performance breeds around the whole globe.

In this scenario, the main stewards of livestock genetic diversity are pastoralists and other "small-scale livestock keepers" that raise animals under low-input conditions. Termed "guardians of biological diversity" (FAO, 2009), these people conserve biodiversity at the level of livestock breeds, vegetation, eco-systems and landscapes.

The livestock breeds kept by pastoralists have unique characteristics, as they are subjected to selection criteria that are almost entirely different from those used in "scientific animal breeding". They

- are part and parcel of their respective eco-systems and provide a host of environmental services
- take droughts and hunger in their stride and act as insurance
- walk for miles in harsh terrain and to seek out scattered, spiky, fibrous plants that survive in areas where crops could never be grown.
- are social animals in the true sense – living in a herd, responding to the voice of their keepers, and defending their young against predators.
- produce delicious and healthy food as well as a range of other organic products

By means of such breeds of livestock that are co-evolved with their eco-systems, pastoralists are in a position to process the dispersed and extremely bio-diverse natural vegetation (and sometimes crop by-products) of drylands and mountainous areas into a range of high value products, including meat, milk, fibre, fertilizer, hides and physical energy. They do this without leaving any carbon footprint, as their animals forage for themselves and no energy is expended to grow or transport feed to them. In the contrary, by keeping sylvi-pastoral landscapes functional, they make a major contribution to carbon sequestration. Although this type of livestock keeping provides an excellent and "green" alternative to industrial production, pastoralists are threatened in their survival in many or most parts of the world. Some of the main pressures include land-grabbing, population growth, absence of services, and unsupportive policy frameworks. Lack of appreciation of their way of life, disregard for traditional knowledge and lack of fair markets are additional contributing factors.

Research questions

How can pastoralists be supported and incentivized to continue their role as stewards of much of the world's remaining livestock biodiversity? And how can governments and the public realize and become aware of the value of these ecological livestock production systems? In order to address these questions, the League for Pastoral Peoples and Endogenous Livestock Development partnered with the Fondation d'Entreprise Hermès to investigate the potential and opportunities for developing value chains around traditional products from pastoralist livestock breeds.

The project is based on the assumption that such products have considerable potential for high value niche-markets. There is an increasing body of evidence from scientific research in developed countries indicating that "pasture produced" livestock products are much healthier than those from animals kept in intensive or industrial systems and fed with standard rations of corn and soy-beans. In particular, meat and milk of such animals are higher in Omega -3 fatty acids and in Conjugated Linoleic Acid (CLA), substances whose absence in modern diets has been made responsible for many diseases, including heart attacks, Alzheimer, cancer, etc. It seems likely that the products produced by pastoralists also have very high nutritional value.

Furthermore, there was evidence that, besides being usually free from the residues of antibiotics, hormones and other drugs, the products from pastoralist (and other indigenous livestock keeping systems) are also often appreciated for their better taste. In Rajasthan (India), the milk from indigenous cows is much preferred to that of exotic or cross-bred cattle which is deemed watery by comparison. The meat of desert raised Jaisalmeri sheep and goats is regarded as a local specialty.

In addition to these material benefits of pastoralist products, there would also be significant immaterial values. Pastoralist breeds are part of the local heritage and contribute to local and regional identity, besides often being essential for traditional rituals as well as a medium of exchange. They attract the attention of tourists and conjure nostalgia among people who have moved away from the area.

Despite this array of advantages, pastoralists currently continue to market their products generically and there is no awareness about the taste and health benefits of their animals among consumers, policy makers and even themselves.

For this reason the project seeks to explore whether there is potential for establishing a special label or brand that identifies products from traditional breeds kept in pastoralist systems and that indicates to consumers that a product is from a locally adapted livestock breeds and derives from biodiversity conserving production systems ("Ark of livestock biodiversity").

Methodology

The project focused on livestock keeping communities in three countries: India, Pakistan and Kenya. The communities were selected because they had previously developed "Biocultural Community Protocols" to put their resources and knowledge on record and thereby claim status as "indigenous and local communities *embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity*" under Paragraph 8j of the Convention on Biological Diversity (CBD). This strengthens their legal position as the CBD is a legally binding international framework that obliges its signatory governments to respect, preserve and maintain knowledge, innovations and practices of such communities.

The projects used participatory community surveys to identify and document traditional livestock products and processing methods, is analysing the special properties of these products in terms of sensory qualities, nutritional value, and medicinal effects in collaboration with scientists and will share the results with communities, private enterprise and policy makers.

In **India**, the efforts focused on the pastoralist communities of Jaisalmer district in Western Rajasthan. While the entry point was the camel keeping families with whom the local partner has a longstanding relationship, the project decided to also include two other products in its research. These were the ghee (butterfat) of local cows and the famous "Jaisalmeri meat" from local goats.

In **Pakistan**, research centered around the traditional products made by the Pashtoon community in Baluchistan, especially sheep.

In **Kenya**, the products of the Red Massai sheep were studied in two districts of Samburu county, namely Samburu Central (Lorroki) and Samburu North (Baragoi).

Results

India

In India, the project looked at products from free-ranging camels (milk, wool), at the ghee (butter-fat) from Tharparkar cattle, and at Jaisalmeri meat which is derived from a local goat breed.

According to traditional knowledge, the camel and the goat in Rajasthan feed on 36 species of trees, bushes and grasses. In focus group discussions, people frequently emphasized that this diversity of plants was responsible for the healthiness of camel milk and the superior taste of goat meat. An analysis of these plants showed that most of them have proven medicinal value

While cows have a much narrower dietary range, eating only grasses, and no shrubs, people also believed strongly in the better quality of their local ghee as opposed to the commercial variety, and were willing to pay almost double for it. However, the quantities that are for sale are very limited, and most of the ghee is used for domestic consumption. It has some degree of ritual value, being necessary for Hindu religious ceremonies, for hosting guests and for strengthening pregnant and post-partum women.

Pakistan

In Pakistan, the processes of making persenda (dried meat) and qourat (dried milk product) were studied. Chemical analysis appears to support the notion of high nutritional value.

Kenya

In Kenya, the project focused on the Red Maasai sheep breed kept by the Samburu community in Northern Kenya. The Red Maasai sheep has been the object of much scientific investigation because it is much more resistant to intestinal parasites than other breeds. Despite this scholarly interest, the breed has undergone rapid diminution due to cross-breeding and replacement with the quicker growing Dorper sheep. The research sought to identify the value of the products of the breed in the traditional culture and to find out whether any of the products might be marketable. Focus group discussions and structured interviews revealed the following:

- The milk has a higher fat content, but the milk yield is low in comparison with other sheep breeds. It is either drank raw, boiled, fresh or fermented.
- The meat also has a higher fat content; it is processed and preserved in various ways, including by drying, deep-frying, boiling, roasting, frying and stewing.
- The Red Maasai sheep has a fat tail from which the fat is extracted, processed locally and used as medicine especially for small children. It is believed to heal whooping cough, tuberculosis, and chest pains.
- Hides are used for beddings, mats, attires as well as and are made to baby carriers.
- Sheep are necessary for cultural ceremonies. During ritual practices, during marriages, prayers, during the elders' meetings a sheep has to be slaughtered.
- When sheep (and other livestock) are drinking salty water, the meat is sweeter. This is attributed to the higher mineral content of the salty water which is also beneficial for lowering infection with gastro-intestinal parasites.

The results of the nutritional analysis are still forthcoming, or need to be interpreted.

Conclusions

While the project is still in progress, the following tentative conclusions can be made:

- Local knowledge of pastoralist communities sees a connection between the dietary composition of livestock feed and the nutritional and sensory value of livestock products.

- The methodology of scientifically analysing and validating the nutritional value of the products derived from livestock kept on natural and bio-diverse vegetation versus animals fed with concentrate need to be developed, improved and standardized.
- Anecdotal evidence suggests that the diet of pastoralists may be much healthier than that of many urban dwellers.
- The products from local breeds kept in bio-diverse husbandry systems would be likely to easily find a market among health-conscious urban people and such products could command premium prices. However, the marketable surplus may be very small and not sufficient to build up economically viable value chains. “In order to eat well, you have to either be a pastoralist or live in a pastoralist area”.
- The feasibility of a special label for products from bio-diverse production systems will need further thought and investigation.
- Basically, these breeds form the foundation for sustainable green livestock development which does not depend on high inputs of concentrate, makes optimal use of local resources and marginal areas, rarely requires and can be kept in systems that are compatible with notions of animal welfare and “natural livestock production.

Acknowledgments

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Linking nomadic and marginal livestock keepers in organized organic system: cost effective production module

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Introduction

Mindset of people towards organic farming is rapidly gaining positive perception and favour from the people in developing countries, irrespective of various arguments and criticisms. It is largely assumed that organic products are free from all kinds of impurities and assures good quality for sound human health. Consequently, demand is increasing day by day for various kinds of organic farm products including animal products. Organic milk and meat are in high demand- low supply situation facing two big challenges i.e. scarce and cost. Despite, great concept revolution for integrated farming, still organic crop farming is being practiced in vogue, without synthesizing livestock into production system. Owing to such trend, it seems, much hard to assure substantial quantity of organic livestock products in future. In such situation, it is urgent need for thinkers to develop some alternate models which can address the issues of cost and availability of organic livestock products in long run so that rules, regulations, standardization, laws can be framed to develop new supply chains to feed the ever increasing demand of organic animal products.

Results and Conclusion

The present paper is aimed towards concept evolution and vision to explore eligibility of synthesizing nomadic farmers in organized organic system to assure supply of organic meat, wool etc. Pastoralist makes a significant contribution to the economy of developing countries. The “old world Arid Zone belt” that stretches across North Africa and North Asia has given rise to many pastoral cultures. The basis of their economic activity is keeping animal herd and practice trans- humane and migrate with their livestock. Pastoralists thrives on native & indigenous breeds of animal, optimize nutrition details with local feedstuffs, keep animals in open runs, treat the livestock with their traditional wisdom without much dependence on allopathic drugs. Nomadi livestock keepers along with marginal and small farmers enjoys non-certified organic status with regard to various husbandry practices. In different pockets of world, pastoralists kept different kinds of livestock viz. cattle, buffalo, small ruminant, camel etc. depending on agro-ecology and tradition. The product i.e. milk, meat, wool can be tagged organic after making local study, surveillance, regulation and certification.

Development of business module targeting those communities will definitely attract corporate as well insure vulnerable farming communities for receiving attractive returns for their untapped treasure of organic principles. Various *organic rings* can be identified in different geographical locations based on complex equation of native society. Group cooperative societies within each ring will be under surveillance for organic livestock practices along with hundred percent supportive backward and forward linkages of organic animal husbandry.

It is being hypothesize that such modules, if properly executed, can address the issues regards to scarcity and high cost of organic livestock products with a great business and social potential. Systematic studies needs to initiate to validate animal husbandry practices of nomads with respect to organic certification and revision/improvement can be made where ever necessary. In this way, organic products will find their way in for society right through from Afar region of Ethiopia to Thar desert of western India and similar regions of the world.

Tackling the challenges of organic livestock production in Namibia with the help of Holistic Management™

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[2] In memory of my beloved husband whose life, passion and successes are reflected in this paper.

Key words: sustainable rangeland management, extensive livestock farming, adapted cattle and sheep, Holistic Management™, Namibia

Introduction

The organic livestock sector in Namibia is still in its nascent stages: up to now only two cattle and no small stock farms are certified by the Namibian Organic Association. Natural circumstances favour extensive livestock farming on the basis of free range grazing on native pasture. The majority of the agricultural land in the semiarid country receives average yearly rainfalls of 150-500 mm forming the base of marginal savannahs. Between 8-30 hectares are needed to supply year-round fodder for one large stock unit (LSU). Even when conventionally managed, these free range conditions naturally allow animal husbandry that is closer to organic ideals than most European farming systems ever achieve.

In such a resource deficient environment (deficient in terms of biomass growth) the adaptability of livestock to their specific circumstances is of utmost importance (Idel, 2006). On Namibia's extensively managed commercial farms (between 3,000 and 20,000 hectares) the natural environment differs greatly, even between two neighbouring farms. (Barrow, Binding and Smith, 2010). This emphasizes the importance of location-adapted animals.

When it comes to organic livestock production, in such rangeland based system it is not about animal husbandry only. Being uniquely able to convert plant material into animal produce, ruminants are simultaneously 'gardeners of their own food'. Animals, the plants they eat and the soil in which these grow, are irrevocably linked and interdependent. None of them can be in a healthy state without the other one flourishing just as well. Therefore sound management of rangelands (soils included!) needs to get as much attention as the wellbeing of the animals. (Idel, 2011; Volkmann, 2011)

The example of Farm Springbockvley is used to showcase the typical Namibian circumstances of livestock farming on the one hand and to distinguish between those and more sustainable managed farms on the other hand. In addition, the challenges and constraints of converting to organic agriculture are demonstrated.

With an average yearly rainfall of 260 mm, Springbockvley is situated in an area of average production capacity which supplies appropriate fodder for cattle and sheep alike. Since 1990 the farm is managed according to the Holistic Management™ decision making framework (Savory with Butterfield, 1999). This generally includes a high level of awareness for sustainable use of resources and improvement of bio-diversity at the same time managing toward profitability and the wellbeing of the people involved. Therefore, farms run according to Holistic Management™ principles and procedures 'present themselves well for the conversion to organic production' (Barrow, Binding and Smith, 2010). This also applies to Springbockvley: with its highly efficient, low input approach and well adapted indigenous animals that require almost no external inputs, the farm is ideally set up for organic production.

Material and methodology

The experiences and knowledge gathered during more than 20 years of sustainable farming on Farm Springbockvley form the base of this paper. In addition various production data is included. Recorded on a daily, monthly and yearly basis these comprise of rainfall figures, livestock numbers, expenses and income statistics. Stocking rates and meat production figures are processed from documentation since 1994 with meat production being kg-live-weight produced per year (cattle and sheep combined) and including increase and / or decrease in livestock (Isele and Külbs 1989-2011; Isele, Külbs with Volkmann, 2010).

Results and Discussion

Well adapted small frame cattle and sheep are run in few combined herds of up to 300 head of cattle and 2000 sheep. With the practice of Holistic Management™ Planned Grazing on Farm Springbockvley it was possible to continually increase stocking rates (see also Barrow, Binding and Smith 2010). This has been achieved in spite of the erratic rainfall which varied between 60 and 680mm since 1989. Stocking rates culminated in more than 40kg live-animal-mass per hectare by the end of 2011 which is significantly higher than on most farms in the region. Simultaneously since 1995 a remarkable ratio in meat production per hectare of more than one third of the stocking rate was and is maintained and compares well with those of areas with higher production capacities. In 2012 animal numbers on the farm have increased to 800 Nguni-cattle and 4500 Damara-sheep, a stocking rate which was never achieved before. Treated with low stress livestock handling techniques, these animals provide for high efficiency of production. Since 1997 this led to continually improving farming income with almost constant levels of farming expenses of only one third of the income (Figures 1 and Figure 2; Isele and Külbs 1989-2011; Isele, Külbs with Volkmann, 2010).

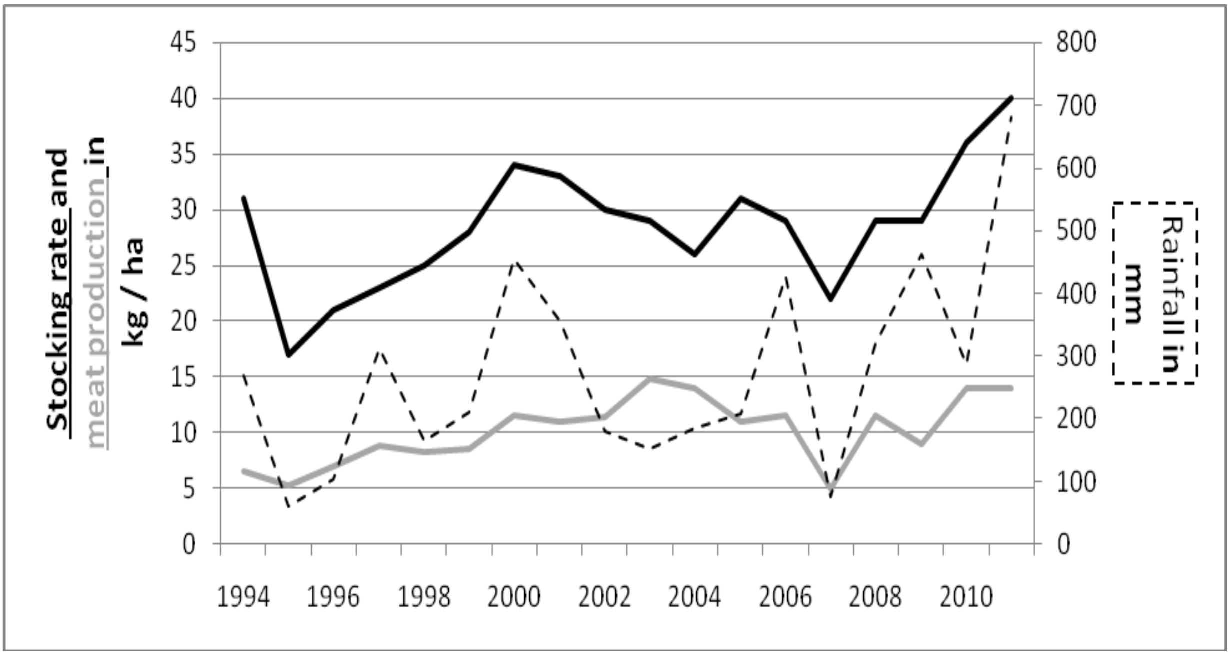

Figure 1. Stocking rate, meat production and rainfall on farm Springbockvley 1994 – 2011 (Isele and Külbs 1989-2011)

Contrary to the trend in conventional and industrial agriculture these outcomes confirm the approach that focuses on combined herd performance i.e. overall animal production per hectare. The unsustainable attention and management toward high individual animal performance is not an alternative because it often is accompanied by high-energy off-farm inputs and increased susceptibility to diseases. (Idel, 2006)

In tackling the challenges of organic livestock production the adoption of Holistic Management™ procedures readily provides tools for sustainable management. Besides the triple-bottom-line financial planning procedure, the sound rangeland management enables the production of healthy soils, plants and animals.

Farm Springbockvley is subdivided into 60 more or less rectangular camps (paddocks) being 160 hectares on average with extremes of 45 and 330 hectares. These camps are managed as four cells: three big cells of 16 to 17 camps each, which contain up to 2000 sheep and 300 cattle and one small cell around the farmyard containing 11 camps which are at the disposal of a herd with around 500 sheep and 100 cattle. The four herds are moved according to a time plan that includes not only the differences in size and quality of fodder in each camp but also factors such as different soil conditions, breeding seasons, compulsory vaccinations, weaning, marketing, special treatment of specific areas and problem species. The nutritional needs of the animals at different times of the year are considered into the planning to optimize condition and production. The resulting average grazing period in the growing season is between four and six days per camp, provided fast growth is observed. For each non-growing season, a new schedule of animal moves is drawn up. Generally, grazing periods of seven to twelve days are planned to combine the needs of the animals with the need to prepare the soil surface for the coming rainy season (Isele and Külbs 1989-2011; Isele, Külbs with Volkmann, 2010).

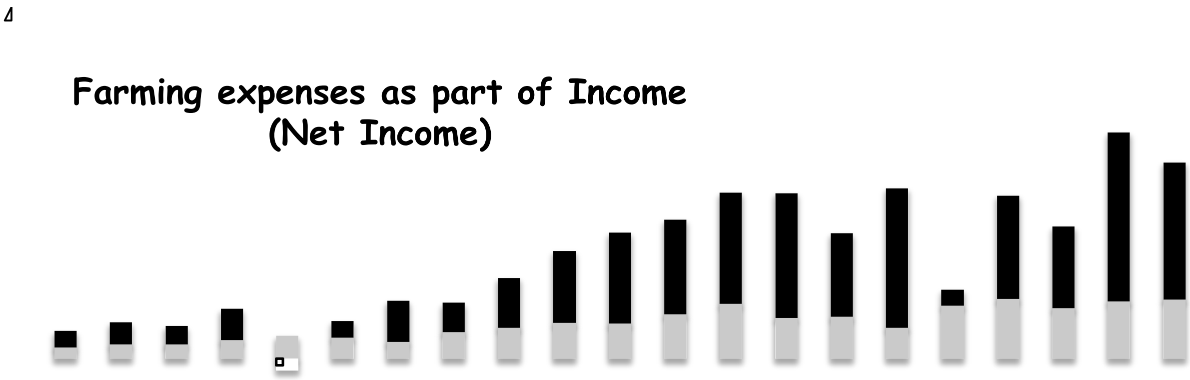

Figure 2. Farming expenses as part of farming income on farm Springbockvley 1991 – 2011 (Isele and Külbs 1989-2011)

Parasite problems are minimized by breaking the lifecycle of external and internal parasites through the above mentioned well planned moves of animals across the landscape. Some animal health issues still need additional attention as there is a lack of research and experience under similar climatic circumstances e.g. the treatment of diseases transmitted by one-host ticks, prevention of fly-borne diseases, etc.. Fence line studies between holistically managed farms and their conventional neighbours could provide further insight into outcomes and emphasize efficiency of such management.

Creative challenges to satisfy the market

Still, there are other hurdles that prevent Namibian livestock farmers to comply with organic animal husbandry practices: Barrow, Binding and Smith (2010) mention the common practice of supplying urea during the dry season as affordable protein supplement to safeguard the productivity of cattle that are destined to compete in the export market requirements. In order to get the best price per kg and carcass, most farmers aim to sell their slaughter animals below the age of 36 months at minimum slaughter weights of 215 to 230 kg. To achieve this most farmers feed a urea lick mix during the dry season. The use of urea and other synthetic nitrogen compounds is prohibited in organic production. Sound grazing planning allows for the optimal supply of all nutrients for the animals' needs. To a certain degree this can eliminate the need for urea.

Farm Springbockvley is watching with great interest the developments on farm Oasis just to the other side of the Namibian border with Botswana in the Ghanzi area. Here the Barnes family are practicing Holistic Management™ planned grazing for over 10 years as well, running very large herds of cattle (up to 2000 cows in one herd). Although the soil (Kalahari sandveld) is similar, the average rainfall is higher and the vegetation composition also different from Springbockvley. On Oasis a higher animal density is achieved by combining 2000 LSU in camps between 188 and 558 hectares with most around 300 hectares and therefore an average density of 6.5 animals per hectare on a given day they are grazing in a camp. This higher animal density and herd effect may well have led to improving the growing conditions and with that the remarkable spread of Brachiaria Negropedata, arguably the most nutritious and palatable perennial grass found in Southern Africa. Brachiaria tufts, if managed well, produce some green shoots nearly the whole year round on farm Oasis. Together with the diversity of browse from nitrogen rich shrub leaves, livestock have access to a carbohydrate-protein balanced diet and can grow muscle and produce more milk even during the dry months. This led to the Barnes' decision to stop supplementing their animals with urea three years after starting with Holistic Management™ planned grazing. (Volkmann 2010)

Nevertheless on farm Springbockvley with its lower rainfall in many years during the dry season an optimal digestion of the "standing hay" may not be given due to high fibre content and low nutritional density. In the absence of organically produced protein feeds, GMO-free oil cakes from non-organic sources may well be used but are still expensive and not widely accessible. Given that most parts of the dry country are unsuitable for crop production (soybeans or else), further (market) research on alternative protein sources might be crucial to sustain healthy and well-fed organic animals. (Barrow, Binding and Smith 2010) In 2011 Judith Isele and Ekkehard Külbs decided to replace urea with milled Acacia Erioloba pods which are mixed with the mineral lick.

For the time being, Ekkehard and Judith see the limiting factor for progress on Springbockvley still in the ability of the animals to perform exclusively on the resources present on the farm. Another factor for limited animal condition on Springbockvley is the very low species diversity of the grasses, where 90 % of the grasses are formed by only two relatively narrow leaved species: the perennial Stipagrostis Uniplumis and the annual Schmidtia Kalahariensis. With all the emphasis on grazing management over so many years, there is still no easily evident increase in diversity. In conjunction with a planned research project a portion of the farm will possibly be subdivided into smaller paddocks to increase the animal density in the hope of this leading to a change in plant composition, similar to farm Oasis.

In the meantime Springbockvley management takes into account that the current market situation does not encourage the conversion to organic production. Domestic markets for organic meat are negligible and provide for little growth potential. Their European counterparts are solely accessible through expensive third party certification toward EU-equivalent standards. The South African outlets are not yet well surveyed, but might provide some viable markets. In all these markets it is questionable if substantial premiums for organic meat are achievable. At any rate most demands relate to organic beef rather than mutton (Barrow, Binding and Smith 2010).

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Effect of wilted cassava foliage supplementation on the growth and parasitic infestation in village managed goats in Nigeria

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Abstract

The influence of parasitic helminthes infestation in village managed goats in Nigeria has been one of the principal constraints to poor resource farmers due to its impact on animal health and productivity as well as associated costs of control measures. This study evaluates the potential of wilted cassava foliage (WCF) as a growth promoter and anti-parasitic agent in a 56-day experiment in village managed goats grazing natural pastures. Twelve goats of the West African dwarf breed with age ranging from 6 - 8months were randomly selected from the farmers herd and allotted to two treatment groups according to receive WCF (T1) and albendazole (T2) and means were compared using a t - test. The results showed that weight gain differed significantly (P < 0.05) among treatments (31.61 and 48.29g/day) with best (P < 0.05) growth rate observed in goats supplemented with WCF indicating rearing goats with WCF can increase productivity. Both treatments reduced worm egg count with a reduction of 67.13% and 69.96% for goats in T1 and T2, respectively. In addition, faecal egg count (FEC) was low in both treatments after 4 week post treatment and remained low (FEC<465) in the goats till the end of the experiment. Taking into consideration the surge in the production of cassava in Nigeria which has generated a lot of underutilized leaves, supplementing grazing goats with WCF containing condensed tannins can play an important role not only in improving the nutritional status of goats and growth rate but also has efficiency in the reduction of faecal egg count thereby serving as a natural low-cost deworming agent especially among poor resource goat farmers to sustain goat productivity.

Key words: Goats, Cassava foliage, growth, parasitic infestation

Introduction

In Nigeria, goats provide a means of livelihood for a large sector of the population as they make a major contribution to the agrarian economy. However, parasitic helminth infestation in goats has been one of the principal constraints to poor resource farmers due to its impact on animal health and productivity as well as associated costs of control measures. Clinical helminthiasis, which is characterized by loss of weight, abortion, preweaning mortality, lung destruction, and finally death (Ogunsusi, 1985), is a full-blown disease condition caused by numerous pathogenic helminthes, particularly nematodes in malnourished goats.

Over the years, goat keepers have been involved in the treatment of animal diseases through the conventional medicaments with variable success. However, the toxic effects of these chemicals on humans, the development of resistance to it by target parasites as well as high cost of drugs have in recent times pave way for herbal remedies as reasonable alternative (Fasae and Ojelabi, 2012). These herbal therapies are natural products, and have been found to be environmentally friendly and cheap.

Cassava (*Manihot esculenta*) is a tropical crop grown for the roots, which commonly are used as food for humans. The foliage is readily available as under-utilized by-products after tuber harvest and found to be relatively rich in crude protein and condensed tannins (Wanapat et al. 1997). Feeding cassava foliage in the form of sun-dried hay has been reported to reduce faecal egg count in grazing buffaloes (Granum et al. 2003). However, wilting cassava foliage promises to be a simpler and more reliable procedure compared to sun-drying in livestock feeding (Chhay Ty et al. 2007). This project was conducted to determine the effect of wilted cassava foliage supplementation on growth and parasitic infestation in goats under the village system of management in Nigeria.

Materials and method

The experiment was carried out at Idera Araromi community in Odeda Local Government area of Ogun State, south-west, Nigeria. Twelve goats of the West African dwarf breed with age ranging from 6-8months, managed on free grazing were randomly selected from the farmers herd. Records from goat's owners confirmed that these animals have not been subjected to any anthelmintic treatment in the last six months. The goats were randomly allocated to two treatments of six replicates each namely: wilted cassava foliage (T1) and albendazole (T2) administered at the onset and 30 days of the experiment. The animals were tagged individually for identification throughout the 56 days duration of the experiment. Cassava foliage variety (TMS 30572) was collected fresh and wilted for 24hrs before been offered to the animals' *ad-libitum,* albendazole were administered at 2 ml/10 kg body weight to each animal, dozed by mouth orally using the barrel of syringe on day zero according to body weight as recommended by the manufacturers. Individual weights of goats were taken at the onset of the experiment and weekly thereafter with the aid of a spring balance.

Faecal samples were collected directly from the rectum of each goat on weekly basis post treatment and analyzed using the Modified McMaster counting technique for the faecal egg count to determine the efficacy of the anthelmintic used. The chemical composition of the wilted cassava foliage was determined (AOAC, 1995), tannin content (Makkar, 1993) and hydrocyanic content (HCN) content (Bradbury, 1999). Data collected were subjected to analysis of variance using completely randomized design (SAS, 1999) and means compared using t-test.

Results and discussion

The chemical composition of wilted cassava foliage (WCF) used as a supplement to village goats are shown in Table 1. The values were within the range reported (Preston et al. 2001). The crude protein (CP) content of WCF in this study which is lower than some values reported in literature (Chhay Ty et al. 2007) might be due to the exposure of cassava foliage to the sun which has been found to affect the protein content of dried cassava foliage when compared to the fresh foliage. The HCN content of WCF is lower than that reported by Chhay Ty et al. (2007) while the tannin content agreed with earlier studies (Wanapat *et al.* 1997), confirming that cassava foliage is relatively rich in condensed tannins.

Table 1. Chemical composition of wilted cassava foliage supplemented to goats

Constituents	Composition
Dry matter (%)	40.32
Crude protein (%)	22.64
Crude fibre (%)	11.51
Hydrocyanic acid (mg/kg)	18.62
Tannin (%)	2.11

Table 2 shows the values for weight changes in village managed goats supplemented with WCF and albendazole. Weight gain (g/day) of goats differed significantly ($P < 0.05$) among treatments. Goats supplemented with WCF however, had a better ($P<0.05$) growth rate compared to the control. The performance of goats on T1 could be attributed to the effect of supplemental WCF that contain good quality protein with condensed tannins. Cassava foliage fed in different forms have been reported to provide good source of protein, improve digestibility and reduce intestinal parasites in goats (Phengvichith and Ledin, 2006).

Table 2. Mean weight changes of goats supplemented with wilted cassava foliage

Parameters	T1	T2	SEM
Initial weight (kg)	8.17	8.07	0.09
Final weight (kg)	10.93	9.84	0.11
Weight gain (kg)	2.76a	1.77b	0.02
Weight gain (g/day)	48.29a	31.61b	4.87

Mean across rows with different superscripts are significantly different ($P<0.05$)
T1- Supplementation with wilted cassava foliage; T2- Natural grazing + Albendazole

Table 3 shows the effect of WCF on parasitic eggs/g of fresh faeces in goats. The rate of parasitic eggs in goats reduced from the first week to the last 8 week of the experiment with WCF supplementation. The rate of decline was similar to the control treatment, suggesting the potential of WCF as an anthelmintic. The reduction in parasitic eggs in goats supplemented with WCF in this study could be attributed to the presence of tannins in cassava foliage. Tannins containing forages has been found to react directly by interfering with parasite egg hatching and development to infective stage larvae. Butter *et al.* (2000) reported that direct effects of parasite eggs might be mediated through condensed tannins nematode interactions, thereby affecting physiological functioning in the gastro-intestinal parasite.

Table 3. Effects of wilted cassava foliage supplementation on faecal egg count (egg per g) in goats.

Weeks	T1	T2	SEM
0	897.0	902.0	17.55
1	681.0	672.0	12.09
2	634.0	614.0	11.11
3	572.0	597.0	10.02
4	501.0	521.0	8.87
5	465.0	444.0	8.02
6	387.0	398.0	7.89
7	348.0	304.0	7.16
8	295.0	271.0	6.22
Mean	531.11	524.78	8.71
Reduction (%)	67.13	69.96	-

T1- Supplementation with wilted cassava foliage; T2- Natural grazing + Albendazole

Faecal egg count (FEC) was low in all treatments after a 4 week of albendazole administration. They remained low (FEC<465) in the goats till the end of the experiment. A reduction in parasitic eggs of 67.13% and 69.96% were observed in goats in T1 and T2, respectively after the 8 week post treatment. The reduction in parasitic eggs in goats supplemented with WCF corroborates the findings of Seng Sokerya and Rodriguez (2001) that eggs per gram counted in goats fed cassava and cassava + grass treatments steadily declined during the experiment from about 4000-5000eggs/g of fresh faeces in the first 30 days to about 1500eggs/g after 70days. Also, in more detailed studies

(Seng Sokerya *et al.* 2009), it was shown that goats fed both fresh and ensiled cassava foliage had reduced worm fecundity. On the other hand, there is increasing evidence to support the view that protein supplementation can reduce the level of gastrointestinal nematodes in growing small ruminants, particularly if given to otherwise malnourished animals during the later stages of infection (Coop and Kyriazakis, 1999). The supplementation of WCF in this study which increased the protein intake of the naturally grazing goat could also have led to reduced FEC in goats.

In conclusion, supplementing grazing goats with wilted cassava foliage can play an important role in improving the nutritional status, growth rate and reducing faecal egg count in goats when fed for more than 4-8 weeks. This would be worthwhile as a natural low-cost deworming agent alternative to the chemical anthelmintics used by the poor resource goat farmers in Nigeria.

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Characterization of sheep management system in Dohuk (Iraq)

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Abstract

Sheep production in Dohuk is based on extensive natural vegetation grazing system. Sheep reared mostly for production of lambs. Therefore, meat from lambs marketed in Dohuk is considered to be organic. Sheep flock management received very little attention by authorities and researchers. A survey was conducted during July-December, 2009 through interview of 26 sheep owners, within the province of Dohuk, Kurdistan, Iraq. The main findings of the survey were: The average size of a flock was 182 heads of sheep. Most sheep owners (69.20%) indicated that flock size increased over the last 10 years. The percentage of flock's fertility of less than 70% is 3.8%, while 23% of the flocks showed a fertility between 71% to 80% and 76.9% of the flocks showed fertility rate of 81% to 100%. The range of lambing rate (average number of lambs born per ewe exposed) was 0.68-1.09. Lambs suckled their mother's udder for a period of not less than 4 months, and most of them were marketed at 25-28 kg. Range of daily milk yield was between 200 -750 ml. Most sheep owners (62.5%) sold their milk as yogurts while 37.5% sold their milk as fresh milk. Mortality ranged from zero to 14% depends on flock's management.

It is concluded that management practices differed with the various geographic areas. Wide range of variations exist in all economical traits studied, this may suggest the possibilities of improving productive as well as reproductive performance and consequently increased meat and milk as well as increase sheep owner profits. Producing of green forages and improving artificial pasture is necessary to improve production of organic milk and meat from sheep in Dohuk, Kurdistan, Iraq.

Key words: Sheep, Natural grazing, Organic meat and milk.

Introduction

Sheep flocks in Kurdistan, Iraq are presumed to have low productive and reproductive performance. Management is the main cause of low productive and reproductive rates among sheep flocks in the region. These include low culling rates of unproductive ewes, under and imbalance nutrition, keeping rams for long time and diseases (Al-Rawi et al. 1997, Thomson et al. 2003 & AlKass and Juma 2005). Sheep flock management received very little attention by authorities and livestock researchers. Increasing meat and milk production to meet the rising demand is a designated development goal in Kurdistan as well as in Iraq. Due to quantifiable information is not available. The objectives of this investigation are:

1- Assess strengths and weaknesses in the sheep flocks management in Dohuk.

2- Based on these assessments provide solutions for some problems facing producers.

3- Provide hands on technical assistance as a guide for developing sheep production

Material and methodology

To provide reliable baseline information on sheep management in Dohuk, Kurdistan, Iraq, a survey was developed and conducted during July - December, 2009. A random sample of 26 sheep herders were interviewed to get details of flock management, using following questionnaire: - Name and age of farmer, name of village, breed of animal, flock size, number of males and females and their ages, number of ewes lambed, lambs born, lambs weaned, lambed born and weaned per ewe, lambs dead per year, mating season, the limiting factor for mating season, are rams joining ewes all year round? Criteria for culling and selection, average milk yield per ewe, dispose and marketing of milk, number of lambs sold a year; does farmer have goat and poultry, which are more profitable milk, lambs or wool? Cropping activities? Land available or owned, land allocated to major crops and livestock, crop/fodder area, grazing land available (area)? How many hours spent for grazing a day? Distance to grazing area.

All flocks were from sedentary production system, and all flocks were based in area receiving 400 – 500 mm annual rainfall. This survey was conducted within the province of Dohuk, It included 26 sheep producers at 16 villages (Bshirian, Kalik Nazmiye, Juma, Kunbak, Darto, Khaliky, Asmaot, Hassaniyeh, Malbroan, Sheikh Hessen, Blasan, Tobzarawat, Cbahrawa, Bagspy and Kojinat) in 3 districts (Purdarsh, Aqrah and Sheikhan).

Results

The main findings of the survey were:

Average age of farmer is 40-year old, this indicates that sheep flocks are managed by old generations using traditional sheep farming. The average size of flock surveyed was 182 heads of sheep. The percentage of adult males in the flock was 4 %. Most rams were culled when aged 6-8 years old. A percentage of 69.2 % of the sheep flocks was increased in size over the last 10 years. A proportion of 61 % of sheep flocks using rams from other flocks to avoid inbreeding. Half of the sheep flocks showed that age of females at first kidding was 12 - 18 months; the other half indicated that the first kidding of females was from 24 – 30 months. The percentage of flocks fertility of less than 70 % is 3.8 %, while 23 % of the flocks showed fertility between 71% to 80% and 76.9% Percent of flocks showed fertility rate of between 81 % to 100 %. The average of lambing rate (average number of lambs born per ewe exposed) was 1.07. Number of lambs weaned per ewe joined is 0.68 to 1.09. The proportion of Karadi breed of sheep in the surveyed was 34.6 %, whereas a crossbred is 53.8 % and the proportion of Naimi, Awassi and Turkish breeds were respectively 3.8 % and 3.8% and 3.8. Production of wool in the flocks ranged between 1 kg - 3.5 kg per ewe. Average daily milk yield was between 200 ml to 750 ml. The percentage of sheep flocks weaned lambs at age of between 2 to 3 months is 30.7 % and the sheep flocks weaned lambs at age of 3.5 to 4 months is 34.6 % and the percentage of sheep flocks who weaned lambs at age of 4.5 to 6 is 34.6 %. Mortality ranged between zero to 14 % depends on flock's management. A percentage of 37.5 % of sheep flocks sold their milk produced as fresh milk and 62.5 % of sheep flocks sold their milk as fermented milk (yogurt). A percentage of 56 % of the sheep flocks consumed between 1 – 2 % of their milk produced and 36 % of sheep flocks consumed 5 % to 10 % of the milk and only 8 % of the flocks consumed 30 % to 40 % of their milk produced. Survey showed that 27 % of sheep flocks sent 20 % to 40 % of their milk to markets, 60 % of the sheep flocks sent from 45% to 65% of their milk produced to markets and 13 % of sheep flocks are sending more than 65 % of their milk yield to markets. Survey showed that 52.1 % of sheep owners selling milk at price 1.1 $ per kg, While 13% of breeders sell their milk at price of 1.7 $ per kg. On the other hand, a proportion of 34.7% of the breeders sell their milk at price of 2.5 $ per kg due to different quality of milk and the reputation of breeder. All sheep herders raised other animals (chicken, duck and turkey) for consumption of meat and eggs. A percentage of 46.1% of farmers showed interest and priority in twins and fertility to increase the number of lambs sold, because the high profit from selling lambs. Furthermore, a proportion of 26.9% of the sheep flocks indicated that priority in increase weight of lambs for meat production and a proportion of 19.2% of farmers had a priority to increase number and size of their flocks,. On the other hand, only 7.60 % of the herders showed a priority of increasing milk production, because of no proper facilities for processing and marketing of milk. The study found that 92.3% of the breeders buy lambs for breeding purposes from their neighbors and this is evidence that most sheep flocks want to use out breeding system. However, 7.7% of the breeders depend on their young male lambs for replacement of old rams. A percentage of 84.6 % of sheep flocks tried to improve their flocks and production. A percentage of 79.9 % of sheep herders have agricultural land owned and this reduces the expenses of raising sheep. On the other hand, 7.7 % of the sheep flocks do not have agricultural land and this leads to increase cost of production. Furthermore, proportion of 15.4 % of sheep flocks leased of farmland for grazing. The planting season in general in Kurdistan region is autumn (fall) for winter crops. Results showed that 15.3 % of sheep flocks grazed in areas between 200 to 500 hectares and 50 % of sheep flocks grazed an area of 800 to 1500 hectares, 23% of sheep flocks grazed in area of 2000 to 3000 hectares and 11.5 % of sheep flocks grazed in 3000 to 4000 hectares. A percentage of 7.6% of the sheep flocks grazing their sheep between 9 - 10 hours a day, whereas, other (38,4%) grazed their sheep for 13 - 14 hours a day and 50% graze for more than 14 hours. Shujaa et al. (2003) indicated that the longer grazing period the higher body gain. The result of this investigation indicated that 7.6 % of sheep owners are buying green forage. The percentage of sheep flocks that are mowing and gather fodder for the sheep is 84.6 %. A percentage of 34.6% of farmers keep sheep in pens, 100 – 1000 meters away from the pasture. On the other hand, 57.7% of sheep flocks were away from grazing area of 2 – 3 km and a proportion of 7.7 % of the sheep flocks away from grazing area for more than 3km. Percentage of 34.6% of sheep herders have benefited from training courses. Results showed that 69.3 % of sheep herders indicated no field visit of the agricultural extension their village. Survey results showed that most sheep flocks (73.1 %) wish to participate and cooperate in sheep associations to improve their sheep production.

Discussion

All flocks surveyed were from sedentary extensive grazing production system (minimum input practices), in area receiving 400 – 500 mm annual rainfall. Therefore, meat and milk marketed is considered to be organic. The average age of farmer is 40-year old, this indicates that sheep flocks are managed by old generations and this may indicate that farmers using traditional sheep farming, this may affect the adoption of new technology. All herders were referring to the importance of nutrition factor in the breeding season, as they had noticed that good feeding and abundance of pasture had influential effect on increasing rate of fertility and increase twins, as well as early estrous cycle and make breeding season short. Authorities should encourage educated young generation with agriculture background (preferably sons of sheep owners) through soft loan to develop semi-intensive commercial sheep production via using new technology such as development of integrated crop–livestock production in Dohuk as a low rainfall area. Producing of green forages and improving artificial pasture is necessary to improve production of organic milk and meat from sheep in Dohuk, Kurdistan, Iraq. This would be possible as high variations exist in all economical traits studied. Management of sheep flocks to get 3 lambing in 2 years is possible as sheep in Dohuk is characterized by a non seasonal reproduction and the rate of fertilization is good. Moreover, marketing arrangements and pricing policies for lambs and milk are not at all satisfactory and do not provide adequate incentive to sheep owners to encourage new developments and adoption of new technologies. Vital tools to increase productivity are urgent need to promote the output of sheep products. A good response of local sheep to accelerated lambing has been reported by Al-Rawi and Shujaa (2002). Screening young male lambs from elite flocks may contribute to genetic improvement of both productive and reproductive traits (Al-Rawi et al. 2002). Thomson et al. (2003) recommended involvement of extension services for adoption of new technology.

Suggestions to tackle the future challenges of organic animal husbandry

As most sheep herders indicated that number of lambs weaned as well as milk produced increased in their flocks over the past 10 years. This is a good sign to increase organic meat and milk production in the future through adoption new breeding and management techniques through governmental channels (extension, demonstration and field days, on-the job training, soft loan and adaptive research) as well as encouragement farmers to establish cooperative which provide assistance, inputs, processing of milk and marketing. Screening of a number of flocks to identify elite young rams, would expect to be more productive and prolific. New technologies, which often involve more work, more time, higher costs and greater risks, should not be adopted without the assurance of a greater return. Implementing appropriate technological alternatives to increase organic milk and meat is complicated and may be offset by the fact that most flocks suffer from shortage of feed. So mixed farming through integration of livestock with crop production should be developed as a top priority in Dohuk to secure forage (mainly legumes) production. As most sheep owners appeared to be more concerned with minimizing risk and cost than maximizing profit, therefore, the sheep production system should be switched gradually to the integration of the livestock and cropping system in mixed farming. Such option will lead to speeding up transfer of many new technologies (early weaning, application of 3 lambings during 2 years, increase twinning rate and using high genetic potential animals for milk yield. Such strategy together with establishing vocational training school for training and technology transfer may improve productive as well as reproductive performance and consequently increased organic meat and milk as well as increase sheep owner profits

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Performance of Black and Meriz goats raised on pasture conditions in Kurdistan region of Iraq

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Abstract

Goats are important domestic animals in many parts of the world because of their adaptability to different environmental conditions, and utilizing poor quality feed stuffs. Furthermore, the native goats are important species in Iraq and in Kurdistan region in particular. They can play an important role for the providing of organic meat and milk, especially under the extensive grazing systems prevailing in the country. The present study was prepared to provide some basic information on some economic traits of black and Meriz goats raised on pasture. Milk yield and composition was studied in black and Meriz goats raised on pasture, it was concluded that black does yielded significantly higher milk; On the other hand, Meriz had a marginal high milk composition than black does. In a comparative study including black and Meriz kids raised on pasture, semi-intensive or intensive feeding, it was noted that intensively fed kids possessed higher daily gain in weight, heavier carcasses, higher fat percentages and lower bone percentages than did kids raised on pasture. In a survey study involving 750 black does raised on 17 farms to investigate some measures of reproductive efficiency, it was noticed a large variation in terms of fertility, kidding percentages and survival rate exist between farms. It is concluded that characterization of breeds is essential in identifying genetic potential resources for economic traits as well as increasing our understanding of management scenarios could offer the opportunity to improve efficiency for organic meat and milk production.

Key words: Black and Meriz goats, organic meat and milk.

Introduction

Goats have adaptive capacities to survive and produce in harsh and difficult environmental conditions particularly in dry areas. Perhaps its greatest advantage relative to large ruminants is low cost, small body size, suitability to small holding and its triple purpose use for meat, milk and fiber, and is of great importance as a major source of small farmers and the landless families in rural areas. important species in Iraq and in Kurdistan region in particular, they can play an important role for the provision of meat and milk production, particularly under the agricultural systems prevailing in the country. Generally goats together with sheep in Iraq, graze extensively on natural pasture, stubble and crop residues for more than six months annually.

The present study was prepared to provide some basic information on some economic trait of Black and Meriz goats grazed on pasture. Such information is of importance for developmental projects, to research workers, goat breeders and conservationists of animal genetic resources.

Material and methodology

The present study was conducted on commercial goats farms at Duhok governorate, Kurdistan region throughout various investigations (Dosky et al. 2009, Dosky 2010, Alkass and Maye 2011, Alkass and Merkhan 2011, Merkhan and Alkass, 2012). To study fattening performance and carcass traits, 12 weaned male kids from each Meriz goat and Black goats were weighed and randomly assigned equally into three groups. Kids of the first group had *ad libitum* access to concentrate (intensive),where as kids in the second group were left at pasture for 45 days and then moved to the farm to fed *ad libitum* concentrate (semi intensive). The third group of kids was freely grazed at pasture (Extensive). At the end of the trial (90 days), the kids were slaughtered and dressed. To investigate milking performance of native goats, a total of 397 test day milk yields obtained from each of Black and Meriz goats raised in one farm and 18 Black does farmed in the second farm were used. Milk and composition was recorded at monthly interval commencing one month post kidding till does was dried off. Also, Also, data on reproductive performance of 750 black goats maintained at 17 farms were collected through survey and regular visits to the farms.

Results

Milk yield and composition: Results on milk production and composition of Black goat and Meriz raised on pasture revealed that within flock comparison Black does yielded significantly ($p \leq 0.01$) higher total milk yield (127.5 vs. 95.5 ml) and peak milk yield (1295.6 vs. 964.8 ml) and longer lactation period (183.7 vs.161.5 days) than did Meriz does. Also, within breed between flocks indicated that Black does maintained in farm 2 yielded significantly ($p \leq 0.01$) higher total (189.8 ml) and peak milk yield (1807.8 ml) and protein percent (3.96 %) compared to those raised in farm 1 (3.65.and 3.77 % for Black and Meriz does). The result also revealed that there was no significant difference between fat percent of Black and Meriz milk (4.2 vs. 4.1 %, respectively).

Growth rates and carcass traits: Maximum daily gain in weight (100gm/day) was attained by kids fed concentrate, followed by semi–intensive kids (60 gm/day), and the lowest values (20 gm/day) was recorded for kids maintained on pasture (Table1). Also, it was found that carcass weights and dressing percentages were lower for kids raised on pasture compared with other treated groups. With respect to tissue distribution of their carcasses, It is noticed that lean percentage was not differ significantly among treated groups; whereas fat percent was lower and bone percent was higher for kids reared on pasture in comparison with other two treated groups.

Table 1. Some fattening and carcass traits of goats raised under different feeding regime.

Trait	Feeding system		
	intensive	Semi intensive	Extensive
Initial wt (kg)	11.68 a	12.03a	12.00a
Final wt (kg)	21.08 a	18.28 a	14.46 b
Daily gain (kg)	100a	60b	20c
Hot carcass wt (kg)	8.99a	7.35b	4.45c
Dressing (%)	42.4a	40.2a	30.6b
Lean%	63.7a	64.4a	62.6a
Fat %	12.0a	10.0a	3.1 b
Bone %	24.2b	25.4b	34.1a

Means bearing different letters differ significantly

Reproductive performance: Fertility, conception and kidding rates averaged 81.7, 92.4 and 94.0 %, respectively, and were affected significantly by flock.. Although the conception rate was relatively high (92.4 %), the reduction in the rate of fertility (81.7 %) was mainly due to the losses caused by abortion (10.7 %). the fertility rate observed herein was higher than those reported earlier in local Iraq goat raised in station conditions (67.6 - 78.3 %). Survival rate of kids up to weaning averaged 90.4 %. The survival rate in general is good and indicates the adaptability to the prevailing conditions in the region as well as to the good management practices followed by the farmers during kidding season.

Discussion

Kidding commenced in January till the end of March. Generally, goats depend on grazing range lands and the availability of crop residues during the entire year, supplementation in form of concentrate (barley or wheat bran), straw or hay is used during winter. Milk is usually left for suckling kids over the first 1-2 months of age. This period may be extended depending on the weight and general condition of the kids. Then-after, kids and their dams are separated overnight and the latter were hand milked in the following morning before going to pasture. Does are milked post-weaning till they dried off. As Black does yielded significantly higher total milk yield and peak milk yield and longer lactation period than did Meriz does. Since the coefficient of variability of milk yield in the current work was found to be 41.6 % and the heritability is moderate, therefore opportunity for improving milk yield by providing good feed and selection is feasible. Growth rate of local Black and Meriz goats are less than reported in literature. High variability in growth rate of local goats suggest the possibility of increasing meat production. It may be stated that genetic differences, concentrate supplementation and better range condition affect body condition of does and resulting in improved fertility.

Suggestions to tackle the future challenges of organic animal husbandry

In view of the increasing human population of Iraq, demand for meat and milk increased. The country is unable to meet the populations demand for animal products. This is because of the human population growth rate (about 3.1 %) and the lower growth rate of animal production which did not exceed 2 %. Goat can play an important role for the production of organic meat and milk, particularly under the agricultural systems prevailing in Kurdistan. Generally goats together with sheep in Iraq, graze extensively on natural pasture, stubble and crop residues for more than six months annually.Therefore, improving pastures, use of supplementary feed, establishment a center for improving goats genetically in order to disseminate improved bucks for farmers, together with the allocation of funds necessary for research and development activities is required to fill the gap between supply and demand of animal products. It was noticed a large variation in terms of fertility, kidding percentages and survival rate exist between farms, this may suggest the possibility of improving reproductive performance and cosequently increase meat production. The results obtained suggested that there is a good potential for organic goats production of meat and milk of good quality as human health concern. Technical, financial and market issues on the development of goat producyion enterprises should be solved.

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Fokus on sheep flocks management in Sulaimani (Iraq)

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Abstract

Sheep in Kurdistan, Iraq provide sustainable organic commodities. To provide reliable information on sheep production in Sulaimani province, Kurdistan, Iraq, field survey was conducted during June until September, 2010. A total of 27 random villages, included 56 sheep flocks with a total of 9241 sheep heads under sedentary natural grazing production system were investigated. The most interested findings obtained were:

Sheep productivity is fairly good in high rainfall than in low rainfall zone. Composition of breeds of sheep was 43 % Karadi and 57 % mixed or hybrid (Crossbred of Karadi, Turkish Awassi, Arabi and Irani). Overall mean of daily milk yield, lactation period and weaning age were 0.783 kg/ewe/day, 5.5 months and 5 months, respectively. Overall mean of accelerated lambing, ewe fertility, litter size, lambing rate, twining rate, weaning rate and mortality rate, were 28.3 %, 89.3 %, 1.1, 97.9 %, 8.2 %, 91.5 % and 8.5 %, respectively. Basically 98.2 % of the owners selected their breeding rams within their flocks and this may cause inbreeding and consequently depress performance. Goats, poultry, cows, horses and donkeys are usually reared with sheep in the same farm. Farmer's priority is production of lambs.Criteria used to select yearling ewes and rams were body conformation and dam's performance. On the other hand, culling reasons were advanced age and infertility.

It is concluded that sheep flocks had low productive and reproductive performance. The main constraint affecting sheep development was shortage of feed and pasture. Therefore, strategic project for the development of pasture and sheep industry in Sulaimani province is vital for the people.

Key words: sheep, natural grazing, production system

Introduction

Sulaimani is an Iraqi province with an area of 11798 sq. km. It is situated in east of Kurdistan region in the northeast of Iraq and lies between latitude 35-37 ° north and longitude 44-47 ° east. The climate of Sulaimani is characterized by extreme conditions with large temperature difference between day and night and between winter and summer. Rainfall ranges from below 600 to more than 1200 mm. Livestock sector has an important role in the province economy. Among domestic animals; sheep plays a significant role in economy. Sheep production is neglected and marginalized sector and largely absent from most of the strategic agricultural plans. ACDI/VOCA (2007) reported that there was a decline of 10 percent in sheep numbers from 2001 to 2005 in Sulaimani. Nevertheless, there are good reasons to consider sheep production as highly strategic and a strong candidate to provide profitable and sustainable vital commodities. As it is well known that sheep provides highly nutritious foods rich in animal protein, minerals and vitamins in the form of meat and milk. Although native breeds (Awassi, Arabi, Karadi and Hamdani) characterized by slow growth, low fertility and low milk production, they are highly tolerant to extreme climate and diseases (Al-Rawi et al. 1997). They are fat-tailed animals with an excessively large tail.

Production traits (milk, meat and wool) affected by the individual genetic make-up and environmental factors surrounding it. Genetic improvements as well as improved environmental conditions specially feed resources lead to increase production efficiency. The present investigation (survey) aims to know the current situation of sheep management and production system in the Sulaimani province via number of sheep flocks distributed in various areas. The objective also to focus on technical aspects of reproductive and productive performance of sheep flocks. Investigating the reasons hinder good productivity help to set up priorities, outline plan and strategic projects for the development of sheep industry in Sulaimani province.

Material and methodology

The current status of sheep production in the Sulaimani province, was investigated via field survey conducted during the period from 20/6 - 20/9/2010. The survey included 8 districts. Similar number of flocks were included for every geographic district (7 flocks/district), with 787, 2050, 1493, 1373, 1076, 732, 785 and 945 heads of sheep in Sulaimani Center, Halabja, Penjween, Pishder, Sharazoor, Sharbazher, Rania and Dokan, respectively. The survey interviewed 56 farmers and herders. Questions related to aspects of sheep production discussed with each sheep owner for average of 3 hours. The interviews were conducted with farmers in the pasture or range in a randomly 27 villages. It was observed that the rainfall in the Sharazoor and Dokan was < 600 mm, in Sulaimani Center and Halabja was 601-700 mm and in the Penjween, Pishdar, Sharbazher and Rania was > 701mm. The field Survey included 56 flocks with a total of 9241 sheep heads with average 165 sheep per flock. Based on the number of female in the flock, the flock which has < 75 heads considered a small flock. Whereas, flock has 76–150 heads and that has > 151 heads considered to be medium and large size flocks, respectively. Accordingly, there were 15, 25 and 16 small, medium and large flocks size included in the survey, respectively. A crossbred sheep was consists of genes from Turkish Awassi, Karadi, Arabi and Irani. The field survey questionnaire included many questions among them were the followings:

Strain of sheep breed in the flock, flock size, number of males and females, number of ewes lambed, number of lambs born, number of lambs weaned, age of weaning, numbers of ewes fail to lambing, number of lambs dead per season, number of lambs sales during the year, criteria for culling ewes and selection of young animals, when is the mating season and for how long? Are rams joining ewes all year round or several months of the year for mating, do rams brought from other flocks? Average of milk yield per ewe per day, dispose fresh milk (lambs feeding %, consumed at home % and that sent to local market %) . What are other types of animals that reared with sheep? Priority of farmers for breeding? (Milk, lambs, or wool)? Does farmer have a land? What are cropping activities? Green fodders or cereals (wheat and barley). How many hours spent for grazing animals in the pastureland? How far pastureland from animals pens? Do farmer wish to cooperate and participate with other farmers for improving the production through the establishment of cooperatives? Percentage of accelerated lambing or frequent lambing (two lambing per year).

Ewe fertility: defined as percentage of ewes lambing out of ewes exposed to rams. Lambing rate: is the number of lambs born, expressed as a percentage of the sum of the adult ewes. Weaning rate: is the number of lambs weaned, expressed as a percentage of the sum of the adult ewes. Twinning rate: is defined as the number of ewes bearing twins, expressed as a percentage of the ewes that lambed. Litter size: defined as the number of lambs born per ewe mated of reproductive age per year. Mortality rate: is defined as the number of mortalities prior to weaning relative to number of lambs born.

General Linear Model was used to analyze the factors affecting productive and reproductive characteristics (geographic district, rainfall zone, breeds of sheep and flock size).

Results

Flock management: The field Survey included 56 flocks with a total of 9241 sheep heads with average 165 heads per flock, distributed in 27 villages in Sulaimani province. The result revealed that the proportion of pure Karadi breed was 43 % and the crossbred was 57 %. Results showed that the owners reared goat, poultry, cows, ducks and horses with the sheep. The majority of farmers kept their rams with ewes throughout the year with a ratio of one ram for every 18 ewes.

A proportion of 98.2 % of the owners depend on selecting rams from their flocks. All owners reported that the criteria used to select yearling ewes and rams is the phenotype (conformation, head, legs and fat-tail). Fifty percent of the owners mentioned that the size of flocks was increased during last 10 years. Priority of all farmers is lamb production, as most of the income is derived from the sale of lambs. The main reasons for culling animals are advanced age and infertility. Just 23.2 % of the owners allocated part of their lands (1 hectare for each flock) for green fodders production, while 62.5 % of the owners cultivated their lands (2 hectares for each owner) for production of cereal (wheat and barley). The average of the natural pasturelands area that owners were grazed their animals were almost 2000 hectares. The owners reported that their animals spent 10 hours per day grazing in the natural pastureland. The average distance from sheep pen to pasturelands is 1 -2 km. A proportion of 94.6% of the owners reported that they store straw, barley grain and hay for winter feeding. Results of the present investigation indicateed that 92.9 % of the farmers wish to cooperate and participate with other farmers for improving production through the establishment of cooperatives and contribute financially at a rate of 4$ per year per 100 ewes in the flock.

Milk production: Ewes are bred during summer to lamb during winter. Accordingly, milk yield usually started early December till end of May. In the current investigation, the mean of milk yield is 0.78±0.03 kg/ewe/day. This result tended to be higher in comparison with the result of many researches (Salleh, 2010; Al-Rawi et al., 1997). While, it tended to be lower than that reported by Kaskous and Massri (2009). Statistical analysis revealed that geographic district and rainfall zone had a significant ($p<0.05$) effects on milk yield. The highest 1.04±0.04 and the lowest 0.57±0.06 milk yield were recorded in Penjween and Dokan, respectively. Results of the present investigation indicated that 80 % of the milk yield used for the lamb suckling. Whereas, 3 % of the milk produced were consumed by the farmer's family and 17 % of the milk yield were sold, as yoghurt, cheese, butter and ghee.

Sheep reproductive traits:

Results indicated that the average percentage of accelerated lambing was 28.27±2.11 %. This is higher proportion than the result of Al-Rawi and Shujaa (2002), while, lower than the result of Thomson et al. (2003). Results indicated that the mean of age at the first lambing was 17.3 months. It was noticed that some (7.28 %) of yearling ewes lambed at less than a year old at first lambing. Results of the present investigation indicated that geographic district, rainfall zone and flock size had a significant ($p<0.05$) effects on yearling ewes lambed at less than a year old at first lambing. In the present study, fertility was 89.30±1.84 %. The result revealed a high rate compared with those previously reported by Salleh (2010). Overall mean of litter size was 1.08±0.0 which is lower than that reported by Yami and Merkel, (2008). Effect of geographic district on litter size was significant ($p<0.05$). The highest 1.13±0.04 and the lowest litter size 1.04±0.01 were recorded in Penjween and Rania, respectively. The mean of lambing rate was 97.85±1.98 percent. The overall mean of twining rate was 8.22±0.86 %.

Discussion

There are many encouraging factors to increase organic milk and meat in Sulaimani province, Kurdistan, Iraq, among are the followings:

- High variability in milk yield as well as all reproductive traits was noticed in different geographic district and rainfall zone. This indicates the high potential producing ability of local sheep.
- Sheep in Sulaimani province are characterized by non seasonality. This should be utilized through good flock's management to improve productivity.
- Willingness and interest of farmers for improving production through the establishment of cooperatives.

Suggestions to tackle the future challenges of organic animal husbandry

1. High productive and reproductive performance can be achieved through improving green forage as well as introducing new techniques (selection based breeding values, flushing up ewes pre-mating season and using milk replacer for feeding young lambs can save ewe's milk for human consumption).
2. Establishing cooperatives will be important to steer and direct providing better inputs, processing of milk and better marketing system.
3. Accelerated lambing system (three lambing in 2 years) as well as higher weaning rate with a lower mortality rate tended to increase of number of lambs born and weaned per ewe and consequently increase farmers' profits, and make sheep production a continuous supply of milk, meat and surplus lambs in such a way to market lambs on a year round basis

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Improving health and welfare in organic animal husbandry

(Foto: Rahmann 2003)

'Stable Schools' to promote animal health in organic dairy farming - First results of a pilot study in Germany

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Abstract

The Stable Schools concept aims at common learning in farmer groups and has previously been implemented in Danish organic dairy farms. Focusing on herd health, four regional Stable Schools on in total 20 German organic dairy farms were initiated following a modified approach; i.e. additionally providing data on the health status of the farms based on a standardized protocol. After one year we investigated the farmers' opinions of this modified concept and assessed the implementation of measures. The participants expressed a positive attitude toward this tool; they appreciated the joint search for effective and feasible measures and evaluated the self-determined approach in the Stable School as highly motivating. Accordingly, the compliance regarding implementation was high (about 2/3 of all recommended measures implemented). Since Stable Schools seem to strengthen the motivation of the participants to implement measures, and may be a promising tool to improve animal health.

Key words: Stable Schools, dairy cattle, animal health, knowledge exchange

Introduction

In organic livestock farming prevention of diseases is of major importance and it is essential to establish concepts to improve herd health. However, several studies indicate that production diseases, such as mastitis, metabolic disorders and lameness, play a considerable role in organic dairy farming (e.g. Reksen et al. 1999, Hamilton et al. 2006, Brinkmann et al. 2009). Since less a lack of scientific evidence but a lack of implementation of improvement measures accounts for sustained health problems, approaches that increase the motivation of farmers to implement measures should be emphasized, for example Stable Schools. This tool aims at fostering common learning in farmer groups and has been successful in promoting animal health and reducing antibiotics use in Danish organic dairy farming (Vaarst et al. 2007). Therefore a pilot-study on German organic dairy farms initiated regional Stable Schools focusing on animal health however additionally providing data on the health status of participating farms based on a standardized protocol. In this paper we present the degree of implementation of measures following the Stable School meetings and how the participating farmers viewed the approach.

Material and methodology

Four regional Stable School groups consisting of five farms each were established. The Stable School concept (Vaarst et al. 2007) was modified in such a way that the participants were provided with standardized information on the health state of the herds in the participating farms. For this purpose, all project farms were visited during winter 2010/11 by independent assessors. The information obtained from these assessments comprised analyses of milk recording data and treatment records as well as animal based parameters assessed in the herds (e.g. body condition, locomotion, cleanliness and leg injuries). It was fed back to the participants and used as basic information for regular meetings of the Stable Schools. Within a 1-year cycle all group-members met once at each farm belonging to the group. The host farmer defined the agenda together with the facilitator, who guides the process but does not provide problem-related input, whereas the group members analyze and suggest changes regarding the farm-specific situation.

After one year, the implemented measures were evaluated and all participants were interviewed about their opinion on Stable Schools and the animal-based indicators used. The questionnaire to assess the farmers' view included open and closed questions to appraise this tool.

Results

Recommendations and subsequent implementation of measures

In the 20 Stable School meetings, in total 71 measures, i.e. the colleagues' recommendations to improve herd health, were found useful by the host farmers after the group discussions. The most common topics were metabolic health and feeding strategies (in total 23 recommendations), in particular possibilities to avoid subclinical ketosis in the early lactation (11 recommendations for 5 farms), and udder health (18 recommendations for 7 farms). Other areas dealt with by the Stable Schools were health of calves and young stock, fertility, lameness and claw health, and aggressive behavior, especially of horned cows, causing injuries and disturbance in the herd. For one farm the other members of the Stable School group did not provide advice because of a very good health situation; the peer farmers only suggested to maintain all existing preventive measures.

Out of all recommendations given by the group members about two thirds had been implemented within one year (completely or at least partly). 14 % of the recommendations were not possible to be implemented within the observation period but are expected to, e. g. timely harvest of forage in the next season to improve forage quality or construction work to improve housing conditions, whose realization takes some time.

Farmers' opinions on Stable Schools

After completion of one round of Stable School meetings all farmers were requested to estimate the benefit of participation in the group for their farm. First, the participants were asked to rate the concept of modified Stable Schools on a scale of 1 to 5, with 1 being the best. The acceptance by the project farmers was very high: 13 times the concept was graded as very good (grade 1) and 7 times as good (grade 2).

Table 1: Aspects considered as positive with regard to the indicator-based Stable Schools in the German pilot-study (n=53 responses from 20 farmers)

	Number answers
Exchange of experiences in the group	9
Common search for practical solutions	8
Farm visits and external impulses	6
Preparation of indicators of herd health	5
Participants' openness in Stable School groups	5
Collaboration between farms with similar strategies	3
Reflection and challenge of farm-individual situations	3
Modules and concept of Stable Schools	3
„Free talking“ – exchange of information between the participants	2
Motivation and encouragement	2
Others	7

The participants liked the exchange of experiences in the group very much and highlighted the common search for solutions taking animal-based indicators into account. They also evaluated the self-determined approach in the Stable School concept as highly motivating (see Table 1). Suggestions for improvements of the concept (n=27) related among others to long distances between the farms of one group, skills of moderating the discussion, insufficient use of the provided health indicators by the group, too unspecific indicators, and time pressure in summer period.

Discussion

Focusing on preventive measures, herd health plans (HHP) could be a helpful tool to optimize the health situation in organic dairy farms (Hovi et al. 2003). Several applied research projects showed the benefits of farm-individual HHP with regard to udder health and lameness (March et al. 2011, Brinkmann et al. 2009). The implementation of this management tool was feasible within the framework of applied research projects and well appreciated by the milk producers. However, at the same time it is rather cost-intensive because of its face-to-face approach (Brinkmann & March 2010). Modified Stable Schools promoting a common learning and development process towards a common goal could be a cost-effective alternative.

The effectiveness in terms of actual health improvements has not been investigated in our study yet (changes in health parameters after a 2-year phase will be assessed at a later stage of the project). However, the participating farmers showed a positive attitude toward Stable Schools and their compliance was high. The degree of implementation was similar to the level achieved in other intervention studies, partly with more input of the advisors/ scientists (cf. Brinkmann & March 2010, Green et al. 2007).

The main focus areas chosen by the farmers in our study are also similar to those reported in other studies (Brinkmann & March 2010, Ivemeyer et al. 2012). Ivemeyer et al. (2012) achieved a reduction in medicine use through animal health planning in 128 organic dairy farms in 7 European countries, either generated in Stable Schools or using face-to-face advice but following similar principles (e.g. guarantee farm-specificity, farmers' ownership, include a written plan based on the farmer's conclusions).

In the present study the participants highlighted the common search for solutions in the group, taking animal-based indicators into account and evaluated the self-determined approach in the Stable School concept as highly motivating. In particular the motivation is very important to achieve a high compliance in implementation of measures to improve animal health (cf. Green et al. 2007).

Suggestions to tackle the future challenges of organic animal husbandry

Achieving and maintaining a good herd health status is an important aim in organic livestock farming and preventive concepts should be strongly encouraged. Since less a lack of scientific evidence but a lack of implementation of improvement measures accounts for sustained health problems, approaches that increase the motivation of farmers to implement measures should be emphasized. Stable Schools seem to be a promising tool, being regarded very valuable and fruitful by the participants.

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Feed no Food - influence of minimized concentrate feeding on animal health and performance of Swiss organic dairy cows

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Abstract

Concentrate feeding (crops, soybeans etc.) is an integral part of the current dairy cow feeding system and the demand for increases yearly. In Switzerland the self-sufficiency of feed crops production decreases continuously and more than 50% of concentrated feed must be imported. The objective of this project was to evaluate the effect of feeding rations without or with reduced shares of concentrate on health, fertility and performance of Swiss organic dairy cows. In total, 69 farms have been analyzed in this study. The results show a significant average reduction of concentrate by 24% or 88kg dry matter (DM) per cow and year. This reduction has no negative influence on animal health and fertility. Milk contents (protein, fat, urea) remained unchanged and milk yield decreased slightly by an average of 0.5% or 0.1 kg per cow and day.

Key words: Organic dairy, minimized concentrate feeding, milk yield, animal health, fertility/

Introduction

One third of the worldwide crop production is used in animal feeding. Hence animal feeding is in concurrence to human alimentation (FAO, 2008). Ruminants are the only livestock category which is able to produce high quality food from pasture and hay without concurrence to human nutrition. Furthermore the digestive tract of ruminants is not adapted to digest a lot of highly digestible starch. This feedstuff could lead to rumen acidosis (Gozho et al., 2007; Bramley et al., 2008). On the other hand during the onset of lactation dairy cows show a low dry matter (DM) intake which leads to low energy availability (Gross et al., 2011). This negative energy balance can be accompanied by health disorders (Bertoni et al., 2009). The domestic production of crops for concentrate feeding in Switzerland decreased severely since 1990 and the current self-sufficiency of feed crops production is less than 50% (Agrarbericht, 2011). In Swiss organic agriculture the self-sufficiency is even lower (Dierauer et al., 2008). Particularly protein plants like soybeans are often imported from countries hosting large rainforest areas where crop production is causing deforestation. The objectives of this project were to evaluate the effect of feeding rations without or with reduced concentrate shares on health, fertility and performance of Swiss organic dairy cows..

Material and Methodology

73 farms of the pro-Q farm network participated in this study. In the final analysis 69 farms were included, 4 farms were excluded because of lack of some data. In the beginning of the study each farmer could choose to join one of the following groups.

1. Total abandonment of concentrate feeding

2. Reduction of concentrate feeding to a maximum of 5% of the total yearly DM feeding ration

3. Keeping the status of concentrate feeding at about 10% of the yearly DM feeding ration (control group in accordance to Organic regulations of Bio Suisse in Switzerland, 2012)

4. Already concentrate-free feeding farms with intention to optimize animal health and fertility

Table 1. survey of project farms

	n farms	Cows/farm	Daily Milk Yield (kg)	Average Number of lactations	Concentrate (DM) in kg/cow/year (% of yearly DM ratio)
Group 1	10	18.4	17.4	3.7	278 (4.3%)
Group 2	34	22.8	19.5	3.7	369.7 (5.7%)
Group 3	16	23	21.4	3.6	594.9 (9.2%)
Group 4	9	20.5	16.5	3.6	16.1[1] (0.3%)
All farms	69	21.9	19.3	3.6	362.6 (5.6%)

[1]concentrate free farms, but they feed wheat bran, which is included in the definition of concentrate by Bio Suisse regulations

The study was conducted from 2009 to 2011. In the first year (Y0) concentrate feeding, milk recordings, fertility and veterinary treatments data on farm level have been collected retrospectively without any changes in feeding management. The second year (Y1) was the transition year to concentrate minimization and the third year was the investigation year (Y2).

The farms were visited 4 times a year, in winter and summer and during the time of transition feeding in spring and autumn. During the farm visits body condition (BCS) of all cows was estimated and all veterinary treatments, the amount of concentrate fed per year on farm level, the quality of the forage, and the feeding management were registered.

At every farm visit the farmer and the FiBL-adviser discussed the current feeding and herd health situation and also problems of individual cows in detail considering all available data.

Milk recording data provided by the Swiss breeding associations were analyzed yearly eleven times and the farmers were given a comment on health status and feeding situation of their herd based on each milk recording.

Results

Development of concentrate use (kg DM per cow and year)

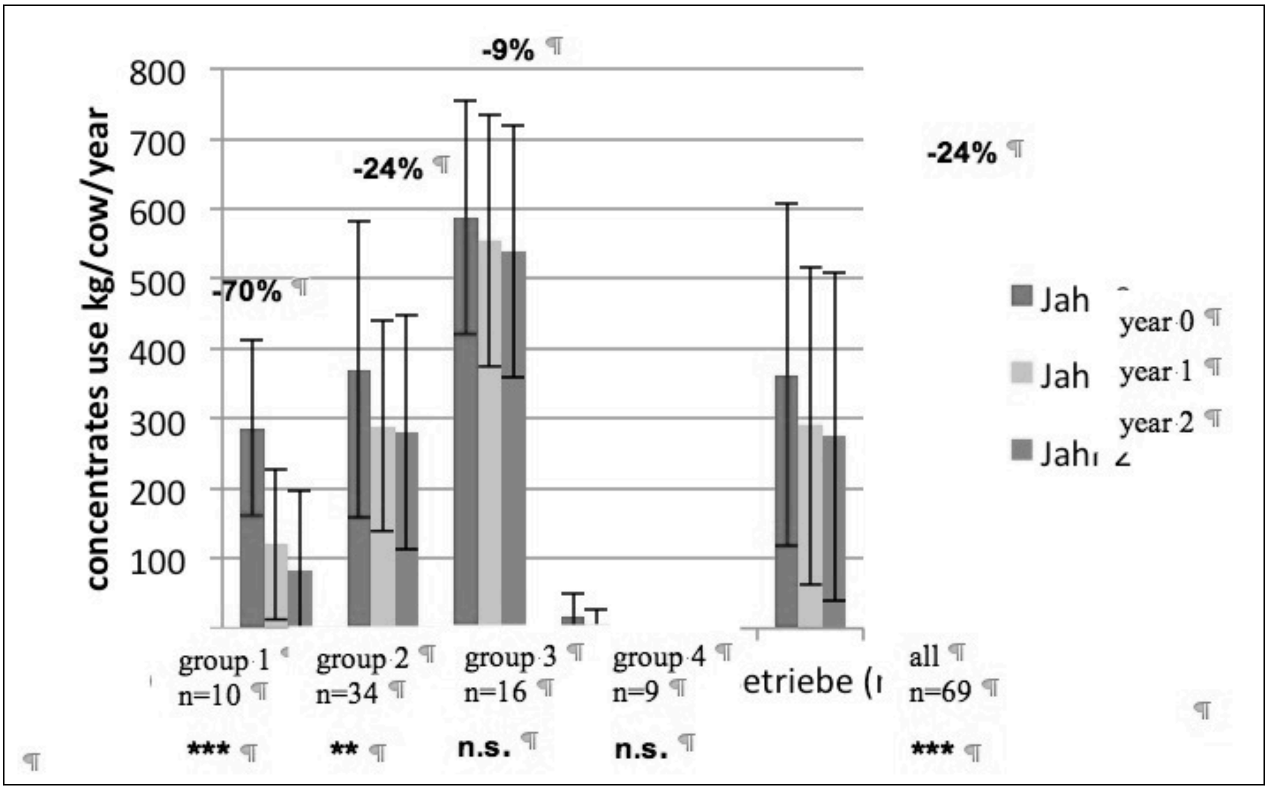
Group 1 reduced concentrate significantly by about 70% ($p< 0.001$) or 204 kg DM per cow and year. Half of the farms reached the goal of concentrate free feeding. Group 2 reduced concentrate significantly by about 24% ($p< 0.01$) or 90 kg DM per cow and year. Two thirds of the farms reached the goal of less than 5% concentrate in the ration (DM). Group 3 was the control group without changes in feeding management, but there was a reduction of concentrate by 9% or 49 kg DM per cow and year. Group 4 abstained from wheat bran and reduced to zero concentrate. In average, all 69 farms significantly reduced the concentrate use by 24% ($p<0.001$) or 88 kg DM per cow and year (Fig. 1).

Changes in daily milk yield from year 0 to year 2

In group 1 milk yield was reduced by approximately 5%. In all other groups the reduction of milk yield was lower. No significant effect of concentrate reduction on milk yield was found in this analysis (Fig 2).

Influence of concentrate reduction on fertility, animal health and milk components.

The significant concentrate reduction in dairy cow feed rations showed no negative influence on animal health and fertility analyzed by veterinary treatments and calving intervals on farm level. An energy deficiency (milk-protein < 3.1%) during the first 100 days of lactation was recognizable only as tendency, but the risk of acidosis based on the low fat-protein ratio (FPR<1.1) decreased significantly after reducing concentrate ($p<0.001$).



*(***: p< 0.001; ** p<0.01; * p<0.05; n.s.:not significant)*

Figure 1. Concentrate use kg/cow/year in year0 year 1 and year 2

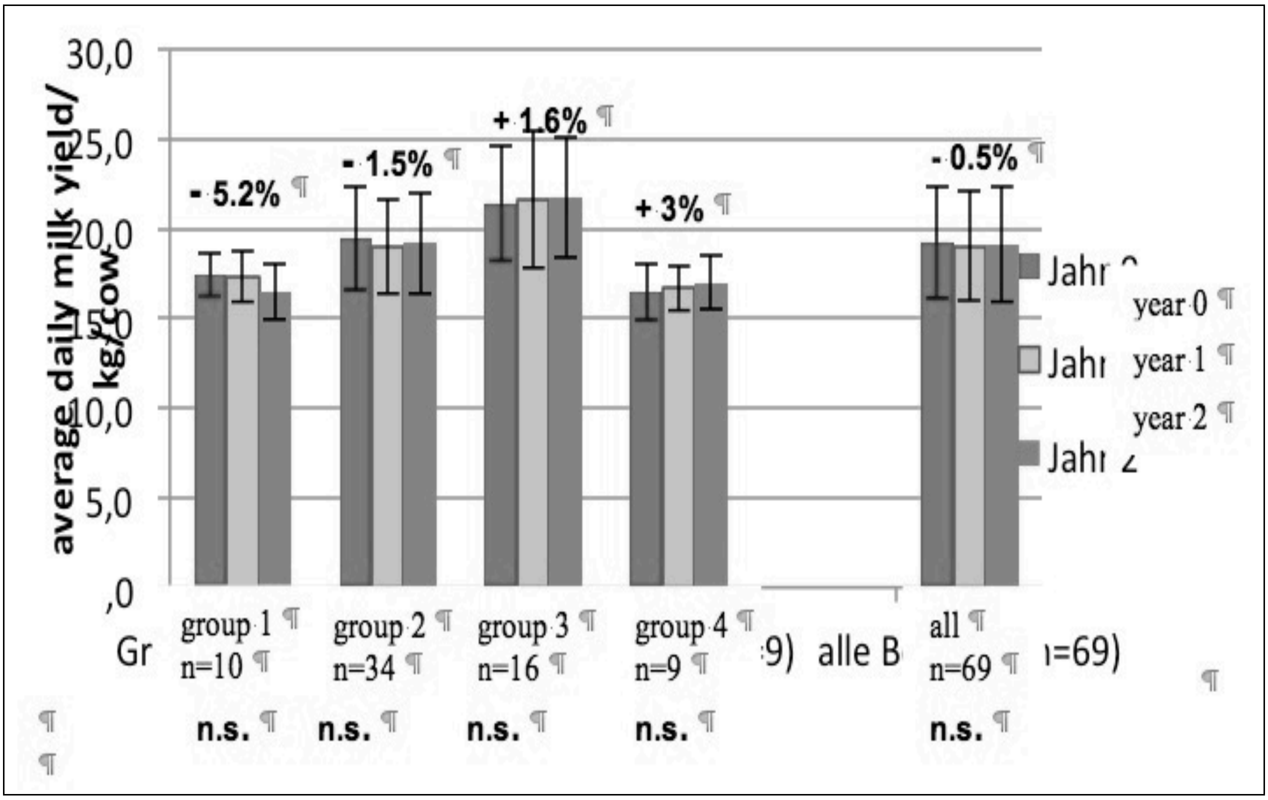


Figure 2. Changes in milk yield from year 0 to year 2

Discussion

In this study reduced concentrate feeding in dairy cows had no negative influence on animal health and fertility which is in accordance to McGowan et al. (1996) who found no differences between feeding levels in terms of fertility traits in cows. But negative energy balance and metabolic stress are significantly related to a lower pregnancy rate (Bertoni et al., 2009). Generally, there is very little literature on the relationship of concentrate feeding and animal health. Milk yield and milk protein content in the first 100 days of lactation decreased slightly. Broderick (2003) observed an increasing milk yield and milk protein concentration if dairy cows are fed with higher amounts of dietary energy. The risk of rumen acidosis (FPR< 1.1) was diminished when concentrate feeding was restricted or given up. Bramley et al. (2008) described that dairy cows fed with highly fermentable carbohydrates showed a high milk yield but also a very low FPR and rumen pH.

Suggestions to tackle the future challenges of organic animal husbandry

One of the challenges of future organic farming will be the site and animal adapted production without concurrence to human alimentation. Furthermore the use of antibiotics and other synthetic drugs should be reduced in organic farming with holistic animal health concepts including prevention on herd level and the use of complementary medicine.

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Knowledge and interest of the Brazilian veterinary class in organic husbandry: preliminary survey

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Abstract

The Brazilian Society of Veterinary Medicine submitted a survey within the veterinary class to *evaluate their degree of knowledge and interest in organic husbandry and food. The survey also intended to generate statistic data to provide recommendations to government, educational institutions and professional bodies to the possible need of introduction of this subject in the curriculum of veterinary courses. Two hundred and fifteen people from sixteen regions of Brazil answered the questionnaire with closed questions, from October 16th to December 09th, 2011. Though the survey reviled a high level of interest in the suject, the results showed that level of knowledge is low.*

Key words: organic husbandry, veterinary medicine, survey, curricula

Introduction

In Brazil, the consumption of organic food is growing, including foods of animal origin (Moraes, 2011). The market demand stimulates organic husbandry across the country creating a growing need of veterinarians with knowledge in this area. However, as it is a recent methodology it is not included in the curriculum in most schools of veterinary medicine (Mitidiero, 2010).

The Vet.Org - Organic Livestock Commission linked to the Brazilian Society of Veterinary Medicine - seeks to generate information on the degree of interest, knowledge and attitude of the veterinary class concerning organic husbandry and food consumption. The goal is to generate data to support the hypothesis that this issue should be more stimulated and be included in the curricula of veterinary medicine schools in the country.

Material and methodology

A questionnaire was developed consisting in two parts. The first part consisted of five closed questions to obtain information about the general knowledge on the subject and habits of consumption of organic foods. The second part was formed by 15 True or False statements related to Brazilian standards. The objective of this second part was to test the knowledge concerning standards of organic husbandry production established by Brazilian legislation.

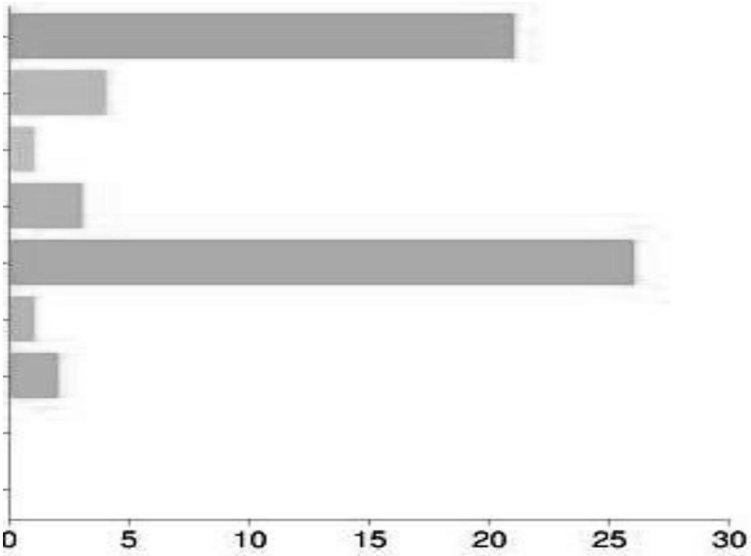
From October 16th to December 09th, 2011, a total of 500 copies of the questionnaire were offered randomly in four locations where there was concentration of students and veterinarians. The chosen places were: two schools (one public and one private) of Veterinary Medicine and the headquarters of the Regional Veterinary Council, both in the city of Porto Alegre; and in the Brazilian Congress of Veterinary Medicine, in the city of Florianopolis.

Two hundred and fifteen people from 21 to 50 years old - 101 professionals and 114 students of veterinary medicine - from 16 regions of Brazil answered anonymously the questionnaire. One hundred and fifteen questionnaires were completed by participants of the Brazilian Congress of Veterinary Medicine, 21 were answered by professionals from the Regional Veterinary Council seat and the other 79 were completed by students from the veterinary colleges.

Results

- 21.8% of the respondents received some information about the subject in the College.
- 90% of the respondents said they would like further information about the subject.
- 34.3% know any organic creation. The table below shows details about the species.

Table 1. Identification of the organic breeding known

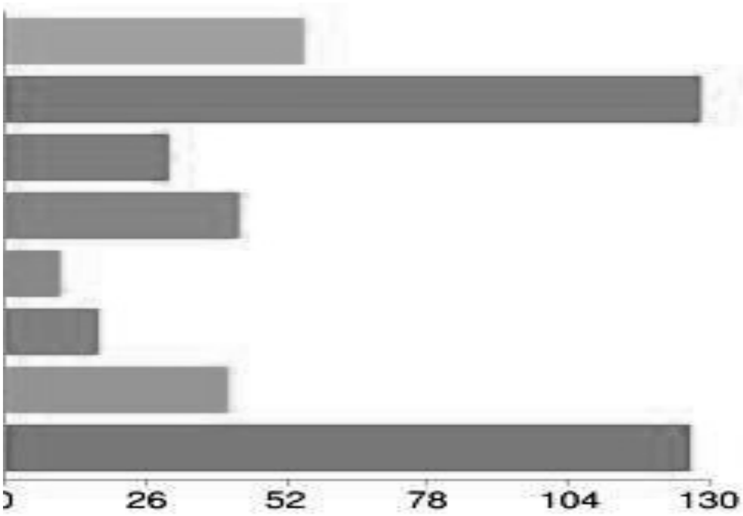


Cattle	**21**	46%
Sheep	**4**	9%
Goats	**1**	2%
Pigs	**3**	7%
Poultry	**26**	57%
Buffalo	**1**	2%
Bees	**2**	4%
Shrimp	**0**	0%
Other	**0**	0%

As some people may have marked more than one answer, the sum may be higher than 100%.

Next Table shows answers about the consumption of organic food. The purpose of these questions was to verify how close they are with the matter and which organic products of animal orgin are being more consumed.

Table 2. Habits of consumption of organic food



Never	**55**	26%
Some times	**128**	60%
Regularly	**30**	14%
Eggs	**43**	20%
Dairy	**10**	5%
Meat	**17**	8%
Honey	**41**	19%
Vegetables	**126**	59%

As some people may have marked more than one answer, the sum may be higher than 100%.

Regarding the assessment of the degree of knowledge of the Brazilian standards, through the identification of correct statements, the result showed that the degree of knowledge is low. None of the respondents got all the answers correct and not even a single statement was answered correctly by all the participants.

Conclusions

The data analysis shows that the degree of knowledge is low, but the interest is high. It is recommended to repeat the survey covering a larger sample, given that the data preliminaries are signaling a strong demand for information on the topic in class and the consequent necessary adequacy of the curricula of schools of veterinary medicine in order to prepare professionals for this new labor market that appears.

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Impact matrix: a tool to improve animal health by a systemic approach

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Abstract

Multifactorial diseases are a serious matter not only in conventional but also in organic livestock production. Due to the fact that the farm specific status of animal health is determined by the interaction of risk factors within the farm system, a systemic approach has been developed for organic pig farming. By making use of an impact matrix, the interactions of 22 health relevant variables were evaluated and their systemic roles calculated on 10 organic farms. Variables in an 'active' role indicated the most effective measures. The set of 'active' variables on the pig farms differed between 6 and 12, mostly different variables. Moreover, most of the variables were found in various systemic roles. The ranking of variables, regarding the impact on animal health, differed widely between the farms. The impact matrix shows options to identify the most effective measures to improve animal health in the farm specific situation, taking the interconnections of risk factors into account.

Key words: fattening pigs, impact matrix, systemic approach

Introduction

Animal health status in organic farming, in general, does not differ from conventional production and as such does not meet the expectations of consumers with respect to healthy animals as a precondition of healthy food. Meeting customers' demands is essential to sell products with premium prices, which are needed to cover the higher production costs in organic farming.

In general, production diseases are of complex aetiology. Previous on-farm assessments revealed a large variability between farms regarding animal health related factors (Dietze et al. 2007, Früh et al. 2011). Hence, animal health management is characterised by uncertainty about the outcome of health relevant measures, complicating the decision processes. To identify the most effective measures in the farm specific situation is therefore a crucial challenge.

In this study an impact matrix was used as a diagnostic procedure to identify those factors on the farm level, which appear sensible with respect to health improvements.

Material and methodology

The study was carried out on 10 organic farms with fattening pigs in Germany. The flock size varied between 200 and 840 fattening places per farm. Two farms had a piglet production in addition to the fattening pigs. All pigs descended from comparable genotypes and were slaughtered at the same abattoir.

Grasping animal health as the outcome of the whole farm system, an impact matrix was implemented as a diagnostic tool to identify effective factors related to animal health in the farm specific situation. A first model of an impact matrix was developed by Vester & Hesler (1980) and integrated in the 'Sensitivity Model Prof. Vester®', a software-based planning and management tool for complex situations, which was used in the current study.

A collection of factors with an impact on animal health, based on literature research, was discussed and applied during farm visits. By making use of the impact matrix, factors are identified as being changeable in a qualitative or quantitative way, and therefore called ‘variables’. In order to obtain the best system-relevant variables, the set was reduced to a manageable number by a screening to essential bio-cybernetic criteria, provided by the Sensitivity Model. The screening adopted different perspectives and was important to avoid a one-sided system model. Further evaluation of the ten farms was based on the condensed set of variables.

In a participative process, a square matrix was formed to detect the interactions between variables. Therefore, the variables were listed in the same rank order in rows (A) and columns (B). To understand how they affect one another, the relationship was quantified by the farmer in a pair-wise comparison, line by line. The underlying question was to what degree a variable B (forming a column) would change if a variable A (forming a row) varied. Only changes as a result of direct influence were taken into account, irrespective of the direction of anticipated shift. The strength of influence was scored with 0, 1, 2, or 3. In the case of no obvious influence, the impact value was scored as 0. A weak connection, marked by 1, was characterised by a weak change in the column factor as a result of a strong change in the row factor. If a change was expected to lead to a related change in the corresponding variable, the proportional connection was scored with 2. Strong impact was valued by a 3 if a small change would induce a disproportionate change in the affected factor.

Following this procedure, the impact matrix was built by the scores of direct influence from one factor to another. The filled matrix was mathematically evaluated to identify the roles of variables in the farm system, depending on its interaction. Systemic roles were defined in several graduations between the systemic key roles active, critical, reactive and buffering.

The outcome of calculating the impact matrix is a hierarchy of variables according to their impact on animal health in the farm system. Variables in an ‘active’ role indicated the potentially most effective measures. Considering all farms, the roles describing an active variable were merged to the class ‘effective factor’ to gain an overview on the number and identity of effective variables for each farm.

The rankings of variables according to their impact on animal health were compared to assess substantial similarities or variation in the hierarchy of factors by calculating the Kendall’s coefficient of concordance (W). The test is a measure of the agreement in ranking different subjects, situations or factors. It compares the rank order, not the exact value of each item, by estimating the variance of the row sums of ranks divided by the maximum possible value the variance can take. Kendall’s W shows values between 0 and 1. A value of 1 represents perfect concordance. Kendall’s W was calculated using SPSS 19.

Results

A set of 22 variables was found to be of relevance to describe the production system in relation to the animal health status of fattening pigs in organic farming. Focussing on the interconnection between these variables, a total of 290 interactions (influence from variable A on Variable B) was scored by the farmers. Only 11 relationships (4%) were found to be similar on each farm, whereas 77 connections (27%) were found only on single farms.

The assessment of farm individual interactions illustrated the systemic roles of variables. In Figure 1 all variables are listed according to the estimation as ‘effective factors’. The bars are related to the number of farms allocating the variable in an active role (merged in the class ‘effective factor’). Only three variables (*Health status of piglet, Trend of prices, and Quality of litter*) were found as effective factors on each farm. Three variables (*Health status of slaughter pigs, Output of fattening pigs, and Profit*) were never found in an active role.

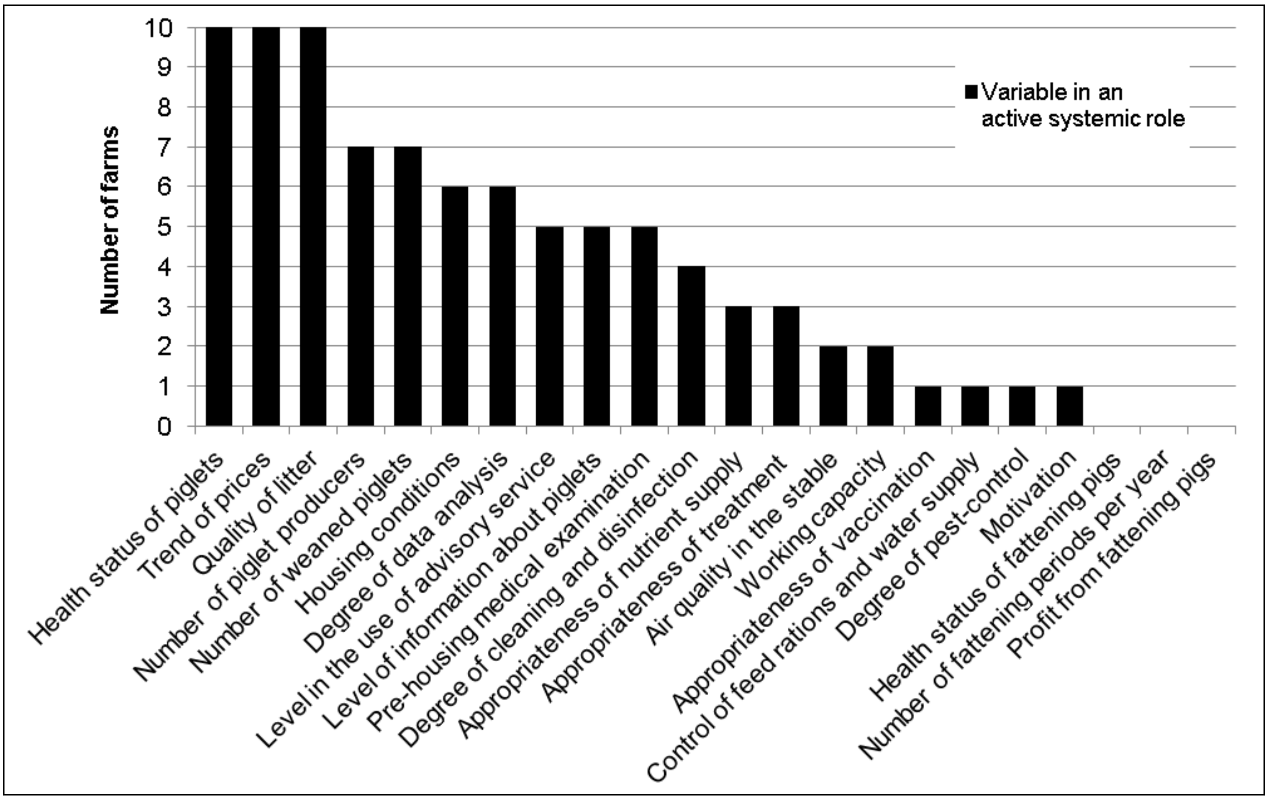

Figure 1. Occurrence of variables as effective factors

As shown in Table, the number of effective factors per farm differed between 6 (Farms C and H) and 12 variables (Farms G and J). Most of them were found in quite different systemic roles.

Table 1: Number of effective factors per farm

Farm	G	J	A	F	E	B	D	I	C	H
Number of effective factors	12	12	11	10	9	8	8	7	6	6

The variables were evaluated and ranked according to their grade of activity, represented by the classes of systemic behaviour. By doing so, a priority list of health related factors was set up for the individual farms. Comparing these hierarchies of impact, Kendall's coefficient of concordance (W) achieved 0.59 (chi-square = 123.85, df = 21, p = 0.00). To a great extent this concordance was based on similar rankings of variables, which were found in an active role either on each or on none of the farms. Excluding these variables, Kendall's W had a value of 0.35 (chi-square = 52.97, df = 15, p = 0.00). Thus, it can be established that the impact on animal health of most variables differed to a great extent, depending on farm specific interconnections.

Discussion

Although the farms were operating under the same EU regulation on organic farming, quite different factors were likely to have an impact on animal health. Hence, the improvement of animal health is determined by the farm specific interconnections of health related variables. Furthermore, the importance of the interconnections dispels the myth that minimum standards are sufficient to set a high animal health standard. The detected variation in the ranking of variables is contradictory to general recommendations relying on effects found in thoroughly defined conditions while neglecting individual conditions and interactions between relevant factors.

The impact matrix has proven to capture and reduce the complexity of a whole farm system and to identify the most effective measures to improve animal health on farm level. Recommendations related to variables identified as 'active' variables enable the farmer to invest limited resources more efficiently where they might provide the highest impact.

Suggestions to tackle the future challenges of organic animal husbandry

Animal health has become an increasing issue of public interest and of concern in organic livestock farming. The variability in health related farm systems provides a strong hint that an increase in minimum standards, characterising organic livestock production in the first place, is not sufficient to improve animal health. Output orientation and a systemic management approach are needed to bring animal health status in general in line with consumers' expectations and legislation requirements.

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Activities of organic farmers succeeding in reducing lameness in dairy cows

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Abstract

Sixty-seven organic producers were among 189 dairy farmers completing the "Healthy Feet Project" in the UK. This aimed to reduce lameness in dairy herds by implementing existing knowledge. Participants received input at two levels: monitoring alone, or monitoring with extra support through a single veterinary advisory visit, annual visits from a trained non-veterinary facilitator and materials and contacts to encourage change. On average lameness on organic farms reduced by12 percentage points over the three year period. On the farms achieving the greatest reduction, the most common changes were improvements to tracks and cubicle comfort, and more frequent footbathing or foot trimming. Practices to improve foot cleanliness, such as more frequent removal of slurry, were less often adopted. Further progress might be achieved by improvements of foot hygiene. Several farms with low lameness that reduced prevalence further improved their handling facilities and treated cows more promptly.

Key words: Dairy cattle, lameness, interventions

Introduction

Lameness in dairy cows has received considerable attention in recent years. Research and, more recently, practical initiatives, have been aimed at reducing the problem to improve both the welfare and performance of cows. Sixty-seven organic producers were among the 189 dairy farmers completing the "Healthy Feet Project" in the UK between 2006 and 2010. This project aimed to reduce lameness in dairy herds by implementing existing knowledge. Farmers received varying amounts of input from the project team and had considerable freedom in choosing the interventions to apply on their farms. This paper summarises the actions taken on the organic farms which achieved the greatest reduction in lameness during this project, and also the changes made on farms with relatively low initial lameness which improved further.

Material and methodology

Farms largely situated in the west of England and Wales were recruited through two organisations purchasing organic milk. Sixty-seven organic farms completed the project, which began in winter 2006-7 and ended in winter 2009-10. On an initial visit to each farm, a trained researcher assessed the prevalence of lameness by scoring all the milking cows, using the mobility scoring system described by Barker et al. (2010). Cows scored 2 or 3 on this 4-point scale were defined as lame. The incidence of four main types of lesions (sole ulcer, white line lesions, digital dermatitis and foul in the foot) was obtained either from farm records or by carrying out an illustrated questionnaire face to face with the farmer. The researcher carried out an assessment of risks for lameness. All farmers received the results of the mobility scoring including the identity of lame cows. For two-thirds of the farms, the results of the risk assessment were reported to the farmer. This was followed up by one optional specialist veterinary consultation, formation of an action plan, and two further annual visits for prevalence assessment and discussion of progress, approaches and future actions, with a trained non-veterinary facilitator, before a final visit to assess the prevalence four years after the initial visit. This group of farmers were guided towards actions that were most likely to address the causes of the most commonly occurring lesions on their farm, but the ultimate decisions on action were taken by the farmers themselves. Information materials such as appropriate technical information and lesion recognition charts were supplied to the supported farmers. For this group, encouragement was provided between visits through reference materials, newsletters, promoting contact with other farmers and suppliers, and opportunities to attend discussion groups. The remaining one third of the farms did not receive any veterinary or facilitator input during the project, but continued to be monitored with annual mobility scoring, with the results reported to them, and collection of lesion records. On each visit any actions taken in the previous year likely to have an impact on lameness were documented for all farms, based on the results of a questionnaire carried out with the farmer.

The change in lameness prevalence over the course of the project was calculated for each farm. The types of changes made on the farms which achieved the greatest reduction, and those that began with low prevalence and improved further, were summarized for this paper.

Table 1. Changes made on the ten organic farms achieving the greatest lameness reduction and the six farms with lowest initial prevalence that improved the most

	Group H 10 farms making the greatest reduction in lameness	Group L 6 farms with initial lameness < 20% that improved further
Initial prevalence (%) median (range)	46 (34 - 72)	10 (7 – 19)
Final prevalence (%) median (range)	12 (5 – 35)	4 (2 – 5)
Herd size (mean, sd, range)	125, 56.9 (40 – 200)	112, 78.3 (65 – 250)
Change made:	Number of farms making this change	
Major changes to buildings		3
Changes likely to affect lying time		
Increased lying area in yards		2
Improved cubicle comfort	5	
Shorter milking time	2	1
Cow numbers/grouping	1	1
Changes to underfoot surfaces		
Created or improved tracks	6	5
Improved indoor floors	3	2
Better cleaning of floors	2	3
Treatment and prevention		
More foot trimming	4	
Training in foot trimming or lameness scoring	2	1
New or improved handling facilities	2	4
More frequent footbathing	5	
New footbath/easier system	1	
Other		
Changed diet	1	2
New staff	4	2

Results

Variation in lameness prevalence was high so medians and ranges are reported. Seventy-eight percent of farms reduced the prevalence of lameness during the course of the project, with a median reduction of 12 percentage points, ranging between and increase of nine and a decrease of 52 percentage points. The reduction in lameness was greater for those farms with a higher initial prevalence. The median reduction for the farms in the upper quartile of initial prevalence (above 36%) was 22 percentage points (range: reduced by 52 to increased by 3) while the median change was zero (range: reduced by 9 to increased by 9) for the lower quartile, which were initially below 16% prevalence. Of the 23 farms that began with a prevalence of 20% or less, ten improved further, six of these by more than three percentage points.

To illustrate the types of interventions that were successful on farms with high and low initial lameness prevalence, management changes are summarized for two groups of farms – the ten farms with the greatest reduction in lameness over the project (H), and the six farms where an initial lameness prevalence below 20% was further reduced by more than three percentage points (L). Some initial descriptors and the main management changes for these two groups are shown in Table 1. In Group H in all but one herd the cows were housed in cubicles, with a variety of different bedding materials including straw, chopped paper and sawdust, with or without mats. Six of the farms were using a footbath at the start of the project. In group L all but one of the herds were housed in straw yards and only one farm was using a footbath.

In group H the changes most commonly occurring were building or improving tracks, improving cubicle comfort, more frequent footbathing, more foot trimming, and new staff. In group L improving tracks was again the most common activity. Four farmers obtained a new handling crush which made foot treatment and trimming easier, and two specifically mentioned that they succeeded in treating cows more promptly. Three farmers in this group improved the hygiene of the floors in the buildings by increasing the frequency or effectiveness of removing slurry and manure. On three farms there were major changes to buildings incorporating a new milking parlour and/or increased lying area for the cows. Only one of these farms was footbathing at the start of the project and none started footbathing.

Discussion

Organic farmers tackled lameness by a variety of methods, as would be expected given the multifactorial nature of the problem and the different types of lesions causing lameness. In herds with high lameness prevalence, increasing the time cows spent lying down was more commonly attempted by improving cubicle comfort, rather than by reducing standing times around milking. This may have been because farmers found it easier to make a structural change than to change the way in which they grouped and moved cows, which was often dictated by logistics imposed by building design and availability of staff. In contrast, there were some farmers in the group with lowest initial lameness prevalence (more of whom housed cows in straw yards) who built new facilities during the project. These alterations either created more lying space or reduced the time cows spent away from the lying area during milking, increasing the opportunity for cows to lie down, which may have contributed to a further reduction in lameness. Among the activities directed at improving underfoot surfaces, it was more common for farmers (particularly those with high lameness prevalence) to improve outdoor tracks than indoor floor surfaces. As organic farms tend to have a long grazing season access to pasture is frequently needed and the outdoor environment has a large influence on the cows. The risk assessments sometimes detected deficiencies with indoor surfaces, such as rough or slippery floors or broken concrete on yards, as well as risks associated with the tracks, or lack of tracks, but these were less often addressed. A change of staff quite often occurred on farms achieving improvements, and it is likely that this was beneficial, bringing new skills or enthusiasm to contribute to lameness control. Several farmers recognized that investment in equipment which made foot trimming and treatment easier increased the likelihood of prompt treatment, which will prevent development of severe lameness.

The project has shown that it is possible to reduce lameness from a range of initial levels by a combination of farm specific interventions. Further progress might be made if farmers paid more attention to the cleanliness of floors. This was an area where farmers with a large herd problem seemed less likely to take action than those with a lesser lameness problem.

Suggestions to tackle the future challenges of organic animal husbandry

One challenge to reducing lameness in organic herds is the treatment of digital dermatitis. Acceptable agents for use in topical treatment and footbaths are required as alternatives to antibiotics and unpleasant and polluting substances including copper sulphate and formalin. Another simple challenge is to encourage farmers to pay more attention to the cleanliness of floors and cows' feet; there appears to be resistance to this based on perceived difficulties of practicalities.

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Interdisciplinary intervention in German organic dairy farms – results on mastitis and metabolic disorders

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Abstract

A nationwide interdisciplinary intervention study in 106 German organic dairy farms was carried out in order to develop preventive animal health management strategies for mastitis and metabolic disorders and to implement and validate this concept. After an initial farm visit focusing on the health situation and the potential risk factors including housing, herd management, feeding and forage production, individual evidence-based advice was provided by the project team. Intervention measures to improve herd health were implemented and their effectiveness was monitored for two years. Udder health regarding milk somatic cell count and treatment incidence for mastitis improved significantly, whereas the percentage of dry-off-treatments with antibiotics and internal teat-sealers increased significantly. Considering indicators of metabolic health, there was an improvement in treatment incidence of milk fever and ketosis, but the percentage of cows with a fat-protein-ratio above 1.5 in the first 100 days in milk -as indication of subclinical ketosis- did not change.

Key words: organic dairy farming, animal health, intervention study, interdisciplinary approach, knowledge transfer

Introduction

Mastitis is one of the most prevalent health problems in organic dairy farming (e.g. Weller & Bowling, 2000) and metabolic disorders play as well a considerable role (Brinkmann et al. 2005). High milk yields pose a challenge in organic dairy farming, resulting from the conflict between the preferential use of in-house feedstuff and the restrictions on the choice of feedstuffs in organic farming and the ration requirements of the high producing animals (Sundrum & Schumacher, 2004). Improving health in dairy production should rely on preventive herd health management. Accordingly the present project pursued an interdisciplinary approach considering the whole production system, including e.g. grassland and ley farming, feed rationing, housing conditions and their relationship to the metabolic and udder health situation on the farms. It was the aim of this study to analyze the effectiveness of farm-individual evidence-based intervention measures to improve herd health within a one to two year period after advice had been provided.

Material and methodology

The intervention study was carried out between 2007 and 2010 in 106 German organic dairy farms (average herd size 57 ± 36 cows, range 18-252). All farms complied with a range of criteria (main breed Holstein Friesian, Simmental or Brown Swiss, free-stall housing, milk recording scheme data) and were located in different regions in Germany. In an initial farm visit the health situation (e.g. lameness, body condition, treatment records, and milk constituents) and a range of potential risk factors including housing conditions, herd management, feeding and forage production was assessed.

Based on this initial assessment, scientists from different disciplines estimated the individual risks of each participating farm, identified the potential for improvement and developed recommendations. These suggestions regarding udder health and metabolic status as well as feeding and grassland management were fed back in the following farm visit(s) within one year and the effectiveness of this prevention-orientated herd health management was assessed using key figures of metabolic and udder health (Table 1). In total four farm visits were conducted until Winter 2009/10.

Incidences of treatments were obtained from farm records for the years 2007, 2008 and 2009 respectively as number of cases per cow and year. Repeated application of drugs connected to the same diagnosis with a maximum lag of seven days between treatments was counted as one event. The average for 2007 and 2008 was used as baseline health indicators. The implementation of recommendations was conducted at the 2nd visit at the end of 2008 and the developing of herd health was monitored for one (treatment incidences) respectively two years (milk recordings) afterwards. Mixed models for repeated measures were used to analyze the effect of time after intervention at farm level.

Results

Topics and implementation of measures

In total 1.268 farm-individual recommendations were worked out and most of these advices dealt with udder and metabolic health (494/456); further 180 recommendations were given with regard to grassland management, 63 to forage harvesting and forage conservation. To evaluate compliance, we assessed the degree of implementation on the farms at the 4th farm visit. About 57 % (702 measures) had been implemented (completely or partly; 39 times information on implementation was missing and about 40 % of the suggestions were assessed as not having been implemented yet). Compliance of the farmers was > 60% regarding the given recommendations to improve udder and metabolic health.

Development of herd health parameters

Whilst the average milk yield and herd size increased significantly (19.8 -> 20.9 kg per cow and day; 56.8 -> 60.4 cows/herd), mean herd age did not change over the project period (5.4 years). Milk somatic cell score (SCS) improved significantly from 2007/08 to 2010 and treatment incidence for mastitis decreased significantly from 2007/08 to 2009. At the same time the percentage of animals with antibiotic dry-off-treatments and internal teat-sealers increased significantly. Considering indicators of metabolic health, there was an improvement in treatment incidence of milk fever and ketosis, but the percentage of cows with a fat-protein-ratio ≥ 1.5 in the first 100 days in milk (DIM) - as an indication of imbalance energy supply - did not change (see Table 1). The fat-protein-ratio (FPR) in these early lactating cows was unchanged as well (mean: 1.28).

Discussion

In this study, levels of SCS and SCC were similar to values reported in other European studies (Gay et al. 2007, March et al. 2011). The initial incidence of allopathic treatments of mastitis was 17 % which is similar to the treatment incidence in 149 Norwegian organic dairy farms (Valle et al. 2007). However, other studies found higher incidences (Weller & Bowling 2000, March et al. 2011), partly including antimicrobial dry-off-treatments (Bennedsgaard et al. 2010, Ivemeyer et al. 2012). The occurrence of hypocalcaemia in organic farms ranges between 7 % (Ivemeyer et al. 2012, Hardeng & Edge 2001) and 12 % (Bennedsgaard et al. 2010). The former is similar with the initial situation 2007/08 in the 106 German farms in our present study and also with treatment rates stated in other studies in organic dairy herds (Brinkmann & March, 2010). In the present study there was an improvement with respect to antibiotic treatments of mastitis due to the farm-individual intervention, which is in accordance with the results of Bennedsgaard et al (2010), Ivemeyer et al. (2012) and March et al. (2011), who investigated different approaches to improve dairy health in organic farms but which all emphasized farm specificity and farmer ownership. In contrast to the other studies, we found an increased use of internal teat-sealers and antibiotic dry-off-treatments, which may be seen as a first measure but is discussed controversially. In accordance with our findings, Ivemeyer et al. (2012) described a decrease in metabolic treatment incidence through herd health planning (1-year-period). On the other hand the incidence of metaphylactic treatments of hypocalcaemia, e.g. calcium boli, increased in our study and the incidence of imbalanced energy supply in risk period in the early lactation (<100 DIM) remained unchanged. One reason could be difficulties to influence the contents of feed-stuff on a short-term basis, particularly in organic agriculture, because changes in forage harvest and conservation may only be effective on a longer term.

Table 1. Development of selected parameters of herd health in all project farms; mean (sd) and level of significance for the effect of time in project (n=106)

		2007/08	2009	2010	Effect of year (p)
Somatic Cell Score (SCS)		3.4 (0.5)	3.2 (0.5)	3.1 (0.5)	< 0.001
Treatment incidence mastitis[2]	[%]	17.0 (17.2)	13.5 (15.1)	- [2]	0.003
Dry-off-treatments with antibiotics	[%]	17.1 (19.1)	27.3 (28.1)	- [2]	< 0.001
Use of internal teat-sealer	[%]	9.4 (20.7)	16.9 (31.6)	- [2]	0.001
Treatment incidence hypocalcaemia[2]	[%]	6.0 (5.8)	4.8 (4.9)	- [2]	0.038
Incidence metaphylactic treatments hypocalcaemia[3]	[%]	2.6 (7.3)	3.7 (11.3)	- [2]	n.s.
Treatment incidence ketosis[2]	[%]	1.5 (3.3)	0.8 (2.0)	- [2]	0.019
Percentage cows with FPR ≥ 1.5 in first 100 DIM	[%]	15.0 (9.9)	14.6 (8.7)	15.1 (9.3)	n.s.

[1] Only SCS used for analysis of variance In order to obtain normal distribution; denoted SCS is equivalent to a SCC of 280.000, 259.000 and 249.000 cells/ml milk, respectively.
[2] Treatment data is only available until 2009. [3] e.g. Ca-Bolus.

Suggestions to tackle the future challenges of organic animal husbandry

In conclusion, these findings provide evidence for improvements of the health situation in commercial organic dairy farms in response to farm-individual intervention measures through an interdisciplinary approach under practical conditions. However, additional studies are necessary to investigate the longer-term development of herd health, in particular to also reduce metaphylactic treatments and enhance preventive measurements regarding housing, feeding, etc.

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Organic egg production


(Foto: BLE 2004)

Run management for organic layers

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Abstract

Layer runs are often bare and loaded with nutrients and with infectious stages of helminths. Various management strategies are recommended in order to better distribute the hens in the run, thereby preventing local accumulation of droppings and related problems. However, little is known about the impact of those strategies.

A series of on farm experiments has been performed in order to test the effects of flock size and of artificial structures on the dispersal of the hens in the run. Further studies evaluated the effects of mowing and run size as well as rotational use of runs on turf quality, nutrient load in the soil and on the infection of the hens with internal parasites.

As a summary, introducing structures or applying a rotational management scheme improves run use and facilitates mowing, thus improving turf quality in the run in front of the henhouse. However, the expected reduction of helminth infections and nutrient accumulation has not been observed.

Key words: laying hen; outdoor run; internal parasites; nutrient accumulation

Introduction

Organic layer farms have become more numerous in recent years. In these systems, hens benefit from access to a free range area. However, management of a hen run is a difficult task, since hens tend to remain near the henhouse, where droppings accumulate. Consequently, this area is often bare and loaded with nutrients (particularly phosphorus and nitrogen) and with infectious stages of the two main helminth parasite species of poultry (*Ascaridia galli* and *Heterakis gallinarum*). Various management strategies are recommended in order to better distribute the hens in the run, thereby preventing accumulation of nutrients in the soil as well as parasitic infections of hens. This paper summarises results of several on farm experiments with different run management regimes carried out by the Research Institute of Organic Agriculture in the past years.

Material and Methods

A series of on farm experiments has been performed in order to test the effects of flock size and of artificial structures on the dispersal of the hens in the run. A first study examined possible effects of a roofed sandbath on numbers of hens using the run and their distribution in the run on an organic poultry farm with 8 flocks of approximately 500 animals. Each flock was observed with and without roofed sandbath during three days by means of eight scan samples per flock and day. Impacts of weather conditions could be eliminated because always half of flocks were with and half without structure at the same time. See Zeltner & Hirt (2003) for further details.

A further study focused on the effects of mowing and run size on turf quality and on infection of the hens with internal parasites. This experiment conducted at four sites in Switzerland investigated the transmission and infectivity of *A. galli* and *H. gallinarum* on outdoor runs with two different stocking rates. Additionally, the influence of a simple management practice (mowing of the run) on helminth transmission was studied. Three run types were created on each site: runs C served as control (stocking rate 10 m^2 /hen, no management), runs B corresponded to runs C but were managed (10 m^2 /hen, management). In runs A stocking rates were doubled compared to control runs (5 m^2 /hen, no management). During two subsequent layer flocks, a set of parasitological parameters (faecal egg counts FEC, helminth prevalence, worm burdens in hens and in tracer animals, helminth eggs in soil) as well as parameters describing the run vegetation were determined. Heckendorn *et al.* (2009) give a detailed description of animals, materials and methods used.

Two additional on farm experiments have been carried out to investigate the effect of rotational use of the hen run vs. continuous use and the effect of wood chips in the run area close to the pop holes with regard to worm burdens determined in layers at slaughter, turf quality, and nutrient load in the soil. In each run turf quality was assessed on four predefined surfaces of $1m^2$ along one compartment; soil samples were taken beside the observation surfaces for the assessment of turf quality. The study was repeated in two vegetation periods on the same farm (rotational vs. continuous use) or in two parallel flocks on the same farm (wood chips vs. bare soil). These experiments will be described into more detail by Maurer *et al.* (*in prep.* 2012).

Results

Effects of artificial structures

Hens with roofed sandbaths did not use the free range area more frequently than hens without structure. On average, 22% of the hens were in the free range (average with roofed sandbath: 22.5%, without: 21.5%). However, hens in runs with a roofed sandbath used the more distant quarter of the run (where the sandbath was situated) more frequently (average 9.4%) than hens without structure (average 4%; $P<0.01$). The roofed sandbaths were used as shelter and as sandbathing area: 4% of the hens in the hen run were in (0.6%) or no more than 1 m away from the sandbath (3.4%).

Effects of stocking rate and mowing

Increased stocking rate (runs A) led to a larger proportion of bare soil and to a reduction of the average vegetation height. In runs with a lower stocking rate (B and C), the proportion of bare soil did not increase during the experimental period. Irrespective of the run type, numbers of helminth eggs in the soil decreased significantly with an increasing distance to the hen houses, while the percentage of ground coverage as well as vegetation height increased. However, across runs the correlation between the percentage of ground cover and the values of eggs per gram soil between runs was very low (r^2 = 0.0007, P = 0.95) indicating a non-causal relationship. Significant differences in FEC were found in the second flock ($P<0.001$): FEC of hens in managed runs B were 24 % lower ($P<0.05$) than those of the control animals. Although not significant, the corresponding helminth prevalence in the animals was lower (-9.7 %) in hens from managed runs as well. Hens from runs with a high stocking rate (A) had significantly higher FEC than hens from control runs (C). Management (n.s.) and higher stocking rates (- 62 %, $P<0.05$) decreased the worm burdens in hens of the second flock. Similarly, tracer animals from runs with a high stocking rate (A) had significantly higher FEC than tracers from runs B and C in two tracer series. This was not reflected in the worm burdens. Overall, the stocking rate of hens in the outdoor run seemed not to alter transmission patterns of *A. galli* and *H. gallinarum* and repeated mowing of runs did not reduce helminth infections. Lower stocking rates, however, led to a substantial improvement of the run vegetation.

Effects of rotational run management and wood chips in front of the layer house

Nitrogen and Phosphorous contents in soil were similar in permanently and rotationally used runs; they were usually higher close to the house than in distant regions. Both nutrients did not accumulate over the observation period.

Rotational use of the runs led to an improved vegetation cover and turf quality. The main effect was a lower proportion of bare soil in front of the henhouse, but not in more distant regions. Correspondingly, there was a higher plant uptake of nitrogen and lower N_{min} contents in the summer sample of the rotationally used run. In both years, however, N_{min} was still frequently higher than plant demand on intensive pastures (120 kg N/ha for 6 grazing cycles; Flisch *et al.*, 2009) or even on intensively managed turf grass. Covering the area in front of the house with chips did not reduce bare areas. However, removing and composting wood chips after use removes 0.03 - 0.2 kg N and 0.06 - 0.6 kg available P/ton of chips (DM) from a heavily loaded area and makes those nutrients available for use in crop production.

There was no significant effect of the two management regimes on worm burdens (*A. galli, H. gallinarum, Capillaria spp.*) at the end of the laying period.

Discussion

Effects of run management measures on helminths are generally overestimated because of epidemiological particularities of the helminth species involved. However, rotational use improves run quality. Flocks should not be divided into too small groups; otherwise rotationally used lots become too narrow for mechanical work. Separations of lots should not be extended to the house, but to a permanently used run in front of the house. This run should be covered with material that allows the hens to scratch and dust-bath. The material must be cleaned or replaced for increased hygiene and reduced nutrient leaching. Inorganic and organic materials such as pea gravel or wood chips fulfill these requirements. In addition, hens should be provided with sufficient shelters e.g. roofed sand baths distributed especially in the more distant parts of the run. To some extent these measures prevent the area close to the house from damage due to locally high stocking rates in commercial organic egg production.

Suggestions to tackle the future challenges of organic animal husbandry

Managing large organic layer flocks remains a challenge. Problems are easily visible in the runs, which are often unevenly used with locally overused bare areas. Mobile housing would reduce this damage, but is rarely used for large flocks. Based on the positive effects on turf quality and manageability we recommend rotational run management, enough natural and/or artificial shelters and a permanently used all-weather run for large free-range layer flocks kept in permanent houses. Organic regulations should enable this.

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Health and welfare in organic laying hens in The Netherlands

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Abstract

The Dutch organic laying hen farmers wanted to know the state of the art of health and welfare in their sector. They also wanted to know how they could influence the health and welfare of their animals in a positive way. Forty nine flocks on 43 farms were visited in 2008 and 2009. The farmers were interviewed and per farm 50 animals between 50 and 60 weeks of age were caught and examined. Health problems according to the farmers were E. coli (37 % of the flocks), blood mites (33 %), Infectious Bronchitis (31 %), piling (31 %), skin infections (22 %), 'burnt out' hens (22 %), parasitic worms (18 %) and chronic gut infection (12 %). The animal scoring showed that 68% of the hens had no/little feather damage, 24% had moderate feather damage and 8% had severe feather damage. Thirteen percent of the hens had skin wounds, 21 % had breast bone deformities and 9% had foot pad wounds. This paper only gives descriptive information. Statistic relations between several farm factors and health and welfare aspects are published elsewhere.

Key words: organic laying hens, health, welfare, feather pecking

Introduction

This study was done because there was no actual overview of animal health and the farmers were in need of practical clues for maintaining or improving animal health.

Material and methodology

An invitation to join the study was send to all organic laying hen farmers. Then they were called in alphabetical order to ask them whether they wanted to join. We stopped calling as soon as we had 50 flocks. Unfortunately in a later stage the results of one flock could not be used. In 2008 and 2009 data were collected of 49 flocks on 43 farms when they had an age between 50 and 60 weeks. There was a questionnaire for the farmer about the performance of the hens and the way he managed them. Observations were done in the stable and in the outdoor run. A manure sample (20 fresh droppings mixed together) was taken and send to the Animal Health Service for analysis on parasites. From every flock 50 hens were scored individually for feather cover (Tauson et al., 2005), skin colour on nude areas, skin wounds (Tauson et al., 2005), foot wounds (Tauson et al., 2005), breast bone deformations and they were weighed. From 35 flocks also information about the rearing period could be collected.

Results and discussion

Here we present the results only in a descriptive way. The paper with the complete and statistical worked out results will be submitted elsewhere.

Farms and breeds

The farms kept a mean of 9300 laying hens. Farms with poultry as the only branch kept a mean of 14.700 hens. Most used breeds were Silver nick (51 %), Hyline silver (20 %), Hyline brown (10 %) and Lohmann brown lite (8 %).

Housing

The hens arrived on the laying farms at the mean age of 16.8 weeks. Most of the times (90 %) they were received on litter or a mixture of sand and litter. 50 % of the farms with a veranda offered these to the hens within 1-2 days after arrival. The other 50 % of the farms offered the veranda at the mean age of 19.7 weeks, also if the veranda was considered as 'stable area'. The same happened for offering the outdoor run. 45 % of the farms had aviaries, the other had floor stables. In the litter area most of the times only dry manure was available, on 29 % of the farms 'real litter' was still 'recognisable'. This means that on most farms a simple mean of 'environmental enrichment', such as edible litter, was not available. On 80 % of the farms no ammonia was smelled in the stable, which means that on most farms the air quality was in order. 45 % of the flocks had only a bit of daylight, 39 % had sufficient, 12 % had much and 4 % had no daylight. Concerning the amount of daylight, which is regarded as a kind of environmental enrichment, 45 % of the farms should improve the situation. 80 % of the flocks had an outdoor run with less than 25 % of its surface covered with trees or bushes. 14 % of the flocks had more than half of the surface covered. Bushes and trees provide shelter, which makes the hens feel safe in the outdoor run. Of flocks with more shelter in the outdoor run, a higher percentage of the animals is seen outside than in runs with less shelter (Bestman and Wagenaar, 2003). This way, shelter contributes to animal welfare..

Additional forages

Additional forages, such as grains or roughage, are a kind of environmental enrichment. 67 % of the flocks received scattered grains, 41 % received grit, 67 % received vitamins and minerals, 24 % received roughage (shredded maize plants, lucerne, grass products) and 31 % received other feeds (corn cob mix, maize, triticale, oats, beans, lupines, rape, rice cakes, bread).

Performance and mortality

At 30 weeks of age the mean daily feed intake was 129 gram, the laying percentage 91 % and the mortality 2 %. At 60 weeks the mean daily feed intake was 133 gram, the laying percentage 80 % and mortality 7.8 %. A mortality of 7.8% looks satisfying, but the experience is that after this age it can repeat rapidly, which means that it can become much higher (van Niekerk, personal communication). According to the results of management programme Albatross the mean mortality of about 20 flocks in 2007-2008 was 16% at 72 weeks.

Health

69 % of the poultry farmers judged the health of their flock as 'very good' at the flocks' arrival on the farm. Health problems according to the farmers were: E. coli (37 % of the flocks), blood mites (33 5), Infectious Bronchitis (31 %), piling (31 %), skin infections (22 %), 'burnt out' hens (22 %), parasitic worms (18 %) and chronic gut infection (12 %). Blackhead, fatty liver syndrome, botulism and amyloidosis were mentioned only incidentally. Not all health problems mentioned here, are 'primary' diseases. E. Coli for example is known as a secondary health problem, which occurs after the animals have become vulnerable due to another health problem or poor management. 25 % of the flocks was not dewormed till the farm visit at 50-60 weeks, 65 % was 1-4 times dewormed and 10 % 5-6 times. Flocks that were not dewormed, mostly had light worm infections, flocks that were few times dewormed had less times a light worm infection and flocks that were dewormed regularly (5-6 times) were hardly infected, which is as expected. However, it is questionable whether worms as such are a health problem or whether they become only a problem after the animals have become vulnerable due to disease or poor management. For several reasons (reduce the risk of resistance of worms against anthelmintics and because of residues in the eggs) the Dutch Animal Health Service advices not to deworm in a preventive way. They advise to monitor the manure on a regular base and only in case of positive test in combination with health problems, to deworm (www.gddeventer.nl).

Feather pecking damage and cannibalism

68 % of the flocks had no or a little bit of feather pecking damage, 24 % had moderate damage and 8 % had severe damage. Before 2003 these percentages for Dutch organic flocks were relatively 29, 19 and 52% (Bestman and Wagenaar, 2003), which means that the amount of feather pecking damage decreased during the last years. It is very well possible that this might be related to the more professional rearing of organic laying hens in the Netherlands. After a study by Bestman et al., (2009), which revealed which circumstances in commercial organic rearing flocks were related to decreased feather pecking, several improvements were made, such as litter or roughage from the beginning and more attention for perches or elevated levels from a young age as well, which are known to have a positive influence on feather pecking (Bestman et al., 2009). Cannibalism, defined as skin wounds on nude body parts, were seen on a mean of 13 % of the hens. This percentage makes clear that further improvement are necessary.

Breast bone deformations

A mean of 21 % of the hens from every flock has a breast bone deformation: bow (6.6 %), notch (10.4 %) or knob (3.6 %). Probably bows are caused by bone weakening, while notches and knobs might be old breaks. If 14% of the hens have broken breast bones, this is a serious welfare problem, because bone breaks are painful.

Foot wounds

A mean of 9 % hens per flock had wounds on their foot soles. It is not clear what the causes are, but probably wounds are related to suboptimal housing or management and they are supposed to cause pain when hens perform their normal behaviour (walking and scratching). They are a welfare problem.

Body weight

The body weights were compared with the standards of the breeding companies. The hens belonging to the two most common breeds had lower weights than the standards: Silver nick 89 gram and Hyline silver 103 gram lighter. It is not clear how the breeding standards are defined. They sometimes vary per country for the same breed. Therefore it might be too early to discuss the difference if the standard does not have a scientific base, but more a commercial base.

Conclusions / Suggestions to tackle the future challenges of organic animal husbandry

Several health and welfare problems in organic laying hens have been identified and quantified, as well as several risk factors for health and welfare. Health and welfare problems for example are still some feather pecking in 32% of the hens (although it decreased considerably last years), cannibalism in 13% of the hens, broken breast bones in 14% of the hens and foot wounds in 9% of the hens.

Opportunities for improving animal welfare, for example by means of environmental enrichment, are: providing litter on a regular base during the whole laying period, provide more daylight, provide much more shelter in the outdoor run and give more additional forages such as scattered grains and roughage.

The results of this study and the observations on the farms were used to write the book ‘Poultry signals. Practical guide for animal oriented poultry husbandry (Bestman et al, 2011). This book is available in Dutch, English, German, French, Italian and Russian.

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Effect of husbandry systems on productive performance and behaviour of laying chickens reared in the tropics

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Abstract

This study was conducted to investigate the effect of conventional and organic husbandry management systems on productive performance and behavior of laying hens reared in the tropics. Two hundred and forty (240), twenty (20) weeks old Black Nera$^{(R)}$ strain laying pullets were randomly allotted to two management systems (conventional : battery cage and organic: deep litter with access to free run) for a period of 10 weeks. Performance of hens (feed intake, hen-day egg production, feed per dozen egg laid and egg yolk colour score) were significantly (P<0.05) affected by management systems imposed. Body weight, feed intake and feed per dozen egg laid values were higher (P<0.05) in the conventionally reared hens compared to organic, while deeper (P<0.05) egg yolk colour was noticed in organic eggs. There was a significant increase in aggression (P>0.05) and poorer (P<0.05) feather cover in birds conventionally reared in battery cage. It was concluded that organic system of egg production supported lower feed intake and feed conversion value (feed per dozen egg laid) and reduced potential management problems due to pecking and aggression among laying hens.

Key words: conventional, cages, organic, free- range, laying, chickens

Introduction

The welfare of laying hens kept in different housing systems in the tropics has been a study focus by experts in order to compare the health and well-being of hens kept in cages, barns and on free-range. And so behavioral responses, performance and measures of physical condition have been useful practical indicators used for assessing the degree of adaptation of poultry to production environment (Newberry *et al.*,2007). The traditional housing of egg-type chickens in conventional cages, long perceived as the most efficient method of housing laying hens, is now widely considered to have a negative effect on the welfare of hens (Craig and Swanson, 1994).This concerns about the welfare of laying birds prompted several scientific search for a better system of housing which has warranted changes in husbandry practices. In the tropical Africa, the majority of laying hens are still raised in conventional cages. In recent years the growing interest in organic agriculture as well as the environmental sustainability, animal welfare, and “ethical quality” of the animal products has favoured studies directed to identify less intensive and more animal-friendly production systems. This work therefore sought to evaluate the comparative advantage of organic husbandry system over conventional battery cage systems.

Material and methodology

Two hundred and forty (n=240), 20- weeks old Black Nera$^{(R)}$ strain laying pullets at the University Teaching and Research Farm were used to investigate the effect of conventional cage and organic free range husbandry management systems on egg laying performance, feather loss and pecking activity of laying pullets reared in the tropics. One hundred and twenty Black Nera® birds (20 wk of age), housed in a four replicate groups of 30 birds in four free –range cabins providing $0.5m^2$/bird with free access to organic grass paddock at stocking density of $5m^2$/bird. Similarly, 120 birds (of the same strain and age) were housed in a conventional battery cages. The battery cages were commercial wire cages containing 6 birds per cage, providing 645 cm^2 of floor space per chicken and also divided into four replicate groups of 30 birds each. The birds were randomly selected from a bank of deep litter pen, to ensure uniformity. Birds were fed organic laying chicken diet that contained no synthetic methionine according to EC Regulation 1804/99. The diet was a standard organic ration which is known to support good performance and it contained in 900grams per kilogram dry matter basis: ground white maize, 310; maize offal, 125; rice bran, 100; full fat soyabean ,210; fishmeal, 70; limestone, 71; dicalcium phosphate, 9; vitamin-mineral premix (Roche Nutripol 5 ®), 2.5 and salt, 2.5. The diet contained per kilogram: ME 11.62MJ, 162g crude protein, 8g lysine, 6g methionine + cystine,4g methione, 61g ash, 36.9g Ca and 4.20g non phytate P.

Birds in each replicate group were weighed together at beginning of the experiment and 30 weeks in lay respectively. Known quantities of organic feed were supplied to each replicate group at the beginning of each week and the left-over at the end of the 7 day period was subtracted from the amount supplied to obtain the feed consumed by the replicate group. Cumulative feed intake was the summation of the feed consumed within a particular time of reference. Feed intake per bird was determined by dividing the cumulative feed intake by the total number of birds that consumed the quantity. feed conversion efficiency was determined by calculating:

(a) Feed per dozen egg (kg/dozen eggs) = $\frac{\text{Amount of feed consumed x 12}}{\text{Total number of eggs}}$

Eggs were collected once daily, at 15.00 GMT. Records of daily egg production were kept throughout the period of experimentation on a replicate basis which were summed up weekly. Weekly egg production figure per replicate were pooled and expressed as percentage Hen- day egg production at expiration of the experiment. Hen day egg production was calculated as the percentage of the ratio of number of eggs laid to the number of hen days. It was derived by the formulae:

Hen- day egg production (%) = $\frac{\text{Number of eggs laid x 100}}{\text{No of hen days}}$

Number of hen days = Number of days in lay x number of birds

Behavioral observation was started at 8:00 am by scan sampling (Altumann, 1974), where the birds were scanned for 10 minutes with at 1 minute interval. The same observations were recorded at 2:00 pm to avoid the effect of diurnal rhythm (El-Lethey et al., 2001), thus a total of 20 minutes/ cage or free-range / day, twice per 2weeks. Evidence of feather loss over the whole body was done biweekly for 20 birds per replicate randomly throughout experimental period and scored as minimal, slight or severe (1 to 3). Visual assessments of feather loss of head/neck area and back/vent areas of the pullets were scored on a scale of 1 to 3, following modification to the system reported by Sikur *et al*.(2004).

A feather score of 1 indicated No/Minimal feather loss (No bare skin visible, no or slight wear, only single feathers missing **)**; a score of 2 indicated Slight feather loss (Moderate wear, damaged feathers or 2 or more adjacent feathers missing up to bare skin visible < 5cm maximum dimension) ; and a score of 3 described Severe feather loss (Bare skin visible ≥ 5cm maximum dimension). The feather loss for each replicate group bird was calculated by adding over all score for each area divided by numbers observations. The number of birds performing pecking activity was recorded and expressed as total number pecks per birdper hour. The data were subjected to one way analysis of variance; differences were tested using student t- test. All statistical procedures were carried out by SAS (1992).

Results

The data on the productive performance and some behavioral traits of Black Nera® birds fed and reared under conventional and organic husbandry management systems are presented in Table 1.

Table 1: Productive performance and behavioral traits of the experimental birds

Parameters	Management systems: Conventional (battery cage)	Organic (deep litter with access to free run)
Body weight (20 weeks) (kg /bird)	1.47±0.01	1.47±0.00
Body weight (30weeks) (kg /bird)	1.66±0.02	1.62±0.01
Feed intake 20–30 weeks (kg/bird)	1.25±0.28^{a}	1.10±0.02^{b}
Hen-day egg production 20-30weeks(%)	73.84±2.93^{a}	51.47±1.11^{b}
Mean egg weight (20–30 weeks) (g)	58.68±1.21	60.23±1.49
Feed per dozen egg laid	2.17±0.10^{a}	2.06±0.58^{b}
Egg Yolk colour	1.66±0.00^{b}	3.00±0.00^{a}
Haugh unit	80.00±0.53	94.11±0.60
Feather loss score		
Head/neck area	1.40±0.05^{a}	1.07±0.03^{b}
Back/vent area	2.45±0.12^{a}	1.32±0.09^{b}
Pecking activity (Pecks/bird/hour)	28.02±1.02^{a}	6.00±0.21^{b}
Mortality (%)	0.33±0.00	0.33±0.00

^{abc} Means in the same row with different superscripts differ significantly (p<0.05)

The data in Table 1 revealed significant difference in feed intake, Hen-day egg production, feed per dozen and egg yolk colour. Body weight, feed intake and feed per dozen egg laid values were higher (P<0.05) in the conventionally reared hens compared to organic, while deeper coloured (P<0.05) egg yolk was noticed in organic eggs. Feed intake and feed conversion value (feed per dozen egg laid were significantly lower in organically reared layers. The behavioral traits (feather loss and pecking) were significantly higher in chickens reared in conventional battery cage than those in organic (deep litter with access to free). The results in Table 1 revealed no significant difference in body weight, mean egg weight, Haugh unit and percent mortality.

Discussion

In implementation of the organic principles (health, ecology, fairness and care) into organic livestock systems as revealed in this study showed that housing and management factors significantly improved the health and welfare of animals and farmer’s income (profitability) in terms of egg size , reduction in feed intake and better feed utilization efficiency. This was partly due fact that outside access is associated with pasture and invertebrate consumption, the nutritional value derived from the intake of such products is unknown. The benefit of organic husbandry to egg quality was observed mainly with respect to albumen quality (Haugh unit) and yolk colour. Raising hens according to the organic production system greatly enhanced the welfare conditions of the animals, while major productive performance trait (Hen-day egg production) was markedly lowered. There was a significant increase in aggression and poorer feather cover in birds conventionally reared in battery cage. The location of the feather loss on the bird was used to provide an indication of potential cause. Loss of feathers to the back and vent areas was indication of feather pecking. Damage to feathers on the head and neck on the other hand indicated the occurance of aggressive pecking caused by failings of the equipment or housing set-up. It was concluded that organic system of egg production supported lower feed intake and feed conversion value (feed per dozen egg laid) and reduced potential management problems due to pecking and aggression among laying hens.

Suggestions to tackle the future challenges of organic animal husbandry

There should be fusion of research and empirical farmers' knowledge in tackling future challenges in area of applying organic principles (health, ecology, fairness and care) into organic poultry production systems as revealed in this study.

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A comparison of egg quality from hens reared under organic and commercial systems

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Abstract

Two flocks of ISA Brown were reared at Heibrucks Poultry Ranch, Michigan, USA. The first flock (98000 birds) reared under organic, aviary production system, while the second flock (22000 birds) reared under conventional 3- tier cages. A total of 240 eggs were randomly obtained on August 9, 2011from hens of 48-wk old were analyzed. The purpose of this investigation was to compare organic and conventional production systems. Similar feed composition (14.6 % CP, 2800 kcal ME / kg feed, 3.95 % Ca and 0.37 % available P) were provided for hens in both systems. Proximate analyses, egg quality as well as the fatty acids and amino acids profiles of eggs were analyzed. Result of proximate analysis revealed that eggs produced under organic system had significantly (P < 0.05) more ash (1.93 vs. 1.74 %) and less fat (13.88 vs. 11.95 %). Storing eggs for 7 days decreased crude protein significantly (P < 0.05) from 31.18 to 28.95%, but did not influence crude fat and ash%. Moreover, eggs produced under organic system had significantly (P < 0.05) lower yolk weight (17.45 vs. 19.13 gm) and yolk percent (29.36 vs. 31.41 %), but higher albumin percent (59.48 vs. 58.29 %), yolk color (8.15 vs. 6.98), Haugh unit (81.87 vs. 77.79), and yolk index (0.47 vs. 0.45). Results also showed that eggs produced under organic system had significantly (P < 0.05) lower amino acids Proline (1.17 vs. 1.28%), Hydroxylysine (0.010 vs. 0.005 %) and Ornithine (0.001 vs. 0.005 %). Fatty acids profile showed that organic eggs had significantly better percentages of total polyunsaturated fatty acids (PUFA), (28.19 vs. 19.56), total Omega-3 (2.37 vs. 1.88) and total Omega-6 (25.82 vs. 17.78).

Key words: Aviary organic egg, conventional cages. egg quality

Introduction

Nowadays organic egg is a term mostly used in many countries. The system producing such commodity called as "organic", "free range" or "cage-free" system. Today's consumers have an increased desire for food produced in range. Eggs coming from the range have an improved nutritional value (Long and Newbury, 2008). Poultry products marketed as free-range still command a premium price due to consumer perceptions of a production method that is more conducive to animal welfare. In Kurdistan, Iraq the free range chickens are reared since long time ago. Such system allows birds to have free space for movement and fulfill most of their natural behaviors. So to enhance such system of poultry production to contribute in self-sufficiency of organic eggs is a vital issue. The aim of this study is to compare the nutritive value of organic vs. conventional eggs quality, amino acids and fat profiles.

Material and methodology

This experiment was carried out in two flocks of ISA Brown at Heibrucks Poultry Ranch, Saranac, Michigan, USA. The first flock (98000 birds) reared under organic, Aviary production system (A steel structure with manure belt, the feed, water, nests and perches located on flat slated floor with stocking density of total 1216 cm^2 of floor space per bird). While the second flock (22000 birds) reared under conventional 3- tier cages (standard cages of 48 x 42 x 45 cm with stocking rate of 4 birds per cage with density of 504 cm^2). All birds were housed in a closed computerized control system. Similar feed composition (14.6 % CP, 2800 kcal ME / kg feed, 3.95 % Ca and 0.37 % available P) and 16L:8D photoperiod were provided for hens in both systems. Feed and water were supplied *ad. libitum.* However, birds on organic system fed ration with all ingredients of organically produced (the ingredients and their percentages were corn 36.653, soybean meal 20.035, oat 10, milo 10, soybean meal by products 8, alfalfa meal 3.509, biotine 0.5, choline chloride 0.045, DL methionine 0.123, probiotics 0.0075, limestone 9.9885, mono-ca-p 0.726, salt 0.207, oyster meal, 0.131and clover mixture feed 0.01). On the other hand, birds on the conventional system were fed commercial diet with the following ingredients and their percentages corn 53.073, soybean meal 12.141, DDGS 12.0, wheat middling 9.442, canola oil 1.85, biotine 0.5, limestone 9.948, mono-ca-p 0.599, salt 0.163, oyster meal 0.081, rhodinmet (ca) 0.072, Rouch mix feed 0.010 and L-lysine 0.121). A total of 240 eggs were randomly obtained on August 9, 2011from hens of 48-wk old. The 120 eggs of each system were randomly assigned to 2 storage treatments (one day vs. 7 days) before chemical analysis, which were analyzed at Biological Lab., Michigan State University. Fatty acid profiles were measured for the 120 eggs/system (15 samples, each was taken from a pooled of 8 eggs yolk). Lipid extraction of egg yolk and preparation of fatty acids methyl esters (FAME) was performed using a direct 2-step transesterification procedure (Jenkins, 2010). FAME was quantified using a GC-2010 plus gas chromatography (Shimmadzu, Kyoto, Japan). Whereas, eggs proximate and amino acids analysis were done on 15 samples/system, each was taken from a pooled of 8 whole eggs, at Agricultural Experiment Station Chemical Lab., Missouri University, according to AOAC (2006a and 2006b, respectively). Hen-day egg production was 165 and 175 at 48 wk for organic and cages system, respectively. Feed consumption was 108.7 gm/day for both systems.

Feed efficiency was 141.6 and 116.3 gm feed/egg for organic and cages system, respectively. As the purpose of this investigation was to examine if production system (organic or conventional cages) affects the quality of eggs, several traits were studies (weights and percentages of egg albumin, yolk and shell) as well as percentages of dry matter (DM) of whole egg, albumin and yolk, also albumin, yolk and whole egg solids. Furthermore, egg quality traits (specific gravity, Haugh unit, yolk index, yolk color, shell thickness and egg shape index) were studied. Statistical analyses were performed using GLM of SAS (2001). The model used for data included the effects of rearing system, storage period and the interaction between them. Duncan's multiple range tests was used to separate group means.

Results

Hen-day egg production, were measured at 48 being 165 and 175 for organic and cages system, respectively. Feed consumption was 108.7 gm/day for both systems. Feed efficiency was 141.6 and 116.3 gm feed/egg for organic and cages system, respectively. Result of statistical analysis showed that storage treatments as well as the interaction between rearing system and storage treatments had significant effects on some traits studied. Generally, storage at 5-7 °C for a week caused unfavorable effects on egg quality and chemical analysis. Result of proximate analysis revealed that eggs produced under organic system had significantly ($P < 0.05$) more ash (1.93 vs. 1.74%) and less fat (13.88 vs. 11.95 %). Storing eggs for 7 days decreased crude protein significantly ($P < 0.05$) from 31.18 to 28.95 %, but did not influence crude fat and ash percentages. Moreover, eggs produced under organic system had significantly ($P < 0.05$) lower egg weight (59.60 vs. 61.00 gm), yolk weight (17.45 vs. 19.13 gm). Shell weight (6.65 vs. 6.27), yolk solid (7.40 vs. 8.27 %), egg solid (22.69 vs. 23.22 %), yolk percent (29.36 vs. 31.41 %), but more shell weight (11.16 vs. 10.30 %), albumin percent (59.48 vs. 58.29 %), egg shape index (76.63 vs. 75.40 %), yolk color (8.15 vs. 6.98), shell thickness(0.45 vs. 0.39 mm), Haugh unit (81.87 vs. 77.79 %), and yolk index (0.47 vs. 0.45). Results also showed that eggs produced under organic system had significantly ($P < 0.05$) lower amino acids Proline (1.17 vs. 1.28 %), Hydroxylysine (0.010 vs. 0.005%) and Ornithine

(0.001 vs. 0.005 %). Furthermore, Methionine was marginally higher in organic eggs compared to conventional (1.064 vs. 1.059). Analysis of fatty acids showed that organic system had significantly influenced percentages of monounsaturated faty acids (37.06 vs. 45.89), polyunsaturated fatty acids (PUFA), (28.19 vs. 19.56), Etrans (0.07 vs. 0.08), Omega-3 (2.37 vs. 1.88), Omega-6 (25.82 vs. 17.78). Moreover, organic production system lowered percentages of the following fatty acids: Myristic (0.24 vs. 0.27), Myristoleic (0.03 vs. 0.04), Palmitic (24.71 vs. 25.55), Hexadecenoic (0.53 vs. 0.62), Palmitic oleic (1.90 vs. 2.72), Hexadecenoic (0.04 vs. 0.06), Elaidic (0.05 vs. 0.07), Oleic (30.52 vs. 37.31), Octadecenoic (3.80 vs. 4.77) and Ricinoleic (0.17 vs. 0.30). On the other hand, organic production system increased percentages of the following fatty acids: Pentadecanoic (0.07 vs. 0.05), Heptadecenoic (0.08 vs. 0.07), Stearic (9.23 vs. 8.21), Linoleic (22.63 vs. 15.12), γ- Linolenic (0.08 vs. 0.06), α-Linoleinic (1.06 vs. 0.96), Eicosadienoic (0.22 vs. 0.09), Homo-γ-linolenic (0.15 vs. 0.11), Eicosatrienoic (0.02 vs. 0.01), Arachidonic (2.23 vs. 1.97), Adrenic (0.16 vs. 0.11), α-Docosapentaconic (0.11 vs. 0.08) and Docosahexaenoic (1.19 vs. 1.06). On the other hand, saturated fatty acids (SFA) were not significantly affected by production system (34.43 vs. 34.20 %).

Discussion

Organic eggs produced in aviary system had significantly better quality traits, proximate analysis, amino acids and fatty acids composition compared with conventional cages. Similar results were found by many researchers (Vits et al. 2005 and Tuyttens et al. 2011). Organically egg produced consistently possessed more ash, higher albumin percent, yolk color, Haugh unit and yolk index. On the other hand, organic eggs had less fat, lower yolk weight and yolk percent, amino acids Proline, Hydroxylysine and Ornithine. Methionine was marginally higher in organic eggs. This may due to increased activity of the birds in aviary system where birds have more chance for free movement. Moreover, Fatty acids profile showed that organic eggs had significantly better percentages of polyunsaturated fatty acids, Etrans, Omega-3 and Omega-6 than eggs produced under conventional system. It is concluded that Omega-6:Omega-3 ratio was higher in organic compared to conventional system. While, the SFA:PUFA and SFA:Omega-3 ratios were lower by 30 % and 20 % in organic compared to conventional systems, respectively. Broughton et al. (1991) showed similar parameters which considered good indices for positively effecting human health and of particular value to consumers concerned about fat and healthfulness of saturated vs. unsaturated fatty acids. It is concluded that hens reared under organic system of production had better egg quality and biochemical composition, and consequently give better human health and welfare.

Suggestions to tackle the future challenges of organic animal husbandry

Hens reared under organic system of production had better egg quality for human as well as bird welfare. Such system can allow the hens performing certain natural behaviors and implementing more welfare-friendly housing systems that minimize stress and safeguard hen well-being. As I am a Fulbright visiting scholar spent 10 weeks in USA and did the current study. I should recommend and encourage the organic poultry production system to Iraqi Kurdistan region. As the traditional rural poultry system characterized as active and independent foragers in a free-range system. The traditional sector is still running by all farmers in Kurdistan as well as in Iraq. Indeed, the favorable effect of local heritage breeds of chicken is the thermo-tolerance and the adaptation of birds to environment. Nowadays, the contribution of the rural sector as a source of meat and eggs is very limited and not exceed 5% of total consumption of poultry products in Kurdistan. Therefore, actions should undertake to promote the organic sector. In the light of the presented study, it could be suggested that local heritage poultry in Kurdistan and Iraq as well can be improved both for organic meat and eggs.

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Organic poultry systems for meat


(Foto: BLE 2004)

Free range for organic pullets?

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Abstract

The effect of free-range access on the health of organic pullets was investigated in order to elaborate recommendations for organic pullets in Germany. Data from 226 rearing batches (58 rearing units in three countries) with free-range access were recorded, analysed and compared with data from 17 organic rearing units without free-range in Germany. Variability in husbandry conditions and management was high. Mortality was on average between 2.5% and 3.1% and similar to mortality in the German units (3.4%). 80% of losses took place before birds had free-range access. Predators were reported to be a problem for many farms. Incidences of antibiotic or antiparasitic treatments were low (0.02 to 0.05 treatments per rearing period). Average pullet weights were similar between countries, but uniformity showed larger variation in free-range systems. No specific health problems due to free-range access could be detected. Recommendations concerning free-range management and design are provided.

Key words: laying hen, pullets, rearing, health, mortality, animal welfare

Introduction

According to the EU-Regulation 834/2007 and 889/2008 pullets must have access to an open air area which shall be mainly covered with vegetation, but no specification regarding available outdoor area per bird was made. At present, in most pullet rearing farms in Germany an outdoor area with vegetation is not available for the birds, because farmers are afraid of infectious diseases which could be carried over to the layer farms. Instead, the birds have access to a covered outdoor run with concrete floor, straw and outdoor climate (also called wintergarden). The aim of our study was to investigate the influence of an outdoor run with vegetation (free-range) on the health of pullets using data from Switzerland, Austria and Denmark and to make recommendations regarding free-range design and management based on practical experiences from these countries.

Material and methodology

Data from 58 rearing units (Switzerland n = 20, Austria n = 19, Denmark n = 19) and from 1 to 6 batches per unit were recorded in 2010. In total 226 rearing batches could be analysed. Data from 17 organic rearing units in Germany were available as reference values (16 only with covered outside run, 1 with free-range).

In all three countries a standardized recording protocol was applied concerning details of housing and management, losses, treatments and birds' body weights. Data were recorded through questionnaire guided interviews, direct measurements or from farm documentation. From body weight data, uniformity and relation to body weight according to the management guidelines of the breeding companies (percentage target weight) were calculated because of differing rearing periods, losses were computed on a weekly basis. Furthermore, the proportion of losses before and after the first day of free-range was determined. Unifactorial analyses of variance (SPSS 19.0.0.1) were used to analyze mortality, percentage target weight and uniformity with regard to potential differences between countries.

Results

The investigated husbandry systems for pullets differed widely between countries and partly also within countries. In Switzerland mainly aviaries were used. In Denmark all rearing houses were barn systems. Austria had 58% aviaries and 42% barn systems. A covered outside run was present in all rearing houses in Switzerland and in Austria, in Denmark only in 53% of the pullet houses. Stocking densities in the covered outside run varied between 11 to 105 animals/m² with the lowest densities in Switzerland (Table 1). In Switzerland 40% of the pullet houses had an outside run with a concrete floor or litter without vegetation ('Geflügellaufhof') additionally to the free-range area. Space per hen in the free-range area was between 0.4 and 2.5 m² (Table 1). Except on one farm, all free-range areas had elements of structure. All farmers applied different hygienic measures such as mulching, mowing, liming and replacing of the soil, but in variable intensities.

Access times to the outside areas also differed largely. In Switzerland and Denmark, the pullets had access to the covered outdoor run on average from the 6th week of life and to the free-range from the 8th to 9th week, according to the legal requirements in both countries. In Austria the pullets had first access to the covered outdoor run with 9 weeks of life and access to free-range with 14 weeks of life (Table 1). The covered outdoor run was available for the birds during the daytime in most pullet houses, whereas the free-range area was closed if the weather was wet or during extremely cold temperatures, especially in winter time. Therefore, in all countries some batches had only access to the free-range for the few last weeks of the rearing period in winter time.

Table 1. Stocking densities and access times concerning covered outdoor run and free-range for pullets in Switzerland, Austria and Denmark

Country	Switzerland	Austria	Denmark
Covered outdoor run animals/m² mean (min – max)	16.9 (11.2 – 32.2)	44.4 (25.9 – 59.0)	43.7 (14.5 – 105.0)
Free range animals/m² mean (min – max)	1.1 (0.7 – 1.8)	0.5 (0.4 – 0.7)	1.2 (0.4 – 2.5)
Covered outdoor run first access according to regulations	43rd day of life	10th week of life (64th day of life)	no regulations
first access day mean (min – max)	42 (34 – 60)	63 (17 – 73)	41 (15 – 63)
Free-range first access according to regulations	43rd day of life	12th week of life (77th day of life)	6th to 7th week of life summer (36th to 43rd day of life), 9th week of life winter (57th day of life)
first access day mean (min – max)	52 (35 – 107)	97 (69 – 111)	57 (36 – 111)

Mortality per rearing batch was not significantly different between countries ($p = 0.33$, Table 2) with on average between 2.5% and 3.1%, and a generally large variance between batches (0.4 to 13.7%). However, only in five out of 217 batches (2.3%) was the mortality higher than 7%. This was similar to the mortality rates from German units without free-range access (Mean: 3.4%, Variance: 1.7 to 12.2%). About 80% of losses took place before birds had free-range access, mostly within the first three weeks of life. However, there was a difference between Austria and the two other countries in that Austria had the same average weekly losses before and after access to free-range, mainly due to killing of birds on some farms at the end of the rearing period. The causes of losses were rarely documented. Losses due to infection were rarely reported and happened early during rearing. Predators were seen as a problem by many farmers (Switzerland 34%, Austria 17%, Denmark 56%). Incidences of antibiotic or antiparasitic treatments were low (0.02 to 0.05/rearing period). Pullet weights reached similar levels in Denmark, Austria and Germany (no weights available for Switzerland) and were on average above target weights. However, uniformity was on average lower in Austria (79%) than in Denmark (84%) and Germany (82%, $p = 0.037$).

Vaccination is partly influenced by different national legal rules. Most vaccines were used in Germany (6 to 9 different vaccines, 11 to 21 vaccinations plus vaccinations directly before restalling). Switzerland had the lowest application of vaccines (3 to 5 different vaccines, 6 to 9 vaccinations).

Discussion

No indications for specific health problems due to free-range access for pullets could be detected. However, the large variation in results hints at a possibly larger challenge regarding proper management under free-range conditions. Especially, a non-adapted feeding management is a possible cause of decreased uniformity. Pullets with low body weight in a flock can cause low laying performance, feather pecking and cannibalism (Lugmair et al. 2005) and is therefore an economic and animal welfare problem. Further management measures are necessary to limit risks of predation and uptake of infectious agents. Based on the practical experiences in the surveyed countries, Keppler et al. (2010) put forward recommendations concerning free-range management and design.

Table 2: Body weight, uniformity and mortality of pullets in Switzerland, Austria, Denmark and Germany

Country	Switzerland	Austria	Denmark	Germany
Body weight % of target weight mean (min – max)	-	105 (94 – 123)	105 (81 – 117)	103 (94 – 111)
Uniformity (%) mean (min – max)	-	79 (50 – 89)	86 (50 – 98)	82 (72 – 91)
Mortality total **(%)** mean (min – max)	3.1 (0.7 – 13.7)	2.5 (0.4 – 7.7)	3.1 (1.0 – 12.2)	3.4 (1.7 – 12.2)**
% of total mortality before access to free-range mean (min – max)	75 (26 – 99)	77 (12 – 100)	82 (35 – 100)	-
weekly % before access to free-range mean (min – max)	0.31 (0.02–1.17)	0.13 (0.2 – 0.47)	0.34 (0.08 – 1.23)	-
weekly % after access to free-range mean (min – max)	0.07 (0.00 – 0.46)	0.07 (0.00 – 0.29)	0.05 (0.00 – 0.29)	-

* according to the references of the breeding companies ** unit with free-range 2.04 %

Suggestions to tackle the future challenges of organic animal husbandry

Outdoor access is a central requirement of organic husbandry, but in specialized, concentrated production systems such as pullet rearing, conflicts arise with the control of predation and infection risks. However, with proper management good health and low mortality can be reached, although this might be more difficult on large scale. In any case, birds should have outdoor climate and natural day light from an early stage of life and in winter time by provision of a covered outdoor run.

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Les Bleues – a new approach to dual purpose chicken

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Abstract

In laying hens, hybrid strain male birds are killed as one day old chicks. Some initiatives try to use these male hybrid birds for fattening. The disadvantage to this is the bad feed to weight ratio, the low weight of the bodies and the small amount of breast meat these birds yield. The bodies of these chickens do not look like broilers. In our trials we used strains that are used in France for programs with slow growth. Because of their French origin and their blue feet we called the birds "Les Bleues". They can be slaughtered after 90 days with a feed to weight ration of 1:3 and the meat quality is good. The new data that was collected by us in 2011 and 2012 is regarding the amount of eggs. The potential egg yield is between 240 and 250 compared to the 280 to 290 of a hybrid hen. The main challenge is for the young laying hens not to become too fat before the start of the egg laying period. 6 organic farms around Berlin have begun to produce these dual purpose chickens in small flocks for the regional market successfully.

Key words: poultry, breeding, dual purpose chicken

Introduction

In laying hens, hybrid strain male birds are killed as one day old chicks. This is an ethical problem especially for the organic sector. (ifoam EU group, 2010). Some initiatives try to use these male birds of egg strains for fattening. The disadvantage to this is the bad feed to weight ratio, the low weight of the bodies and the small amount of breast meat these birds yield. The bodies of these chickens do not look like broilers and the consumer does not recognize these bodies as broilers. So the only chance for using these animals is processing (e.g. sausage, cans). In our trials we used strains that are used in France for programs with slow growth. Because of their French origin and their blue feet we called the birds "Les Bleues". They can be slaughtered after 90 days with a feed to weight ration of 1:3 and the meat quality is good. But we did not have information regarding amount of eggs because these birds are only used for fattening in France (except the parent flocks).

Results

Meat

A trial on fattening comparing with other slow growing fattening strains and with egg strains already was made in Austria.

The growth of the Les Bleues was between the normally used slow growing fattening strains JA957/JA457 and the most promising old land races. The positive aspect is that the bodies looks like a broiler with sufficient amount of meat. The meat of these older birds does taste good but there has to be a certain amount of fat on the meat. Birds killed with an age older than 16 weeks can have the danger of lower meat qualtity because of meat with longer fibre structure.

Table 1. Comparision of Strains, Iber/Lugitsch 2010

Male+female	Period in days	Amount of feed in kg	Weight in kg	Weight:feed
Sulmtaler	133	10,75	2,24	1:4,80
Altsteirer	133	7,60	1,61	1:4,72
Rhodeländer	133	9,57	2,21	1:4,33
Les Bleues	97	7,00	2,34	1:2,99
JA 957 (white)	56	4,84	2,20	1:2,20
JA 457 (brown)	70	5,72	2,20	1:2,60

6 organic farms around Berlin have begun to produce these dual purpose chickens in small flocks (200 – 1000 birds) for the regional market successfully. The concept is to build up laying hens flocks up the amount of eggs being needed. When having enough laying hens also female birds will be used for fattening. Both male and female birds show good results for meat.

Table 2. Survey on farms

Farm	Main activity	Second activity	Comments
1	Laying hens	Rearing male and female birds	Own natural reproduction
2	Broilers	Rearing female birds for farm 2 and 5	
3	Laying hens		
4	Laying hens	Rearing male and female birds	
5	Laying hens		In future own reproduction
6	Laying hens	Rearing male and femal birds	Own strain

Results on meat

The weight, feed uptake and weight:feed ratio for the birds slaughtered in week 12 and 13 is in the expected frame. When slaughtering in week 16 the weight:feed ratio gets worse than 1:4. There are problems with appearance of breast blisters on some birds. The reason has not yet been found and we cannot exclude genetic disposition. This would be quite unusaual because breast blisters have been connected with faster growth in former research (Knierim et al., 2009) The male birds show a good acceptance of the outdoor range.

Results on eggs

The new data that was collected by us in 2011 and 2012 is regarding the amount of eggs. In hybrid hens the amount of eggs per year that can be reached “in theory” is between 280 and 290, but in reality is often between 240 and 250 (sold eggs). The Les Bleues parent flock on the farm “Geflügelzucht Hetzenecker” in Bavaria (who was the first having the idea of using the Les Bleues as a dual purpose chicken) gets between 240 and 250 eggs per year. The main challenge is for the young laying hens not to become too fat before the start of the egg laying period. As reduction of feed uptake is not an option for organic farms. Instead of that these hens need to have feed with a lower content of energy and higher content of fibre.

On the farms the amount of eggs is up to now between 180 and 240. That is not surprising because all the the farmers are beginners in poultry production. Start of laying period is between week 20 and 22, that means later than in hybrid strains. The amount of small eggs (S size) is about 50% in week 24. A concept of a dual purpose chicken has to include a good use for small eggs. As the colour of egg is a bright brown the egg can be differed from normal brown eggs.

Feed uptake in the laying flocks is up to 170 grammes per day and hen. That’s a lot higher than usual although there is a certain amount of feed waste in these small flock sizes. Solutions have to be found to reduce feed costs.

Les Bleues laying hens are heavier than normal laying hens, 2200 g on farm 3 and 2500 g in the parent flock instead of 2000 g. But weight is inhomogeneouos ranging from 1900 g to 3000 g. Although the Les Bleues hens are heavier the acceptance of the outdoor range is very good and the laying hens show a very good activity in the outdoor range. Some of the farms have got mobile houses which fit very good to this system. With good activity outside feed costs can be reduced.
The fact of showing good activity although of heavy weight unluckily includes a tendency to feather picking. The challenge is to have both an attractive outdoor range and to have more time for feed consumption.

Discussion

The experience of 6 farms around Berlin show that a concept for dual purpose chicken can work. There has to be a higher price both for the eggs and for the meat, but in this concept both eggs and meat can be sold as a "premium" product. That is an advantage to concept working with more or less "normal" hybrid hens having no extra price on the eggs but meat which is only usuable for processing. But economics of the Les Bleues have to be improved especially in egg production. That is not a surprise because main target in the original French breeding programme was on meat and meat quality.

Further research, selection and/or crosses will be needed to get strains that are acceptable for a bigger market.

Suggestions to tackle the future challenges of organic animal husbandry

Killing of male birds of laying hens strains should be not accepted in organic farming anymore. Our trails show that a dual purpose chicken can offer both good quality of eggs and meat. But nevertheless a lot of breeding activities are necessary to improve performance and economics.

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Dietary supplementation of Artemisia annua to free range broilers and its effects on gastro-intestinal parasite infections

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Abstract

In a factorial experiment, effects of dried leaves of Artemisia annua as an anti-parasitic supplement in two different broiler genotypes, raised in a free range system, were investigated. Birds were grown indoors until 29 days of age free of parasites. Twelve groups, each of 35 randomly selected birds naturally infected with coccidia (Eimeria spp.), were placed in plots cultivated with a mix of grass and white clover (previous two years without poultry) thus forming three replicates for each treatment combination (2 genotypes and +/- supplementation of A. annua). Ten individual birds from each of the 12 groups (n=120) were monitored twice a week for excretion of coccidia oocysts (OPG) and gastrointestinal nematode eggs (EPG). At the end of the trial, when broilers were 74 days of age, 5 broilers per plot (n=60) were necropsied and their intestines opened for coccidia speciation and to account for the presence of gastrointestinal nematodes. In general, broilers from both genotypes coped well with coccidia infections as no deaths were reported. Broilers supplemented with A. annua showed a reduced number of excreted oocysts (67% less; p<0.05) with no interaction to genotype. Females had a higher shedding of oocysts than males (45% more; p< 0.05) and we suggest it was related to a higher foraging activity. No eggs of gastrointestinal nematodes were observed during routine EPG. However, during necropsy, juvenile larvae of Ascaridia galli were found in 73% of the broilers with no differences in respect to treatment or genotype. A median of 3 larvae per broiler was observed. In conclusion, an integrated system for parasite management may benefit from A. annua supplementation to reduce negative effects of coccidiosis whereas it is difficult to avoid infections with A. galli, if paddocks are permanently used. Eggs of A. galli are hard-shelled and persistent for years on pasture.

Key words: Organic Poultry; Foraging; Parasites; Eimeria spp.; Ascaridia galli

Introduction

In organic and free range systems, animals are more exposed to parasites as a consequence of access to permanent paddocks. Coccidiosis (*Eimeria* spp.) and ascaridiosis (*Ascaridia galli*) are important parasitic diseases responsible for severe losses in poultry production worldwide (Allen et al. 1997; Permin et al. 1999). *Artemisia annua* has been considered as a potential botanical anti-parasitic feed additive for chickens (Abbas et al. 2012). On this background, the aim of the present study was to investigate the effects of *A. annua* in two different slow growing genotypes of broilers (White Bresse - L40 and Kosmos 8 Red - K8R) in relation to levels of naturally acquired parasite infections and subsequent impact on live weight gain in a system closely resembling common farming practices.

Material and methodology

The experiment was conducted at the Research Centre Foulum, Aarhus University, Denmark. The study used a 2 x 2 factorial design – with two genotypes and two dietary treatments (supplemented with *A. annua* dried leaves or not) as main factors – and with three replicates for each treatment combination. In total, the experiment thus included 12 flocks of 35 broilers of mixed sex. During the study, animals were fed a typical organic concentrate, whole wheat and supplemented with water. 30 broilers were randomly allocated to 12 plots outdoor at 29 days of age. Six groups, three of each genotype, were fed *Artemisia* mixed in diet while the non-treated groups received diet without *A. annua*. 60 broiler called "seeders" were naturally infected with contaminated manure according with Velkers et al. (2010) and after 10 days, at 39 days of age, 5 "seeders" were introduced to each of the 12 plots. Ten broilers called "tracers" where randomly selected per plot and monitored twice weekly for coccidia oocyst (oocysts/g faeces; OPG) and *A. galli* egg (eggs/g faeces; EPG) excretion. In the end of the study, at 74 days of age, 5 broilers per plot (n=60) (not "seeders" and not "tracers") were harvested for lesion score in accordance with Johnson and Reid (1970) and for counting nematodes in the intestinal tracts. Consumption of diet was recorded twice a week and a mean individual feed consumption was calculated for both genotypes. All broilers in this study were weighed individually in four specific moments at different ages. Analysis of variance was performed using the MIXED procedure in SAS for infection and performance attributes. Total weight gain and the daily weight gain were calculated individually while feed conversion rate was calculated per plot. More information on methods can be found at Almeida et al. (2012).

Results

The overall body weight gain and the weight gain when coccidia infection was subdued showed a three-way interaction among genotype, sex and treatment (Table 1). Weight gain was higher when K8R females were supplemented with *A. annua* whereas supplemented K8R males had a lower weight gain than non-supplemented males (Table 2). No differences for the overall performance of flocks treated and untreated were reported at the end of the trial.

Table 1. Levels of significance of factors influencing performance and infection

	Weight Gain (Kg)	Daily gain (g/d) periods[a]			Mean OPG [b]	*A. galli* larvae [c]
		29-42	42-56	56-74		
Treatment	NS	*	NS	*	*	NS
Genotype	**	**	**	**	NS	NS
Genotype x Treat.	NS	NS	NS	NS	NS	NS
Sex	**	**	**	**	*	-
Treatment x Sex	*	NS	NS	*	NS	-
Genotype x Sex	*	NS	NS	*	NS	-
Treat. x Gen. x Sex	*	NS	NS	*	NS	-

NS = Non Significant; * significant at P<0.05 and ** significant at P<0.01 [a]Growing period – interval described by the age of the broilers in days. [b]Log_{10} transformed for each experimental broiler (n=120). [c]Log_{10} transformed worm count of each broiler (n=60).

The mean number of oocysts excreted by the "seeders" when introduced to the 12 plots was not different (p<0.05). In addition, no clinical symptoms of disease were reported. Only few lesions caused by coccidia were observed in the intestine of broilers while juvenile larvae of *A. galli* were found in 73% of slaughtered animals with no statistical differences observed (Tables 1). During the experimental period, oocyst output was significantly influenced by treatment (p<0.05) and sex (p<0.05) (Table 1). Thus, non-treated broilers showed 67% higher oocyst output than broilers with access to *A. annua* dried leaves and on average, females excreted 45% more oocysts than males. No effect of genotype was found and no interaction between genotype and treatment was observed (Table 2). Before the coccidial infection build-up (29-42 days), broilers from both genotypes and sex fed the diet supplemented with *A. annua* had significantly lower average body weight gains ($p<0.05$) than broilers in the control groups (Table 2). There were no statistically differences for mean daily weight gain in the intermediate period (42-56 days) while in the late period (56-74 days), treated groups gained significant more weight ($p<0.05$) than control birds after the coccidial challenge.

Table 2. *Artemisia annua* effects on performance attributes and infection

		White Bresse (L40)				Kosmos 8 Red (K8R)			
		Treated		No Treated		Treated		No Treated	
Gender [a]		M	F	M	F	M	F	M	F
Weight Gain (Kg)		1.47	1.17	1.47	1.18	1.96	1.67	2.06	1.57
Daily Gain (g/d)	29-42 d	26.6	22.3	28.8	23.8	34.4	29.9	40.9	34.2
	42-56 d	30.7	25.3	30.2	25.6	43.6	38.2	44.2	35.4
	56-74 d	38.6	29.1	37.6	28.5	50.7	41.6	50.5	35.0
k OPG [b]		40.0	56.3	61.3	91.3	68.8	56.3	72.5	145
A. galli Larvae[c]		2	-	3	-	1	-	2	-

[a] Gender of Broilers: M = Males and F = Females.
[b] k OPG = 1000 OPG (Oocysts per gram of faeces).
[c] Median of juvenile larvae found. Necropsy was performed in male broilers only (n=60).

Discussion

The supplementation of 3% *A. annua* in the feed significantly reduced oocyst output (OPG) in sub-clinical coccidia infections and increased weight gain when infections were subdued. However, *A. annua* supplementation did not show major advantages in performance when the whole flock was considered supposedly due to non palatable components bio synthesized in the plant. No effects of the plant were observed against natural infection of the nematode parasite *Ascaridia galli*. Our results agree with those of Allen et al. (1997) who reported 80% suppression in OPG, and that *A. annua* protected broilers against coccidiosis. However, it remains speculative to what degree the reduction in oocysts output observed in our study (60-70%) may positively impact the epidemiology of the disease at higher infection levels. While the complete elimination of the parasite seems unattainable with a natural treatment such as *A. annua*, a smaller infection level may lead to a build-up of immunity in infected birds, supporting the overall flock resistance. This is a desirable outcome for free range and organic systems and may reduce the risk of infections by secondary opportunistic organisms like bacteria. On this background, our results indicate that supplementation with *A. annua* to broilers raised in a free-range organic system may be used as a botanical coccidiostat. In addition, we observed that the effect of treatment against the coccidia was not dependent on genotype. However, we observed a sex effect on oocyst excretion. Females in the control group shed 75% more oocysts than males (Table 2). As males and females were reared together, this finding suggests a true sex-related difference. Meanwhile, it was also observed that females from both genotypes in our study spent more time moving around, interacting socially and pecking for food when compared to males, which agrees with Masic et al. (1974) who also reported females with higher activity in the range compared to males. Infective oocysts are mainly available in faeces which were more abundant close to the broiler-house and to the sources of food. Thus, we consider that females were more exposed to infection than males and this may explain the sex differences in oocyst excretion in the untreated groups. Even though no eggs of *A. galli* nematodes were observed during routine EPG, juvenile larvae were found in the intestinal tract of 73% of the broilers after a period of 45 days exposed in the range. According to Velkers et al. (2010), the introduction of coccidia with "seeders" provided rapid dissemination to broilers in all groups. It is a useful technique for experimentation with animals reared in organic systems as it avoids artificial inoculations, an undesirable practice regarding animal welfare. Nevertheless, due to its potential coccidiostatic effects, alternative ways to provide natural bioactive plant components must be further investigated.

Suggestions to tackle future challenges of organic animal husbandry

Despite market demands for natural coccidostats and anthelmintics compatible with organic farming systems, there is no efficient natural product currently available to control parasites in poultry systems. The discovery of natural treatments against parasites to be delivered via feed or drinking water would reduce the reliance on commercial medicine, be more acceptable to consumers and perhaps be more profitable to farmers, leading to an immediate boost in the organic poultry market. In addition, the significant increase in oocysts output found in non-supplemented females in our study suggests a sex influence related to either a more active foraging behaviour (resulting in higher oocysts intake). What we highlight based in our own findings and from other studies available in the international literature is the importance of not using permanent paddocks in organic poultry systems. This strategy may alleviate problems with coccidiosis but will not work against *A. galli* eggs that survive in the environment for longer periods.

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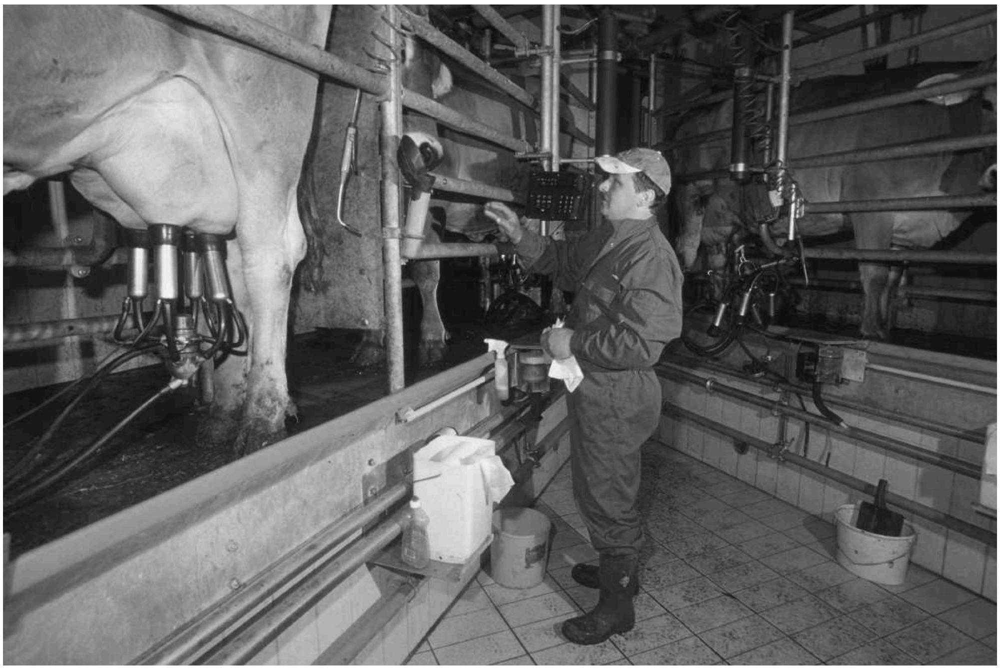
Alternative approaches in organic dairy farming



(Foto: BLE 2004)

Dam-associated rearing as animal friendly alternative to artificial rearing in dairy cattle

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Abstract

Dam-associated rearing provides contact between cow and calf, with cows being milked additionally. For 3 months postpartum, unrestricted cow-calf contact (UNRESTR), 2×15min contact (RESTR), and no contact (NO) were tested in two experiments (suffix 1 and 2). Sucking duration was longer in UNRESTR2-calves than in NO2-calves, and cross-sucking was never observed in UNRESTR-calves. Lying duration was shorter in UNR2-calves, indicating increased activity due to the diversified environment of the cubicle barn compared to the calf-area. Stress-related behavior was increased in RESTR1-cows in the beginning of lactation. Yield was reduced in UNRESTR1- and RESTR1-cows. Permanent cow-calf contact proved to be the most animal-friendly way of rearing. Restricted contact seemed to cause mild stress in cows but not in calves. Dam-associated rearing was advantageous for calf welfare, irrespective of contact intensity.

Key words: calf, sucking, welfare, cow-calf contact, restricted suckling

Introduction

In dairy production, calves are usually separated from their dam shortly after birth, and further cow-calf contact is prevented. However, there is growing concern of both, consumers and (mainly organic) farmers who question this practice. Some of these famers allow contact between cows (dam or foster cow) and calves for suckling and milk the cows additionally. Due to farm to farm variability it is difficult to assess the impact of cow-calf contact on animal welfare and productivity. Aim of this study was thus to examine the effects of dam-associated versus motherless rearing on behavior and milk-yield on the same farm and in the same housing conditions.

Material and methodology

In experiment 1, 14 cow-calf pairs were kept with unrestricted contact (UNR1), 15 cow-calf pairs had contact two times per day for 15 min each (before milking, RESTR1), and 28 calves were reared without contact to their dam (NO1). In experiment 2, 21 cow-calf pairs were kept with unrestricted contact (UNR2) and 19 calves were reared without dam (NO2). Treatments lasted for three months, after which calves were weaned off milk and brought to a separated building. All cows were milked twice daily and kept in a cubicle barn. Calves with unrestricted contact to their dams were allowed to enter the cubicle barn via a sensor controlled gate or to stay in the calf area. All other calves were kept in the calf area which was adjacent to the cubicle barn. RESTR1 cows were brought to the calf area before milking to suckle their calves. The calf area was equipped with a computer controlled milk feeder providing 8 or 16 L/calf/day for the NO1 and NO2 calves, and a concentrate feeder to which all calves had free access at all times. In experiment 1, we observed:

- sucking behaviour and concentrate feed intake of calves,
- proximity between cows and calves,
- behavioural stress reactions during milking, and
- milk yield gained by machine milking

at different times during the rearing period.

In experiment 2, we observed sucking, lying and feeding behavior of the calves (35h per calf).

Results

Concentrate intake was higher in NO1-calves than in UNRESTR1-calves (Fig. 1a). Cross-sucking as abnormal oral behavior was observed in 93% of NO1-calves and 28.6% of NO2-calves, in 1 RESTR1-calf, but never in UNR-calves.

During milking, stress-related behaviour was increased in RESTR1-cows (p=0.033). RESTR1-cows were more often in proximity to the calf-area in the beginning of lactation (p=0.003) and showed more searching calls than UNR1-cows (p=0.006), indicating short-term stress caused by separation from the calf. Milk yield was reduced in UNR1- and RESTR1-cows (p<0.001, Fig. 1b).

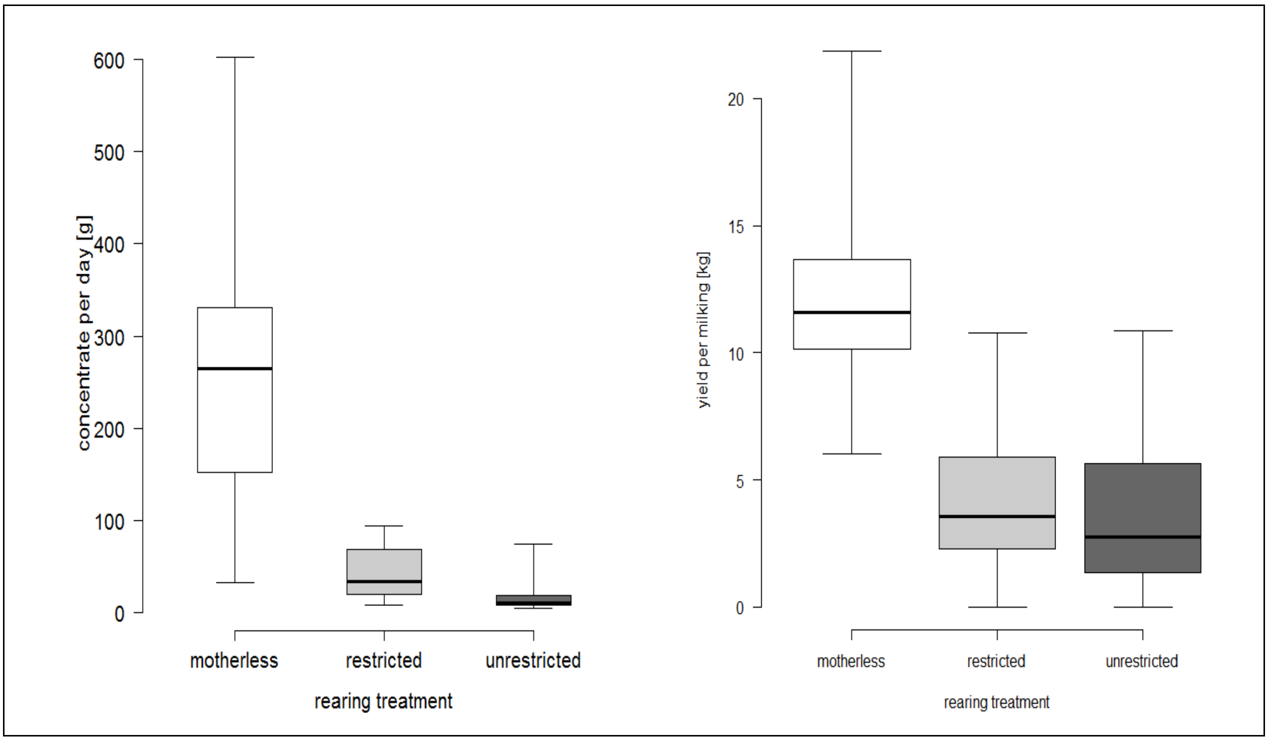

Figure 1. left: Concentrate intake [g/day] of calves and right: milk yield of cows in different rearing treatments in experiment 1

Sucking duration was longer in UNR2-calves than in NO2-calves (Table 1). Duration of roughage feeding did not differ between treatments, but UNR2-calves had a shorter lying duration, which may reflect increased activity due to a more diversified environment in the cubicle barn compared to the calf-area (Table 1).

Table 1: Behaviour of calves in different treatment systems in experiment 2

	unrestricted contact			motherless (no contact)			
	Median	Min.	Max.	Median	Min.	Max.	
lying (min h^{-1})	19.9	12.1	22.5	24.4	20.1	27.0	**
feeding roughage (min h^{-1})	1.24	0.15	3.27	0.38	0.53	2.4	ns
sucking (udder/automatic feeder, min h^{-1})	0.8	0.33	2.74	0.49	0.26	0.9	**

* significant at P<0.01 due to Wilcoxon rank sum test

Discussion

Calves that were reared with contact to their dam did not develop abnormal oral behavior (cross-sucking), irrespective of contact intensity (Roth et al. 2009). In parallel, milk yield of cows with contact to their calves and concentrate intake of calves that were suckled by their mother was very low indicating that calves' nutritional needs were fulfilled by sucking. While a low milk yield seems to be a mainly economic loss for the farmer, the low concentrate intake may lead to a subop-timal rumen development and thus, to nutritive difficulties after weaning (Khan et al. 2007).

In the first two weeks of lactation, restricted contact seemed to cause mild stress in cows but not in calves. Permanent contact, on the other hand, proved to the most animal-friendly way of rearing, but in our study weaning stress that is assumed to increase with contact intensity, was not exam-ined. Milk yield, feed intake by calves and weaning stress clearly have to be optimized for imple-menting dam-associated rearing on-farm.

Suggestions to tackle the future challenges of organic animal husbandry

Animal welfare and the reduced use of antibiotics are the main reasons of consumers to buy organic dairy products. Whereas barn design and equipment (e. g. brushes) aim to fulfill the physical needs of organic dairy cows, most of the cows are not allowed to express their maternal behaviour. To an increasing degree, this concerns consumers, especially in developed countries where the majority is no longer related to practical farming. Future organic husbandry should be aware of this. Maybe a high price “calf milk”-label might compensate the farmers' loss in milk yield and fulfill consumers' expectations as well.

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Non-killing cattle husbandry

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Abstract

It is an ethical challenge for vegetarians to look for milk-products that are produced without the killing of cows after their productive life and without the killing of the male offspring as fattened beef cattle. Narrative interviews on 5 organic farms that do not kill their cattle were analysed applying Grounded Theory. The emerging four categories of a care-system for healthy, handicapped, old, ill and dying cattle are described and related to the IFOAM principles. Leading to an agri-care-system, farm stiles are outlined along their properties as (Agricultural) Sanctuaries and Vegetarian milk Farms.

Integrity within the IFOAM Health principle does not include the integrity of a "whole life" of cattle and other farm animals. Non-killing cattle husbandry is an emerging innovative example of an ethical choice that has the life of the animals as its main "product" and milk rather as a by-product – all of which could be communicated as OrganicVeg.

Key words: Sanctuaries, Care Ethics, IFOAM principles, Integrity, Vegetarianism

Introduction

Since organic agriculture became an accepted mainstream in society, vegetarian ethics and food habits did the same last year in Germany. People become vegetarians mainly for ethical reasons of dealing with life and living beings (Leitzmann and Keller 2010). However, with their milk consumption also vegetarians are indirectly responsible for the killing of milk cows and the fattening of their male offspring. This raises the question, how to develop agricultural systems without killing of animals and what kind of consequences this entails for the management as a whole.

In narrative (and semi-structured) interviews (Rosenthal 2005) with 5 organic farmers who practise non-killing cattle husbandry, the biographical context, ethical attitudes and management were asked, and analysed using Grounded Theory.

As a result 4 categories of a Care(-ethics)-system are described and compared with the IFOAM principles. The farm management was analysed as "systems that work" and presented as different stiles.

Material and methodology

Four farms were in Europe and one in India. As with theoretical sampling in Grounded Theory (Corbin and Strauss 2008) the farms were selected during the ongoing research, drawing on emerging results and opportunities during field research.

Data segments were coded and categorized (Charmaz 2006) using ATLAS.ti. Additionally, text-segments were selected and analyzed by sequential micro analysis (cf. Rosenthal 2005, Charmaz 2006).

The coding process and writing of memos led to the emerging of categories and subcategories with their respective properties and dimensions. The cases were compared along the categories within the three given interests of research: the biography of the farmers (not further referred to in this paper), the ethics of action and the management of an agri-care "system that works".

The care-system

Four main categories of a shared care-system were identified[4]. They resemble the situational, contextual and relational framework of an ethics of care (Donovan and Adams 2007, Kheel 2008). These categories are:

- Universal: Cattle from both sexes, all ages and of different health status are taken up and held at the farms. They are cared for as in a Sanctuary. Besides that, other farm animals and occasionally wild animals are accommodated on the farms and cared for in a widening circle of activity and moral consideration (cf. Meyer-Abich 1990, Verhoog et al. 2003).
- The whole life - a lifetime of care: Once taken or born on the farm, the animals have the promise of a lifetime of being cared for until they die due to their age and through natural causes, or they may be euthanised (on 3 farms).
- Free: Care is rendered independent of the productivity of the animal. Although products like milk, draught power and dung are welcomed and/or looked for on most farms (see table 1), productivity is not a precondition for longevity and care.
- Comprehensive and intensive: On most farms special attention is paid to the animals as individual beings besides their species specific needs. Caring for healthy, sick and especially the handicapped and dying cattle often resembles the intensive care for humans and family members - within caring facilities like homes for elderly or retarded people.

Care in the context of theise four empirical ethical categories is emphasised as an individual, non-instrumental value of a "subject of a life" (Regan 2004) in comparison with the IFOAM Principles of Care which emphasizes the precautionary aspect.

The categories "Free" and "Whole life" have no equivalent within the common framework of organic farming. "Universal" features are encompassed, with a different understanding, by the inclusiveness of the IFOAM principle of Health (from soil to human) and Ecology (all animals). The principle of Health, which includes the integrity of living systems does not specifically include the integrity of the individual life.

The *agri*-care-system: Farming stiles

The categories of a "care-system" represent a common basis, shaped into a specific agri-care-system by its interdependency with the adopted "agri-system" (Table 1).

Having the emphasize on their function as a sanctuary, the "whole life" of the animal is the main product of farm 1-3. The agricultural sanctuaries by in large amounts of fodder. Besides the pure sanctuary all farms have horticulture and/or arable farming. The two milking farms have a calving interval averaging about 3 years, they milk their cows after calving for 1-10 years, with an average of about 3 years. Farm 5 has an average yearly milk production of 3.500 litre milk per cow from 10-11 cows out of 45 cattle being milked in 2007 and 2008 (c.f. Prime 2009). Since 5 years at farm 4 there have been (recurrent) spontaneous lactations in spring by 5 different cows that have been dried off and without being in calf again. Three of them have been milked.

Two farms (3 and 5) have the necessary workforce to work with the oxen, while farm 2 and 4 shed to do the same. The castration of the bulls at all farms and sterilization (tubectomy) of the cows at farm 3 is viewed as an unavoidable ethical compromise by most farmers.

4 The features partly also draw on the 5 Principles of Sai Ideal Healthcare (Sathya Sai World Organisation 2009) which are: Universal-, Free-, Loving-, Comprehensive- and Preventive.

Table 1. Farms and their properties

	Sanctuary	Agricultural Sanctuary		Vegetarian Milk Farm	
	Farm 1 (EU)	Farm 2 (EU)	Farm 3 (IND)	Farm 4 (EU)	Farm 5 (EU)
Number of cattle[a]	35	42	ca. 200-320[b]	35	45
LU/ha	1	3,3	(9,6)[b]	0,6	1,2
Milking				X	X
Breeding				X	X
Ox draft			X		X
Dung products		X	X		
Horticulture-, Agri-cultural products		X	X	X	X
Sanctuary	X	X	X	X	

[a] The numbers are from different years, ranging from 2008 (Farm 3) to 2011 (Farm 2 and 3) and 2012 (Farm 1 and 5).
[b] Fluctuating between 100-200 cattle and 100-120 buffalo.
[c] The figure is not precise since there are fluctuations in the number of animals, different conditions in India and the animals also graze in the forest and other common grazing areas that are not included in this figure.

Farm 2 uses dung for the production of insent sticks, soap and massage oil besides different types of (fermented) fertilizers. Farm 3 is in the process of developing traditional Indian dung and urine products, e.g. for ayurvedic treatments. Finances are also generated e.g. by bed and breakfast (farm 1 and 4), donations and adoptions (all), and as a cattle keeping service provider for an animal protection organisation (farm 1), or as a milk provider for a Hare Krishna Hindu-temple and community (farm 5). Milk has become a by-product of cattle keeping. However, there are other examples of so-called vegetarian milk farms. Since last year Ahimsa Milk[5] sells milk for 2,40 £ per litre and Cow Nation[6] for 1,60 £ per pint (568 mL) in London.

Discussion

Within the framework of an agri-care system (agricultural-) sanctuaries and segetarian milk farms are identified as relevant farm stiles. The features of these care-systems present an expansion of the current ethical values within organic farming as. The main product of (agricultural-) sanctuaries is the "whole life" of the animal, based on a widened interpretation of life and living (Verhoog et al. 2003). The integrity of an individual animal is violated by the act of slaughtering and thus impeding possible future expressions of it. Vegetarian milk farms found a solution to combine ecology with the ethics of non-killing plus a limited amount of milk production.

The challenge for the farmers is to explore and develop ecological functions for the male and female cattle within their emerging agri-system while making a living by that – as e.g. done in Italy by the biodynamic Menicocci farm[7] that grazes cattle between vines and olive trees without breeding and slaughtering.

[5] www.ahimsamilk.org [07.04.2012]

[6] www.goodfoodnation.co.uk/cow-nation.php [07.04.2012]

[7] www.biodynamic.it

Suggestions to tackle the future challenges of organic animal husbandry

Besides research about (the behaviour of) old and naturally dying cattle a certification scheme for sanctuaries and vegetarian milk farms can be implemented in collaboration with vegetarian and sanctuary organizations.

The ethics and systems of agri-care can be communicated as OrganicVeg. The integrity approach within organic farming and the IFOAM principle of health should be expanded to include the integrity of a "whole life" from birth to natural death, chosen at the animal's own timing.

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How much space do horned dairy cows need in the waiting area?

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Abstract

The influence of three difference space allowances in the waiting area of the milking parlour (4.0, 2.5, 1.7 m²/cow) on the number of physical agonistic interactions ('attacks') per minute in this place, number of flinches, steps and kicks (FSK) per minute in the parlour and heart rate (HR) in both areas was investigated in 12 lower and 12 higher ranking focal cows in a research herd of 85-87 horned German Black Pied cattle. Social position had no influence on HR and behaviour. HR in the waiting area and parlour and FSK increased with decreasing space allowance. HR was significantly higher in V1.7 than in the other two pen sizes, FSK in V1.7 compared to V4.0. 'Attacks' occurred fewest in V2.5 with a significant difference compared to V1.7. Thus, in terms of animal welfare and milker's working comfort a space allowance of 1.7 m²/horned cow in the waiting area is not advisable. Major benefits of V4.0 were not detected under the given conditions.

Key words: agonistic behaviour, heart rate, animal welfare, milking parlour

Introduction

A potential hot spot of agonistic behaviour in dairy cows is the waiting area before the milking parlour (Schneider et al. 2009). Menke et al. (1999) found a negative correlation between general space availability per cow and agonistic behaviour and skin lesions caused by horn butts. Crowding the cows so that they can hardly move, was found to decrease agonistic behaviour, but to increase heart rate (HR) up to 25% (Czako 1978), indicating stress. Social rank may modify the stress reaction to space restriction (Aschwanden et al. 2008). Finally, stress may influence behaviour and HR of the cows in the parlour (Rushen et al. 2001), so that space allowance in the waiting area may affect these, too.

The aim of this study was to assess the risk of injury and stress level of horned higher and lower ranking cows in the waiting area and parlour at three different space allowances by measuring HR as well as the number of agonistic interactions before and agitation behaviour during milking.

Animals, material and methodology

In September 2009 the experiment was conducted on the research farm of the University of Kassel where at this time 85-87 lactating cows of the breed German Black Pied were housed in a loose housing barn with 48 deep bed cubicles and a deep litter area of 312.5 m². Out of the lactating, horned animals without lameness or other impairments of health 12 higher and 12 lower ranking focal cows were chosen via counting the injuries and hairless areas caused by horn butts and observation of agonistic behaviour (2x 2h) at the feeding rack (rank index: Schrader 2002). The data of one higher and one lower ranking cow were eliminated from analysis because they became lame or came in heat during the experiment. Due to missing values the number of analysed animals decreased further for some parameters (n see Table 1).

In three consecutive weeks the cows were subjected to three space allowances, beginning with the largest and then decreasing space: 4.0, 2.5 and 1.7 m²/cow (V4.0, V2.5, V1.7). Before the experiment, the size of the waiting area was about 2.3 m²/cow. In the course of milking the space allowance in the waiting area increased because cows went into the parlour and size of the waiting area was not adjusted. At each space allowance, the cows had at least two days to adjust following four days of assessment of 12 focus animals per milking (2x morning, 2x afternoon per animal). Only one familiar person was milking during the whole experiment.

HR was measured non-invasively via Polar S810i (Polar Electro Oy, Kempele, Finland) in beat-to-beat mode. The equipment was fixed by neoprene or rubber belts, covered with cloth of different colours to discriminate between the focus cows. The cows always waited for 15 minutes in the waiting area before milking started. After 10 minutes calming down time, the observations of 5 minutes started. This allowed HR recording at consistent space availability (HR5Min). Every 2 minutes Instantaneous Scan Sampling (Martin and Bateson 2007) of all focal cows concerning standing or not standing was carried out. HR in the waiting area was accordingly differentiated into HRstand and HRtotal for the whole period in the waiting area. Furthermore, HR from entering until leaving the milking parlour (HRmilk) was analysed. For HR5Min and HRstand only HR while cows stood was analysed whereas for HRtotal and HRmilk all HR independent from movements was taken.

In the waiting area the frequency of butting, chasing up, chasing and fighting ('attacks'), regardless of being actor or receiver, and in the parlour of flinches, steps and kicks (FSK) were counted continuously during all the time the focus animals were in that place. Inter-observer reliability between the five observers in the waiting area and four observers in the parlour involved was tested before and after the experiment and was acceptable to very good (Scan Sampling: κ_{Cohen}=0.702-0.985, n=140-150; 'attacks': r=0.748-0.935, n=6 or 7; FSK: r=0.994-0.999 n=3-7). The number of flinches (0.5), steps (1) and kicks (3) were multiplied by the factor in brackets in order to calculate one FSK value per cow and minute.

Since HR (n=39-64) as well as agonistic (n=66) and agitation behaviour (n=64) were significantly higher in the afternoon milkings than in the mornings (paired T-Test, $p<0.05$), means of the same milking time were calculated before averaging them to one value per space allowance. In case of missing values in HR and FSK (5.6-13.5% of all measurements), the single morning or afternoon values were used. Only data of the morning milking was analysable in seven cows for HF5Min and one animal for HFmilk and only evening-milkings were available for one cow for HF5Min, HFmilk and FSK. A two factor ANOVA with repeated measurements (SPSS Statistics 17.0) was calculated (within-subject-factor: space allowances, three levels; inbetween-subject-factor: social rank, two levels). Where sphericity was not given, the degrees of freedom were corrected (Greenhouse-Geisser). In the pair-wise comparisons multiple comparisons were adjusted with Bonferroni correction.

Results

No influence of social rank could be detected in any parameter concerning HR or behaviour. Therefore, further results are presented for higher and lower ranking animals together (Table 1). All HR parameters increased with decreasing space allowance. Differences were not significant between V4.0 and V2.5, but HR was significantly higher in V1.7 than in the other space availabilities. The number of 'attacks' per minute in the waiting area was lowest in V2.5, but the difference was only significant compared to V1.7 (P=0.006), while there was a trend towards lower numbers in V4.0 compared to V1.7 (P=0.055).

FSK responses per cow and minute in the parlour increased with decreasing space allowance in the waiting area with a significant difference between V4.0 and V1.7 (P=0.003) and a trend concerning V4.0 versus V2.5 (P=0.052).

Discussion

The increased HR in VR1.7 indicates mild stress, with the highest means of HR being in the range of the resting pulse rate for cattle (50-80 bpm; Loeffler 2002, 192). In addition, the increased FSK in the parlour at V1.7 reflects a certain aversiveness of this treatment and affects the milker's working comfort.

The significant increase of 'attacks' in the lowest space allowance may be due to the lack of space for effective avoidance of threatening cows, resulting in stress and 'attacks' and, thus, potential injuries.

Table 1. Influence of space availability in the waiting area on heart rate, agonistic and flinch, step and kick (FSK) behaviour

Parameter	V4.0	V2.5	V1.7	n
HR5Min. (bpm)	73.2 [a]	74.4 [a]	77.0 [b]	21
HRstand (bpm)	73.4 [a]	73.9 [a]	76.6 [b]	18
HRtotal (bpm)	74.1 [a]	74.3 [a]	76.9 [b]	18
HRmilk (bpm)	72.9 [a]	73.4 [a]	76.7 [b]	20
'Attacks'/cow/min	3.1 [ab]	2.6 [a]	4.6 [b]	22
FSK/cow/min	2.2 [a]	3.0 [ab]	3.3 [b]	21

values with different letters are significantly different ($p<0.01$), bpm: beats per minute

Altogether, a space allowance of 1.7 m²/horned cow in the waiting area is not advisable. Major benefits of V4.0 were not detected under the investigated conditions, but it must be mentioned that German Black Pied cows are relatively small cows with relatively small horns.

Suggestions to tackle the future challenges of organic animal husbandry

Though the integrity of animals should be respected in organic husbandry, dehorning is a common practice. This rises questions concerning the authenticity of organic farming. Providing sufficient space is not the only, but one important aspect of meeting the challenge of keeping horned cows. Increased research activities taking into account the complex interactions between different housing and management aspects should help farmers to find ways to keep intact cows on a high welfare level.

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Electronic animal identification and organic farming

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Abstract

Traceability of meat and meat products is becoming increasingly important to consumers and producers, especially with regard to strengthening domestic and international customers' confidence in the integrity of organic producers and products. The electronic identification of animals (eID) has gained in importance over the last years. Its implementation on a wider scale (obligatory and voluntary official animal identification) will improve the current traceability system for animals and food products (e.g. beef) by making it faster and more accurate. The implementation of eID is being discussed controversially, mainly because direct costs and benefits are not balanced along the production chain.

For the past five years electronic animal identification has been the focus of a number of research projects at vTI (formerly FAL) including a cost-benefit analysis of cattle eID in Germany, the tolerance of eID devices in goats and additional benefits of eID (e.g. transponders with integrated temperature sensors).

Key words: electronic animal identification, organic farming

Introduction

The electronic identification of animals (eID) has gained in importance over the last years. It is used worldwide in a wide range of species including productive lifestock, pets, zoo animals, endangered species and wildlife. It is becoming increasingly important as an obligatory official animal identification in more and more countries because of the associated benefits resulting from this form of animal identification.

Depending on the animal species the electronic device can be an electronic ear tag, a bolus, an injectable transponder or an electronic mark on the pastern (leg band).

In cattle mainly electronic ear tags and in some cases boli are used. For small ruminants (sheep and goat) electronic ear tags, boli and in some countries leg bands are available. In equine and companion animals an injectable electronic transponder is the method of choice. The injectable transponder is not yet available for productive lifestock because of the difficulties in recovering it after slaughter (European Union, 2012a; Schwalm et al., 2009).

Electronic animal identification: worldwide

In cattle the ISO-conform eID is obligatory for example in Canada, Australia, Uruguay, Botswana and Denmark. Many countries at least support a voluntary eID in bovine animals such as Argentina, European Union, Japan, South Korea, Brazil, Mexico, New Zealand, USA (for detailed references see Schwalm and Georg, 2011). The European Commission is currently exploring the possibility of introducing electronic identification as an official method to identify bovine animals within the EU on a voluntary basis. Electronic identification can contribute to improvements in existing systems of cattle identification. (Europäischen Union, 2012b).

Sheep, goats and equine have to be electronically identified in die EU. There are obligatory eIDs also in the pet sector. For example pets have to be chipped when they travel in the EU (starting in

2012) and for import in many countries worldwide (for detailed references see Schwalm and Georg, 2011).

Electronic animal identification: ISO-standards and database

In the light of global trade it is necessary to optimize the use of eID worldwide; therefore, it is essential to have international standards concerning eID of animals. ISO (International Organization for Standardization) is a global network that develops and publishes International Standards. For an overview concerning ISO-standards eID see Schwalm and Georg (2011).

The structure of the RFID-dataword for animals is descibed in ISO 17784. Within ISO 3166-1 each country has a three-digit country code (e.g. Germany 276). When the country code is used the legal authority must ensure uniqueness of animal identification codes. A country, which does not have a competent authority allocating identification codes may only use manufacturer codes. In the case when the manufacturer code is used, each manufacturer is responsible for ensuring the uniqueness of their codes. ICAR (International Committee for Animal Recording) registers the manufacturers that are allowed to use a (shared) manufacturer code. (Hogewerft et al., 2008)

Table 1: RFID-dataword for animals (ISO 11784)

Bit-Nr.	Number of digits	Information
1	1	Flag animal/non animal application
2-4	1	Retagging counter
5-9	2	User Information field
10-14	2	reserved
15	1	Flag indicating advanced transponder
16	1	Flag indicating data block
17-26	4	ISO 3166-1 numeric country code
27-64	12	National code of identification

For animal identification two types of databases are relevant. First a database for animals: For tracking and tracing of animals databases are used. In these databases individual animal identification is linked to owner information and possibly other information. The owner of the database can be a government or private organization. A country may use several databases e.g. one for companion animals, one for pigs, one for sheep, one for goats, another for cattle etc. Different organizations can be responsible for different databases (Hogewerft et al., 2008).

Second a database for RFID tags compliant with ISO 11784 and ISO 11785: The allocation of ID-codes must be registered to eliminate the risk of identical identification codes for different animals. When the manufacturer code is used the manufacturer must install and maintain such a database. When the country code is used the legal authority must ensure uniqueness of animal identification codes (Hogewerft et al., 2008).

Electronic animal identification: pro/con (organic farming)

The precondition for traceability is the collection, verification and availability of relevant data without delay, to ensure quality, origin and disposition of the products over the entire value chain. With eID animals can be identified quickly and automatically. EID in combination with a central database will provide a consistent traceability of animals from birth to slaughter. This means that in the case of an animal disease outbreak, electronic identification provides a clear link to the history of each individual animal allowing quicker and more effective action to be taken to eradicate or prevent the spread of infectious diseases. (European Union, 2012c)

With eID manual transcription errors can be eliminated even in downstream sectors such as transport, slaughter and marketing. One keystone of organic farming is the consistent certification of organic origin, rearing and husbandry of livestock. The potentials of eID can be fully used and are the precondition for the compliance with maximum safety and quality standards within the production of animal and food products.

Apart from the traceability benefits, electronic tagging can also be a very useful tool for on-farm management. Increasing herd sizes must not lead to a decrease in individual animal caring. The automatic animal monitoring on an individual basis is becoming increasingly important. EID is the basis to record animal individual data on a large scale (Hartung, 2005). Through optimizing animal management and through better recording, detecting and fulfilling individual animal needs, eID can lead to an improvement in animal welfare. This aspect is consistent with one of the main goals of organic farming, animal welfare.

In calf and dairy management, for example, integrated systems with sensors detecting performance and health parameters are used (Platen et al., 2007; Hartung, 2005).(Thus needs-based individual feeding and monitoring is possible.

Finally, it may bring benefits to farmers and other stakeholders as it will reduce the administrative burden through the simplification of the current administrative procedures. (Europäische Union 2012c).

The implementation of eID is being controversially discussed, mainly because direct costs and benefits are not balanced along the production chain. Costs are mainly born by the animal keepers (farmers) at the holding of birth while most of the eID benefits seem to affect the downstream actors (markets, slaughterhouses).

Electronic animal identification: vTI- projects

In a study on the introduction of electronic animal identification (eID) by electronic ear tags in cattle in Germany a questionnaire was given to experts and a cost-benefit appraisal was calculated. It turned out that the farmers are holding a positive view of eID, since they are expecting synergy effects. Model calculations indicate that the ensuing costs will be reasonable. Farmers, who do not want to use eID, only pay the cost of the electronic eartag (Georg et al., 2008 a,b).

The objective of our studies concerning the additional benefits of eID was the evaluation of injectable transponders with temperature sensing option in cattle and goats. At this point not all difficulties have been solved, such as the effect of the injection point and the environmental temperature on the measured temperature in comparison with the rectal temperature. (Georg et al., 2009, Ude et al., 2011)

Another study concerned with the evaluation of an early identification of goat lambs while grazing with electric netting and hedges. Four different types of ear tags were tested in 115 lambs. Only a few inflammations of the ears were observed. Only one loss of ear tag was observed and the functionality was 100 %. The electronic identification with ear tags can be recommended for goat kids starting at birth (Ude et al., 2010; Bender et al., 2011).

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Status quo of the practice of polling on organic dairy farms in Lower Saxony, Germany

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Abstract

A survey was carried out in 2011 in order to find out how many cows are polled on organic dairy farms in Lower Saxony. Furthermore it was investigated for what reason farmers are dehorning and if they are willing to stop polling calves. All organic dairy farms in Lower Saxony were interviewed by a questionnaire based telephone interview. Interviews were done with 92 farms, seven of these farms with tied housing (not further considered) and 85 of these farms with loose housing. Nearly all dairy cows in surveyed farms (Median = 100%) were polled. In 58 organic dairy herds more than 90% and in 16 herds less than 50% of cows were polled. The main reasons for polling that were mentioned by the farmers were fear of injuries with animals (95%), farmers (84%) or family members (48%). Several farmers could see reasons for not polling: Many farmers (40%) said that horns belong to the essence of cows and some (15%) mentioned keeping cows with horns would prevent the effort of dehorning. 19 farmers stopped polling in the last years. However, the majority of farmers expect problems with horns, therefore most farmers (95%) planned to use genetically polled bulls in the future.

Key words: status quo, dairy cow, polling, lower Saxony

Introduction

Operations such as dehorning are not supposed to be carried out routinely in organic farming (EC, 2008). The topic of dehorning cattle in german organic dairy farms is widely discussed in the organic sector caused by a change of the way in which permission is given for dehorning cattle. Dehorning may be authorised by a competent authority on a case-by-case basis (EC, 2008). This authorisation for dehorning cattle is given rather facile in different counties in Germany as well as in different EU countries.

Framers in northern Germany are debating this topic controversially. One important aspect is the personal attitude of the animal keeper to horned animals. Furthermore there is a lack of experience with the management of horned animals. Aims of the survey carried out are to find out how many cows are polled on organic dairy farms in Lower Saxony, for what reason farmers are dehorning and if they are willing to stop polling calves.

Material and methodology

All organic dairy farms in Lower Saxony were contacted by telephone and later on interviewed by a questionnaire based telephone interview. The questions concerned farm structure, animal husbandry and the reasons for dehorning. The farmers were informed by mail about the aim of the interview, but they did not know the questions beforehand. The answers were formulated freely by the farmers.

There are 103 organic dairy farms in Lower Saxony which of 92 were contacted by telephone. 11 farmers refused to take part in the interview, 7 farmers kept the animals in tied houses (not further considered). The survey was carried out on 85 farms keeping the cows in loose housing.

The farmers kept between 18 and 240 cows (Median 65 cows). The common breed was Holstein Friesian as pure breed (51 farms) or cross (19 farms) followed by the breed "Deutsches Schwarzbuntes Niederungsrind" (nine farms) and other. Cows were kept in cubicles on 69 farms, in a loose housing on 13 farms and in a mixture of both on three farms. In summer on most farms cows were kept on pasture for grazing (80 farmers day and night, one farm half day) and on four farms the cows were kept in stall with access to open air areas. Young cattle were kept in loose housing (51 farms), in cubicles (42 farms), on pasture (three farms) and in tied stalls (three farms) in winter. In summer on nearly all farms young cattle were kept on pasture (81 farms) and on two farms in a loose housing with access to open air areas. Two of the farms did not keep young cattle at all.

Results

On organic dairy farms in Lower Saxony most cows were polled: The percentage of polled cows was 100% of the cows on 44 farms, more than 90% of the cows on 14 farms, between 50% and 90% of the cows on eleven farms, between 0% and 50% of the cows on eight farms. On eight farms all cows were not dehorned. On one farm all cows were genetically polled and further six farmers kept a few genetically polled cows.

Most farmers (62 farmers) claimed to poll their calves (PO-farmers). As the main reasons for dehorning the PO-farmers named fear of injuries with animals (95%), with farmers (84%) or family members (48%), with visitors (8%), and with employees (5%). Twelve farmers had own experiences with injuries caused by cows with horns (five of these with humans, four of these with animals, three of these with dead animals).

However several PO-farmers saw reasons for not polling: Many farmers (40%) stated that horns belong to the essence of cows, some mentioned keeping cows with horns would prevent the effort of dehorning (15%). Further aspects were the conversion of the farm to Demeter (5%), traditional reasons (3%) and health advantage for the cow due to horns (3%).

Nevertheless, PO-farmers expected problems caused by horned cattle first of all in the case of battle for status (76%), followed by too small stable size (52%), and not suitable bunk (50%). Others named the problems of blind alleys in the stable (16%), not suitable feeding station (15%), and parlour (13%). In addition some expect problems marketing horned heifers (13%), while keeping horned and dehorned cows in one group (11%), with automatic milking (6%), and due to stress while feeding (5%).

19 farmers had stopped dehorning in the past but started again and practiced it at the time of the survey. The reasons for dehorning again were injuries with animals (84%), more stress in the herd (26%) and injuries with humans (11%).

Most PO-farmers planned to use genetically polled bulls in the future (95%). 56% of the farmers had already started in order to stop polling someday.

14 farmers stopped dehorning in the last years. They alluded the following reasons: claimed for not polling: the conversion to organic farming (64%), the essence of the cow (43%), just do not want to dehorn anymore (21%), the large size of the stall (7%) and the better milk quality from horned cows (7%).

Discussion

There is a considerable gap between the aim of organic farming and the reality of several farms concerning dehorning cattle. All participators in the organic section agree with the fact that dehorning should not be done any more. It is important to make sure, that changes are undertaken in the same manner in Europe as well as in all counties in Germany. The foreground should be to ensure that in case of the farmers being forced by law to stop dehorning, cattle do not suffer more.

Concerning this issue two possibilities exist for dairy farmers: either keeping horned animals or using genetically polled bulls. In the mean time polling should be done with as little suffering as possible for the animals. Three further questions need to be investigated:

1. Is it sufficient to apply anaesthesia and analgesia to avoid pain for the calves?
2. Are there circumstances that lead to smaller injuries between horned cattle kept in stables not specially designed for horned cattle?
3. How can the variety of genetically polled bulls be brought forward?

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Alternative weaning strategies to diminish acute distress during weaning and separation from the dam after prolonged suckling

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Abstract

Prolonged suckling allows the dam to perform behaviours associated with maternal care. These behaviours allow the cow to bond with her calf and to provide it with nourishment. However, this maternal bonding process has practical challenges at the time the farmers want the calves to be weaned and separated from their dam as both the dam and calf often show a pronounced behavioural response. By means of on-farm research we have identified characteristics signalling emotional distress resulting from weaning and separation and investigated practical management strategies to reduce weaning- and separation-induced distress. These include social buffering at the time of weaning, postponement of separation after weaning by the use of nose-flaps, and gradual weaning and separation by means of fence line contact. Compared to abrupt weaning and separation after a prolonged suckling period, the investigated strategies significantly reduced distress vocalisations, stereotypy's and replacement behaviour and prevented weight loss of the calves.

Key words: dairy cattle, calf rearing, prolonged suckling, weaning, animal welfare

Introduction

The major stressors in conventional calf rearing during weaning are the transition from a mainly milk-based diet to a solid diet and a change in physical and social environment as the calves are often moved to a different pen (Weary et al. 2008). Although prolonged suckling has several benefits on health, production and behavioural development of calves, prolonged suckling adds separation from the dam or foster cow as a stressor, which has been shown to be more than just milk and suckling deprivation (Veissier and le Neindre, 1989; Newberry and Swanson, 2008). Weaning and separation after prolonged suckling is most straightforwardly achieved by removing the calf from the dam or foster cow (abrupt weaning) and placing it in a different barn, either socially or individually housed. When the calf stays on the farm, the distance between the calf barn and dairy herd usually allows auditory signals to be exchanged between mother and calf, while visual and tactile communication is impaired. Behavioural changes upon abrupt weaning in calves generally include an increased frequency of standing, walking and vocalizing and less lying down, feeding and ruminating during the first days (Solano et al. 2007; Enríquez et al. 2010).

Alternative weaning methods that minimize distress after prolonged suckling make the application of prolonged suckling as a calf rearing system more feasible. The aim of this study is to investigate and compare the immediate behavioural response to different types of weaning and separation from the dam after prolonged suckling. The main question is whether gradual weaning and two-step nose-flap weaning lessen distress compared to abrupt weaning. Under the hypothesis that separate stressors are potentially less stressful, it is expected that both nose-flap and gradual weaning lessen the behavioural response to weaning and separation.

Material and Methods

Animals, housing and care

The study was conducted on two organic dairy farms in the Netherlands. The cows were kept on straw in a deep litter housing system combined with a slatted floor behind the feeding rack. Both farms had around 50 dairy cows, either dehorned (farm 1) or horned (farm 2), that were crossbreds of Holstein-Friesian with either Maas-Rijn-IJssel (farm 1) or Friesian cattle (farm 2).

Both herds had permanent access to pasture in spring and summer and ad libitum roughage was provided every morning. Cows were milked twice daily, also when nursing a calf.

Cows calved throughout the year. Calving took place in a separate area in the same barn, so that animals still had visual and possible tactile contact with their herd. Calves remained with their dam in the herd until they left the farm at the age of 2 to 4 weeks, or, in case of replacement heifer calves, until weaning off milk at around 3 months of age. Calves moved freely in the herd or pasture and had ad libitum access to their dam, water and roughage. Once (partially) separated from their dam and herd, calves had ad libitum access to water and roughage and were fed a limited amount of concentrate.

Treatments

Treatments for all calves comprised both weaning and separation, in which weaning refers to the cessation of milk intake by the calf and separation to the removal from the dam in such a way that tactile and visual communication is impaired.

Abrupt weaning and separation

At farm 1, six calves were abruptly weaned and separated from their dams at 10 weeks of age. They were housed in a different barn at the farm, either individual or social (two calves in one pen; 3.3 × 4 m of which 7.6 m^2 slatted floor and 5.6 m^2 with straw bedding). Tactile and visual communication was possible with calves in the adjacent pen.

Gradual weaning and separation (fence-line)

At farm 2, five calves were subjected to a gradual weaning treatment in which weaning was achieved in three stages. At around 10 weeks of age, the calves were placed in a pen within the cow barn with one or two other calves (stage 1; 3.5 × 3.5 m deep litter). Contact with the dam, including suckling, was possible when the dam stood parallel to the fence. After two weeks, the fence was barred during the day for a period of two weeks to prevent diurnal suckling (stage 2), after this the fence was permanently barred (stage 3). At this point weaning was complete, but calves remained in the pen for two to three more weeks before they were separated from the dam and introduced into a heifer calf group in a separate barn (stage 4; 8 × 8 m of which 34 m^2 slatted and 30 m^2 concrete with 5-10 calves in total).

Abrupt weaning and gradual separation (nose-flap)

The farmer at farm 1 was willing to adapt a different weaning and separation strategy because of the calves' overt signs of discomfort and stunted growth at abrupt weaning. Consequently, as a preliminary study, two calves at farm 1 were weaned by means of a nose-flap (QuietWean nose-flap, JDA Livestock Innovations) at 10 weeks of age (stage 1). They remained in the herd for two weeks before separation (stage 2). Housing of the calves is described under 'abrupt weaning'.

Behavioural observations, handling and measuring breast circumference

Calves were observed in the herd a day before treatment started (day -1), at the day treatment started (day 0 respective to initiation of treatment) and on the three consecutive days (days 1, 2 and 3), as well as a week after initiation of treatment (day 7). In case of gradual and nose-flap weaning, calves were also observed when a new stage of weaning and separation from the dam initiated (day

0 respective to stage 1/ stage 2/ weaning/ separation), as well as the three consecutive days and one week after initiation of a new stage of treatment (days 1, 2, 3 and 7).

Animals were observed from 10.00 to 14.00. This period was chosen because it is a relatively quiet time on both farms, with no feeding or milking activities. One-zero focal sampling was used to record the occurrence of the different behaviours (table 1; ethogram derived from Loberg et al. 2008 and Enríquez et al. 2010) in 48 intervals of 5 minutes. The following behavioural elements were scored; Lying, eating and ruminating are traditional comfort behavioural indicators (Price et al. 2003; Hernández et al. 2006) as well as play (Houpt and Wolski, 1982), while excessive moving, standing, vocalizations and head out of the pen are thought to indicate distress and perhaps willingness to reunite with the dam (Loberg et al. 2008; Enríquez et al. 2010). As weaned calves suddenly do not have milk as their primary source of energy and water, it is crucial that water intake is adequate and food intake starts soon upon weaning, while the calves have no prior experience with concentrate (Weary et al. 2008). The possible onset of abnormal oral activities such as cross-sucking, tongue rolling and excessive exploring and grooming are thought to reflect reduced welfare. Restlessness can also be reflected in an increased number of transitions between behavioural activities such as lying and standing (Munksgaard and Simonsen, 1996).

On the day that the treatment or a new stage of the treatment initiated, as well as on the observation days a week after such a change, the heart girth of the calves was measured as an indication for their weight (Heinrichs et al. 1992).

Results

Pre-weaning behaviour

Calves spent most of the observation period lying calm with other individuals, as often with cows as with other calves. Ruminating, autogrooming and moving either slow or fast was observed in about 30 per cent of the intervals.

Ten out of thirteen calves suckled their dam during the observation period, the duration of which varied from 1 to 4 intervals. Furthermore, all calves were observed eating some type of roughage, which could be grass, hay or straw, during on average 9 intervals. None of the calves had access to concentrate at this point. Only one calf has been observed to drink water on the pre-weaning day and she drank from a puddle in the field, not a drinker.

One calf was observed to cross-suck an object in one interval and performed tongue rolling in three intervals prior to weaning, while no such abnormal behaviours were observed in the 12 other calves. No pacing has been seen, nor any cross-sucking on other calves or cows.

Comparison of the different weaning methods

The behavioural change in response to any stage of weaning and separation was most intense in the abrupt weaning treatment. Abruptly weaned calves peaked in the number of transitions, the frequency of alertness and abnormal behaviours, as well as both the amount of intervals in which vocalizations were emitted and the total amount of vocalizations per observation period. Abruptly weaned and separated calves also ate hay less frequently after weaning and separation than the gradually weaned calves.

A clear exception to the more restless pattern as shown by abruptly weaned and separated calves was the lower frequency of escape attempts compared to the frequency of escape attempts of gradual weaned calves when they were housed in the pen next to the dairy herd. This frequency peaked at about three times the intensity observed in abrupt weaning. A possible explanation for this is that the restless dam and her udder as external stimuli are likely to add greatly to the internal motivation to reunite and to feed and suckle. This explanation seems legitimate, since both head out and pacing behaviour were decreased to a minimum on day 1, when most calves had already been observed to suckle their dam.

Unsuccessful suckling attempts were also observed in the first stage of nose-flap weaning (also described in Enríquez et al. 2010). However, it seems that the abrupt inability to suckle causes less frustration than complete abrupt weaning and separation from the dam as shown in less distress signs. Calves that were gradual weaned often lied, ate and ruminated in the company of their dam.

Upon initiation of treatment, most calves in the abrupt weaning treatment had a decreased breast circumference and none had a positive difference, while both nose-flap weaned calves had an increased breast circumference. The difference was not directional in gradual weaning. Breast circumference did not change much a week after separation for both nose-flap and gradual weaned calves. Interestingly, all calves had at all times a larger breast circumference than they were supposed to be on optimal growth schemes used in artificial rearing (Sprayfo, 2012).

Discussion

This study investigated the immediate behavioural response to abrupt weaning, gradual weaning and nose-flap weaning with the hypothesis that the latter two methods are less stressful than abrupt weaning and separation.

The overall impact of weaning is thought to be composed of cessation of milk supply and severing the mother-young bond (Newberry and Swanson, 2008; Weary et al. 2008). Vocalizations have been found to be related to milk consumption and occur more often after milk deprivation in newborn and 5-week-old calves (Thomas et al. 2001). Moreover, vocalizations that occurred before feeding in conventionally reared calves (receiving 10% of their body weight in milk per day) seemed not to occur in calves receiving two times that amount of milk, suggesting that milk supply plays a role (Khan et al. 2007). In the nose-flap treatment and gradual weaning treatment, weaning and separation occurred at two different moments. This creates the opportunity to discuss the effect of weaning and of separation separately.

Weaning

Gradually and nose-flap weaned calves were weaned without much of a behavioural response compared to the abrupt weaned and separated calves who performed distress behaviours like excessive standing, moving, alertness, transitions and vocalizations. This difference in coping might suggest that weaning in itself apparently is not necessarily a stressor threatening biological functioning, and does not necessarily evoke a disproportionate increase in standing, moving, transitions, alertness and vocalizations, as is supported by other studies on alternative weaning methods (Hayley et al. 2005; Loberg et al. 2008).

Separation

Being separated from the dam in nose-flap weaning did not lead to the increase in moving, standing, vocalizations and alertness that are thought to reflect the motivation to reunite with the dam (Enríquez et al. 2010). Gradually weaned calves did move a lot upon separation, but this was most likely due to dominance interactions, as standing, vocalizations and alertness were not affected. This suggests that reuniting with the dam is less important when the calf is nutritionally independent, or at least that the separation is experienced as less stressful than it seems after abrupt weaning. However, as with abrupt weaning, abnormal behaviour was observed in the days following separation in the nose-flap treatment, as well as an increase in autogrooming. Apart from suckling, the calf and cow also exchanged affiliative behaviours, mostly grooming or being in each other's proximity. The calf might compensate for not being mothered by increasing its autogrooming frequency.

Another possibility is that the change in housing causes unrest, or that the confounding factor of individual housing leads to this increased grooming frequency, as gradually weaned calves that were housed socially after separation did not increase grooming behaviour. This is also confirmed in other studies in which pair-housing prevented the impaired growth (Chua et al. 2002; Bach et al.

2010) and lessened the behavioural response (De Paula Vieira et al. 2010) that singly housed calves experienced after weaning, suggesting that the experienced distress due to weaning is less intense in socially housed calves.

General conclusions on prolonged suckling and subsequent weaning methods

During prolonged suckling, calves behaved like they were expected based on the behavioural patterns of (semi-)wild herds. They were observed in the presence of other calves as often as with cows, while cows were far more abundant, and were often found in calf groups, as well as cared for by their dam. Only one calf was observed to display abnormal behaviour before weaning, while cross-sucking commonly occurs in hand-reared dairy calves while they are still fed milk (Lidfors, 1993; Fröberg and Lidfors, 2009).

All calves observed had a larger breast circumference than they were supposed to have according to optimal growth schemes used in artificial rearing (Sprayfo, 2012). Concluding that good biological functioning as well as a normal social development seemed to be facilitated by prolonged suckling.

Gradual weaning as well as nose-flap weaning appeared to lessen the distress upon weaning and separation from the dam. However, in practice, the gradual weaning as it was applied on this farm is quite a burdensome alternative for the farmer, as the fence needs to be barred and opened up daily, and requires an additional pen to be present adjacent to the herd. Nose-flap weaning, on the other hand, seemed to diminish distress even more in this preliminary study, and is much easier to apply. The nose-flap itself is cheap, easily fitted into the calves' muzzle and removed again after separation. This alternative will be further investigated.

Tackling future challenges

Organic livestock farmers try to ensure better animal welfare by taking animals' natural behaviours and needs into account (IFOAM, 2010; von Borell and Sørensen, 2004). However, the rearing of dairy calves is a practice that is often in contrast to the philosophy of organic farming. Dairy calves are separated from their dam directly after birth or within three days after birth, after which they are bucket fed until weaning and housed in such a way that contact with animals of different age groups is little (LBI, 2011; Wagenaar and Langhout, 2007). This 'artificial' rearing contrasts with natural rearing in several aspects (von Keyserlingk and Weary, 2007). For example, while natural weaning in cattle occurs at the age of 6-14 months (Phillips, 1993 as cited in Flower and Weary, 2001; Reinhardt and Reinhardt, 1981 as cited in Enríquez, 2010), milk supply to dairy calves is often stopped at or before they are three months old.

Despite the supposedly well-balanced feeding after weaning and the supposedly smaller risk of disease transmission, mortality amongst calves is high. A report by the Flemish government (2009) reports about 12% mortality from calves born alive until first calving; a recent UK survey reports mortality rates of 13-16% (Brickwell and Wathes, 2011). Calf welfare is likely to be reduced, as is reflected in both the reduced growth and high mortality (biological functioning) and the occurrence of abnormal cross-sucking behaviour (affective states).

As an alternative for the conventional rearing practices , prolonged suckling should be integrated in dairy production systems. Animal welfare and animal health can be improved as prolonged suckling bears a closer resemblance to natural calf rearing than artificial calf rearing, as calves are raised in their natural social environment and dams can express their maternal behaviours. Dams can lick and nurse their calves, while calves can suckle their dam and socially learn adequate behaviour. According to the natural living approach, better welfare may therefore be expected for both calf and cow.

Secondly, prolonged suckling appears to have positive effects on the health and physical development of the calf (biological functioning approach). Calves in a prolonged suckling treatment had a lower disease incidence and mortality than artificially reared calves (Boonbrahm et al., 2004). Diarrhoea, a major cause of death in calves, was found to cause fewer problems in suckling systems than in artificial rearing (Wagenaar and Langhout, 2007). In addition, calves grow faster and mature well-balanced and naturally when they are allowed to suckle (Bar-Peled et al., 1997; Flower and Weary, 2001; Grøndahl et al., 2007; Metz, 1987; Roth et al., 2009) and cows that suckled as a calf have been reported to have a higher average weight gain until conception, an earlier age of conception and a tendency to have a higher milk production during their first lactation (Bar-Peled et al., 1997).

Thirdly, artificial rearing induce negative affective states that can be averted by prolonged suckling (feelings approach). Separation from the mother has a serious impact on an individual's development due to the lack of a mother-young bond that normally encompasses food and protection, social learning and exchange of affiliative behaviours (Newberry and Swanson, 2008; Mogi et al., 2011). Suckled calves have been reported to be more social than individually housed calves at 6 weeks of age (Flower and Weary, 2001) and later in live when being reintroduced in the herd, as well as higher up the hierarchy (le Neindre and Sourd, 1984) and showing more adequate maternal behaviour (le Neindre, 1989).

In The Netherlands 30 farmers have successfully applied a prolonged suckling system with an average calf mortality of 7%. A third of these farmers also don't use antibiotics at all.

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Organic goats and sheep systems

(Foto: BLE 2004)

Immunological effects of feeding different sources of vitamin E and seaweed in a sheep herd during the winter season

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Abstract

In winter fed organic raised sheep inadequate plasma vitamin E levels is common and therefore supplementation is recommended. The objective of the present work was to test the supplementation of natural vitamin E and seaweed meal on the immune status of ewes and their offspring.

Forty Norwegian White Sheep ewes were randomly allocated to three supplementation treatments: natural vitamin E, synthetic vitamin E, seaweed meal, and control. The feeding experiment lasted the entire indoor feeding period. Ewes and newborn lambs were vaccinated against different environmental microorganisms and pathogens. Different immunological parameters were measured.

Supplementing the ewes with natural vitamin E had positive effect on immunity against Mycobacterium bovis in lambs. Seaweed, on the other hand, had negative effect on the passive transfer of maternal antibodies in lambs the first week after birth. The adaptive immunity was not affected by seaweed supplementation.

Key words: Ascophyllum nodosum, macroalgae, antioxidant, immunological parameters, α-tocopherol, nutrient element

Introduction

Ruminants fed on preserved forages are dependent of vitamin E and antioxidant supplementation in order to optimize milk and meat quality, immune function, reproduction traits and animal health. There is an aim in organic production to avoid synthetic vitamins, and therefore a need for knowledge on potential natural vitamin and antioxidant sources. The supplementation of seaweed meal is especially interesting, since seaweed is an abundant and easy accessible raw material on the coastline and has traditionally been used as a winter supplement to sheep in Norway.

The hypothesis was that supplementation with natural vitamin sources improves the immunologic status in ewes and their offspring. A feeding trial was performed to study the effects of supplementing ewes‘ diets with seaweed meal, and natural or synthetic vitamin E on different immunological parameters.

Material and methodology

Forty Norwegian White breed ewes were divided into four treatments. Within each treatment the ewes received an iso-energetic diet that included a daily ration of concentrate supplemented with seaweed meal (SW), natural vitamin E (natE), synthetic vitamin E (syntE) or without any supplementation (C). In the SW concentrate the seaweed meal added up to 4.4 % of the total DM intake. The trial lasted the entire eight month indoor feeding period.

The concentrates were analysed for α-tocopherol (Jensen and Nielsen, 1996) and the nutrient elements Na, Se, As and I.

Production of specific antibodies and cell mediated immunity following immunization, production of antibodies against environmental microbes and the immunoglobulin concentration in the mothers and the lambs were registered, as well as the mitogen and antigen induced lymphocyte proliferation (Table 1).

Table 1: Overview of immunological parameters measured in the feed trial

Ewes	Lambs
Specific antibodies after vaccination (Tetanus toxoid, *Mannheimia haemolytica*, equine herpes- and influenza virus)	Specific antibodies after vaccination (Diphtheria toxoid)
Antibodies against environmental bacteria (*M. haemolytica*)	Antibodies against environmental bacteria (M. haemolytica)
Immunoglobulin concentration in blood and colostrum (IgG, IgM)	Cell mediated immunity after vaccination with *Mycobacterium bovis* (IFNγ)
	Transfer of maternal immunity (equine herpes- and influenza virus, tetanus toxoid, IgG, IgM)
	Production of immunoglobulin (IgG, IgM)
	Mitogen and antigen induced lymphocyte proliferation

Results

The ewes consuming the SW and C concentrates had lowest daily intake of α-tocopherol and SW highest intake of As and I (Table 2).

Table 2: Weighted mean daily intake of α-tocopherol, Na, Se, As and I

	SW	syntE	natE	C
α-tocopherol (mg/day)	28	138	72	21
Na (g/day)	44	42	40	38
Se (mg/day)	0.55	0.45	0.43	0.38
As (mg/day)	3.30	0.57	0.56	0.56
I (mg/day)	51.3	2.74	2.52	2.25

The serum IgG concentration in the ewes in the SW group was 37 mg/ml. This concentration was significantly lower ($P<0.05$) than in the ewes on other treatments, which had serum IgG concentrations ranging from 43 mg/ml to 57 mg/ml. There was no effect of dietary treatment for the other immunological parameters measured in the ewes.

The lambs in the natE feeding group showed significantly stronger cell mediated immunity to *M. bovis* following immunization than the other treatments (Table 3).

The transfer of maternal immunity in one week old lambs in the SW group was severely impaired both regarding serum IgG and IgM concentrations, and specific maternal antibodies against tetanus toxoid, equine herpes- and influenza virus (EIV) and *M. haemolytica* (MH) (Table 4). There was no difference between the feeding groups in the antibody levels after vaccination against *Diphtheria* toxoid (data not shown).

Table 3: Mean values of IFNγ (ng/ml) four weeks after vaccination with M. bovis

	SW	syntE	natE	C	P
IFNγ	2.4	5.1	8.0	2.6	*

* significant at P<0.05

Table 4: Levels of maternal immunological parameters transferred to the offspring during the first weeks after lambing in the different feeding groups

	SW			syntE			natE			C			P
Age (week)	1	4	6	1	4	6	1	4	6	1	4	6	
IgG (mg/ml)	7	28	32	49	33	23	57	29	29	52	31	29	**
IgM(mg/ml)	0.4	1.3	1.5	2.0	1.1	1.3	1.8	1.1	1.6	2.3	1.6	1.7	**
Tetanus (titre log_2)	6.9	5.6	4.8	10.5	9.9	8.5	11.7	9.8	9.1	11.6	10.2	9.7	**
EIV (titre log_2)	3.5	3.2	2.7	5.7	4.1	3.9	6.0	4.0	3.3	5.9	3.9	3.8	**
MH (titre log_2)	4.4	4.3	5.5	8.3	6.1	6.4	7.8	6.1	6.2	7.8	6.2	6.3	**

** significant at P<0.01

Discussion

The cell mediated response to *M. bovis* suggests that supplementation with high levels of natural vitamin E could be an effective support to the immune mechanisms involved in the disease resistance to virus infections, fungal infections, cancer and infections with intracellular bacteria such as *Mycobacterium sp*.

The consumption of seaweed meal by the ewes at the concentration and the duration applied in this study left the newborn lambs unprotected against infection during their first week of life. However, the adaptive immunity was not affected by the seaweed meal intake. These results indicate that whole seaweed meal has one or more components that interfere with the intestinal uptake of the maternal immunity in the lambs.

As a product of marine origin, the seaweed meal has a high iodine (I) concentration. Low levels of immunoglobulin G has been observed in lambs where their mothers have been fed high amounts of minerals, including iodine, the last week of gestation (Boland et al 2006). This is an aspect to take into consideration when formulating diets including whole seaweed products.

Our immunological results indicate that on milligram basis half the amount of natural vitamin E equalize the effect of synthetic vitamin E. Seaweeds are definitely an interesting organic renewable resource that can be can exploited in agriculture due to their properties (Allen et al., 2001; Kuda et al., 2005; Devi et al., 2008). However, seaweeds have a very complex composition, and it is not yet understood how the different components influence the animal physiology. Fractionation of seaweeds and studies of the separate fractions should be the future approach in order to find new natural supplements to be used in organic farming. Seaweed should however not be fed to ewes in late gestation and early lactation as it may suppress maternal transfer of antibodies.

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Suggestions to tackle the future challenges of organic animal husbandry

There is a need to provide mineral supplements based on organically bound selenium and vitamin E, and knowledge of their bioavailability and distribution in the animal body to improve the animals' antioxidant defence system in organic farming. However, the current study showed that good animal health may be achieved without supplementation.

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Development of a marketing concept for organic goat meat from dairy goat farms

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Abstract

Organic goat milk products are becoming increasingly popular in Germany. Goat milk production is coupled with the birth of usually two kids per goat and year, which is more than needed for restocking the herds. Marketing goat kid meat is difficult due to low consumer awareness and almost nonexistent marketing structures. This causes economic problems for the goat farmers. To explore the market for organic goat kid meat, promotional measures to stimulate consumers' interest in eating goat meat were tested in six retail stores in October 2011. The focus was on tasting of goat meat and providing recipes for consumers accompanied by a consumer survey. It could be shown that tastings of goat meat are a promising way of improving awareness and acceptance of the product. The effect of the sales promotion activities on the quantity of sales of organic goat kid meat was positive. On average 72 % more goat kid meat was sold in the six test stores than in 126 reference stores without tasting events.

Key words: consumer acceptance, goat kid meat, organic dairy goats, sales promotion

Introduction

Organic goat milk products are becoming increasingly popular in Germany. Goat milk production is coupled with the birth of usually two kids per goat and year, which is more than needed for restocking the herds. Yet, marketing of organic goat kid meat is difficult. Most consumers are not aware of the meat and some have misconceptions regarding taste and quality (Löhle and Leucht 1997). Moreover, there are almost no existent marketing structures besides direct marketing (Herold et al. 2007), which is not feasible on every farm. This causes economic problems for the organic goat farmers, as the costs for raising goat kids are high. This paper presents results from a sales promotion for organic goat kid meat accompanied by a consumer survey. Consumers' attitudes towards organic goat kid meat and their buying intentions were examined in order to give recommendations for marketing activities to increase consumers' awareness of goat meat products.

Material and methodology

To explore the market for organic goat kid meat, promotional measures to stimulate consumers' interest in eating goat meat were tested in six retail stores of a conventional supermarket chain in October 2011. The focus was on offering goat meat samples (prepared as roast meat) for tasting and providing recipes for consumers. Goat kid meat was communicated as a specialty of the Mediterranean cuisine with positive nutritional attributes and it was highlighted that goat keeping is very suitable for organic farming (enjoy with a good conscience). A consumer survey was conducted parallel to the sales promotion. Customers who tried goat meat were asked to participate in a face-to-face interview with a standardised questionnaire. 229 consumers tried goat meat samples and answered the questionnaire. Participants were between 18 and 86 years old (mean: 52 years) and 42 % of the participants were men. In order to examine the effect of the promotional activities, sales of organic goat meat in the six test stores and 126 reference stores without such activities were measured over several weeks.

Results

Consumers were asked to rate the taste of the meat samples they had eaten on a scale from 1 = “not good at all” to 7 = very good. The results are shown in figure 1. Overall, tastiness was perceived rather positively. More than 80 % of the consumers rated the taste of the goat kid meat samples with 6 or 7 (very good) and the average rating was 6.3.

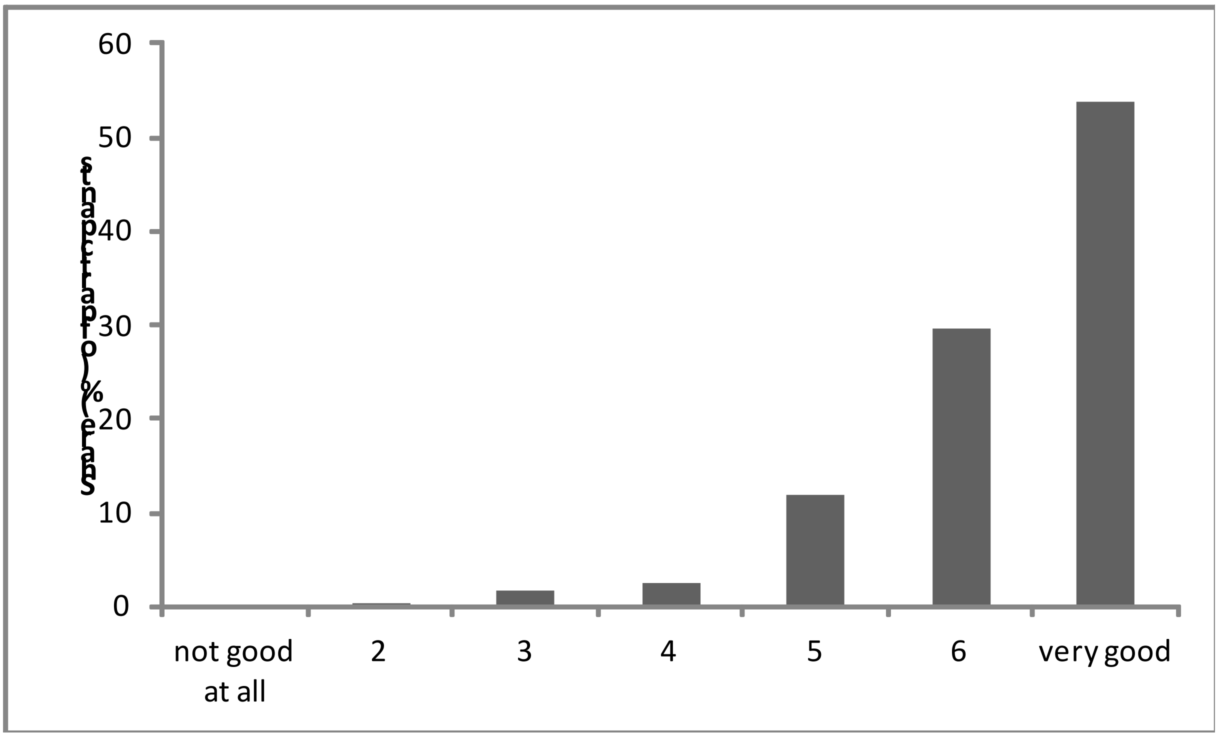

Figure 1. Ratings for the taste of the goat kid meat samples

After the tasting consumers perception was measured with several statements about goat kid meat (figure 2). Strong agreement was found for items stating that goat kid meat is healthy and low in fat. 81 % and 77 % of the participants agreed with these statements. A majority of consumers (68 %) would also prepare goat kid meat for special guests. Regarding price, consumers were rather undecided (32 %), however, 55 % disagreed that goat kid meat is inexpensive. Most consumers (74 %) believed that it is not difficult to cook the meat. More than 90 % of the participants disagreed with the statements that goat kid meat tastes of goats and is tough, which is not surprising considering the ratings of the taste of the sampled meat.

49 % of the participants had never eaten goat kid meat before the sales promotion. These consumers are potential new customers for goat kid meat. Participants who had eaten goat kid meat previous to the sales promotion indicated where they had done so. More than 50 % of the participants had eaten goat kid meat at home but restaurants in Germany and abroad played a considerable role, too.

Consumers’ ratings of the taste of the offered meat samples and their perception of goat kid meat were positive. Therefore, it stands to reason that the self-reported buying intentions were also high. 72 % of the participants stated that it is (very) likely that they will buy goat kid meat in the future, 22 % said that it is (very) unlikely and the rest was undecided.

Considering the reported buying intentions, increased sales of goat kid meat should be expected. Indeed, with regard to sales of organic goat kid meat in the six test stores the sales promotions had a positive effect. On average 72 % more goat kid meat was sold in the test stores than in the reference stores in the three weeks following the promotional activities.

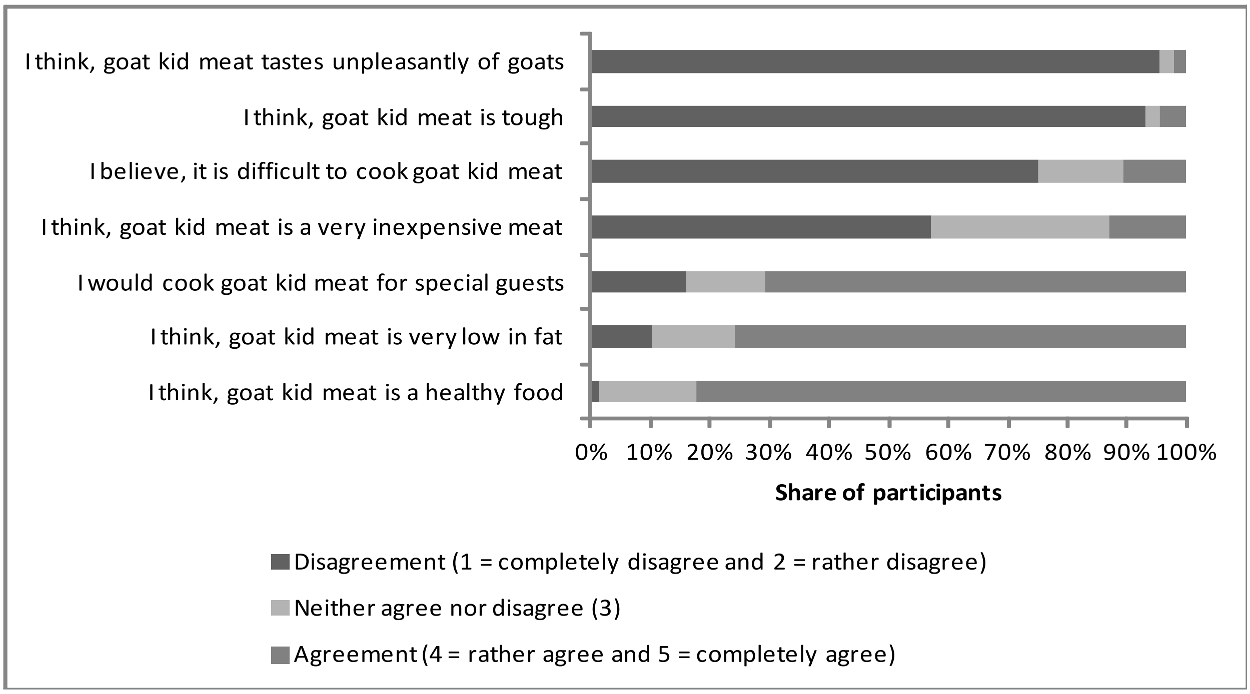

Figure 2. Consumers' perception of goat kid meat

Table 1. Locations where participants had eaten goat kid meat (multiple answers possible)

Location	Share of participants (n=115)
At home	53,9 %
Restaurant abroad	33,9 %
Restaurant in Germany	23,5 %
Friends / Relatives / Acquaintances	19,1 %
Others	5,2 %

Interestingly, 90 % of the participants trying goat kid meat had eaten lamb before. A significant relation between frequency of lamb consumption and buying intentions for goat kid meat could be found. Consumers eating lamb at least four to six times a year were significantly more likely to buy goat kid meat in the future than consumers eating lamb less than two times a year.

Discussion

Overall, the sales promotion activities had a positive effect, as sales of goat kid meat in the test stores increased considerably. In addition, the activities reached a substantial share of consumers who had no previous experience with goat kid meat and are potential new customers. Sales promotions including samples for tasting are therefore a promising way to increase consumers' awareness of organic goat kid meat. Perceptions of goat kid meat were clearly more positive among participants than could be expected from indications in the literature (Löhle and Leucht 1997). Hence, perceptions were obviously influenced by the tasting and the communication efforts. As regards potential consumer groups for goat kid meat, it seems appropriate to target consumers of lamb, if possible. Knight et al. (2006) also found that consumers of lamb were more likely to eat goat meat.

Suggestions to tackle the future challenges of organic animal husbandry

Producers of organic goat milk products are faced with the situation that it is expensive to raise the goat kids not needed for restocking the herd and difficult to market them properly. One way to deal with this situation is to try to reduce costs as much as possible. Here, ethical and animal welfare standards of organic farming set limits. Another option is to improve marketing strategies and increase consumers' awareness and willingness-to-pay through adequate communication measures.

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Present status of goat rearing under rural conditions in south-west regions of Bangladesh

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Abstract

The study was conducted to know the present status of goat rearing and problem confronted by the goat rearers in three selected Upazila under Khulna district of Bangladesh viz. Batiaghata, Dumuria and Rupsha. A total of 150 respondents were randomly selected for collecting data by using an interview schedule during the period from April to June 2011. The average age at first kidding of goat was lowest in Rupsa Upazila (340.70 ± 26.38 days) and highest in Dumuria Upazila (358.30 ± 29.68days) and differences were significant (P<0.01). The average number of kids per calving was lowest in Dumuria Upazila (1.72 ± 0.64) and highest in Rupsa Upazila (2.02 ±0.32) and differences were significant (P<0.05). The average kidding interval (days) of goat was lowest in Rupsa Upazila (203.10 ± 14.95) and highest in Dumuria Upazila (216.40 ± 19.77) and differences were significant (P<0.01). Most of goat farmers were faced some problems such as high price of good breed, lack of vaccines and medicines, lack of quality breeding facilities, lack of knowledge of feed production and storage, lack of capital and loan facilities, unavailability of veterinary surgeon, high price of feeds and fodder, unavailability of quality feeds and fodder and improper marketing facilities. It can be concluded that the goat reared under rural condition had lower kidding age, short kidding interval and they are prolific in nature. Instead of their low milk yield it was profitable to rear goat under rural conditions of Bangladesh.

Key words: Goat rearing, rural conditions

Introduction

Bangladesh is mainly an agricultural country. Agriculture is the single largest producing sector of the economy and it contributes about 22% to the total GDP of the country (BBS, 2008). Livestock is an integral part of farming systems in Bangladesh. The major livestock in Bangladesh are cattle, buffalo, goats, sheep, chicken and ducks. Among livestock, goats constitute important member of animals in small farming systems in the developing countries like Bangladesh. More than 95% of the goat population is found in developing countries (FAO, 2006). Goat is numerically and economically important and promising animal resources in the developing countries especially in Asia and Africa (Hussain, 1999). It is an important source of sustainable income generator for the resource poor people. Goats are raised by poor farmers and distressed women with little capital investment (FAO, 1991). Goat rearing is an integral part of farming systems in Bangladesh and it ranks 4th in goat population in the world and the Asian countries, her position is also fourth (FAOSTAT, 2008). In FY 2007-08 the estimated share of the livestock sub-sector in GDP at constant prices is 2.79 percent (BBS, 2008). The world total numbers of goats and sheep were 861.9 and 1078.2 million, respectively (FAOSTAT, 2008). The goat is such animal which in Bangladesh is managed for multiple uses: meat, skins, milk and manure. It is a major contributor of protein and fat and often the goat enterprise can help resource poor farmers to overcome an unforeseen crisis and natural calamities which demand immediate finance. The goat is a prolific animal; twins or triplets are common in kidding (Anonymous, 2008). The skin of the Black Bengal goat in particular is unique throughout the world (Banerjee, 1980). Although reared by resource poor farmers to provide food security and sustain livelihoods, small ruminants are not adequately paid attention under National Livestock Development Policy of Bangladesh. Several researches have conducted research on genetic parameters and reproductive performances of goat, but there is an acute shortage of information regarding the present status of goat rearer and rearing pattern of goat in rural areas in Khulna district. For this the study was conducted with the following objectives:

1. To analyze the socio-economic characteristics of the goat farmers.
2. To know the present status of goat rearing in some selected areas of south-west regions of Bangladesh.
3. To identify the problems related to goat rearing and recommendations to overcome the problems.

Methodology

The study was conducted at randomly selected three Upazilas from Khulna district namely Batiaghata, Dumuria and Rupsha Upazila. These Upazilas are situated under the same Agro-Ecological Zone (AEZ) of the Ganges Tidal Flood Plain (Anonymous, 1988). An interview schedule was used as the research instrument in order to collect relevant information from the respondents. Data for this study were collected by the researchers through door to door interview during the period from April to June 2011. The personal and socio-economic variables of the respondents were included in the present study. The variables were age of the farmers, their education, family size, occupation, farm size, experience in farming, annual income, farming system, organizational participation, cosmopoliteness, training exposure and extension media contact. Data were also collected on housing pattern for goat, income from goat rearing, number of goats per family, age at puberty of goats, age at first kidding, litter size, kidding interval, milk yield, information about availability of buck, common diseases of goats, feeding management of goats and preventive measure against diseases, problems confronted by farmers to determine the present status of goat rearing. Data were compiled, tabulated and analyzed based on the objectives. Different statistical treatments such as number, mean, standard deviation, range, minimum, maximum and percentage were used to describe the variables. The SPSS 11.5 computer package program was used to analyze the data.

Results and Discussion

Personal and socio-economic characteristics of the respondents

Majority (50.7%) of the respondents were middle aged as compared to 31.3% being young aged and 18% old aged. It means that middle aged people were more interested in goat rearing. Majority (54.0%) of the respondents had secondary level of education followed by primary (32.0%), higher secondary (3.3%) and only a few had above higher secondary (0.7%) levels where 10.0% respondents had no institutional education. Majority (60.7%) of the respondents had small compared to marginal (32.7%) and medium (6.6%) sized farm. Occupation of majority of the respondents (61.3%) was agriculture followed by day labourer (18.7%), businessman (13.3%) and the lowest number of respondents (6.7%) was engaged in service. Majority (64.0%) of the respondents belonged to low income group as compared to medium (26.7%) and high (9.3%) income group. Majority (83.3%) of the respondents had no organizational participation as compared to medium (8.0%), low (5.3%) and high (3.4%) organizational participation. Highest proportion (54.7%) of the respondents had medium cosmopoliteness as compared to low cosmopoliteness (31.3%) and high cosmopoliteness (14.0%). Cosmopoliteness enhances the opportunity for an individual to have himself to contact with outside information sources. Highest portion of the respondents (68.7%) had medium experience followed by short experienced (22.0%) and had long experienced (9.3%) in farming. Few of the respondents (42.0%) belonged to medium experienced in goat rearing followed by low experienced (30.7 %) while about 27.3% were highly experienced in goat rearing. Majority (79.3%) of the respondents had no training on goat rearing. However, 16.7% of the respondents had low training, 3.3% had medium training. Around two-third (70.7%) of the respondents had medium extension media contact where 26.0% had low extension media contact and 3.3% had high extension media contact.

Table 1. Personal and socio-economic characteristics of the respondents

Characteristics	Categories (Score)	Distribution of respondents (in %)	Obtained score (Possible score)	Mean	Standaard deviation
Age (years)	Young aged (Up to 35) Middle aged (36-50) Old aged (>50)	31.3 50.7 18.0	22-61	41.73	10.20
Education (years of schooling)	Illiterate (0) Primary level (1-5) Secondary level (6-10) Higher secondary level (11-12) Above Higher secondary level (> 12)	10.0 32.0 54.0 3.3 0.7	0-16	6.17	3.44
Family size (No.)	Small sized family (1-4) Medium sized family (5-7) Large sized family (>7)	34.0 49.3 16.7	3-10	5.63	1.76
Farm size (ha)	Landless (<0.02) Marginal (0.02-0.20) Small (0.21-1.0) Medium (1.01-3.0) Large (>3)	0 32.7 60.6 6.7 0	0.02-1.42	0.39	0.32
Occupation	Agriculture Business man Service holder Day labourer Others	61.3 13.3 6.7 18.7 0.0			
Annual income (USD)	Low income (upto $937.50) Medium income ($937.51-$1875.00) High income (>$1875.00)	64.0 26.7 9.3	437.50-3750.00	984.50	562.47
Organizational participation	No participation (0) Low participation (1-4) Medium participation (5-8) High participation (> 8)	83.3 5.3 8.0 3.4	0-17	1.05	2.98
Cosmopoliteness	No cosmopolite (0) Low cosmopolite (1-4) Medium cosmopolite (5-8) High cosmopolite (>8)	0.0 31.3 54.7 14.0	1-14	5.72	2.33
Experience in farming	Short experience (upto 10) Medium experience (11-30) Long experience (>30)	22.0 68.7 9.3	3-42	19.63	9.77
Experience in goat rearing	Short experience (upto 7) Medium experience (8-14) high experience (>14)	30.7 42.0 27.3	2-30	10.79	5.70
Training	No Training (0) One Training (1) Two Training (2) Three or More (>3)	79.3 16.7 3.3 0.7	0-4	0.26	0.59
Extension media contact	No contact (0) Low (1-10) Medium (11-20) High (>20)	0.0 26.0 70.7 3.3	6-23	12.22	3.38

Present status of goat rearing

More than one-third (37.3%) of the respondents had semi permanent house for goat keeping as compared to 26.7% had bamboo house, 25.3% had kacha (made of mud) house and 10.7% had permanent house. The annual income from goat farming ranged from $125.00-187.50 with the mean and standard deviation of 163.18 and 38.94, respectively. The goat rearing knowledge score of the respondents ranged from 6-20 with mean and standard deviation of 12.51 and 2.36, respectively. The goats were affected by some diseases such as Peste Des Petits Ruminants (PPR) disease (40.0%), goat pox (28.7%), foot and mouth disease (FMD) (22.0%) and others (9.3%). Most of the respondents (73.3%) called on local doctors and the rests (26.3%) called veterinarians for the treatment of goat's disease. Most of the respondents (61.3%) provided grass and leaves to feed goats because of its availability in the study areas. Most of the cases, women (80.0%) were involved in goat rearing, followed by men (9.3%), labour (9.3%) and children (1.3%). Majority of the respondents (86.7%) hired bucks for matting while the rests (13.3%) used their own bucks to breed goats.

Table 2. Present status of goat rearing

Characteristics	Categories (Score)	Distribution of respondents (in %)	Obtained score (Possible score)	Mean	Standaard deviation
Housing for goat	Permanent house Semi permanent house All bamboo structure Kacha (made of mud)	10.7 37.3 26.7 25.3	22-61	41.73	10.20
Annual income from goat rea-ring (USD)	Low income (upto $62.50) Medium income ($62.51-125.0) High income(>$125.00)	61.3 34.7 4.0	125.00-187.50	163.18	38.94
Knowledge on goat rearing	Low knowledge (Upto 10) Medium knowledge(11-20) High knowledge (>15)	20.0 69.7 9.3	6-20	12.51	2.36
Common dise-ases of goats	Peste Des Petits Ruminants Goat pox Foot and mouth disease (FMD) others	40.0 28.7 22.0 9.3			
Treatment pro-cedure diseases	Local doctor Veterinarian	73.3 26.7			
Types of feeds used by the farmers	Grass Grass +Leaves Concentrate others	38.0 61.3 0.7 0.0			
Caretaker of goats	Men Women Children Labour Others	9.3 80.0 1.3 9.4 0.0			
Bucks for ma-ting	Owned Hired	13.7 86.3			

Performances of goats

The average age at puberty (days) of goat was found lowest in Batiaghata Upazila (190.10 ± 29.74) and highest in Rupsa Upazila (196.10 ± 24.61). The overall mean was 193.33 ±26.63 days. The mean difference in three Upazila was non significant (P> 0.05). Hassan et al. (2007) reported that the average age at first heat of crossbred and Black Bengal goats were 222.5± 5.5 and 196.5± 7.5 days, respectively which is almost similar with the present findings. The average age at first kidding (days) of goat was found lowest in Rupsa Upazila (340.70 ± 26.38) and highest in Dumuria Upazila

(358.30 ± 29.68) with overall mean 352.17 ± 29.25. Faruque et al. (2010) reported that average age at first kidding was calculated to be 352.98±21.32 days. The mean difference in three Upazila was significant (P<0.01). Hassan et al. (2007) reported that in Black Bengal goat the average age at first kidding was 360.5±10 days whereas in crossbred goats it was 411.5±15.5 days. The average number of kid per calving was found lowest in Dumuria Upazila (1.72 ± 0.64) and highest in Rupsa Upazila (2.0 2 ± 0.32) with overall mean 1.89 ± 0.53. The mean differences in three Upazila were significant (P<0.05). Hassan et al. (2007) reported that in Black Bengal goat the average liter size was 1.96± 0.75. The average kidding interval (days) of goat was found lowest in Rupsa Upazila (203.10 ± 14.95) and highest in Dumuria Upazila (216.40 ± 19.77) with overall mean 210.37 ±19.89. The mean differences in three Upazila were significant (P< 0.01). Hassan et al. (2007) reported that the average kidding interval in Black Bengal and crossbred goats were 179±20 and 270±22 days, respectively and differences were highly significant (P<0.01). The average mortality (%) of goat was found lowest in Batiaghata Upazila (4.02 ±13.70) and highest in Rupsa Upazila (10.07 ±19.30) with overall mean 6.75 ± 16.53. The mean differences in three Upazila were non significant (P< 0.05). Webb and Mamabolo (2004) reported that the mortality rates in goats in communal systems were extremely high (40.6%) compared to systems with better management (<5%). The average milk yield (kg/d) of goat was found lowest in Dumuria Upazila (0.16±0.35) and highest in Rupsa Upazila (0.88±4.70) with overall mean 0.50 ± 2.80. The mean difference in three Upazila was non significant (P< 0.05). Due to genetic factor Black Bengal goats yield very poor amount of milk (Payne, 2000). The average number of goat per family was found lowest in Dumuria Upazila (5.98±2.64) and highest in Batiaghata Upazila (6.42 ±3.36) with overall mean 6.25 ±2.99. The mean differences in three Upazila were non significant (P> 0.05).

Table 3. Performances of goats

Parameters	**Batiaghata (50)** Mean ± SD	**Dumuria (50)** Mean ± SD	**Rupsa (50)** Mean ± SD	**Overall (150)**	**Signifi-cance**
Age at puberty (d)	190.10± 29.74	193.80 ± 25.47	196.10 ± 24.61	193.33± 26.63	NS
Age at first kidding (d)	357.50 ±28.68	358.30 ± 29.68	340.70 ± 26.38	352.17± 29.25	**
Litter size (no.)	1.92 ± 0.53	1.72 ± 0.64	2.02 ± 0.32	1.89± 0.53	*
Kidding interval (d)	211.60 ±22.28	216.40 ± 19.77	203.10 ± 14.95	210.37± 19.89	**
Mortality (%)	4.02 ±13.70	6.16 ±15.85	10.07 ±19.30	6.75± 16.53	NS
Milk Yield (kg/d)	0.45 ±1.22	0.16± 0.35	0.88±4.70	0.50± 2.80	NS
Number of goat / family	6.42 ±3.36	5.98±2.64	6.34±2.97	6.25± 2.99	NS

NS=Non significant, ** P<0.01= significance at 1% level, * P<0.05= significance at 5% level.

Extent of problem confrontation

Fifty eight per cent of the respondents were under medium problem confrontation followed by low problem confrontation (2.0 %) and high problem confrontation (40.0%).

Table 4. Distribution of respondents according to their problem confrontation score

Categories of respondents	**Respondents (N=150)**	
	Number	**Percentage**
Low problem confrontation (up to 15)	3	2.0
Medium problem confrontation (16-25)	87	58.0
High problem confrontation (>25)	60	40.0
Total	150	100

Problem confrontation in goat rearing

The study revealed that the main problems in goat rearing were the high price of good breeds (62.0%), high price of vaccine and medicine (61.33%), lack of quality breed in time (57.33%), unavailability of vaccine and medicine (54.0%), lack of knowledge of feed production and storage

(52.67%), lack of capital and loan facilities (52.67%), lack of veterinary surgeon (46.0%), lack of Government help (35.33%), high price of feeds and fodder (24.0%), lack of marketing facilities (14.67%), unavailability of quality feeds and fodder (14.0%) and high mortality rate, etc.

Table 5. Level of occurrence and severity of the problems faced by the respondents in goat rearing

SL. NO.	Problems	Highly severe %	Moderately severe %	Less severe %	Not at all %
A	**Breed related problems**				
1	High price of good breed	62% (93)	37.33% (56)	0.67% (1)	0% (0)
2	Lack of quality breed in time	57.33% (86)	38 %(57)	4.67% (7)	0 %(0)
3	High mortality rate	0 % (0)	4.67 % (7)	34%(51)	61.33%(92)
B	**Feeds / fodder related problems**				
4	High price of feeds and fodder	24% (36)	24.67% (37)	20.67% (31)	30.66% (46)
5	Unavailability of quality feeds and fodder	14.0 % (21)	30% (45)	27.33%(41)	28.67% (43)
6	Lack of knowledge of feed production and storage	52.67% (79)	38.0% (57)	8.67% (13)	0.66% (1)
C	**Health related problem**				
7	Unavailability of vaccines and medicines	54.0 % (81)	40.67% (61)	5.33% (8)	0.0% (0)
8	High price of vaccines and medicines	61.33% (92)	34.67% (52)	4.0% (6)	0.0% (0)
9	Lack of veterinary surgeon	46 % (69)	46 %(69)	6.67 %(10)	1.33% (2)
D	**Other problems**				
10	Lack of capital and loan facilities	52.67 % (79)	39.33 % (59)	7.33% (11)	0.67% (1)
11	Lack of marketing facilities	14.67% (22)	36% (54)	38.67% (58)	10.66% (16)
12	Lack of Govt. help	35.33% (53)	44.67 % (67)	20.0% (30)	0.0% (0)

Note: The figures within the parenthesis indicate the number of respondents

Conclusion

It can be concluded that most of the goat rearers have semi-permanent houses for goat keeping and medium knowledge on goat rearing. The goat rearer indicated high price of good breed and vaccine and medicine, lack of quality breed in time, unavailability of vaccines and medicines, lack of knowledge of feed production and storage, lack of capital and loan facilities, unavilability of veterinary surgeons, high prices of feeds and fodder, lack of marketing facilities, unavailability of quality feeds and fodder as main problem they are facing in goat rearing. Majority of the respondents had confronted medium problem in goat rearing. Goat reared under rural conditions had short age at kidding, short kidding interval, high litter size, lower mortality. However, they had low milk yield.

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Success of a participatory research and extension programme in the Dutch organic dairy goat sector

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Abstract

In 2004, most organic dairy goat farms had financial problems due to a gap between the milk price paid and the cost price on farm. In 2005, a research project "BIOGEIT" was started. In 2007, the research project was combined with an extension programme. A framework was set up with 3 shells. The first shell consisted of two farmer research groups in which goat keepers worked in close cooperation with researchers on a specific theme. One research group has worked constantly on cost price optimisation and milk price. One of the activities in the farmers research group on cost price was monitoring the cost price and milk price over the years. Its objective was threefold: determining priorities for cost price optimisation, using the cost price for milk price negotiations and monitoring the project results. The cost price inclusive labour costs evolved from 58.92 euro/100 l in 2004 to 65.24 /100 l in 2009. The milk price (7% fat and protein; exclusive tax) evolved from 51 euro/100 l in 2004 to approximately 70 euro/100 l in 2012. From the year 2009 onwards, the cost price is covered by the milk price.

Key words: dairy goats, organic farming, participatory research, extension, cost price milk, economics

Introduction

In the Netherlands, 74 out of the 566 dairy goat farms are organically working (SKAL, 2011). In 2004, most organic dairy goat farms had financial problems due to a gap between the milk price paid and the cost price of the milk produced on farm. In 2005, a research project "BIOGEIT" was funded by the Dutch Ministry of Agriculture. The long term objective of the project was to strengthen the sector as a whole with a special focus on cost of production, nutrition, animal health, animal welfare and product quality. Each year the organic dairy goat keepers and a working group appointed by the Ministry, identified and prioritized research themes. In 2007, the research project was combined with an extension programme. A framework was set up with 3 shells (Figure 1). The first shell consisted of two farmer research groups in which goat keepers worked in close cooperation with researchers on a specific theme. These themes could change over the years, but one research group has worked constantly on cost price optimisation and milk price. In the second shell, goat keepers of three regional farmer study groups discussed and exchanged information with advisors regarding themes directly related to their daily management. In the third shell, organic and conventional goat keepers, advisors, veterinarians, feed companies cooperated closely in thematic meetings and different media (newsletters, reports etc.).

One of the activities in the farmer research group on cost price was monitoring the cost price and milk price over the years. Its objective was threefold: determining priorities for on farm cost price optimisation, using the cost price for milk price negotiations and monitoring the project results (Govaerts & van Eekeren, 2010). Results of the cost price development in this research group are discussed in this paper.

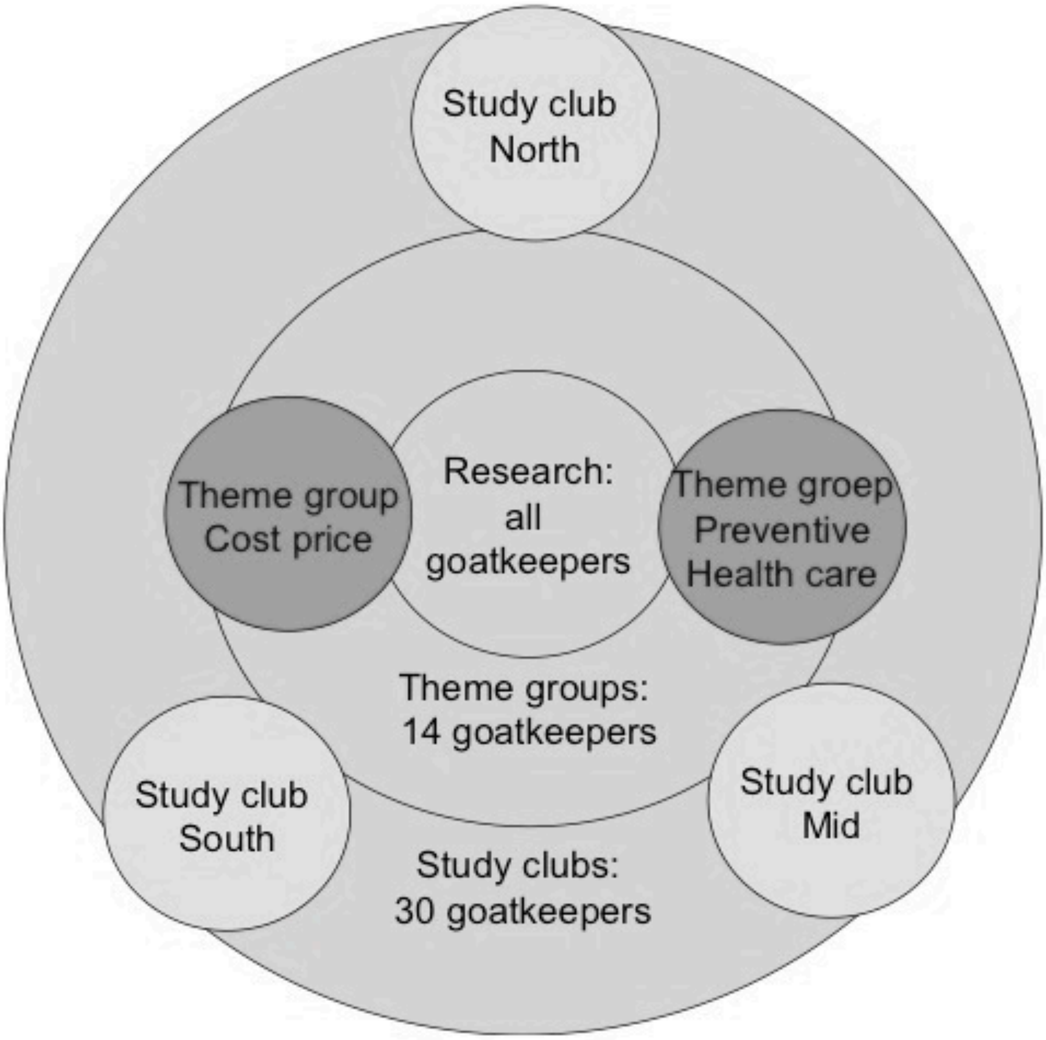

Figure 1. Combination of research with extension, whereby the extension approach distinguished 3 shells

Material and methodology

For the cost price calculation a sample of 10% of the total organic dairy goat farms was taken. Out of the 74 organic dairy goat farms in the Netherlands, 8 goat farms were selected for cost price calculation over the years 2004-2009. Selection criteria for the farms selected were the availability of accurate figures on milk production, separated financial administration of milk production, cheese production and arable production, a farm size of 400-1200 goats, an equal distribution of farms over the soil types and regions of the Netherlands. Figures were collected over the years 2004, 2007, 2008 and 2009 on basis of the yearly financial statements of the farms. Interest costs were accounted at an interest rate of 4%, regardless of whether this was external or own capital. The costs for land were calculated on basis of the actual rent paid or on basis of an interest rate of 3% on the current value of the land. Labour costs were calculated with an entrepreneurial wage of € 46800 for the farmer and € 23240 for the other workers, per person per year. External labour was brought in against the actual costs. The costs were adjusted for non-milk yields as premiums received, sale of breeding material or growth in animals on holdings etc. The final cost price per 100 litres of milk was corrected for 7% fat and protein.

Results and discussion

In table 1 the development of the farm size is shown. The number of full time persons working on these farms remains relatively stable over the years. The number of productive goats increased by 12% from 2004 to 2009. The average milk production has increased substantially with 17%: from 727 litres per goat in 2004 to 852 litres in 2009. This was mainly the result of technical improvements on farm and better health of the animals. In addition to milk production the protein content of the milk has increased from 3.35 to 3.45% by matching the energy and protein requirements. The fat content was rising again in 2009 after an initial dip due to the requirement of 100% organic ingredients in the ration. In their demand for good quality roughage, many farms established a partnership with organic arable farms for grass clover production. The production per hectare own fodder crops increased significantly over the years to 24.946 litres per hectare in 2009. If the ha fodder crops on partner (arable) farms are included, the milk production per hectare fodder crops was 13.346 litres hectares per hectare in 2009.

Table 1. Average size of farms over the years 2004, 2007, 2008 and 2009

	2004	2007	2008	2009	2009 rel. to 04
Number of full time employers (fte)	1,53	1,50	1,54	1,54	101%
Number of goats	575	546	607	641	112%
Delivered milk (litres)	416.375	437.514	475.717	556.967	134%
Fat (%)	3,82	3,71	3,69	3,73	98%
Protein (%)	3,35	3,37	3,43	3,45	103%
Milk per goat (litres)	727	786	772	852	117%
Milk per fte (litres)	271.022	283.804	299.363	352.778	130%
Number of goats per fte	376	360	388	416	111%
Number of goats / ha own fodder crops	22	21	26	29	132%
Number of goats / ha incl. fodder crops on partnership arable farms				15	

The costs were calculated per hundred litres of milk delivered to the factory corrected for 7% fat and protein (see table 2). The general costs stabilised in 2009 after a sharp increase in 2008. The costs for buildings decreased after an initial rise in costs in 2007. With approximately 60% of the costs, the feedings costs are the highest.

Table 2. Cost overview per 100 litres of milk over the years, adjusted for 7% fat and protein (euros, excl. VAT)

	2004	2007	2008	2009
General fixed costs	4.18	4.05	5.48	5.43
Costs buildings and non-feed mechanisation	8.4	9.97	9.09	8.84
Roughage costs	13.69	17.10	17.63	15.94
Concentrate costs	16.87	24.97	32.16	22.12
Other variable costs	5.95	8.53	7.44	6.26
Correction for non milk returns	-3.34	-7.23	-8.38	-5.95
Cost price excluding labour costs	45.78	55.39	63.42	52.64
Labour costs	13.15	15.74	14.75	12.61
Cost price including labour	58.92	71.13	78.17	65.24
Milk price	51.00	55.60	70.79	67.00

After a strong increase in 2007 and 2008, due to the requirement of 100% organic ingredients in the ration and a rise in commodity prices, this dropped sharply in 2009. This was the result of a focus of most farms on high quality roughage in the ration combined with a higher productivity of the animals due to improvements in feeding and animal health. The cost price was adjusted for non-milk yields, such as sales of animals and premiums. To have enough farm income goat farmers were looking in previous years for non-milk yields return. Since the cost price became under control, the need for non-milk yield returns became less important and the focus was more on the milk revenues of the goats. The gap between milk price and cost price was already substantial in 2004. In 2007 the gap between milk price and cost price took the full margin of labour. In 2008 a moderate margin could be realized. In 2009, despite a drop in milk price, the gap was covered due to a reduction of costs price.

Suggestions to tackle the future challenges of organic animal husbandry

For a sustainable development of organic goat husbandry, a balance between cost price and milk price is necessary. This requires efforts on milk price realization and cost price optimization. Balancing milk supply and demand through deliverance cooperatives of farmers is an important tool in stabilizing the milk price. Cost prive optimization through healthy goats, good roughage quality, balanced nutrition, craftsmanship and dedication of the farmer and his wife have proven to be the keys to success for cost price optimization.

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Prevalence of udder infections and effects on milk somatic cell count during lactation in dairy goats

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Abstract

The objective of this study was to investigate the effects of udder infections, milk yield, teat shape and condition, lactation stage and parity on SCC in goats' milk. Of the 126 udder halves sampled over the lactation period, 52% were continuously or sporadically infected with mastitis pathogens (coagulase-negative staphylococci (CNS), corynebacteria, major pathogens). Most prevalent species found in milk samples were CNS with 47% of bacterial isolates. The analysis of milk SCC revealed the lactation week as the most influential factor, followed by the lactation number. The average daily milk yield also had a highly significant effect on milk SCC. A significant effect of the udder infection status on milk SCC could be observed, but no differentiation could be made among different pathogenic groups. A classification of teat shape by classifying different types of teats and the degree of callosity yielded no significant effects on milk SCC.

Key words: dairy goat, staphylococci, SCC, milk yield

Introduction

An inflammation of the mammary gland is one of the most common infectious diseases in dairy goat farming. Somatic cells are a normal milk constituent that can be considered as indicator for the immune defence of glandular tissue. Interrelationships between variations in goat milk somatic cell count (SCC) and the presence of different causative agents, as well as other influencing factors, were already discussed (Stuhr and Aulrich 2010). The aim of research was to examine the course of milk SCC in correlation to infection status as well as milk yield, teat shape and condition and parity over an entire lactation period of a goat herd.

Material and methodology

From February to November 2010, 63 lactating goats between Lactation Numbers 1 and 8 of the dairy goat herd of the Thünen-Institute of Organic Farming, Germany, were investigated. Udder half milk samples were collected immediately before the routine morning milking at weekly intervals over a period of 40 weeks. Milk samples were taken under aseptic conditions for cyto-bacteriological examinations according to the guidelines of the DVG (2009). Milk SCC was analysed by a fluoro-opto-electronic method according to ISO 13366-2/2006 (International Organization for Standardization 2006). All animals were examined three times during lactation with regard to teat shape (normal, short, funnel and bottle-shaped) and the degree of hyperkeratosis of each gland. Furthermore, the average daily milk yield was determined for every goat. Statistical analysis was based on logarithmic values and was carried out with the software program SPSS for Windows® using GLM procedure with repeated measures analysing the fixed effects of lactation week, lactation number, milk yield and infection status of udder halves.

Results

Of the 126 udder halves sampled over the lactation period, 52% were continuously or sporadically infected with one pathogenic group (coagulase-negative staphylococci (CNS), corynebacteria, major pathogens). The most prevalent species found in milk samples were CNS with 47% of bacterial isolates. Corynebacteria were detected in 40% of the infected udder half samples, 9% were infected with *Staphylococcus aureus* and 5% with the streptococci species *Streptococcus* (*Sc).* *dysgalactiae* or *Sc. uberis*. Uninfected halves showed the lowest, udder halves with the detection of major pathogens the highest mean value of SCC, whereas CNS and Corynebacteria infected halves ranked between these two groups (Table 1).

Table 1. Somatic cell counts (SCC) in goat milk samples in relation to different intra-mammary infection status of udder halves

Infection status	Log10 SCC				
	N	Min.	Max.	Mean	S.E.
Uninfected	3173	3.78	7.44	6.17	4.78
Coagulase-negative staphylococci	620	4.34	7.42	6.20	5.12
Corynebacteria	537	4.51	7.34	6.34	5.09
Major pathogens	174	4.48	7.45	6.55	5.58

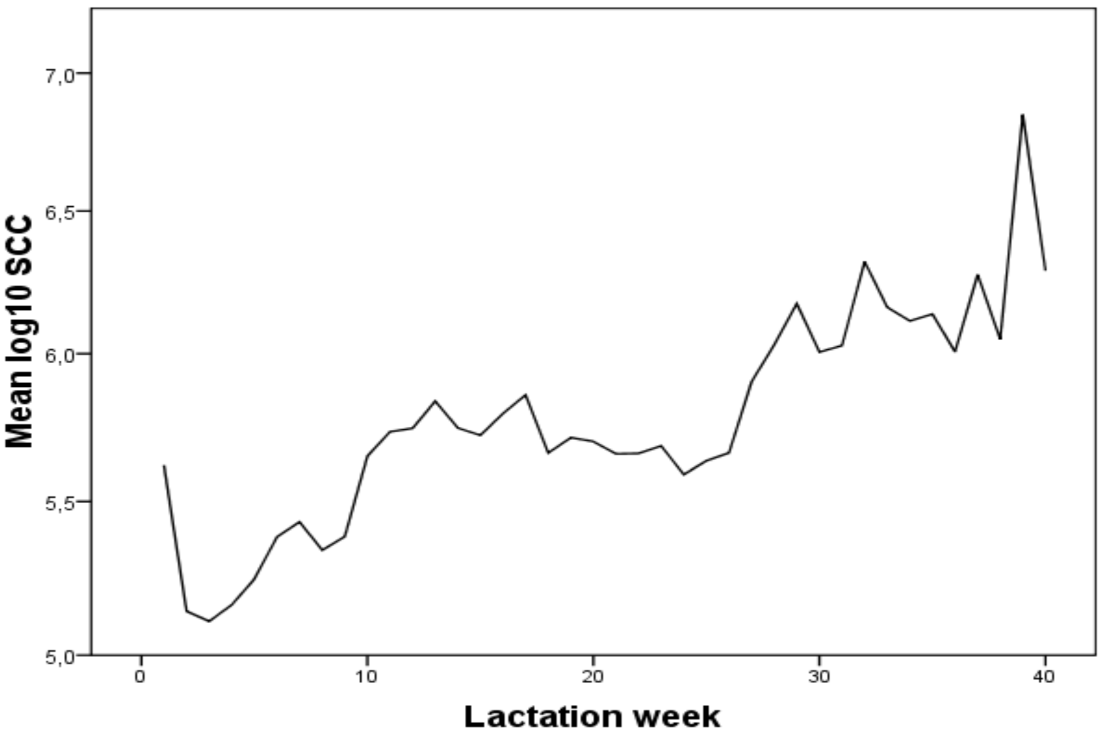

Figure 1. Mean somatic cell counts (SCC) in goat milk udder half samples recorded weekly during the lactation period 2010

The analysis of milk SCC revealed the lactation week as the most influential factor, followed by the lactation number ($F_{39,2277}$=19.57 P<0.001; $F_{5,124}$=14.46 P<0.001). The first week of lactation showed elevated values of SCC, but these decreased during the following two weeks. A clear trend of steadily increasing SCC values could be observed over the lactation period (Figure 1). A high number of lactation was correlated with increased levels of SCC. The average daily milk yield also had a highly significant effect on milk SCC ($F_{330,3359}$=2.46 P<0.001). In early and mid lactation milk yield levels ranged between 2.1 and 2.8 l/d, while in late lactation a decrease to 1l/d was noticeable. A lower daily milk yield resulted in higher values of SCC. With $F_{3,2867}$=2.91 (P<0.05) a significant effect of the udder infection status on milk SCC could be observed but no differentiation could be made among different pathogenic groups. The classification of teat shape and the degree of callosity yielded no significant effects on milk SCC.

Discussion

According to other studies, CNS was the most common group of bacteria isolated from udder half milk samples (Contreras et al. 2007, Hall and Rycroft 2007). Unexpectedly high levels of Corynebacteria in bacteria isolates were detected during this study, a low prevalence of streptococcal infections is in correspondence with Manser (1986). Our study on herd level over the lactation period demonstrated the great variability of SCC in dairy goats. SCC is highly influenced by the stage of lactation and tends to increase during lactation period, but even higher values may not indicate an intramammary infection. Very high levels in autumn might be caused by the influence of estrus, which was already stated by McDougall and Voermans (2002). Increasing levels of SCC until the end of lactation may be linked to a decreasing amount of milk production and lower daily milk yields, as has already been stated by Zeng and Escobar (1995). In contrast to investigations of Aulrich and Barth (2008) parity did highly affect milk SCC with a significant increase in the case of greater parities. The presented study proved a significant effect of infection status on SCC, but a differentiation of pathogenic groups by the level of SCC could not be confirmed by our results. Nevertheless, in case of suspected udder infections SCC in goat milk could be suitable as first and cost-effective screening parameter to initiate further analysis.

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Comparison of environmental and economic indicators of organic and conventional sheep farms in milk production

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Abstract

Society is concerned about emissions of greenhouse gases and climate change, one of the sectors involved in them is ruminates livestock. Because organic production represents a sustainable alternative for the environment, we studied the greenhouse gas emissions of six farms, two intensive farms, two organic and two conventional of the same race and geographic location, all of diary production Results in absolute terms show the highest emissions per year in the organic farm Eco2 (674 t CO_2 eq) that have greater resources and greater agricultural food autonomy than the rest. The greenhouse gas emissions obtained per hectare and year are similar to those obtained in the literature, corresponding lower emission to the farm Eco2 (2.61 t eq CO_2/ha and year), which demonstrates the effectiveness self-sufficient system when studied per hectare of earth. Intensive farms get three times more emissions per hectare and year that conventional and organic Australian and French references, which demonstrates the effectiveness of the intensive Spanish dairy producer.

Key words: sheep, organic, economic, greenhouse gases

Introduction

In recent years, European society has increased the interest in strengthening the structures that maintain the economic activities in rural areas. These activities are linked to the environment, trying to conserve and improve it and, at the same time, they strengthen the workforce of these areas. These activities include those related to livestock and agriculture.

As a result of the climate change, the agricultural activities are being studied to make them sustainable economic sectors that do not increase the balance of greenhouse effect gases. Agriculture and livestock in Spain account for 11% of total dioxide emissions (CO_2) equivalent, with an increase of 17% over the base year (Nieto & Santamaría, 2002). In addition, certified organic production allows binding of organic farming with the environment and promotes sustainable practices. There are authors who claim that organic farms have better environmental performance than conventional ones (Bochu *et al.* 2008).

Material and methodology

In this paper, we study the differences between six farms, three are of Churra breed and the others three are Assaf. They are located in Castilla y Leon (Spain), and the period of study is during a year of production. Two organic farms will be compared with two conventional farms with similar characteristics (in terms of its geographical location, production system and Churra breed) and two other intensive farms with similar geographical location and Assaf breed. The geographical distribution of farms can be seen in Figure 1.

The case study methodology is used in order to analyze the investments, the economic results and the environmental indicators related to the emission of greenhouse effect gases. Economic data were collected at the farm on a quarterly frecuency, in each period we collected the composition of income and variable costs of each farm.

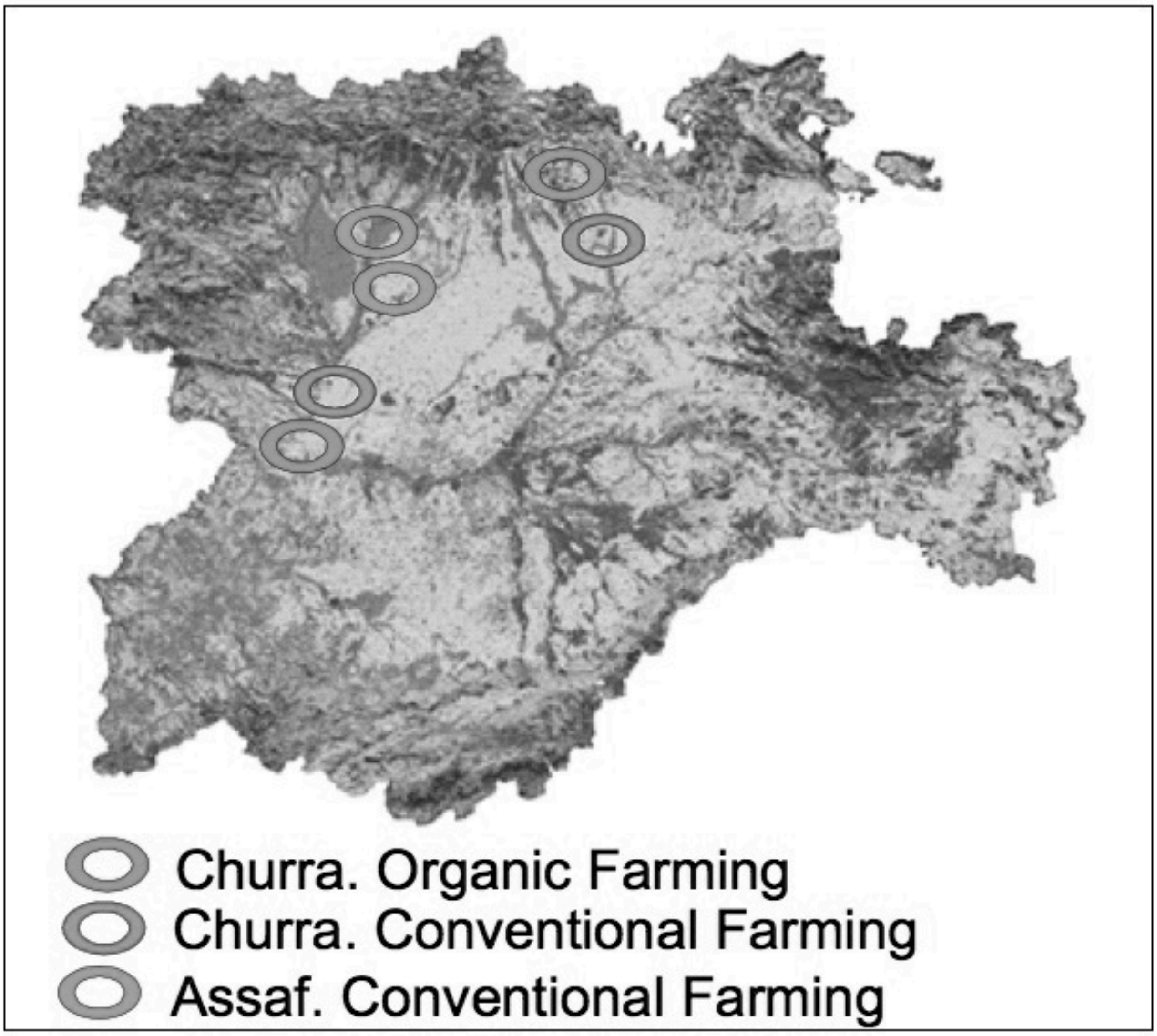

Figure 1. Geographical distribution of farms

Emissions of greenhouse gasses were computed using the tool PLANETE. We calculated the emissions of CO_2 (Carbon Dioxide), CH_4 (methane) and N_2O (nitrous oxide). Emissions referred to the direct and indirect emissions of each gas in tones of CO2 equivalent totals (Rossier, 1998) were computed using the equivalence ratios of CO_2, 1 kg = 1 kg eqCO_2, CH_4 1 kg = 21 kg eqCO_2, N_2O 1 kg = 310 kg eqCO_2, IPCC (2007). Then, we calculated the power of global warming of the atmosphere and expressed in equivalent tons of CO_2 (Bochu et al,. 2010).

Results and discussion

The calculated CO_2 emissions were 33 t CO_2 eq in the conventional farm semi extensive (Con1) with little agricultural crops (Table 1). The biggest value was in the organic farm (Eco2) with 81.43 t CO_2 eq per year. We did not found differences between the other farms.

CH_4 emissions are ranged from 3.6 t CO_2 eq from the conventional farm (Con1) to 13.24 for the other conventional farm (Con2), without differences between groups. N_2O emissions are estimated between 204.27 t CO_2 eq conventional farm (Con1) and 1603.16 t CO_2 eq for the organic farm (Eco2).

N_2O emissions in the study are the highest, between 84% and 90% of total emissions. This results are very different from the obtained by Bochu, et al. (2008) in France, where these emissions are 26% on organic farms and 33% on conventional farms.

The largest average CO_2 eq emissions calculated in 100 years (100YCO_2) is the organic farm (Eco2), earning 678.04 t. The remaining farms obtain similar values except 171 t CO_2 eq for the conventional farm (Con1)

Table 1. Emissions of CO_2, CH_4, N_2O in tons per year and cumulative amount of CO_2 TEQ per year for 100 years per year, the farms under study

	Eco1	Eco2	Con1	Con2	Int1	Int2
CO_2	68.15	81.43	33.00	59.22	52.86	68.21
CH_4	10.43	4.74	3.60	13.24	5.86	7.19
N_2O	409.38	1603.16	204.27	425.87	594.83	671.34
100YCO_2	**414.07**	**678.04**	**171.11**	**469.18**	**360.26**	**427.32**

With the aim to understand the results discussed above, the emisions per hectare were computed (Table 2). In all studied gases, the organic farm (Eco2) has the lowest levels of emissions for CO_2 with 0.31, 0.38 and 1.91 for CH_4 to N_2O t CO_2 eq / ha, these results defined the farm as self-sufficient. The reason is because this system uses efficiently the acres of crops for food supplies of their animals. The highest emissions were obtained in a conventional farm, Con2 obtains maximum values in all emissions, 7.4 for CO_2, CH_4 and 34.74 to 16.5 for the t eq N_2O CO_2/ha year.

Table 2. Global warming potential per hectare and year, expressed in equivalent tons per year CO_2/ha

	Eco1	%	Eco2	%	Con1	%	Con2	%	Int1	%	Int2	%
CO_2/ha	1.51	16.41	0.31	11.88	0.82	19.16	7.4	12.62	1.76	14.65	2.44	15.99
CH_4/ha	4.87	52.93	0.38	14.56	1.87	43.69	34.74	59.23	4.1	34.14	5.39	35.32
N_2O/ha	2.82	30.65	1.91	73.18	1.58	36.92	16.5	28.13	6.15	51.21	7.43	48.69
Total	9.2		2.6		4.28		58.65		12.01		15.26	

The total estimated emissions per hectare of organic farms were 2.6 t eq CO_2/ha year (Eco2) and 9.2 t eq CO_2/ha year (Eco1). The reference of the dairy sheep French in 2010 was 3 t eq CO_2/ha, within the range of our organic farms. Conventional farms with dairy breeds were 4 t eq CO_2/ha year and

58.65 t eq CO_2/ha year (Con1 and Con2 respectively). Intensive farms had higher emissions per hectare (12 and 15 t eq CO_2/ha). The range of emission in meat sheep farms in Australia, in 2010, was between 2.8 t eq CO2/ha and 4.3 t eq CO_2/ha (Browne et al., 2011), the resuls are similar to our organic farms and Con1 whose system is very extensive. For extensive systems, the Australian values are also similar to ours with 4.1-5.6 t eq CO_2/ha and year but higher than general industry (Bell et al, 2012).

Regarding the distribution of emissions, comparing our results with those obtained in the France dairy sheep sector (Bordet et al, 2010), the emission of CH_4 reachs a level of 48%. It corresponds with our results, with an exception, the Eco2 farm get a ratio of 14%.

For emissions of N_2O, the French results show a 30% of total emissions which corresponds with our results, except in Int1 and Eco2 wich reach higher values. For CO_2 emissions in France, the farms obtain values of 21%, our farms get all values below 20%.

In conclusion, the largest absolute emissions were obtained by self-sufficient organic farm, but it had the lowest emissions per hectare. Intensive farms obtain values three times higher than the Australian meat sheep farms and French dairy sheep ones. Intensive systems require an external supply of raw materials and it cause great amount of emissions. The semi-extensive organic or conventional farms have similar emissions to those obtained in the consulted references. The farm Con2 have large emissions per hectare and year, because although its production system is semi-extensive, it needed in 2011a large amount of food supplies.

Organic farms has the best level of emissions because they manage their own crops and they become self-sufficient.

Acknowledgements

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Effect of production system, organic vs conventional, on antioxidant capacity of sheep milk

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Abstract

Antioxidant capacity is a result of a delicate balance between the anti- and pro-oxidative processes and most of them are affected by the production system. Taking into account that organic sheep diet should include at least a 60% of forage the aim of this work was to study if TEAC was affected as compared with other conventional production systems. Sheep's milk samples from intensive (8), semi-intensive (10) and organic (2) flocks and two breeds- Churra (local) and Assaf (foreign)- were studied throughout 5 months. Total Antioxidant Capacity was measured using ABTS and FRAP methods. Results show a significant effect of time for both methods, showing higher values in May and June. Regarding breed and production system Assaf breed and intensive production showed the lower TEAC (ABTS) values. FRAP method results did not showed significant effect of breed but semi-intensive production system showed higher values of this parameter.

Key words: Trolox equivalent antioxidant capacity, organic, conventional, time, breed.

Introduction

The oxidative stability of milk and dairy products is of concern to the dairy industry. Milk antioxidants have important roles in preventing lipid peroxidation and maintaining milk quality (Lindmark-Månsson & Åkesson, 2000). Milk and milk fractions e.g. skim milk, whey, casein and lactoferrin have been found to be antioxidative (Cervato et al., 1999; Taylor & Richardson, 1980). The composition of the feed, in part, influences the composition of the ewe's milk, consequently certain feeding regimes can increase the content of polyunsaturated lipids (Cabiddu et al., 2005) and make the milk more vulnerable to oxidation (Focant et al., 1998) Moreover, some studies have shown that antioxidants as carotenoids, tocopherols and others can be transferred from the feed to the milk and thereby improve the oxidative stability of milk (De Renobales et al., 2010).

Among the distinctive features of organic livestock production it is remarkable that organic farming regulations (CE 834/2007) restrict the use of concentrates as well as growing promoters or feed additives. With more forage in the diet some changes in milk, including antioxidant capacity, can be expected. Recent studies on sheep's milk have demonstrated that Trolox Equivalent Antioxidant Capacity (TEAC) is primarily associated to the milk caseins but also shown that grazing significantly increased the TEAC due to the presence of low molecular weight components in whey (De Renobales et al., 2010). There is no agreement on the effect of organic production system on milk protein content. However, in general the organic milk shows significantly higher levels of mono and polyunsaturated fatty acids but also tocopherol (Bergamo et al., 2003; Revilla et al., 2009) and, as previously reported for grazing sheep, perhaps higher levels of other antioxidant compounds. Taking into account that antioxidant capacity is a result of a delicate balance between the anti- and pro-oxidative processes and most of them are affected by the production system the aim of this work was to study if TEAC of organic sheep's milk was affected as compared with conventional production systems.

Material and methodology

Sheep's milk samples were obtained from 20 commercial flocks sited in six different provinces of Castilla y León region. Samples were taken the 27 and 28th of each month from February until June. Three types of production systems- intensive (8), semi-extensive (10) and organic (2)- and two breeds- Churra (local) and Assaf (foreign)- were studied. Sheep under the intensive system (IS) remained on a feedlot and they were allowed *ad libitum* access to the commercial concentrate. Sheep under semi-extensive system (SES) remained on a feedlot for one month after the lamb birth where they had access to the commercial concentrate, after this month they went to pasture and when they back to the feedlot their diet is completed with concentrate. In this SES system there are simultaneously milked sheep in different lactating points. Finally sheep under organic system (OS) went to pasture where they were allowed to graze *ad libitum* and their diet was supplemented (maximum 30% of the ration, approximately 700 grams) with a mixture certified by the "Organic Agriculture Council of Castilla y Leon (CAECYL)". Total Antioxidant Capacity was measured using ABTS and FRAP spectrophotometric methods as described by Chen et al (2003) on skimmed milk diluted 1:10 as proposed by (de Renobales et al., 2012), using Trolox® as a reference antioxidant. The calibration curves were linear and the total antioxidant capacity was given as the equivalent amount of Trolox (mmol mL^{-1} milk). The effect of production system, breed and sampling time were considered. The significance of effects (production system, breed and sampling time) and their respective interactions were obtained using the General Linear Model procedures (1995 Manugistics, Inc.). The LSD Fisher multiple range test was used to show significant differences among means at the $p \leq 0.05$ level.

Results

The results of the TEAC for ABTS and FRAP methods for the five months analised are shown in Tables 1 and 2. Although previous works showed that the low pH necessary for FRAP method led to some protein precipitation (Chen et al., 2003) the use of skimmed milk and the applied dilution allowed the measure of TEAC by this method. The analysis of the results showed a significant effect of production system, time and their interaction for both methods ($p \leq 0.001$). Regarding sampling time, the last sampling points, May and June, had the statistically higher values for both methods. The evolution of the TEAC values (ABTS and FRAP) showed that semi-extensive and organic milk were the most affected by sampling point, while the values for intensive milk remained more or less constant pointing out this increase may be related with changes in the composition of graze with the season (Zervas et al., 2000).

Regarding the effect of production system it could be observed that according with ABTS method, milk from semi-intensive and organic production system showed higher TEAC. This result is in agreement with previous works that clearly showed that fresh grass contributes water-soluble compounds which significantly increase the TEAC of milk (De Renobales et al., 2012). This work also showed that even part-time grazing increased the nutritional quality of milk as observed for SES. In fact, according with FRAP method only semi-extensive milk showed significantly higher TEAC values.

Table 1. Means (+ standard deviation) of TEAC determined by ABTS method expressed as nmoles of Trolox® depending on production system

	February		March		April		May		June	
IS	1.290[a]	±0.009	1.280[a]	±0.013	1.297[a]	±0.017	1.297[a]	±0.020	1.298[a]	±0.011
SES	1.298[a]	±0.022	1.296[b]	±0.026	1.195[a]	±0.019	1.323[b]	±0.014	1.325[b]	±0.014
OS	1.302[a]	±0.012	1.328[c]	±0.005	1.292[a]	±0.018	1.336[b]	±0.011	1.332[b]	±0.007

[a] Different type in the same column shows statistically significant differences due to the production system.

Table 2. Means (+ standard deviation) of TEAC determined by FRAP method expressed as nmoles of Trolox ® depending on production system

	February		March		April		May		June	
IS	15.77[a]	±3.24	10.39	±2.48	14.49[b]	±2.41	14.42[a]	±1.88	15.02[a]	±1.74
SES	14.78[a]	±3.51	16.01	±4.59	15.50[b]	±5.44	20.52[b]	±6.03	13.85[a]	±5.04
OS	12.23[a]	±5.19	9.30	±0.92	8.16[a]	±5.71	15.50[a,b]	±2.27	20.11[b]	±2.22

[a] Different type in the same column shows statistically significant differences due to the production system.

Table 3. Means (+ standard deviation) of TEAC determined by ABTS and FRAP methods expressed as nmoles of Trolox ® depending on breed.

	FRAP		ABTS	
Assaf	14.88[a]	±3.50	1.295[a]	±0.002
Churra	15.59[a]	±6.52	1.318[b]	±0.018

[a] Different type in the same column shows statistically significant differences due to breed.

Taking into account that Assaf breed were reared only on IS and SES and Churra breed only on SES and OS, the effect of breed on TEAC was considered. The results (Table 3) showed that breed had a significantly effect on ABTS results, showing the Churra breed milk significantly higher values, but not on FRAP values. This result is due to the higher casein content of Churra milk (Rodríguez-Nogales et al., 2007) because TEAC(ABTS) is primarily associated to the milk caseins (Havemose et al., 2006) while FRAP method cannot detect compounds that act by radical quenching particularly proteins (Ou et al., 2002).

Table 4. Means (+ standard deviation) of TEAC determined by ABTS expressed as nmoles of Trolox ® depending on production system for each breed.

Breed	PS	February		March		April		May		June	
Assaf	IS	1.290	±0.009	1.280	±0.013	1.297	±0.017	1.297[a]	±0.020	1.298[a]	±0.011
	SES	1.290	±0.019	1.281	±0.017	1.290	±0.013	1.314[b]	±0.014	1.317[b]	±0.104
Churra	SES	1.314	±0.019	1.310	±0.026	1.301	±0.024	1.332	±0.009	1.332	±0.010
	OS	1.298	±0.012	1.328	±0.005	1.292	±0.018	1.336	±0.011	1.332	±0.007

[a] Different type in the same column shows statistically significant differences due to production system within each breed.

Due to the strong influence of breed, the effect of the production system for each breed on the TEAC was considered (Table 4). The results showed a significant effect of production system (IS *vs* SES) for Assaf breed ($p \leq 0.001$), showing the SES the higher values mainly at the end of the considered period. This result again is in agreement with the results of De Renobales et al., (2012) that conclude that part-time grazing with a small amount of concentrate supplementation increase the TEAC when comparing with intensive, indoor milk production during spring. However, no significant differences due to the production system were observed for Churra breed because both systems went to pasture and the differences in grass intake were not enough to be observed by this method.

Regarding FRAP method, no significant differences due to the production system were observed, nor for Assaf neither for Churra breed, although SES showed higher values for both breeds.

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Differences between organic and conventional ewe's milk cheese during the ripening process

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Abstract

Previous studies have shown that fat macroelements in milk were unaffected by the change of production system from conventional to organic however the fatty acid composition and microelements are affected. Since sheep's milk is used for the production of cheese and there are no references about it, the aim of this work was to study the evolution of physico-chemical, colour and textural characteristic of ewe's milk cheese of two breeds during the ripening process and to determine the influence of production system organic vs conventional on them. Results showed that freshly made organic cheese had higher values of dry extract, fat acidity, hardness and yellow colour and lower values of pH. At the end of the maturation these cheese maintained higher values of fat acidity and were yellower and darker than conventional ones.

Key words: Ewe's milk, cheese, quality, colour, texture, ripening.

Introduction

Differences between organic and conventional systems are based on the origin of the feed that the animals have and their conditions of husbandry (Council Regulation (EC) No 834/2007). However, there are other implicit factors as well as the productive system such as breed, seasonality and ripening that may influence on dairy products and make difficult the differentiation between organic and non organic product (Sundrum, 2001). Previous studies have shown that fat, protein and lactose percentages in milk were unaffected by the change of production system from conventional to organic (Bergamo et al., 2003, Revilla et al., 2009) although other studies found significant differences in macroelements (Zervas et al., 2000; Vicini et al.,2008). The greatest differences between non organic and organic systems have been found in the fat and fatty acids composition (Bergamo et al., 2003, Collomb et al. 2008) since the composition of the fat in milk is fundamentally determined by feeding of animals (Revilla et al., 2009). Thus, differences between non-organic and organic milk have been found using macro and micro elements (Gabryszuk et al., 2008) but no references have been found for cheese.

Sheep's milk is used almost exclusively for the production of cheese, so the aim of this work was to study the evolution of physico-chemical, colour and textural characteristic of ewe's milk cheese of two breeds (Castellana and Churra) during the ripening process and to determine the influence of production system organic vs conventional on them.

Material and methodology

Bulk tank ewe's milk from flocks of two local breeds (Castellana and Churra) and two production systems (organic and conventional) all of them from the same geographical area (Zamora, Spain) were taken on the first week of February. Cheeses were manufactured in accordance with the Regulatory Board of the Zamorano Cheese Denomination of Origin (BOE, 1993). Raw milk (150 L), not standardized, was incubated with 5.78 mg L^{-1} direct-vat-set starters made of Streptococcus lactis, Strep. cremoris and Strep. diacetilactis, (MA400, Choozit, Danisco, Sassenage, France) at 32 ºC. After 30 min at 32 ºC, when the pH was 6.5-6.6, 0.30 ml L^{-1} calf rennet (1:150,000 strength) was added to each vat. Coagulation was allowed to take place over 50 min. When the coagulum had developed the desired firmness, evaluated subjectively, the curds were cut with a cheese harp until pieces similar in size to a grain of rice were obtained. Then, the curd was stirred and heated for 25 min at 36 ºC until it had reached the desired consistency to improve its drainage with sieves. The curd was packed in round hoops (2.5 kg) and pressed for 6 h, starting at1.5 kg cm^{-2} up to 4 kg cm^{-2} at 15 ºC. After pressing, the cheeses were salted by soaking them in sodium chloride brine (11º Baumé) at 15ºC for 24 hours. The cheeses were then moved to a drying chamber where temperature (11ºC) and relative humidity (82-87%) were controlled. After two months the cheeses were moved to another chamber at 5-7ºC and 80-85% RH. For each manufacturing process, two cheeses were removed from each vat for analysis at 0, 1, 2, and 3 months of ripening.

Cheeses were analysed for pH (potentiometric method, CRISON Basic20), fat (Van Gulik method, ISO 1975), moisture (IDF, 1982), ash (AOAC, 2000) and fat acidity (IDF, 1969). To determine the instrumental texture six rectangular parallelepipeds, 1 x 1-cm thick and 3 cm long, were obtained from a slice from the central diameter of each cheese wheel. A TX-T2iplus equipped with a Warner-Bratzler probe (Stable Micro Systems, Surrey, England) was used to determine the instrumental texture. The crosshead speed was 1 mm/s and the maximum peak force necessary to cut each parallelepiped transversally and completely was recorded (WBSF). Cheese colour was measured with a MiniScan XEPlus on the central slice and CIELab parameters were calculated for the CIE illuminant D_{65} and 10º standard observer conditions. The parameters calculated were lightness (L*), redness (a*) and yellowness (b*) (C.I.E., 1976). Data were analysed by one-way analysis of variance (ANOVA) (1995 Manugistics, Inc.).

Results

Regarding the physico-chemical parameters (Table 1), the results revealed statistically significant differences in freshly elaborated cheeses for pH, dry extract and fat acidity. However, at the end of the ripening process the differences were statistically significant only for fat acidity and ash. The lower pH of organic cheese is agreement with the lower pH observed for the milk (Revilla et al., 2009). The evolution of the cheese showed an initial decrease in the pH up to the second month, due to the conversion of lactose into lactic acid by acidolactic bacteria during the first 30 days of ripening (Upreti et al., 2006). After proteolysis, these release neutral and basic groups moities (Sousa et al, 2001), which leads to an increase in the pH. A more intense proteolysis in organic cheeses would explain why the differences began to decrease until they disappeared. Regarding the dry extracts, the absence of differences for fat, lactose and protein contents observed between organic and conventional ewe's milk (Revilla et al., 2009) shows that the lower value of this parameter observed in freshly elaborated organic cheeses could be attributed to the lower pH of these cheeses that favoured the syneresis process (Vivar et al., 2008). The differences disappeared up to the second month of ripening because the drying conditions were identical. Finally, fat acidity was significantly higher in organic cheeses than in conventional ones. This parameter is related to higher levels of free fatty acids and hence with a more intense lipolytic activity (Bachman et al., 1988). In addition, the differences between both production systems increased with the ripening time. Finally, the ash content did not show significant differences in freshly elaborated cheeses, in agreement with the composition of the milk. However, the ash levels were significantly higher in organic cheeses up to the second month of ripening, which could be due to a more intense proteolysis, as pointed out previously, which would have produced a higher mineralization of the samples.

Table 1. Means of physico-chemical parameters during the ripening period depending on the production system organic (Org) or conventional (Conv).

	pH		Dry extract		Fat		Fat acidity		Ash	
Month	Org.	Conv.	Org.	Conv.	Org.	Conv.	Org.	Conv.	Org.	Conv.
0	5,22[a]	5,31[b]	56,58[b]	54,65[a]	53,01[a]	52,57[a]	0,68[b]	0,48[a]	3,19[a]	3,17[a]
1	5,12[a]	5,10[a]	60,95[b]	59,75[a]	53,43[a]	51,08[a]	0,92[b]	0,57[a]	3,96[a]	3,81[a]
2	5,06[a]	4,96[a]	61,92[a]	61,01[a]	53,57[a]	53,98[a]	1,10[b]	0,82[a]	4,20[b]	3,96[a]
3	5,11[a]	5,18[a]	63,97[a]	62,32[a]	54,75[a]	53,86[a]	1,40[b]	0,92[a]	4,26[b]	4,07[a]

[a] Different type in the same row shows statistically significant differences for each parameter due to the production system.

Freshly elaborated organic cheeses showed a significantly higher hardness (WBSF) (Table 2) related to their lower dry extract, since the higher the moisture of the cheese, the lower the hardness, fracturability, chewiness and gumminess (Pinho et al., 2004). As ripening progressed, the values for WBSF increased due to the decrease in moisture, because water acts as a plasticiser in the protein matrix, making it less elastic and more susceptible to fracture upon compression (Fox et al., 2000). Water molecules are bound in the three-dimensional protein matrix and weaken the structure of the network. Since moisture evolution was similar under both production techniques, and since in medium-matured cheeses this effect predominates over others such as proteolysis, at the end of the period considered the cheeses from both systems did not show statistically significant differences as regards this parameter.

Table 2. Means of textural and colour parameters during the ripening period depending on the production system organic (Org) or conventional (Conv).

	L*		a*		b*		WBSF	
Month	Org.	Conv.	Org.	Conv.	Org.	Conv.	Org.	Conv.
0	93,03[a]	93,57[a]	-0,77[a]	-0,67[a]	16,30[b]	13,23[a]	4,15[b]	3,59[a]
1	86,39[a]	89,22[b]	-0,77[a]	-0,74[a]	23,97[b]	19,26[a]	4,43[b]	3,17[a]
2	86,78[a]	89,71[b]	-0,98[a]	-0,93[a]	23,32[b]	18,65[a]	3,82[b]	3,11[a]
3	87,41[a]	89,64[b]	-0,88[a]	-1,06[a]	22,34[b]	18,54[a]	4,41[a]	4,32[a]

[a] Different type in the same row shows statistically significant differences for each parameter due to the production system.

Regarding instrumental colour, at the beginning of the ripening period, organic cheeses had a more intense yellow colour. This observation could be related to the composition of the starting organic origin of the cheese, which –as reported previously (Revilla et al., 2009), was more enriched in unsaturated fats, which are characterized by a yellower colour. However, it could also be due to the greater inclusion of green pasture in the diet of the organically raised sheep, which could afford compounds such as carotenes or hitherto unknown elements (Priolo et al., 2003), leading the cheese to become more yellow. The differences in the b* parameter increased during the ripening period, and as from the first month of ripening the organic cheeses were also significantly darker, with a lower L* value. Colour changes are due to the processes that occur during ripening, such as the loss of moisture, proteolysis and lipolysis (Saldo et al., 2002), which seem to be more intense in organically produced cheeses, as observed in the physico-chemical parameters.

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Sainfoin – New Data on Anthelmintic Effects and Production in Sheep and Goats

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Abstract

Gastrointestinal nematodes (GIN) are one of the most important problems affecting health and therefore performance and welfare in small ruminant husbandry. The control of these parasites in the past strongly relied on the repeated use of anthelmintic drugs. This has led to nematode populations which are resistant to most of the currently available anthelmintics. Furthermore customer's demands for organic and residue free animal products are increasing. The aforementioned problems have given a strong impetus for the development of new non-chemical strategies to control GIN. Previous research has pointed out the anthelmintic potential of sainfoin (*Onobrychis viciifolia)* and other tanniferous (CT) feed sources in goats and lambs infected with GIN. A recent Swiss experiment focussed on the use of sainfoin and field bean (*Vicia faba,* cv. Scirocco) as single CT sources as well as in combination for additional synergic effects, to reduce periparturient GIN egg rise of ewes in late gestation and early lactation. Another experiment with Alpine goats concentrated on the influence of sainfoin on milk performance and cheese quality. The results of these experiments will be presented and discussed in connection with previous knowledge on (i) anthelmintic effects of sainfoin and (ii) the influence of sainfoin administration on performance.

Introduction

Infections with nematode parasites remain a major threat to small ruminants worldwide. This is particularly relevant in grazing livestock systems. As organic farm animals should have daily access to pasture (or an open-air based exercise area), contact and therefore infection of goats and sheep with pasture borne-parasites is unavoidable. At the same time, the IFOAM Basic Standards for Organic Production (IFOAM, 2005) suggests the use of natural remedies and treatments. This commits organic farmers to use preventive procedures to minimise the use of chemotherapeutic treatments. However, the abdication of anthelmintics only works to some extent, as therapeutic application often remains essential to cure livestock suffering severe infection with gastrointestinal nematodes (GIN) (Waller and Thamsborg, 2004). The emphasis on preventive procedures on the one hand and increasing nematode populations resistant to anthelmintics on the other hand (Besier and Love, 2003; Jackson and Coop, 2000; Voigt et al., 2012; Waller et al., 1996), constrains farmers and scientists to find novel solutions for a sustainable control of GIN. Promising approaches such as grazing management, genetic selection, nutrition and nutraceuticals have been investigated (Hoste and Torres-Acosta, 2011). Nutraceuticals amongst other, refer to feeds containing plant secondary metabolites such as condensed tannins (CTs). CTs are assumed to have a direct anthelmintic effect (Hoste and Torres-Acosta, 2011). In Central Europe (e.g. France, Switzerland) studies have focused on the anthelmintic effect of the tannin containing legume sainfoin (*Onobrychis viciifolia*) of the *fabaceae* family (Heckendorn et al., 2007; Heckendorn et al., 2006; Paolini et al., 2005). The choice of this species is mainly linked to its comparatively good agronomic properties under Central European climate conditions (Häring et al., 2007), amongst which the tolerance of *O. viciifolia* to cold, drought and low nutrient status are of particular importance (Carbonero et al., 2011).

Although a substantial body of knowledge on anthelmintic properties of sainfoin have been compiled with respect to lambs, the impact of sainfoin feeding on periparturient egg rise (PPR) in ewes or the effect of sainfoin administration on product quality of dairy sheep and goats (e.g. milk, cheese) have not been investigated so far. We therefore designed a study (Study 1) to investigate the effect of the administration of a sainfoin diet to reduce parasite egg excretion of PPR ewes and its potential to minimise pasture contamination during PPR when animals are turned out on pasture after lambing. Additional to sainfoin, in this study, the anthelmintic properties of a tannin rich concentrate (*Vicia faba*) was investigated. The rationale of the PPR is, that ewes in late gestation and early lactation often show an increased susceptibility to nematode infection. In another experiment (Study 2) we looked at the impact of sainfoin administration on the quality of goat milk and cheese. The background of this work was the reluctance of farmers to use sainfoin as fodder with anthelmintic properties without knowing the effect this might have upon product quality.

Study 1: Effect of sainfoin and faba bean on GIN in periparturient ewes

A herd of Red Engadine ewes in late gestation was randomly distributed to four comparable groups. To allow a differentiation of the effect of single CT sources (e.g. sainfoin and faba bean) and their combination, the following groups were established: A control group (C) received a ryegrass and clover mixture (n = 21). A sainfoin group (S; n = 19). A faba bean group (B) fed with 500 g faba bean pellets per day and a ryegrass/clover mixture (n = 19). Furthermore, a combined sainfoin/faba bean group (SB) fed with sainfoin and 500 g faba bean pellets (n = 19). Total trial time was 29 days. Feeding start was at day 4 of the experiment. Ewes were naturally infected by grazing and experienced an additional super infection with 1500 *H. contortus* infective third-stage larvae (L3) 20 days before trial start. During the 29 day trial faecal sampling took place every 3^{rd} to 4^{th} day. Individual faecal egg counts were performed using a McMaster technique at a sensitivity of 50 eggs per gramm faeces. A corresponding subsample of faeces was dried at 105°C to constant weight for dry matter assignment and FEC was corrected for dry matter content and expressed as Faecal Egg Count Dry Matter (FECDM).

Statistics

Data were analysed using a linear mixed model (LMM), where FECDM was the repeatedly measured dependent variable from trial days 1 to 29. All analyses were performed at animal level:

$$Y_{ij} = \mu + group_j + lamb_j + time_{ij} + group_j{*}time_{ij} + id_j + \epsilon_{ij}$$

where y = dependent faecal egg count with dry matter correction (FECDM) for every individual (i) at occasion (j), μ = overall mean effect (intercept), *group* = group affiliation effect for every individual (i), *lamb* = effect of number of lambs for every individual, *time* = effect of changes of the repeated dependent variable for every individual (i), *id* = control for the characteristics of the individual at occasion (i) (random intercept) and ϵ = error term for every individual (i) at occasion (j). The two way interaction between *time* and *group* was included in the model.

Results

Considering change in FECDM over trial period, significant differences were found in slope for groups S and SB (- 1.51 and + 18.56 per day, respectively) compared to C (+ 224.09 per day). In contrast, change in group B (+ 244.03 FECDM per day) was not statistically different from C. Having two or more lambs increased FECDM about 727.34 versus having a single lamb, however difference was not significant. FECDM data are displayed in figure 1. Independent variables, standard errors and corresponding p – values are shown in table 1.

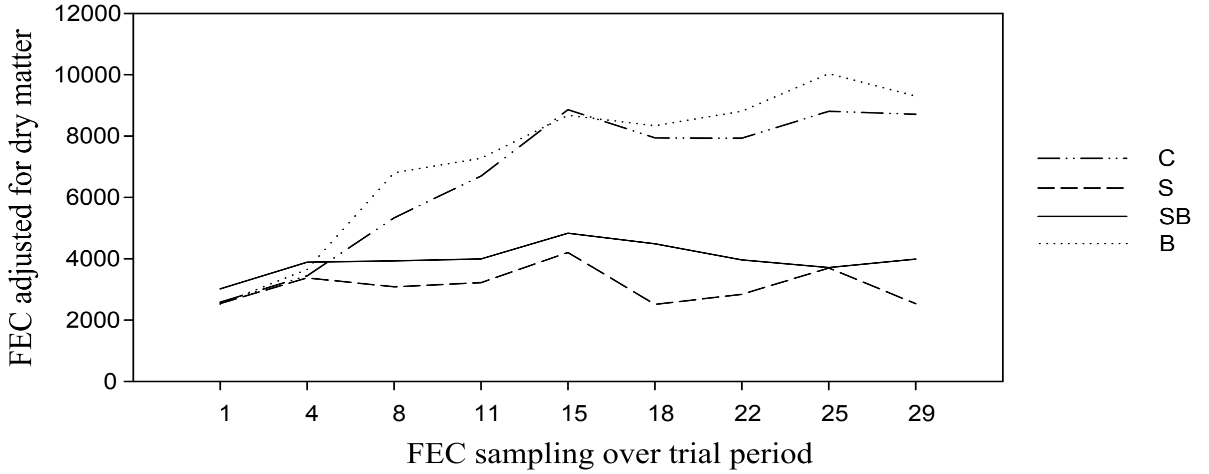

Figure 1. Faecal egg count [FEC; adjusted for dry matter (FECDM)] development of feeding groups over total trial period (original data) for groups SB (sainfoin & faba bean), B (faba bean), S (sainfoin) and C (control). Average lambing date was day 14.63 ± 1.67. Error bars are not displayed due to clarity of illustration.

Table 1. List of independent variables, their coefficients, standard errors and corresponding p – value explaining correlation in FECDM

Variable	Coefficient	Standard Error	P - value
Group S	- 295.19	953.47	0.757
Group SB	239.60	956.00	0.802
Group B	193.76	953.74	0.839
> one lamb	727.34	687.74	0.290
Time	224.09	20.21	< 0.001
Time x Group S	- 225.60	29.30	< 0.001
Time x Group SB	- 205.52	29.30	< 0.001
Time x Group B	19.94	29.30	0.496
Constant	2892.35	800.53	< 0.001

Study 2: Influence of sainfoin on goat cheese quantity and quality

Twelve lactating Alpine goats (mean 2.6 lactations) were used for the study. All animals were group fed with dehydrated alfalfa and ryegrass hay for a period of 15 days (control feeding period, CFP). Thereafter the feeding was switched to sainfoin hay for another 15 days period (sainfoin feeding period, SFP). Rations administered in CFP and SFP where balanced with commercial concentrates in order to assure isoproteic and isoenergetic feeding throughout the experiment. On day 10 of the respective feeding period, milk yield was determined for every goat and milk was analysed for fat, protein and urea content. Furthermore, milk collected between day 4 and 15 of the respective feeding period was separately transformed to cheese and matured for 8 weeks. The matured cheese resulting from the CFP and the SFP period were subjected to sensory analysis using 12 panellists and the two-out-of-five test with corresponding statistical analysis (Hough, 2012). Feed and milk data were analysed with paired T-Tests and p-values were corrected for multiple testing using the Bonferroni procedure (Hochberg, 1988).

Results

Mean daily feed intake for CFP and SFP and corresponding nutritive values are given in table 2. During the SFP animals ingested significantly less fibre ($p<0.05$) when compared to CFP. There were no statistical differences with respect to DM, energy and protein intake.

Table 2. Mean feed intake during CFP and SFP and corresponding nutritive values.

	Intake			
Experimental period	Kg DM	Energy[1] (MJ/kg)	Protein[2] (g/kg)	Fibre (g/kg)
CFP	2.5	13.3	221.0	675.4
SFP	2.1	12.0	231.3	486.9*

[1]Net energy lactation, [2]Protein absorbable at duodenum, * = significant difference at $p < 0.05$

There was no difference in milk yield between CFP and SFP (table 3). However, sainfoin feeding was associated with significantly increased milk protein and milk fat contents ($p<0.01$ and $p<0.05$) while urea levels were comparable between CFP and SFP.

Table 3. Mean milk yield and milk contents in CFP and SFP.

	Yield (kg)	Fat %	Protein %	Urea (mg/dl)
CFP	1.56	4.13	3.06	52.9
SFP	1.37	3.55**	3.79*	50.9
Difference	-0.19	-0.58	+0.73	-2.0

* = significant difference at $p < 0.05$; **significant difference at $p < 0.01$

Sensory analysis revealed a significant difference in flavour of the cheese produced during CFP compared to the one produced during SFP ($p<0.05$). However, there was no preference for either type of cheese.

Discussion

The results of the first study demonstrate that sainfoin feeding in the case of the PPR significantly reduced egg excretion (-55%) in comparison to a control feed. A reduced number of excreted eggs not necessarily implies a reduction in worm burden. However, a reduction of this magnitude may downsize infection risk for parasite naïve animals grazing the pasture subsequently. Our results are in line with the findings of other studies which found a FEC reduction of comparable size in lambs (Heckendorn et al., 2007) and goats (Paolini et al., 2005). The administration of faba bean did not have an effect on egg excretion. Neither separately nor in addition to sainfoin. One possible explanation for this finding might be the low tannin content of the used batch of beans, which was approx. 1.5-fold lower compared to sainfoin forage. Bean intake of ewes in the SB group presumably reduced sainfoin intake and thus might have lowered total CT ingestion. The absence of an effect on egg output in group B may have been due to a dilutive effect of tannin concentration by control feed. The faba bean variety 'Scirocco' was promising in order to test its anthelmintic properties (Makkar et al., 1997). However, tannin concentrations in literature are difficult to compare due to methodological and laboratory distinctions. Equally important is the immense structural diversity of tannins in feeds (Mueller-Harvey, 2006). Therefore an alternative explanation for the lack of effect of faba bean could be the tannin structure which might not be suitable for nematode control.

The second study showed that sainfoin feeding does not negatively impact either on milk yield or on milk quality. On the contrary, our results suggest that the administration of sainfoin is associated with increased milk protein content and decreased milk fat content. Although cheese production parameters were not determined in this study, it is possible that the higher protein content in the milk of sainfoin fed goats may lead to a higher cheese yield. Panellists could not point to a preference of the cheese produced from animals fed alfalfa/hay when compared to sainfoin. Nevertheless they were able to discern the two types of cheese, which in turn may also be beneficial from a commercial point of view, because diversity in taste is in demand by consumers.

The fibre intake in SFP was low when compared to the intake in CFP. This most probably is a result of the feeding habits of goats, which are highly selective (Jalali, 2012). We found that most of the leaves within the sainfoin hay where consumed by the animals while the stems where left over. The selection of leaves in the sainfoin ration was much easier than in the alfalfa ration as the sainfoin hay was not chopped before administration while alfalfa was. For future experiments where balanced feeding is of importance, it is suggested to find ways of sainfoin administration which reduce selective feeding.

Our study on milk and cheese quality showed that sainfoin feeding does not negatively influence product quality. Moreover the PPR study has shown the potential of sainfoin feeding as a preventive procedure to lower pasture contamination. Overall, administration of sainfoin may be a useful strategy to avoid/reduce anthelmintic treatments.

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Effect of vitamin E and selenium and different types of milk on health and growth of organic goat kids

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Abstract

Newborn goat kids are low in blood levels of vitamin E and selenium. Not known is how this affects health and growth of the kids. In a study on an organic farm 40 kids were allotted to 4 groups. Parenteral administration of 0.5 ml vitamin E and selenium solution (treated groups) or 0.5 ml salt solution (placebo) at the day of birth was combined with powdered full goat milk or goat milk replacer during the raising period.

The milk-groups were housed in one group. Housing conditions and additional feed were the same for all groups. Blood samples were taken at days 0, 31 and 102. Kids were weighed at blood sampling days and at day 14. Health and medical treatments were recorded by the farmer.

In goat milk selenium content was 116 µg/kg and vitamin E was 1.5 mg/kg while milk replacer contained 682 µg/kg and 102.7 mg/kg resp. Health did not differ between groups and number of treatments were low. No kids were lost till day 31 indicating a good farm management. Blood GSH-Px and vitamin E values in treated groups and in milk replacer groups were significantly higher than in placebo groups and goat milk groups at day 31 but not at day 102. The average daily gain in the first 14 days, the first 31 days and over the whole period of 102 days was 181, 181 and 165 grams. Treated groups gained on averages 10 grams more a day than the placebo groups, milk groups did not differ in daily weight gain. Although blood levels are different between treated and between milk groups, no relevant differences in health and weight occurred under well managed farm conditions.

Key words: organic goat kid, vitamin E, selenium, blood values, weight gain

Introduction

In newborn goat kids selenium and especially vitamin E can be very low, although Ghany-Hefnawy et al (2007) state that goat keep the selenium status in kids at a high level. Smolders et al, 2010 found low blood levels of vitamin E in kids although the level in pregnant goat were at an acceptable level. This could negatively affect resistance in kids and cause health problems and high mortality rates. Administering selenium and vitamin E could have a positive effect on animal health and on mortality of newborn goat kids. Shi et al (2010) found no difference in the form of selenium supplied. On the other hand supplementing selenium and vitamin E could result in zinc deficiency (Kojouri&Shirazi, 2007). In the Netherlands temporarily overproduction of goat milk occurs. To keep the milk price at a acceptable level, the surplus milk from a cooperation of goat farmers is taken from the market and powdered. It is used to feed goat kids in automatic feeder systems to avoid contact with the mother because of high risk of infection with Johne´s disease. Not known is whether minerals and or vitamins should be added to promote daily gain and health of goat kids.

Material and methodology

On an organic goat farm with 800 dairy goats in the lambing period October – November 2010 40 newborn goat kids were allotted to 4 groups within two day. The design of the experiment is shown in table 1.

Table 1. Design of the experiment with 10 kids per group

Milk	Goat milk (full, powdered)		Milk replacer	
Treatment	0.5 cc Vitesel	0.5 cc placebo	0.5 cc Vitesel	0.5 cc placebo

Within an hour after birth the kids were collected from the barn with the pregnant and lambing mothers. The first 20 kids were placed in a group supplied with powdered full goat milk and the second lot of 20 kids was placed in the group supplied with milkreplacer[8], in the same barn and the same housing system with long straw as bedding material. In both groups 10 kids were treated with Vitesel[9] and 10 kids were treated with salt solution as a placebo. The kids were separated from the mother before they could get colostrum. The kids were weighed, eartaged, injected with either 0.5 ml of Vitesel or 0.5 ml salt solution and supplied with the first colostrum replacer from a bottle with teat within two hours after birth. Weighing was done at a person scale with the caretaker and the kid. The first two days colostrum replacer was fed by automatic feeders and also the powdered milk and milk replacer were supplied by automatic feeders till weaning at 12 kg live weight (about 6 weeks of age). Hay and concentrates were available from 5 weeks after birth. Blood samples were taken before administering the vitamin E + selenium solution at about 2 hours after birth (=day 0), at day 31 and at day 102. Blood samples were stored at 4 degrees Celsius and transported to the laboratory the next day for analysing GSH-Px and vitamin E. The kids were weighed at days 0, 14, 31 and 102. Powdered full goat milk and milk replacer were analyzed for minerals and trace elements. Diseases were recorded by the farmer and treatments were given in accordance with the practicing veterinarian.

Results

Full powdered goat milk contained less selenium (116 vs. 668 µg/kg) than milk replacer and also vitamin E was lower in goat milk (1.5 vs. 102.7 mg/kg respectively). In table 2 the mean and standard deviation of the GSH-Px blood values of the goat kids at day 0, day 31 and day 102 are given per treatment and milk group. At day 31 the treated kids have significantly higher GSH-Px values than the placebo kids and the kids fed with milk replacer have higher values than the kids fed with powdered full goat milk. At day 102 the differences between groups decreased but all groups had high GSH-Px blood levels.

In table 3 the mean and standard deviation of the vitamin E blood values at day 0, day 31 and day 102 are given per treatment and milk group. At day 31 the powdered goat milk group kids have a significant lower vitamin E blood level than the other groups while the vitamin E blood level in the milk replacer group is significantly higher than the other groups. The high standard deviation in the Vitesel and placebo group at day 31 indicates large differences between kids within the groups, caused by differences in goat milk and milk replacer. At day 102 differences fades away and groups have the same vitamin E level.

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[9] Vitesel (Vitamin E + Selenium), Norbrook Laboratories Ltd, Northern Ireland

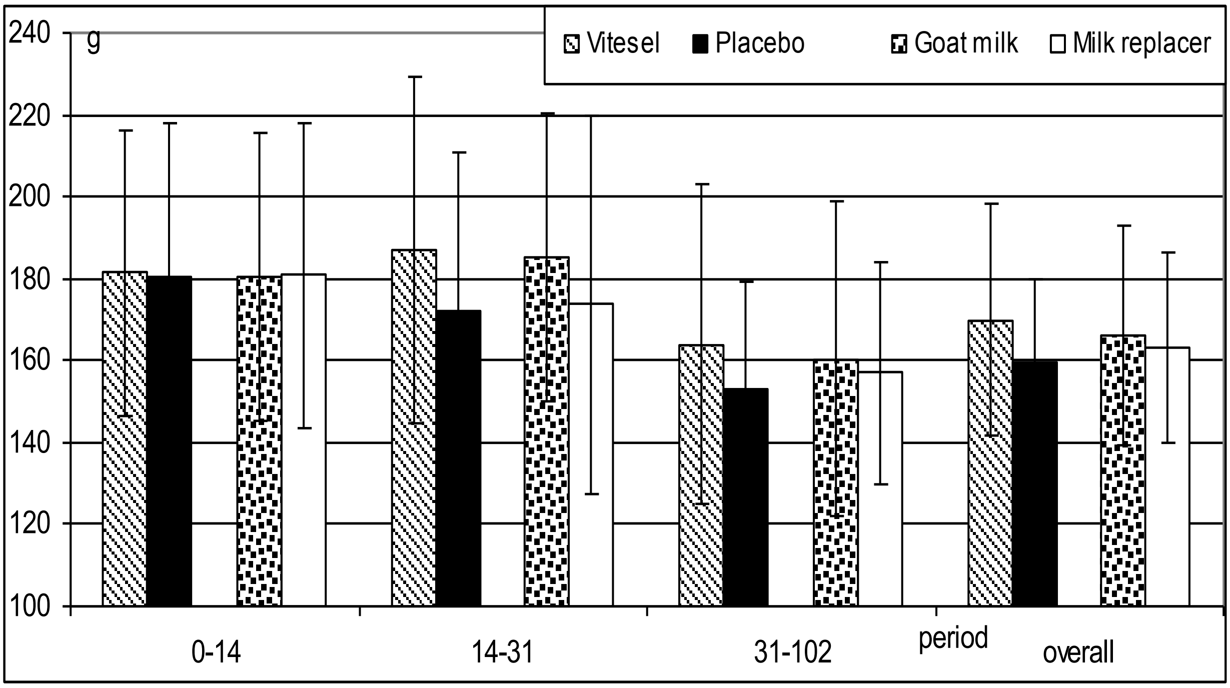
Table 2. Mean ± stdev of GSH-Px-values in blood of organic goat kids treated with Vitesel or placebo and fed with powdered full goat milk or milk replacer

Group	Treatment		Milk	
	Vitesel	Placebo	Goat milk	Milk replacer
Day 0	384±71	435±110	427±121	392±56
Day 31	840±155	697±172	660±170	877±104
Day 102	887±266	844±255	933±125	797±333

Table 3. Mean ± stdev of vitamin E-values in blood of organic goat kids treated with Vitesel or placebo and fed with powdered full goat milk or milk replacer

Group	Treatment		Milk	
	Vitesel	Placebo	Goat milk	Milk replacer
Day 0	0.18±0.10	0.31±0.30	0.38±0.27	0.11±0.02
Day 31	6.41±5.89	5.36±5.47	0.67±0.60	11.10±2.75
Day 102	2.34±0.83	2.46±0.76	2.22±0.80	2.58±0.69

Figure 1. Mean and stdev of daily gain (in g) of organic goat kids per period in treatment and milk groups



The daily gain of the kids in different periods is given in figure 1. There are no significant differences in daily gain between groups, nor within treatment groups nor within milk groups.

The health status of the kids was good. In the treated group two kids had meningitis and one kid was lame. In the placebo group one kid was lame, one had diarrhoea and one kid died for unknown reason. In the goat milk group one kid had meningitis, one was treated for diarrhoea and one was lame while in the milk replacer group one kid had meningitis, one was lame and one kid died for unknown reason.

Discussion

The GSH-Px- values are at a high level from day 31 on. In goat the reference values are adapted from cattle and should preferably be between 120 and 600 U/g Hb (Dercksen et al, 2007). It seems that not only older goats but also goat kids use selenium in feed very efficient: at day 31 the mean values in all groups exceeds the upper reference value. The vitamin E values at day 31 are at a very low level in the goat milk group, due to a lack of vitamin E in the diet and despite the treatment with Vitesel. The kids in the milk replacer group showed extreme high vitamin E blood values at day 31. After weaning and with a diet of roughage and concentrates the vitamin E values equalizes over groups at a low level, compared to reference values (Smolders et al, 2010). Seeing the development of the daily gain of the kids in the different periods and overall, these different vitamin E values do not have an effect on development of the kids. All groups realize an acceptable weight gain. Circumstances and management on the farm were the experiment was executed was excellent, with much focus on offering good quality roughage and concentrates during and after the weaning period. In those conditions injection of selenium and vitamin E seems not effective. Even with the lower mineral and vitamin content of powdered full goat milk, compared to the content in milk replacer, daily gain and health of the kids were not negatively affected.

Suggestions to tackle the future challenges of organic animal husbandry

In organic goat husbandry prevention of diseases should be the main focus, preferably in natural surroundings. That also includes feeding according to requirements with a diverse diet offering goat kids at a young age good quality roughage and high quality concentrates supports sufficient intake of minerals, trace elements and vitamins and promotes resistance and a better chance to self cure and no need for using antibiotics.

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The romanianTsigai sheep breed, their potential for organic cheese production

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Abstract

The indigenous Tsigai sheep is the second most important sheep breed in Romania. The share is 24.3% of the total sheep in the country. Until 1989, Tsigai sheep were mainly kept for wool production, milk and meat were coproduction. During the communist period research focused mainly on wool production and wool characteristics. The production targets of sheep keeping in Romania has changed. Since 1989, the total number of Tsigai sheep decreased by 44% to 2.100 mio ewes. Given this aspect and the fact, that after 1989 keeping directions of Tsigai breed have changed, lamb and milk production are equal importance*. Nowadays, wool production is nearly unimportant. It is desirable to know the current state of Tsigai breed and to define and design strategies to rescue this local breed with new functions and performance. This shall be the future target of the research station in Reghin. A participatory study has been carried out in 2011 to define the future strategy for Tsigai sheep research. The results of the study showed that 77 % of the total surveyed farms predict that they will increase the sheep number in the future. In terms of direct payments per area, 90 % of breeders receive payments/land area. 37 % of the breeders believe that without payments/land area, they would not practice this activity. The direction of sheep raising is for milk-meat for 77 % of the surveyed farms. In the future, provided significant changes of sheep keeping direction of Tsigaie breed for meat-milk production (53 %). Organic cheese production is considered as a market option for the export.*

Key words: Tsigai sheep breed, milk, meat, research, Romania, organic cheese

Introduction

Sheep keeping were, is and will be important part of Romanian agriculture. 20 % of the country areas and about 30 % of Romanian agricultural areas is represented by permanent pasture (about 5 million ha) (Maruşca 2011). This area, other marginal land and marginal agricultural products can feed 12 to 16 million sheep. Today less than 9 million sheep are kept in Romania. Moreover in Romania there is still a great tradition and experience for sheep production with adopted local and multi-purpose breeds. Second important sheep breed in Romania is the Tsigai sheep with 24,3% of the national sheep herds (first is the Turcana sheep with 52,4%). Tsigai breeds are kept in mountain and submontain regions with large areas of pastures in an extensive way. Like Turcana, Tsigai sheep breeds are multipurpose breeds with focus on cheese production. The lamb production becomes more interest in the last years, due the possibilities to export the lambs, being in live delivered in the largest share in the EU countries.

Having to face the twentieth century challenge, to change from and to the market economy, Romanian sheep production is now in a turning point with no clear future. This paper will try to explain the recent performance and the future outline of the Tsigai breed. The role and the challenges for research in context of the socio-economic frame conditions in Romania to develop and protect this adapted breed will be derived.

Today, Tsigai breed are kept in Romania for their dairy products, for the slaughtered young lambs (4-6 weeks, 10-12 kg), and for wool production. The ewes are milked. The performance of some Romanian sheep breeds for milk production and milk composition is shown in Table 1.

Table 1. The performance of some Romanian sheep breeds

Breed	Milk production (liters)	Fat (%)	Protein (%)	Solid (%)
Turcana	100-140	7,7	6,0	16,65
Tigaia	70-90	7,0	6,5	15,02
Merinos de Cluj	85-95	7,4	6,3	13,49

Source: Lujerdean et al. 2009

Sheep's milk is consumed only as processed (either traditional or industrial) in the form of feta cheese, sheep cheese or other products obtained only from sheep or sheep's milk mixed with cow's milk. Cheese consumption in Romania is around 2.5 kg $year^{-1}$ $person^{-1}$ (Nistor et al 2010). Most of the milk production is traditional processed, and is for family consumption or for sale on tourist markets or peasant markets, through direct marketing channels. A small amount of milk production is delivered to processing companies and marketing channel in this case is short, consisting of processor, intermediary and consumer (Manole, 2011). The main traditional products made from sheep's milk are: „caş'' (cheese), „brânza de burduf'' (a strong, salty and kneaded cheese kept in stomach/skin of the sheep), „brânza în coajă de brad'' (kneaded cheese kept in pine bark), telemea (a fresh, whole feta-type cheese), „urda'' - is made with the whey of the „caş'' (cheese). It is like ricotta, relatively high in protein and low in fat.

Milk production and its transformation into different products are important activities that contribute to the supplement of farms income, but, unfortunately, sale of dairy products is poorly organized. An important outlet could be foreign market, where products obtained by traditional methods enjoy a good appreciation, demand being in growing. A new string of organic production is appearing. Organic sheep cheese farms are more professional compared to traditional production.

Because Tsigai race is a rustic breed, over time there were a series of researches to improve milk and meat production, works which were based on the use of industrial crossings with imported specialized breeds.

Thus, to improve milk production of Tsigai breed, at Research Institute of Palas Constanta were conducted industrial crossing in the period 1975-1983 between local Tsigai breed with rams from Awassi and East-Friesian sheep breeds. Although the yields obtained from female crossbred were superior to Tsigai breed, introducing a crossing program was not possible, because the breeds used in the experiment was difficult to adapt to environmental conditions in our country (Păunescu et al. 1985).

The starting point to avoid giving up the raising of Tsigai breed, it would be an economic motivation, that will provide decent incomes for families of sheep breeders. As noted, the most important reason for increasing the national sheep flock since 2002 has been awarded grant for animals under the *official control of production* (OCP), and since 2007 by providing animal and land area payments, which has been beneficial for farm development.

In this context, finding new niches to bring added value (organic) to sheep farms would be a good argument for the breed preservation and keeping.

Material and method

For the collect information, were made visits in sheep breeders farms, surveys and telephone interviews. Regarding data collection, visits were made on farms and telephone interviews in 30 small, medium and large sheep farms (10 from each category). The investigation was conducted in November-December 2011. The addresses of surveyed sheep farms were taken from breeders' associations.

For the survey achievement, before was conducted a questionnaire comprised 55 questions grouped into seven categories, as follows: data on the farm (12 questions), farm management with questions related to milk, meat and wool production (19 questions), market and marketing (4 questions), the existence and necessity of research units (9 questions), research and development (1 question), education and extension (5 questions), organic agriculture (5 questions).

The interviews lasted between 15 and 45 minutes, the average was estimated at about 20-25 minutes. At the end, was requested opinion of sheep breeders regarding survey questions and points of view, that were not included in the questionnaire.

Results

In total were 30 farms surveyed which have 18 273 sheep of Tsigai breed (average 609.10 ± 160 sheep). Tsurcana breed can be found alongside the Tsigai breed in 43 % of the surveyed farms. Of the total surveyed farms, 77 % predict that they will increase the sheep number in the future. A percentage of 33 % of the farms were included in the official control of productions (OCP). Practicing this activity, provide a decent living for 70 % of farmers family, those who can't provide a decent family living by practicing this activity are generally farms with effective till 350 sheep, and only a farm with over 800 sheep. 73 % of surveyed farms have foreign staff employed at farm, works being carried out, both in winter and summer, by family members.

Currently, the direction of sheep raising is for milk-meat for 77 % of the surveyed farms. In the future, provided significant changes of sheep keeping direction of Tsigaie breed for meat-milk production (53 %). The main reason for the orientation of sheep breeders of meat-and-milk production is the lack of human resources. Farmers believe that, if sheep raising is oriented for meat production, labor volume is much lower (by removing the milking and leaving lambs to suck up to the end of August). On the other hand, increasing demand for meat production and satisfactory prices obtained from the lambs capitalization is a strong enough motivation for them, to straighten to this production.

In terms of milk production, 93 % of the farmers are satisfied with the milk production obtained from Tsigai breed. Although farmers believe that milk yields from Tsigai sheep is good, 77 % want to improve this production in the future by crossing it with specialized breeds for milk production (39 %) or selection (61 %).

More than a half of farms included in the survey, process the milk in their own farms (70 %), while 27 % deliver it directly to a processors. From the milk obtained and processed in farms, breeders made traditional products, the first among manufactured products is telemea (a fresh, whole feta-type cheese), which is produced in 85 % of the farms, followed by sheep's cheese („caş''). In general, at farms level is done more than one dairy product. Therefore, 57 % of the farms that produce traditional dairy products is done three products, so:

„Telemea''(feta-type cheese) + „Caş'' (cheese) + „Urda'' (67 %), „Telemea+„Brânză frământată'' (kneaded cheese) + „urda'' (25%) or „Caş'' + „Brânză frământată'' + „Urda'' (8.33%). In 97 % of surveyed farms, products are both for market and consumption.

Regarding the sale of dairy products obtained from sheep, majority of breeders sell their products directly, either in markets or fairs (33 %), directly from home (13 %) or trough intermediaries (20 %). Just a little part from the breeders (67 %) capitalize their products in supermarkets. The main reason, that the breeders can't capitalize they're products in supermarket is that only 7 % from the exploitations have got products with trademark.

90 % from the interviewed would like in the future to realize at associations level, where they belong, regional products with trademark (e.g., organic). Dairy regional products with trademark are desired by 63 % from breeders, while the meat products are desired just from 22 %. For the dairy and meat products achievement have expressed their option 15 % from the questioned.

97 % of the questionated exploitations practice conventional agriculture, just one exploitation being in conversion (3 %). In general, the breeders knowledge about organic agriculture are minimal (80 % from the questioned) and it is limited at the fact that, they know that using chemical fertilizer and pesticides are forbidden in the case they would practice organic agriculture. The reasons, why they don't practice organic agriculture are various, but in the most cases is invoked by the lack information (28 %), lack of ownership land (21 %), the documentation volume for the exploitation certification (10 %), and on the same level (7 %) is the low animal effective with the lack of organic feed.

The strongest motivation for practicing organic agriculture could be of economic nature (34 %), this meaning the incoming obtained in the practice of the organic agriculture to be superior of which they done in present. Not only the economic factor plays an important role in taking a decision in this direction, but also owning their own land (17 %) and the existance of the organic certificate feed (14 %). In the same measure (3 %) are said to simplify the documentation, the existence of other breeders who practice organic farming, and better knowledge of the situation of organic farming.

Regarding the problems of sheep breeders which could meet for practicing organic farming, 31 % of those surveyed do not know what problems they would encounter, 28 % believe that lack of certified organic feed would the main problem with which would face, 14 % think that there would be no problems, while equally 7 % of those surveyed believe that treatments, lack of demand and market products could be major problems.

Conclusions

In order to improve sheep husbandry in Romania, and especially to preserve local Tsigai breed, are necessary to perform direct actions involving both research and the sheep breeders, and other decision makers, actions materialized in:

1. Establishing dairy premium products, identifiable by quality labels and geographical origin (PDO, organic) and their inclusion in a chain of organic production for adding more value to the race.
2. Improving the marketing of the product by conducting activities to help strengthen the product profile, creating a regional image and inform customers about products quality, production conditions and conservation benefits of the Tsigai breed.
3. Recovery of feed resources on submountain and mountain pastures by extensive grazing with effect on landscape conservation and the maintenance of valuable plant species in vegetal cover leading to regeneration and nature conservation.

4. Involvement of decision makers for providing the state aid regarding the use of genetic resources of endangered animals.
5. Initiating research for organic cheese production from Tsigai breeds.

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Sustainablity in organic dairy farming

(Foto: Rahmann, 2006)

Sustainable livestock buildings – a challenge for the future of organic farming

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Abstract

The function of livestock buildings is mainly to give shelter for confined animals and protect against predators. Up to date, most buildings used for organic livestock farming are mainly constructed using concrete, steel or wood elements. Thus, negative environmental impacts have to be considered. Annual world production of cement as one of the main building raw materials implies 4 % of annual CO_2 emissions. Sustainable livestock buildings can be more environmentally friendly and cost-efficient, if renewable raw materials of local resources and even waste materials are used.

Key words: renewable raw materials, organic livestock buildings, energy saving,

Introduction

Straw bales from rice, wheat or other cereals can be used to build simple insulated livestock buildings which require only minimum of energy and can be easily recycled at the end of the life span. In countries, were straw is still burned on the fields, it is evident, that CO_2 emissions can be reduced drastically by using those materials substantially. Straw structures for livestock buildings can be used in all climate zones, for example in arid regions to protect heat sensitive livestock like poultry or rabbits. Consequently, the energy consumption for cooling and heating can be reduced by more than 80 %. Load bearing constructions using straw bales do not require any wood or steel frame within the wall.

A more sophisticated approach uses straw or plants like miscanthus to produce natural sandwich boards. In contrast to fibre boards which are mainly used for constructions, this invention uses whole stems of straw and/or miscanthus perpendicular between two plywood layers for ultra-light and loadable sandwich boards. Natural sandwich boards can be used for mobile shelters for small ruminants, calves, pigs and poultry. Our experimental work shows advantages regarding climate and heat load compared to fibre reinforced plastic shelters. Durability is given for more than ten years.

In areas, where reduction of heat stress for animals is a main topic, green roofing of livestock buildings can be an alternative to energy intensive cooling and fans. Results of our study of the natural cooling effect of marshland plants on a dairy cow building indicates a 5 °C lower temperature compared to the same building without green roof.

Straw bale buildings

Burning of straw or other crop residues is a common practice in developing countries (IPS 2009) as well as in industrialized countries like Canada (Comeau 2007). Together with CO_2 emissions from cars and industry, burning of crop residues is an environmental, health and safety risk. Burning crop residues on the fields may have negative effects on biodiversity and soil fertility (Virto et al. 2007).

Amongst other alternatives to burning, use of crop residues like straw as building materials has several advantages: Less environmental pollution, less energy than producing concrete or other building materials and good insulation properties. A wholistic evaluation of a straw bale building has been conducted by Ashour et al., 2011. Fig. 1 shows the temperature evolution inside the wall at different locations of the straw bale wall. The temperature gradient increased from outside (low temperature) towards the inner side of wall. Outside temperature peaks were smoothed by the straw bale wall (Ashour et al. 2011).

Buildings with straw bale walls can be an effective way to use crop residues. With good insulation properties straw bale walls can play a major role in the future of energy saving and environmental friendly building concepts.

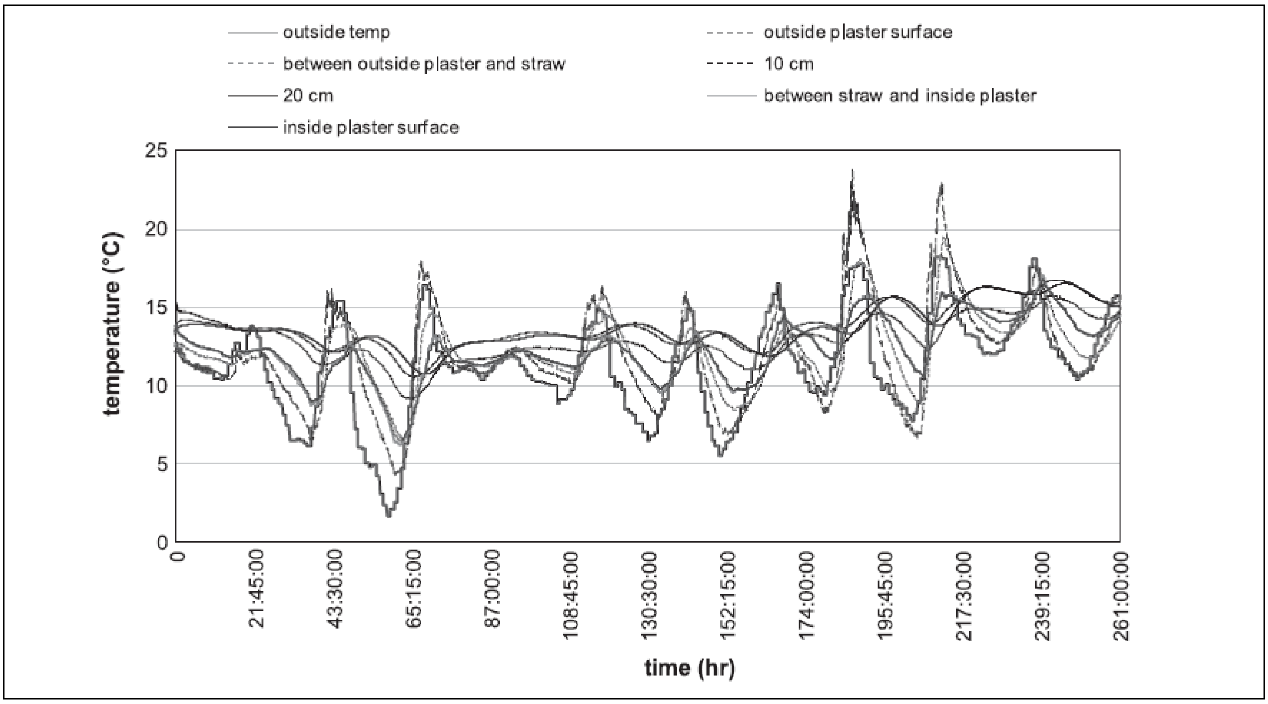

Figure 1. Temperature inside and outside of a straw bale wall (from Ashour et al. 2011)

Light Natural sandwich boards (LNS)

Livestock housing even in moderate climate need to provide shelter from heat stress in summer and prevent from condensation inside during winter time. Building materials used to house calves and small ruminants tend to be made out plastic materials, either reinforced with fibre or by construction. Recent studies have shown, that plastic used as building material has increased indoor temperatures in summer and show condensation at the inner surface in winter. Thus, a superhutch from renewable raw materials was developed, as easy to set aside as superhutches made of fiberglass reinforced plastic (GFK). The building material of the new hutch was light natural sandwich (LNS), a light panel material from renewable raw materials (see fig. 2). The LNS-Panels were used to form a load-bearing superhutch of 16 m² area without framework but moveable with a tractor. For a comparison, two LNS and two GFK- hutches with same size (16 m² area) were investigated. Groups of six calves (3 months old) each were housed till an age of 6 months in the period from February 2003 to February 2004 in the hutches. In total, 96 calves were housed in the hutches. Temperature and relative humidity was recorded in every hutch as well as reference values for both parameters outside in the shade.

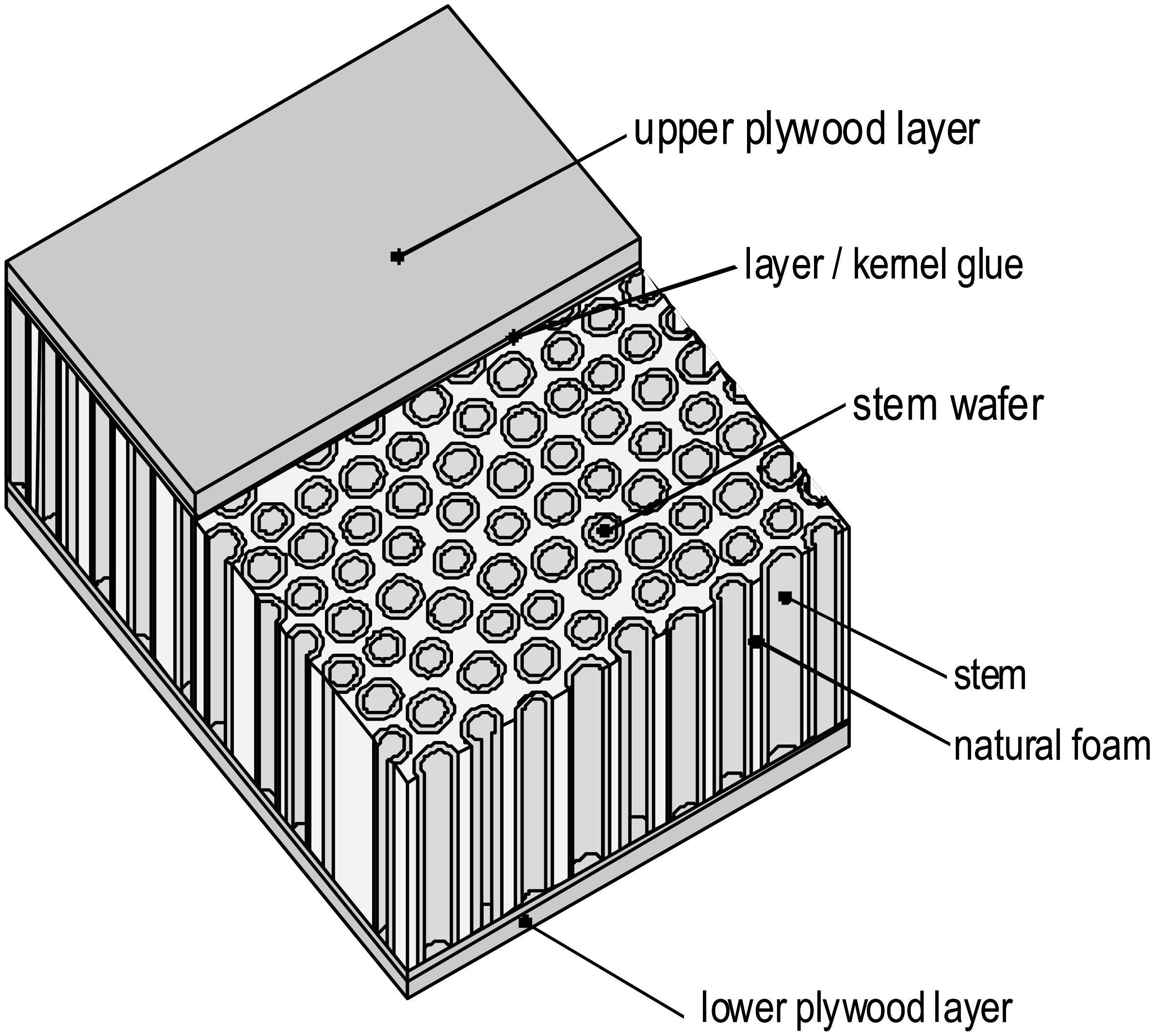

Figure 2. Principle design of Light Natural Sandwich Boards (Möller et al. 2001)

Results

During summer 2003 mean indoor air temperature as shown in figure 3 in LNS hutches was 5 to 6 °C lower than the value in the plastic hutches (measured between 10 a. m. and 4 p. m.). The temperature in LNS-hutches was close to the outdoor temperature in the shade, whereas the indoor temperature of GFK-hutches was higher than 30°C for several hours.

Green roofing with marsh plants

The reduction of summer heat stress for dairy cows is an important question for the design of dairy buildings in many climate zones. Parallel to an increasing milk yield metabolic energy production of cows is rising as well, inducing the necessity for additional energy transfer. Heat stress for dairy cows starts with 20 to 21 °C ambient temperature and has negative effects on milk yield when exceeding 25 °C. Changes regarding the lying behaviour indicate heat stress at 21 °C. Lying time for cows at a thermo-neutral climate is significantly longer, this may be another reason for a reduced milk yield as well.

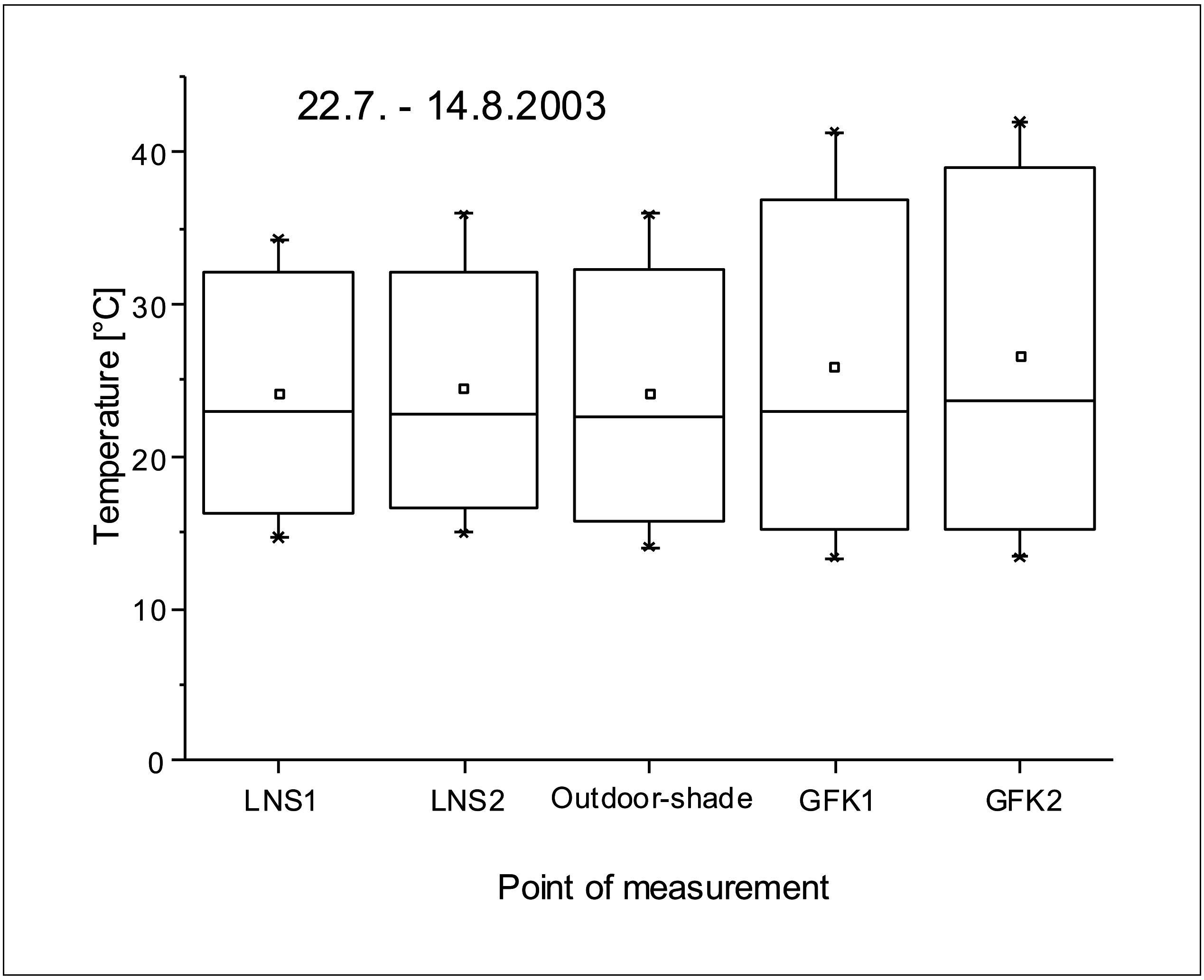

Figure 3. Temperature distribution inside LNS and GFK hutches compared to outdoor situation

One of two identical dairy buildings was equipped with the marsh plant green roof. Both dairy buildings had measuring devices for ambient temperature and humidity. A meteorological station was placed close to the buildings to record outdoor climate parameters. Within a second configuration level it is planned to collect the water for irrigating the roof in a storage basin beside to reuse it. The water may be elevated to the roof by a solar powered pump. The marsh plants consist almost of sedge varieties (Carex), Mimulus lutus, Lythrium salicaria, Iris pseudacorus etc. A foil was placed between roof (fibre cement) and the mats carrying the plants to prevent roots from growing between the roof tiles. The watering of the plants is controlled by an irrigation micro-computer, the water overflow is collected using the eaves gutter.

Results

Analysis of ambient temperature in both dairy barns demonstrates that a reduction of ambient temperature by 5° C could be realized using marsh plant green roof. The ambient temperature in the green roof barn did not exceed 25°, whereas the control building temperature came up to 30 °C during afternoon. The difference of -5 °C could be achieved from June to September, too. A comparison of the temperature under the roof of both, green roof and fibre cement, gave us a difference in mean temperature (on the surface) of 25 to 30 °C. The green roof acted as a shield to protect from solar radiation. The marsh plants were stimulated by the solar radiation to evaporate more intensively, which may lead to an additional cooling effect.

Conclusions

The presented alternative way of cooling down a dairy building by green roofing could reduce ambient temperature by 5 °C, compared to a fibre cement roof.

Suggestions to tackle the future challenges of organic animal husbandry

Why do we still use conventional building materials for organic livestock buildings? Future development should consider ecological functions of buildings like biodiversity, life cycle, appearance and energy saving. Natural and local building materials should be used to build green livestock buildings in the future.

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Reducing the amount of slaughter transports in modern Swedish cattle production systems

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Abstract

Two methods that can help to reduce the distances involved in transportation of cattle to slaughter are presented, route optimization and spatial redistribution of slaughter capacities. In a comparison of three route optimization techniques we show that RuttOpt is the most effective and that the number of stops on routes can be reduced compared to what is the case today. We also find that transport distances can be reduced by 40 % compared to the real transports of 2008 if animals are sent to the closest available facilities. We believe that the methods highlighted here can help improve the sustainability and animal health in both organic and conventional farming.

Key words: animal transport, slaughter, route optimization, abattoir

Introduction

Animal transportation is related to economic costs and environmental costs in the form of carbon dioxide emissions which makes it desirable to minimize them. Reducing transport distances and time would also benefit animal welfare through less stress (Gebresenbet *et al.* 2005, Hartung 2003), shorter lairage times (Geverink *et al.* 1996, Jarvis *et al.* 1996), and fewer injured animals (Hoffman *et al.* 1998, Huertas *et al.* 2010). Many consumers are positive towards paying more for meat from animals with improved welfare (Andersson *et al.* 2004, Lagerkvist & Hess 2011, Ljungberg *et al.* 2006). Stress and injuries also yields meat of lower quality which leads to reduced profit (Huertas *et al.* 2010, Fernandez *et al.* 1996). Using an extensive transport data set provided by the Swedish Board of Agriculture, we demonstrate two approaches that can reduce the distances and time involved in transporting animals to slaughter, (1) a tactical approach through optimization of the transportation routes, (2) a strategic approach altering the localization and capacities of abattoirs throughout Sweden.

Material and methodology

Route optimization

Slaughter transports are suitable for optimization since a truck often visits multiple farms during one route, especially when transporting cattle. The mean size of reported batches in Swedish cattle slaughter transport data from 2008 is 4.53 with a large variation (4.68 std). Of the 94 573 transport events, 23 % were for only one animal, translating into roughly 4-5 stops per route. With such a large amount of sites to visit per route and considering that an abattoir easily can collect animals from 200-300 farms during a week, manually finding an optimal transport solution is not possible.

Route optimization software is widely used within other parts of the transport sector, but there have only been a handful of studies on slaughter transports and these have used relatively small datasets (Ljungberg *et al.* 2007, Oppen & Løkketangen 2008, Oppen, *et al.* 2010).

We test the efficacy of three different route optimization methods, the Clarke & Wright heuristic (C.W), drivers choice (D.C) and RuttOpt. All of the methods work on the same type of data: a set of spatially separated nodes, representing farms and abattoirs, each farm having a number of animals to be transported to an abattoir. C.W is a heuristic commonly used in route planning and works by iteratively connecting nodes to find the ones that minimizes costs (distances) (Clarke & Wright 1964). D.C is based on C.W but works in a more random fashion, reflecting realistic choices made by the drivers. This algorithm uses a distance dependent probability distribution to connect farms on a route. For more details on C.W and D.C see Håkansson (2012). RuttOpt is a route optimization algorithm originally developed for the forest industry. It utilizes a modified unified tabu search algorithm to find optimal routes from farms to slaughterhouse (Andersson et al. 2008).

To test the C.W and D.C heuristics, areas from three densely farmed regions in Sweden, each of 10 000 km^2 were chosen. 1-16 animals were randomly assigned to each farm and the two heuristics were used to create transport solutions for each of the regions. For the RuttOpt method the five largest abattoirs in Sweden were chosen and 52 cases were constructed for each of them. The cases contained all the registered transport events for each week of the year 2008 related to the particular abattoirs, describing from what farm and how many animals were sent. RuttOpt was then used to construct routes for each case.

The results from the three methods were then set in relation to the equivalent results when only 1 farm was allowed on each route. This was not considered as a realistic scenario but it allowed comparison of the relative efficacy of each method.

Spatial analysis of slaughter capacity

A trend in the slaughter industry within Sweden and Europe has been that fewer large abattoirs constitute a larger part of the total capacity. In Sweden the amount of abattoirs slaughtering 90 % of the cattle was reduced from 26 to 14 abattoirs between the years 1985 and 2002, with longer transport distances as a result (Kaspersson & Gullstrand 2004). In 2008 the ten largest abattoirs slaughtered 91 % of pigs and cattle (out of 62 abattoirs). This affects transport distances as some animals will have to be transported farther if there is insufficient local slaughter capacity.

Two methods were used to quantify the importance of the distribution of slaughter capacity in Sweden. The first method use virtual landscapes that were created using discrete Fourier transformation to generate a representation of farms in a landscape (Håkansson 2012). Both large and small slaughterhouses were added to the virtual landscapes, and the C.W algorithm was used to measure the differences in distance that resulted from varying the amount of abattoirs.

The second method involved creating a model of the complete slaughter transport system of 2008. The system was then optimized such that each farm sent its animals to the abattoir that will minimize the total distance traveled. Abattoirs were then removed one by one and the resulting total transport distances recorded. The outcome of the model was compared to the actual transports that took place in 2008 (Håkansson 2012).

Results

Route optimization

The D.C algorithm was the least successful in reducing the distances that the transport vehicles travel, resulting in 15-35 % lower distances compared to if the trucks only stop at one farm each route. The corresponding value for C.W was 40 % and for RuttOpt the distances were reduced by 59 %. The mean number of stops for D.C was between 1.72-1.73 (varying between 1.53 and 1.88) and 1.78 for C.W (varying between 1.59 and 1.92). For RuttOpt the mean number of stops per route was slightly higher at 2.87.

Spatial analysis of slaughter capacity

The results from the virtual landscapes showed that by adding small abattoirs to a landscape where only the large ones are present can reduce the slaughter transport distances by 29 %. The slaughter transport model showed that by optimizing the choice of slaughterhouse to which animals are sent while the number of abattoirs were kept at the original 46, transport distances could be reduced by 40 % compared to if the animals were sent to the actual abattoirs of 2008. The number of slaughterhouses could even be decreased to 13 and the resulting transport distances would still be 25 % lower compared to the real transports. However, the results showed that keeping a larger number of abattoirs can be important from a welfare point of view, because there were 66 % fewer animals that were transported on long journeys (4-10 hours) if there were 46 slaughterhouses compared to if there were 13.

Discussion

By using real transport data from a whole year we could show that the RuttOpt-method could reduce the transport distances the most compared to simulated choices made by the drivers (D.C) and another heuristic commonly used when planning transports (C.W). Due to welfare concerns (Raussi *et al.* 2005) and possibility for spread of infectious disease (Wray *et al.* 1991), the number of stops made on a route should be kept at a minimum. However, this is in conflict to the fact that fewer stops will increase the shortest distance that is achievable. However, RuttOpt constructed routes with a mean of 2.87 stops; this is lower than 4.1 which have been reported for real routes (Ljungberg *et al.* 2007) and shows that using good optimization techniques does not only reduce CO_2 emissions and transport costs, but is also beneficial to animal welfare and can lower the risk of spreading infectious disease. We have also shown that by keeping a well planned distribution of slaughter capacity it is possible to greatly reduce the necessary transport distances.

Suggestions to tackle the future challenges of organic animal husbandry

With small changes such as by making sure that animals are sent to local abattoirs and by introducing route optimization methods into the slaughter industry as well as by forming national strategies concerning the distribution of slaughtering capacity a large improvement of cattle transportation can be achieved. These are straightforward ideas that we believe would be relatively easy to apply to the current transport system, and the benefits would be very much in line with the principles of organic farming, relating to both sustainability and animal health. A challenge is to find the means that embrace the community of farmers and abattoirs to jointly apply these methods.

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Economic Evaluation of Longevity in Organic Dairy Farming

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Abstract

The aim of this study was to highlight the economic importance of longevity in organic dairy cattle husbandry. Performance and reproductive data of 44,976 Austrian organic Simmental dairy cows were analysed by applying a bio-economic model. A farm scenario as well as different market situations were modelled. Overall costs declined with increasing longevity, due to dropping replacement costs. Annual profit was influenced considerably by milk yield and longevity. Short-lived animals needed substantially higher annual milk yields than long-lived animals to achieve equal annual profits. The applied market scenarios showed an increasing importance of longevity in situations of increasing economic pressure (+20% of concentrate price). It has been proven that extending longevity allows lower milk yield levels without decreasing profitability. Lower use of concentrates and reduced dependence on off-farm inputs and market fluctuations are further benefits.

Key words: lifespan, profitability, costs, dairy cow, sustainability

Introduction

Animal health and welfare, sustainability and minimal off-farm inputs are crucial principles of organic dairy farming. In contrast, maximizing milk yield per cow and early maturity have been main breeding goals during recent decades in dairy cow breeding. As there are several negative genetic correlations between performance and fitness traits as well as between milk production level and animal health, increasing milk performance has led to serious declines in fitness and health as well as animal welfare and therefore longevity (Essl 1996, Fleischer et al. 2001, Knaus 2009, Oltenacu and Broom 2010). The stated developments and the changes in diets resulted in a sharp increase of feeding, replacement and veterinary costs. Therefore the high-performance strategy is very questionable from both an ecological and an economic point of view. The aim of this study was to highlight the economic importance of longevity for organic dairy cattle husbandry.

Material and methodology

Performance and reproductive data of all Austrian organic dual-purpose Simmental dairy cows (n=44,976) included in the national recording program and culled between 2000 and 2010 formed the data set for a bio-economic model. Animals were grouped according to completed lactations (culled after 1, 2, 3…10 lactations) and within these lactation groups into performance groups according to lifetime energy-corrected milk (ECM) performance (average, 5,000 best, 1,000 best, 500 best and 50 best animals). Model assumptions were made in order to represent an average Austrian organic dairy farm with 150,000 kg annual milk quota. Ascertainment of profits was done by full cost accounting including the following parameters:

Profit (€ year^{-1}) = revenues (milk, culling, calves) – costs (feed, replacement, veterinary treatment, insemination, building occupancy, factor costs) + subsidies (environmental subsidies, livestock aid, single farm payment)

A precise description of the methods used and model assumptions was reported by Horn (2011). In short, to estimate annual feed costs rations were modelled taking into account milk yield and milk composition, life weight and life weight gain as well as nutrient mobilisation. During lactation rations contained forages (grass silage, hay, pasture and corn silage) and concentrates for energy and protein supplementation, but rations composition was adjusted according to milk yield. During the dry period ration consisted of forages only. Annual feed costs were calculated as full costs taking the maintenance of grassland and harvesting activities, manure application as well as fence building and maintenance costs for pasture into account. Corn silage and concentrates were assumed to be purchased. Costs for heifers needed for replacement, revenues of calves as well as costs for insemination and veterinary treatments were estimated depending on milk yield potential. Annual building occupancy and factor costs were estimated based on official reference values and included barn and storage charges as well as land use, milk quota and labour wage rate. Milk price was set according to Austrian organic milk market data. Culling revenue was estimated based on life weight at the end of the animal's productive life, carcass yield and slaughter price. Subsidies included in the calculations were single farm payments, livestock aid and environmental subsidies pursuant to European and Austrian regulations for organic agriculture. To estimate how future market developments and changing production costs might affect farm profit, varying costs of concentrates (+/-20% price) were tested under ceteris paribus conditions.

Results

The description of the results excludes intermediate performance groups and focuses on the average and 50 best animals of each lactation group.

Costs

Annual mean total dry matter feed intake of the average cows was 5,402 kg (± 207) and 6,531 kg (± 214) for the 50 best animals respectively. It rose with increasing milk yield, as did concentrate intake. Annual concentrate consume of average animals was calculated 787 kg (± 81), while the mean concentrate intake of the 50 best animals was 2,087 kg (± 226). Cows´ feed and replacement costs constituted the largest proportion to total costs. Feed costs of cows increased with annual milk production and were € 906 (± 31) and € 1,657 (± 160) for average and best 50 animals, respectively. Feed costs seemed to react disproportionately in comparison with annual milk yield increase, for example for animals culled after four lactations, they increased by 96 % while annual milk yield increased 60 %. When comparing total annual costs, they increased with rising milk yield and were € 1,864 (± 225) and € 2635 (± 398) for average and best 50 animals respectively. With advanced longevity, replacement costs clearly declined and dropped by 74 % comparing animals with one and five completed lactations. Total annual costs rose with increasing milk yield, but declined with rising longevity.

Revenues

Milk revenue constituted the largest share and follows annual milk yield. Culling revenues declined with increasing longevity. Higher yielding groups had substantially higher total revenues than average cows, € 4,082 (± 322) and 2,779 (± 64), respectively. Total revenues rose until the 4th lactation for average animals, and the 3rd lactation for the 50 best cows.

Profit in farm model scenario

The number of cows and the acreage required declined with rising milk yield. In contrast, total profit increased and was clearly higher for the 50 best animals than for the average cows. By increasing longevity, profits increased up to the 6th lactation for the average and up to the 5th lactation for the

50 best animals. Groups with a higher milk yield achieved positive profit earlier than the average animals, in the second and third lactation, respectively. In Figure 1 profit functions for different levels of average herd life are plotted. As mentioned, both milk yield and longevity affected profits. Increasing milk yield led to declining marginal profits, as the slope of functions decreases considerably. Furthermore, marginal profits dropped less in higher lactation groups (for example 2 versus 5 lactations). It can be seen that extending longevity led to degressively increasing profits, as the level of profit functions moved upwards. As a result, an annual targeted profit of € 4,000 could be achieved with different strategies. A herd with an average herd life of two lactations needed 7,300 kg ECM per cow year^{-1}. To meet the same profit goal, herds with a longevity of three, four and five lactations needed 6,650, 6,400 and 6,150 kg ECM per cow year^{-1}, respectively.

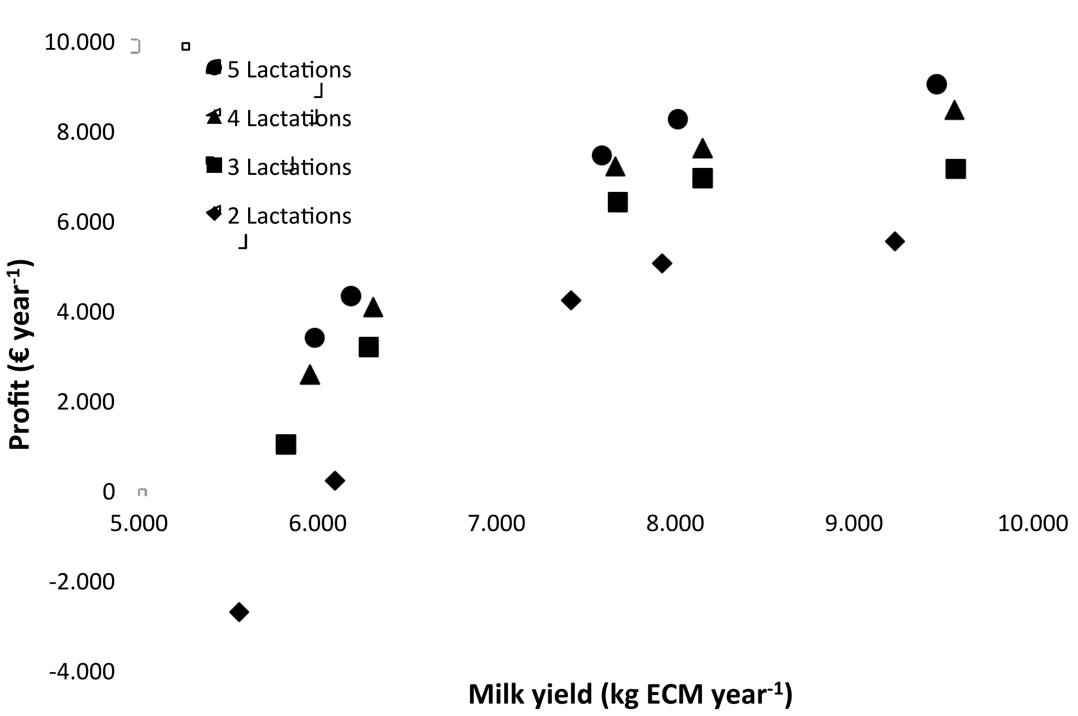

Figure 1. Effect of annual energy corrected milk yield (ECM) and longevity on total annual profit

Changing conditions of concentrate markets had severe effects on model farm profitability (Figure 2). A 20% increase in the price of concentrates (+20 C) made profits drop considerably and also reduced the marginal profits of increasing milk yield. Lower concentrate prices (-20 C) had the opposite effect.

Discussion

The current average herd life levels do not exhaust the full potential of dairy industries' profitability, therefore the relative importance of herd lifespan, health, and reproductive traits should be strengthened. A reduction of milk yield does not necessarily lead to lower profits, if it is accompanied by an increase in longevity. This allows lower amounts of concentrates and sustains the on-farm production of feedstuffs, especially in pure grassland areas. Additionally it supports fulfilment of the organic farming principles of sustainability, minimizing off-farm inputs and closing nutrient cycles, and may lead to a higher consumer acceptance. Given that in the future, less market regulation, decreased economic compensation for farmers, lower milk prices, and a potential increase in production costs seem likely, strategies to minimise inputs and costs appear to be economically and ecologically superior.

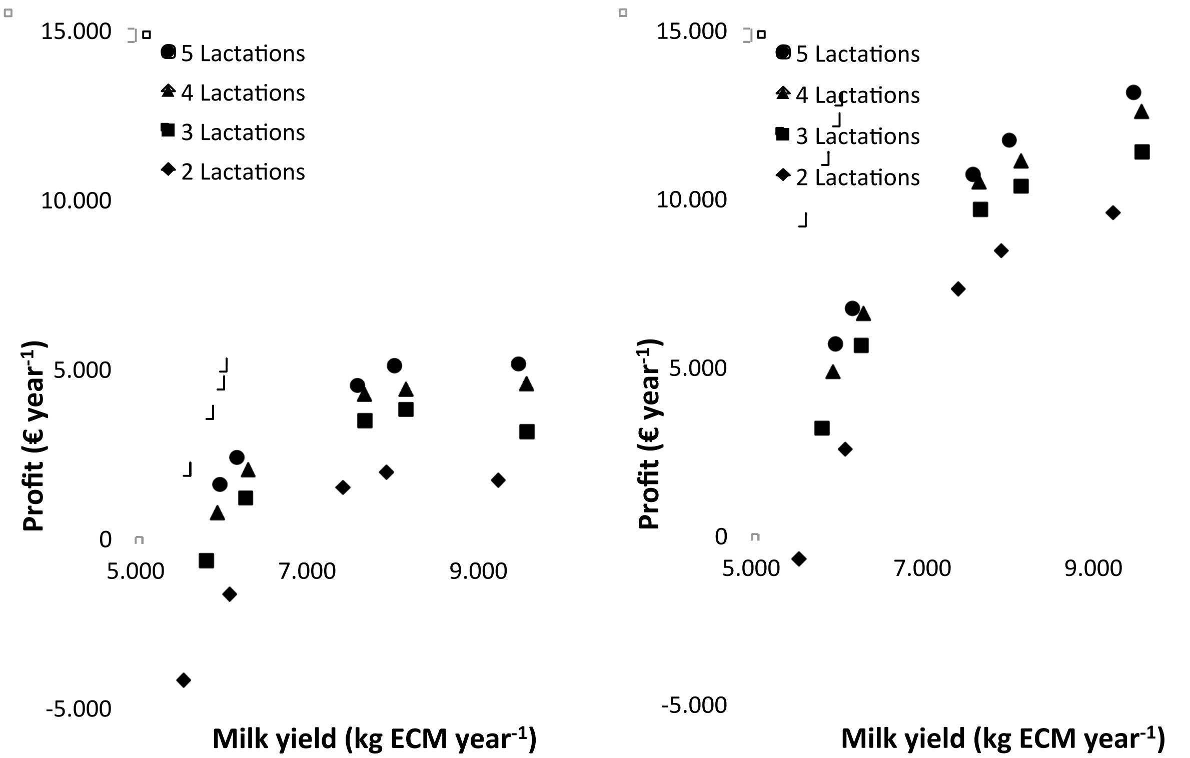

Figure 2. Annual profits for different market trends (left figure: + 20% of price of concentrate; right figure: -20% of price of concentrate).

Suggestions to tackle the future challenges of organic animal husbandry

Dairy cow´s longevity is an essential indicator for animal health and welfare and therefore for the sustainability of a milk production system. It´s advancement should be one of the main targets in the future of organic dairy cow husbandry. This will not only lead to a reduction of concentrate input and production costs but also to a higher consumer acceptance, which might be of crucial importance in the near future as Alpine agriculture is strongly depending on public subsidies.

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Herd parameters in organic and conventional dairy farms and their role in greenhouse gas emissions from milk production

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Abstract

In the study on „Climate effects and sustainability of organic and conventional farming systems" 44 paired organic and conventional dairy farms in Germany were compared. Over three years, data on performance, management and feeding were collected on the farms and feed samples were collected and analyzed. First analyses show that on average the organic farms have a significantly higher longevity (39 month) and grazing time (2510 $h*a^{-1}$) than the conventional farms. On the other hand, mean milk yields (6478 $kg*cow^{-1}*a^{-1}$) and lifetime efficiency (10.3 $kg*cow^{-1}*d^{-1}$) are significantly lower on the organic farms. In both farming systems lifetime efficiency significantly decreases with increasing age at first calving ($p<0.05$). Further analyses shall highlight influences of farm management on the GHG balance of dairy farms and illustrate optimisation potential.

Key words: performance parameters, greenhouse gas, dairy cattle, conventional, organic

Introduction

Several factors affect the greenhouse gas (GHG) emissions in dairy farming. One important measure for reduction of the GHG-emissions is an improved milk yield, since for the same amount of milk produced the number of cows can be reduced (Zehetmeier et al., 2011). However, the increased milk yield should not induce an increased input of concentrates in the feeding ration, which enhances the GHG-emissions upstream the production chain (Reenberg and Fenger, 2011). Further alternatives for a reduction of GHG-emissions are variations of the feeding regime: Methane emissions from enteric fermentation can be reduced by an improved digestibility of the roughage or by a higher fat percentage in the ration (Flachowsky and Brade, 2007; Sejium et al., 2011). An increased productive life-span of the cows can decrease product-related emissions as well (Bell et al., 2011). But possible interactions of these factors and their effects on GHG-emissions in different farming systems are only partly known.

Material and methodology

In a joint project (www.pilotbetriebe.de) 44 dairy farms (22 pairs of neighbouring organic and conventional farms) in Germany were studied in the years 2009 to 2011. Data on herd parameters and feeding regime were collected. Feed samples were collected and analyzed with the Weender method according to the guidelines of VDLUFA (1995). Results include dry matter, crude ash, crude protein, crude fibre and crude fat. The nutrient content (metabolizable energy, net energy lactation und usable crude protein) was calculated (single feedstuffs according to the GfE, 2001; compound feedstuff according to Menke und Steingaß, 1987). For statistical analyses means and range of data were determined and means were compared using t-test ($p<0.05$). Possible correlations between data sets were determined by regression analysis.

Results

A short description of the 22 studied farm pairs is given in table 1. Figure 1 shows correlations between several performance parameters of the farms.

Table 1. Overview of selected parameters of the organic and conventional dairy farms (mean and range (min-max) of the years 2009/2010/2011)

	n	organic	n	conventional
number of farms		22		22
farm area (hectare)	22	249 (30-1299)	22	312 (35-1959)
herd size	22	71 (18-257)	22	113 (26-450)
milk yield (kg*cow^{-1} year^{-1})	21	6478** (4307-9289)	21	8571** (6130-10588)
milk protein (%)	21	3.28** (3.03-3.66)	21	3.42** (3.18-3.55)
milk fat (%)	21	4.06 (3.68-4.43)	21	4.10 (3.38-4.39)
age at first calving (months)	19	31** (26-35)	17	28** (25-33)
productive life-span (months)	19	39** (25-59)	16	27** (18-37)
lifetime efficiency (kg*cow^{-1} day^{-1})	19	10.3** (6.1-14.8)	17	12.0** (7.6-15.4)
calving interval (days)	21	409 (364-502)	19	406 (365-433)
NEL (MJ*kg^{-1} in DM) in roughage	22	6.0 (3.94-7.32)	22	5.95 (3.86-8.46)
NEL (MJ*kg^{-1} in DM) in concentrate	22	8.11 (6.64-8.99)	22	7.88 (5.04-8.96)
grazing time (h*year^{-1})	16	2510 (1008-5856)	13	774 (0-3048)

** significant at p<0.01
DM: dry matter, kg: kilogram, n: number

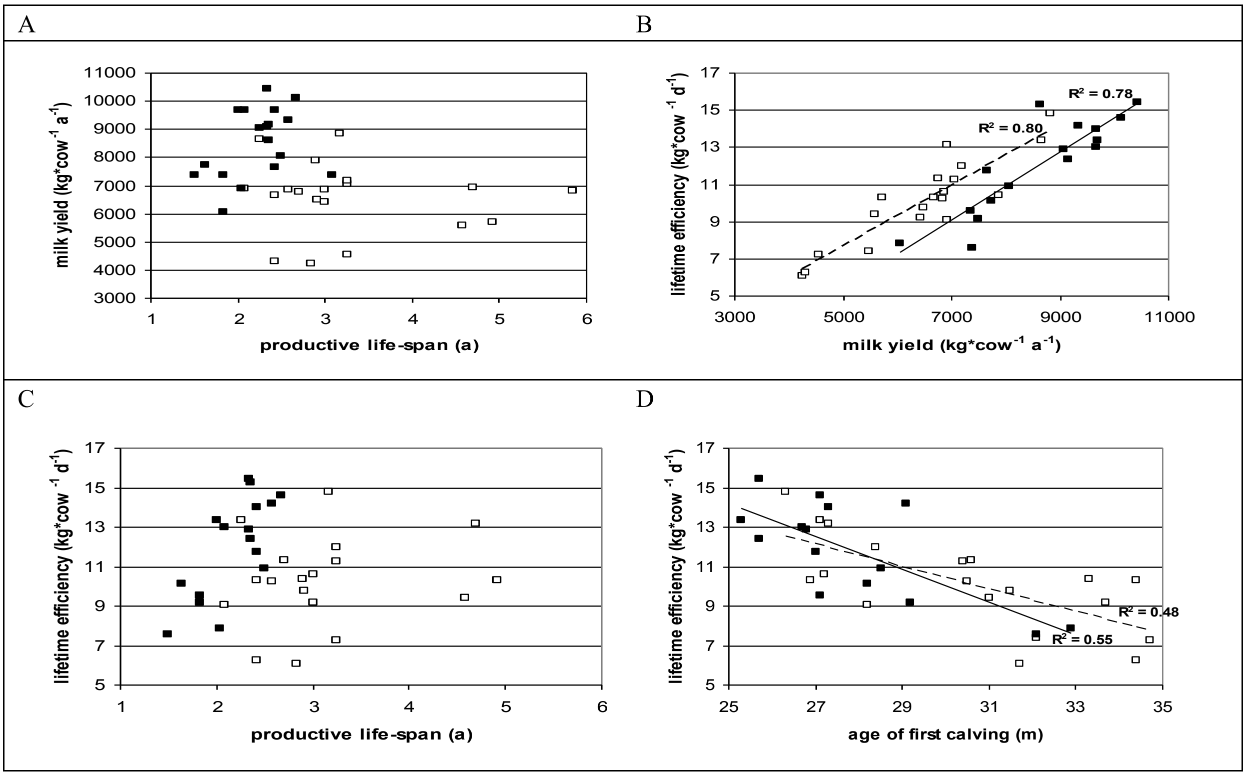

Figure 1. Correlation between milk yield and productive life-span (A, n=37), lifetime efficiency and milk yield (B, n=35), lifetime efficiency and productive life-span (C,

n=34), lifetime efficiency and age at first calving (D, n=34) of organic and conventional dairy farms in Germany, means of 2009/2010/2011

No significant correlation between milk yield and productive life-span was found (figure 1 A). But organic farms have overall lower milk yields (on average 24 % lower) than conventional farms (table 1). The productive life of cows on organic farms (on average 3.3 years) was one year longer than on conventional farms (table 1). Figure 1 B shows the positive correlation between lifetime efficiency and milk yield in both farming systems ($p<0.001$). No significant correlation between productive life-span and lifetime efficiency (figure 1 C) was observed, but a negative correlation between age at first calving and lifetime efficiency ($p<0.001$, figure 1 D). In both farming systems herds with high lifetime efficiency exist. The highest values of age at first calving (figure 1 D) and productive life-span (figure 1 C) can be found on organic farms.

Discussion

In the present study the mean milk yield on organic farms is considerably lower than on conventional farms. From numerous other studies similar results are known (Wangler and Harms, 2006; Benbrook et al., 2010).

The longer productive life-span of the animals in organic farms also agrees with the results of other studies (Benbrook et al., 2010). A short productive life-span implies that GHG-emissions from the rearing of replacement animals are spread over a lower number of productive months (Bell et al., 2011). A negative correlation between productive life-span and milk yields, as Klug et al. (2002) found in their study, could not be proved with the own or other studies (Fürst and Fürst-Waltl, 2006). Due to their higher milk yield the lifetime efficiency of conventional herds is higher than of organic farms, although cows on conventional farms have on average a shorter productive life-span. But also dairy herds on organic farms reach high lifetime efficiencies of more than 13 $kg*cow^{-1}$ day^{-1}.

Conclusions

There exist general differences between organic and conventional dairy farms in several performance and feeding parameters. However, the parameters, which affect the GHG-emissions in dairy farming, depend strongly on the management on the individual farms. High milk yields and lifetime efficiency can be found in both systems. The effects of different performance and feeding parameters and their interactions on GHG-emissions have to be analysed on the basis of individual farms.

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Striving for efficiency in nutrient utilisation on organic dairy farms

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Abstract

To organise a closed nutrient cycle is still recognised as a leading idea in organic agriculture. However, the idea fails to serve as a proper guideline to improve nutrient management in the farm system for several reasons. To develop a concept for nutrient management, efficiency in the use of external and internal N sources was assessed on 9 organic dairy farms. For this purpose farm specific data related to the N flow and losses between subsystems were collected and integrated into a model.

N import into the farm system varied considerably between farms as did the efficiency in N utilisation between sub-systems within and between farms. Each farm showed specific starting points for improvements of the nutrient management, contradicting any attempts of generalised recommendations. Instead of a closed nutrient cycle, a high efficiency in nutrient utilisation within the farm system should be established as a leading goal in organic agriculture.

Key words: nutrient flow, sustainability, productivity, systemic approach

Introduction

While the metaphor of a closed nutrient cycle intends a careful handling with home-grown resources and restriction in the use of external inputs to a minimum, it runs contrary i.e. to the aim to feed farm animals according to their specific requirements. On most organic farms, an adequate nutrient supply is nearly impossible without considerable amounts of external feed supplements. Indeed, a review of farm gate nutrient balance sheets showed considerable charges of feed imported into the farm system (Sundrum & Sommer 2011). On the other hand, bio-dynamic farmers justify the abstinence of external minerals with the goal of a closed nutrient cycle (Ivemeyer & Walkenhorst 2011). Apart from being widely ignored, the idea of a closed nutrient cycle does not provide a guideline for nutrient management but impedes a balanced nutrient supply.

The aim of the study was to estimate the nutrient flow within organic dairy farms and through defined sub-systems and identify how nutrients can be managed efficiently.

Material and methodology

Nitrogen enters the farm in various forms and leaves as production of milk, meat or cash crops or by leaching, runoff, volatilisation, or denitrification. An optimised nutrient management is given when nutrient losses are reduced to a minimum, relative to the product output. In general, there are two ways to increase nutrient efficiency in agricultural production: reducing inputs while maintaining or increasing the output or increasing input while increasing the output disproportionately.

Based on a model, developed by Kohn et al. (1997), nitrogen (N) input into the farm (purchased feed, legume fixation, inorganic fertiliser, imported manure) and N-flow through the subordinate sub-systems: 'livestock', 'dung storage/distribution', 'arable land/pasture', and 'feed storage/distribution' were assessed on 9 organic dairy farms in Germany, based on concrete data from the farms and by making use of equations from the literature to estimate relevant figures. N-efficiency (defined as the relation between input and output of N with respect to a defined system) and N-losses were determined with regard to the total farm system and subordinate sub-systems.

N flow through defined sub-systems within the farm system is illustrated in figure 1.

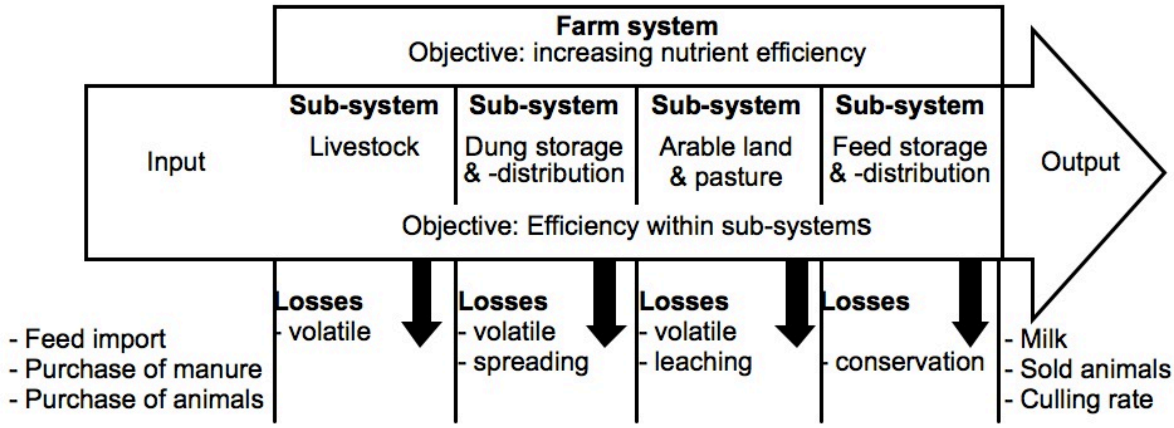

Figure 1. Nitrogen flow through defined sub-systems within a whole farm system

Results

Amount of N input into the farm system via bought-in feedstuffs in relation to the land area averaged to 15.2 kg N/ha, ranging from 0 and 49.1 kg N/ha. Nutrient content of feedstuffs and diet rations varied considerably between farms. Also average milk yield per cow and year and the nutrient and energy requirements deriving therefrom showed huge differences between the dairy herds and the farm animals within the herds.

Mean value of N-surplus, calculated as farm-gate nitrogen balance sheet on the level of the whole farm resulted in 38.4 kg N/ha and ranged between 5.4 and 93.4 kg N/ha.

Results of the data calculations with respect to N-efficiency in the whole farm system and in the sub-systems are shown in Table 1. N-efficiency (product related N-output per N-input) on the level of the whole farm system averaged to 44%. The min-max-values (23 - 72%) indicate a large variability between farms. The efficiency defined as the relation between N-input and N-output was on a comparably high level in the sub-systems 'livestock' and 'feed storage/distribution', whereas clearly lower grades of efficiency revealed in the sub-systems 'dung storage/distribution' and 'arable land/pasture'.

The assessment of data concerning the nutrient management provided farm specific information regarding possible weak points and adjustments to be used for improvements in the nutrient management. When looking for options to improve N-efficiency, each farm showed different starting points for improvements of the nutrient management. Some farms showed considerable potentials in reducing feed input and feed losses by improved nutrient distributions between feeding groups. Other farms were well recommended to reduce the number of cows showing an imbalanced nutrient supply or to improve storage and distribution of manure or to make better use of manure with regard to plant biomass.

Discussion

A nearly closed nutrient cycle as a leading idea of organic farming contradicts with the need of a more or less balanced feeding ration. Also the general advice, to use as few inputs as possible and as many as necessary, does not necessarily offer a feasible guideline for the nutrient management

(Sundrum et al. 2008). In general, requirements for external N inputs on livestock farms can be reduced by improving N utilisation (Paul & Beauchamp 1995). However, farmers often do not have a clue about the amounts and quality of nutrients, flowing through the different sub-systems of their farms, and on how to strive for possible savings in expenses and nutrient losses, simultaneously. Thus there is a need for more orientation, data and criteria to deal with.

Table 1. Mean and min-max values of N-efficiency in relation to the whole farm system, to different sub-systems, and to feed efficiency on organic dairy farms

Organic dairy farms (n = 9)	Efficiency (in %)
Whole farm system (N-input / product related N-output)	**44** (23 - 72)
Sub-systems Livestock	**84** (79 - 87)
Dung storage/distribution	**65** (49 - 88)
Arable land/pasture	**62** (40 - 81)
Feed storage/distribution	**87** (59 - 95)
Feed efficiency (N-feed / N-milk)	**14** (10 - 18)

Due to the ban of mineral N fertiliser, N is the first limited factor for growth processes in plant cultivation in organic farm systems. Limitations in the purchase of cheap N sources enclose an inherent incentive to increase the efficiency of N, available within the farm system and to reduce N losses to a minimum when striving for an increased productivity. Hence, N-efficiency serves as a production goal and simultaneously as key criteria to estimate the potentials for reducing inputs and nitrogen losses while increasing productivity.

In the current study, average farm-gate N surplus and variation were similar, compared to those found by Haas et al. (2007) on organic dairy farms in Germany. However, farm-gate nutrient balance assessments provide very little information with respect to improvements of the nutrient management while at the same time bear the risk of leading to unjustified self-content or misinterpretation.

Although the number of farms investigated in the current study was small, the data indicate both large variation in N efficiency between sub-systems and farms and a considerable potential for improvements. The investigations gave reasons for the assumption that the knowledge of organic farmers concerning the farm specific nutrient flow might be low.

Farm specific data on N-efficiency in sub-systems provide helpful information about the weak points in the nutrient management. Whether the farmer is well recommended to implement specific measures to increase N-efficiency depends on the effectiveness and the cost-benefit relationship of the measures in the specific situation. Due to the fact that both effectiveness and efficiency are the result of complex interactions between various factors within the farm system, estimations cannot be deduced from general knowledge derived from scientific results or from text books. Instead, management decisions should be based on the farm specific boundary conditions and on sound data that reflect the nutrient flow and the transformation processes of nutrients within and between sub-systems.

Suggestions to tackle the future challenges of organic animal husbandry

Data from organic dairy farms indicate a large potential to increase N efficiency while at the same time enhancing profitability. The systemic approach proved to be a powerful tool to identify weak points in nutrient management within the farm system. Main challenges in nutrient management are due to considerable variation in the boundary conditions between individual farms, demanding farm specific assessments and calculations. The concept of nutrient efficiency offers a feasible guideline for nutrient management and should replace the outmoded idea of a closed nutrient cycle.

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Assessing the sustainability of EU dairy farms with different management systems and husbandry practices

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Abstract

The EU funded SOLID project supports research which will contribute to the competitiveness of organic and low input dairy systems, and increase their sustainability. There are many aspects of the sustainability of dairy farms, relating to economic, environmental and social dimensions, and methods of animal husbandry can affect all of these. A UK spreadsheet based tool for rapid assessment of the whole farm was adapted for application on a range of organic and low input dairy farms across the EU. This tool was used to assess approximately ten organic dairy farms in each of four EU countries. Data on farm management practices collected in face to face interviews with farmers were entered and the tool then calculated a composite score for each of 11 separate "spurs" or dimensions contributing to sustainability. The results can be used to stimulate discussion between farmers and point to areas where farm sustainability might be improved or topics that would benefit from further research.

Key words: Dairy farms, cows, sustainability; participatory research

Introduction

The EU funded SOLID project supports research which will contribute to the competitiveness of organic and low input dairy systems, and increase their sustainability. The project involves a large participatory component, in which research partners work closely with SME (Small or Medium Enterprise) partners to identify potential topics for on farm projects to achieve this goal. To support this process a rapid assessment of farm sustainability was carried out on a small number of farms, mostly members of the SME partner in the participating country. The results were used to stimulate discussion with the participating farmers, and later with others, on the research needs of organic and low input dairy farms. This paper focuses on the results from the four countries where all the farms assessed were organic farms producing milk from dairy cows. Of interest were the experiences of carrying out the rapid assessment in different countries and similarities and differences found within and between countries.

Material and methodology

During a project evaluating "public goods" in the UK (Gerrard et al. 2011) a spreadsheet based tool was created in Microsoft Excel, which records quantitative farm data and farmers' answers to questions and generates scores for different components of sustainability. The tool covers eleven aspects of sustainability (see Figure 1) and relies only on data that are likely to be available on farm, taking not more than 4 hours to complete. The original tool was adapted to be more specific to dairy farms and applicable in other EU countries. Further alterations included provision for goat farms and commonly grazed land and additions to the sections on biodiversity and animal welfare. To collect data for the SOLID project, in each country a research organization worked in collaboration with a SME, either a farmer co-operative or a dairy company buying and selling organic milk.

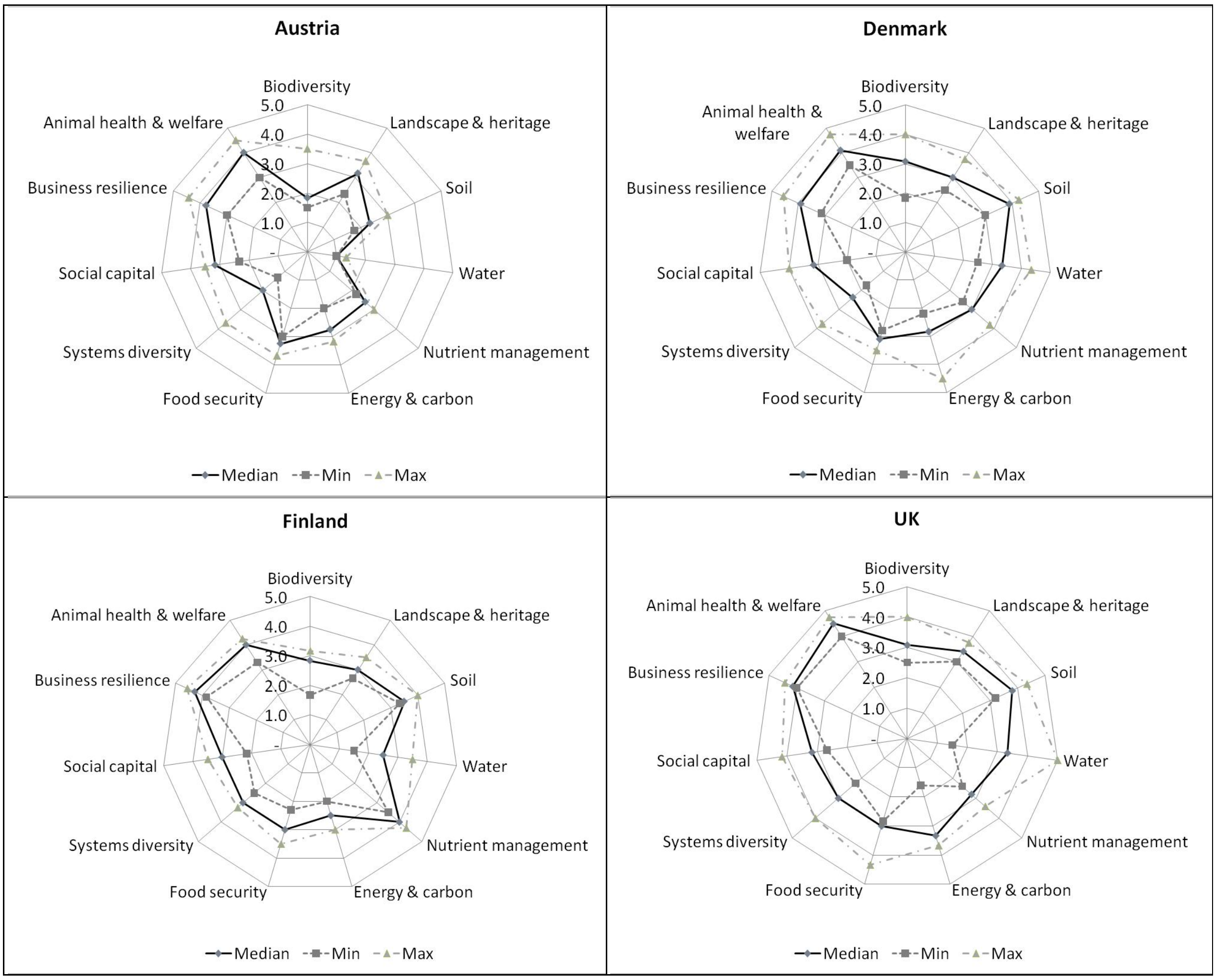

Figure 1. Median, minimum and maximum scores for sustainability for dairy farms in four EU countries (higher score suggests more sustainability)

The objective was not to carry out representative statistical analysis, but to provide a description of a selected group of farms. Austrian farms were all members of a small cheese-making co-operative located in the mountains. UK farms were largely members of OMSCo, the largest organic milk supply co-operative in the country. Finnish farms comprised all seven members of Juvan Luomu Ltd, the only totally organic dairy in Finland. Danish farms were members of the Thise Dairy Company, a pioneer of organic milk production in the country. Seven to twelve farms were selected that reflected the range of farm types working with each SME, and were considered potential farms for becoming involved in participatory research. Farms needed to have good records, and a willingness to engage. It should be noted that this does not constitute a representative sample of all organic dairy farms in the country, or even in the SME.

A researcher, sometimes accompanied by a representative of the dairy company, visited each farm and conducted an interview and data collection exercise which took approximately three hours. Data were immediately entered into the tool, which automatically generated the scores for each aspect or "spur" of the assessment. The diagrams produced (as in Figure 1) were used to discuss the concept of sustainability with the farmer.

The overall scores for the different spurs were summarized within countries using descriptive statistics of median and range, since the scores are ordered categorical data (Figure 1). Some performance data describing the group of farms in each country are also presented, to illustrate the similarities and differences of the farms studied. Since data generally had high variance, the median and range were also used to describe these parameters.

Results

Structural and performance characteristics of the farms studied are summarized in Table 1. These illustrate the wide variation in the types of farm and systems producing organic milk in these four countries. Herd sizes ranged from the smallest in Austria, across wider ranges in the remaining countries, particularly in the Danish group, to the largest in the UK. The Austrian farms chosen were small and generally had several different enterprises, usually including forestry.

Table 1. Characteristics of farms included in the sustainability assessment in each country – median and (range)

	Unit	Austria	Denmark	Finland	UK
Number of Farms	No	12	10	7	10
SOLID SME Partner organisation		Sennerei Hatzen-städt	Thise Dairy	Juvan Luomu	OMSCO
Time in organic farming	Years	20 (20-39)	16 (12 – 28)	17 (10 – 22)	11 (3 – 17)
Farm size	ha	19 (12 – 31)	194 (50 – 512)	139 (18 – 414)	268 (46 – 422)
Herd size (adult cows)	No	13 (10 - 17)	123 (36 – 480)	28 (9 – 124)	192 (72 – 378)
Stocking rate and land use					
GLU per total forage area (incl. common)	GLU/ha	0.9 (0.6 – 1.4)	1.5 (0.9 – 2.3)	0.7 (0.5 – 1.20	1.4 (1.1 – 2.1)
Proportion of area in arable	%	0	26 (11-44)	25 (6 – 44)	6 (0 – 21)
Proportion of area in permanent pasture	%	100 (62 – 100)	11 (2 – 22)	0 (0 – 16)	28 (4 – 93)
Milk production					
Milk sales	litres/cow/year	4523 (2352 – 6375)	6313 (4554 – 8750)	7306 (6400 – 10071)	5857 (4145 – 6711)
Purchased concentrate per litre	kg/litre	0.05 (0 – 0.38)	0.15 (0.01 – 0.33)	0.10 (0.06 – 0.36)	0.16 (0.02 – 0.27)
Purchased concentrate per milking animal	t/head	0.3 (0 – 1.5)	0.9 (0.04 – 2.9)	0.9 (0.4 – 2.3)	0.9 (0.1 – 1.7)
Animal housing					
Percentage of farms where cows go outdoors day and night during the grazing season	%	33	80	28	100
Percentage of herds kept tethered	%	50	0	14	0
Percentage of herds kept in straw yards (loose housing)	%	0	70	14	33
Percentage of herds kept in cubicles	%	50	30	72	66
Labour input					
Annual Labour Units (ALU)	ALU/100 ha	3.8 (2.0 – 6.9)	1.0 (0.6 – 2.3)	2.1 (0.6 – 5.5)	1.6 (0.4 – 6.5)
Milking cows per Annual Labour Unit	No/ALU	20 (12 – 30)	69 (36 – 105)	17 (9 – 53)	52 (24 – 119)

No farms in the Austrian group had any arable land, but Finnish, Danish and UK farms had varying amounts, with least in the UK where a considerable proportion of the arable land was in short term grass leys three years old or younger. On the Austrian mountain farms the majority of grass was permanent pasture, while this was much less common in Denmark and Finland. Most UK farms had some permanent pasture, but this comprised a lower proportion of each farm than in Austria. Stocking rate of the forage area was highest for the UK and Denmark and lowest for Austria and Finland.

The level of milk production also varied, the median being lowest in the Austrian group, followed by the UK, Denmark, and then Finland. Austrian farms consistently used little or no purchased concentrates while levels varied at a higher level in each of the other three groups.Finnish farms thus included some that were relatively small in size but high in purchased feed inputs, in contrast to the Austrian farms which were all small and low input. The majority of the Finnish and Austrian herds only grazed during the day, and three Finnish farms had a grazing season of less than six months, whereas for all other farms in the study the grazing season was six months or more.

Labour input per cow was very high in Austria and Finland, compared with Denmark and UK (although interpretation of the question may have resulted in overestimation of the value of farms with other sources of income, or many different enterprises).

Overall, all countries scored well on animal health and welfare, and relatively highly on farm business resilience (Figure 1). Other spurs showed greater variation.

Three sustainability indicators with links to animal husbandry in the broadest sense are selected for description here:

Animal health and welfare

The animal health and welfare spur was scored by asking questions about animal health (eg parasite control and the incidence of lameness and mastitis), herd health plans, longevity, and aspects of housing and feeding that affect welfare. This spur scored highly across all countries but Austrian scores tended to be lower than the others. On half of Austrian farms, cows were kept tethered, which reduced the scores for housing facilities and freedom to perform natural behavior. Longevity tended to be highest in Austrian herds and lowest on Finnish farms. The number of annual labour units working with the dairy cows was also taken into consideration in this spur, and this differed widely between countries. The ratio of cows to staff hours was far lower on the Austrian and Finnish farms than in Denmark and the UK. This has implications for rural employment as well as for animal welfare. Even allowing for the fact that accounting for time spent working on farms, particularly by family labour, is notoriously difficult, there are likely to be real differences in this parameter between farms and countries. However, although there is often an assumption that animals will receive better care if there are fewer in the care of one person, there is limited evidence for this.

System diversity

System diversity was influenced by crop and livestock diversity, marketing channels and on-farm processing. Crop diversity was greatest on the Finnish farms, which had least diversity of livestock, while no Austrian farms grew crops. Although the UK farms had the highest mean proportion of the farm in arable rotation, the diversity of crops was less than in Finland. Livestock diversity was greatest on the Austrian farms, closely followed by the UK, where cross-bred cattle were often present which increased the score.

Biodiversity

In Austria and Finland, biodiversity was not a particularly high priority objective for the farmers or industry organisations, and in general achieved lower scores than in Denmark and the UK. The biodiversity spur incorporated information on the management, creation and restoration of particular habitats, the presence of rare species of fauna, and plans and awards for nature conservation. There was also a section on pesticide use, which many respondents classed as “not applicable” to organic management. As a result of these factors, biodiversity scores were often lower than might have been expected for low input grassland based farms, where species rich grassland is likely be found. Surprisingly, Austrian farms with a large proportion of permanent mountain pasture scored lowest on biodiversity. The Finnish group's median biodiversity score was closer to those of Denmark and the UK, despite a low proportion of the farms being under permanent pasture. These three countries scored relatively highly on participation in agri-environment schemes. It is likely that the farmers underestimated and undervalued the work they did which contributed to biodiversity, if it was not recognized by being part of a supported scheme.

The results at the level of the "spurs" illustrate the variety within and between different facets of sustainability for a range of farms producing organic milk in four EU countries. However, it is necessary to look at the detailed activities within the spurs to understand why individual farms achieve different scores. The tool does not allow exploration of the interactions and relationships between different aspects of sustainability, which is a complex exercise. The mixed data types contributing to the scores and the fact that answers are influenced by farmers' personal interests mean that the numbers are not suitable for deep statistical analysis; indeed this is not the purpose of the tool. Rather, the experience of using the tool in this context has shown it to be a useful method for opening discussions with farmers.

Discussion

The rapid assessment tool detected differences in various components of sustainability between farms. It was useful in the context of generating interest in sustainability issues and collecting ideas for on-farm participatory research, both with individuals while carrying out the assessment, and by presenting the results to groups. Its framework led farmers to think about aspects which they might not otherwise consider without prompting. There are, however, some difficulties of consistency of data collection when using such a tool across a range of farming systems and countries, particularly when translation is involved.

For future use the biodiversity spur could be further refined to reflect better the variety of species in grassland, particularly permanent pasture. The extent to which animal welfare can be properly represented using this type of assessment without primary data collection is limited. However, in making further amendments, care should be taken not to increase the time required of the farmer.

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Organic pig systems


(Foto: BLE 2004)

A study on single versus group housed organic lactating sows concerning piglet performance and sow behaviour

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Abstract

Group housing of lactating sows is close to natural behaviour and therefore favored in organic farming. But there is no information about advantages or disadvantages, especially concerning the imponderability of the longer organic suckling period. Therefore 74 litters of single housed lactating sows, 51 litters of sows grouped at 3 and 39 litters of sows grouped at 6 were tested concerning sow behaviour and piglet performance with the following results: Group housing causes a higher level of activity and disturbance; grouping at 3 or at 6 results in nearly the same total level of agonistic behaviour; piglets' live weight gain, health status and loss rates remain unaffected by the 3 systems. It is concluded that group housing is practicable for organic lactating sows. The strict obedience of the grouping rules (≤ 5 days between piglets' grouping age, no grouping of diseased sows and no primiparous sow alone with multiparous sows) is essential for a successful implementation.

Key words: Organic group housing, lactating sow, piglets, behaviour, performance

Introduction

Post partum group housing of lactating sows is close to natural behaviour (Rist 1989) and is often favored by organic farmers and advisors. Disadvantages can consist in agonistic interactions between sows (Weary *et al.* 2002), reduced animal health and higher loss rates (Weber 2001), and spreading of litters' live-weight development (Wülbers-Mindermann 1992). Especially the longer organic suckling period compared to conventional piglets is an imponderable effect. But there is only scientific information for conventional group housing systems (e.g. Weber 2000). Hence, the following study was designed in order to reduce the gap concerning group housing of organic lactating sows.

Material and methodology

The study comprised 74 litters of single housed lactating sows versus 51 and 39 litters with lactating sows grouped at 3 and at 6 respectively. The trial started with litter grouping 14 days *post natum* and ended at day 63 *p. n.* with a 49-days suckling period. The following grouping rules were obligatory: maximal difference of 5 days between piglets' grouping age, no grouping of diseased sows, and no primiparous sow alone with multipara sows. Data sampling included (i) piglets' growth performance (weekly weighing), health status (documentation of diseases) and loss rates (documentation), and (ii) sows' behaviour (12-h video recording and continuous analysis software programmed in VBA) recorded at three times (day of grouping, middle and end of suckling period) concerning activity, duration of sitting, of ventral and of lateral recumbency, duration and number of suckling acts, and rate of agonistic acts (chasing-up; cranial, lateral and caudal head butts; disturbance of suckling; violence against piglets). Suckling (act) is defined as "at least 50% of the piglets of a litter massage the teats". Data were analyzed with ANOVA / GLM-procedure using SAS; frequency-related data were tested with FREQ-procedure.

Results

Table 1 shows the results concerning growth performance. Obviously, there are no differences in piglets' live weight development between the three housing systems. The separate description is necessary because the age structure of the sow herd changed during the trial period and 6-sow-grouping took place in the second half of the trial period after 3-sow-grouping. The statistical data analysis showed that the coefficient of variation of the litter weight and the ethological data were unaffected in this regard leading to a combined presentation (Tables 2 – 5).

Table 1. Live weight development of piglets of single housed sows and group housed sows (LSQ ± SE)

		Housing system	
First trial period:		Single housed	Grouped at 3
Birth	[kg]	1.4 ± 0.1	1.4 ± 0.1
Grouping day (start of trial, day14 p.n.)	[kg]	5.1 ± 0.5	5.2 ± 0.5
Day of weaning (day 49 p.n.)	[kg]	16.2 ± 1.2	16.1 ± 1.2
End of trial (day 63 p.n.)	[kg]	23.1 ± 1.5	22.9 ± 1.5
Second trial period:		Single housed	Grouped at 6
Birth	[kg]	1.4 ± 0.1	1.4 ± 0.1
Grouping day (start of trial, day14 p.n.)	[kg]	4.7 ± 0.5	4.5 ± 0.5
Day of weaning (day 49 p.n.)	[kg]	14.5 ± 1.2	15.2 ± 1.2
End of trial (day 63 p.n.)	[kg]	21.6 ± 1.6	22.5 ± 1.5

LSQ-Means without letters within row differ NOT significantly

In Table 2 it can be seen that the coefficient of variation of the litter weight remains unaffected from the three different housing systems with a minor numerical decrease when piglet age increases.

Table 2. Coefficient of variation of litter weight according to three different housing systems (LSQ ± SE)

Housing system:		Single housed	Grouped at 3	Grouped at 6
Birth	%	21.5 ± 0.01	21.2 ± 0.01	22.1 ± 0.01
Grouping day* (day14 *p.n.*)	%	22.7 ± 0.01	22.0 ± 0.01	22.0 ± 0.01
Day of weaning (day 49 *p.n.*)	%	18.7 ± 0.01	17.5 ± 0.01	18.9 ± 0.01
End of trial (day 63 *p.n.*)	%	17.8 ± 0.01	16.8 ± 0.01	18.1 ± 0.01

* Start of trial
LSQ-Means without letters within row or within column differ NOT significantly

Health status (92.3%, 92.3%, 95.2% piglets without diagnostic findings) and piglets' loss rates (2.5%, 3.4%, 1.2%) for single housed sows, sows grouped at 3 and sows grouped at 6, respectively, were unaffected from the three housing systems.

Table 3. Behaviour characteristics of lactating sows in the suckling period according to three different housing systems (LSQ ± SE)

Housing system:		Single housed	Grouped at 3	Grouped at 6
Activity	[min/2h]	$33.3^{b} \pm 1.8$	$37.3^{ab} \pm 1.7$	$39.1^{a} \pm 1.6$
Sitting	[min/2h]	$3.0^{a} \pm 0.4$	$3.2^{a} \pm 0.4$	$1.2^{b} \pm 0.4$
Ventral recumbency	[min/2h]	$37.0^{b} \pm 2.0$	$38.1^{b} \pm 1.8$	$48.5^{a} \pm 1.8$
Lateral recumbency	[min/2h]	$33.6^{a} \pm 2.0$	$30.4^{a} \pm 1.8$	$22.0^{b} \pm 1.8$
Suckling time	[min/2h]	$13.0^{a} \pm 0.6$	$11.0^{b} \pm 0.6$	$9.4^{c} \pm 0.5$
Suckling acts	[n/2h]	2.3 ± 0.1	2.3 ± 0.1	2.4 ± 0.1

$^{a, b, c}$ different letters within a row denote significant differences for $p<0.05$

Table 3 shows that agitation increases with increasing group size. Furthermore, agitation decreased – at least to certain degree – with continuing suckling period (data not presented). In Table 4 it can be seen that the agonistic interactions between the sows are largely independent of the group size.

Table 4. Agonistic behaviour of group housed lactating sows in the suckling period (LSQ ± SE)

Housing system:		Grouped at 3	Grouped at 6
Chasing-up	[n/2h]	0.57 ± 0.14	0.74 ± 0.15
Cranial head butts	[n/2h]	1.34 ± 0.22	1.00 ± 0.23
Lateral head butts	[n/2h]	0.83 ± 0.19	0.71 ± 0.20
Caudal head butts	[n/2h]	0.29 ± 0.08	0.18 ± 0.08
Disturbance of suckling	[n/2h]	0.24 ± 0.09	0.49 ± 0.09
Violence against piglets	[n/2h]	$0.39^{a} \pm 0.09$	$0.13^{b} \pm 0.09$
Total of agonistic acts	[n/2h]	3.67 ± 0.54	3.25 ± 0.57

$^{a, b}$ different letters within a row denote significant differences for p<0.05

Table 5 shows that the number of agonistic acts within the housing system decreases in most cases during the suckling period (i.e. continuation of the togetherness in the group).

Table 5. Agonistic behaviour of group housed lactating sows according to different times of observations (LSQ ± SE)

Housing system:		Grouped at 3	Grouped at 6
Grouping day			
Chasing-up	[n/2h]	$0.95^{x} \pm 0.20$	$1.27^{x} \pm 0.22$
Cranial head butts	[n/2h]	$1.86^{x} \pm 0.32$	$1.85^{x} \pm 0.35$
Lateral head butts	[n/2h]	0.78 ± 0.27	$1.37^{x} \pm 0.29$
Caudal head butts	[n/2h]	0.38 ± 0.11	0.34 ± 0.12
Disturbance of suckling	[n/2h]	$0.42^{x} \pm 0.13$	$0.73^{x} \pm 0.14$
Violence against piglets	[n/2h]	0.48 ± 0.12	0.25 ± 0.14
Total of agonistic acts	[n/2h]	$4.86^{x} \pm 0.78$	$5.80^{x} \pm 0.86$
Middle of suckling period			
Chasing-up	[n/2h]	$0.20^{y} \pm 0.19$	$0.21^{y} \pm 0.19$
Cranial head butts	[n/2h]	$0.83^{y} \pm 0.30$	$0.15^{y} \pm 0.31$
Lateral head butts	[n/2h]	$0.89^{a} \pm 0.26$	$0.05^{by} \pm 0.26$
Caudal head butts	[n/2h]	0.20 ± 0.11	0.02 ± 0.10
Disturbance of suckling	[n/2h]	$0.07^{y} \pm 0.12$	$0.25^{y} \pm 0.12$
Violence against piglets	[n/2h]	0.30 ± 0.12	0.01 ± 0.12
Total of agonistic acts	[n/2h]	$2.49^{y} \pm 0.74$	$0.69^{y} \pm 0.75$

$^{x, y}$ different letters within a column (within the same housing system and for the same agonistic behaviour) denote significant differences for p<0.05 between the observation days
$^{a, b}$ different letters within a row denote significant differences for p<0.05 between different housing systems

Discussion

The effect of improved post-weaning weight gain of already pre-weaning grouped piglets (D´Eath 2004) could not be confirmed (Table 1). Spreading of litters' live-weight development (Wülbers-Mindermann 1992) is refuted by the missing variation of the litter weights' coefficients of variation (Table 2). Further, the results do not confirm the negative effect of group suckling on health status and loss rates, supposed by Weber (2001). The increasing rate of ventral recumbency, the decreasing rate of relaxation-indicating lateral recumbency and the decrease of suckling time (Table 3) stand for a higher rate of acticity and disturbance in group suckling systems. The nearly same level of agonistic behaviour rates between sows grouped at three or grouped at six indicates that both group sizes are practicable. However the behaviour-related results (Table 3-5) emphasize that there were behavioural adaptations of the sows but these adaptations did not negatively affect the piglets live weight gain, health status and loss rates.

It is concluded that group housing is practicable for organic lactating sows. The strict obedience of the above mentioned grouping rules (≤ 5 days between piglets' grouping age, no grouping of diseased sows and no primiparous sow alone with multiparous sows) is essential for a successful implementation.

Suggestions to tackle the future challenges of organic animal husbandry

The present paper will contribute to improve animal welfare in organic animal production systems.

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A study on four feeding strategies of 100% organic origin for piglets concerning performance, health status, losses and economy in organic agriculture

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Abstract

Organic agriculture is defined as a low-external-input-system but piglets' necessity for high quality diets seems to contradict low-external-input feeding strategies. Hence, a total of 361 piglets was tested from day 14 – 63 post natum concerning performance, health status, losses and diet costs by means of four feeding strategies of 100% organic origin: (i) high-external-input diet, (ii) medium-external-input diet, (iii) low-external-input diet, each with grass-clover-silage as roughage source, and (iv) above mentioned low-external-input diet with straw replacing grass-clover-silage. The high-external-input-diet achieved the significantly highest live weight gain; all other strategies were similar at a lower level. There were no differences in health status and loss rates between the four strategies. Low-input-strategies were economical at best in producing a standardized 20 kg piglet. A verification of the results is necessary with a higher number of piglets for a final recommendation.

Key words: piglets, 100% organic feeding, performance, health, losses, economy

Introduction

Organic agriculture is characterized as a low-external-input-system (Conway 1987). Hence, livestock's nutrient supply should be of predominantly farm-own production and of complete organic origin (Weißmann 2011). But this approach seems to be problematically for piglets due to their high nutrient requirement and simultaneous lack of organic feed with high protein quality (Zollitsch 2007). It is the aim of the following study to test a 100% organic low-external-input feeding strategy without lowering piglets' performance and health status.

Material and methodology

The four feeding strategies consisted of (**i**) a high-external-input diet (HID), (**ii**) a medium-external-input diet (MID), (**iii**) a low-external-input diet (LID), each with grass-clover-silage as roughage source, and (**iv**) LID with straw replacing grass-clover-silage (Table 1). Concentrates and roughage were offered *ad libitum* in the form of a one-phase diet during the whole trial period. The amount of concentrates was recorded as offered to (not consumed by!) the piglets; the amount of roughage had not been recorded. Piglets were of modern hybrid genetic origin. The trial with a total of 361 piglets started 14 days *post natum* and ended at day 63 *p. n.* with a suckling period of 49 days. Data recording included live weight development (weekly weighing), health status (documentation of diseases), losses (documentation) and diet costs (monetized amount of offered concentrates). The data of growth performance were statistically analyzed with the analysis of variance procedure GLM of SAS Version 9.2 using fixed effects (i. a. the four feeding strategies, piglets' sex, sow parity factor) and co-variables (i. a. piglets' live weight at trial onset, litter size at birth and at trial onset). The LSQ-Means were statistically compared using the Tukey-Kramer-Test at 5% significance level.

Table 1. Characterization of the concentrates and grass-clover-silage

	HID*	MID*	LID*	GCS*
Diet costs (€ / 100 kg)	120.-	57.-	47.-	- -
Diet composition (%)				
Triticale	- -	27.5	30.0	- -
Winter barley	28.0	20.0	27.0	- -
Field peas	- -	20.0	20.0	- -
Lupines, blue	- -	10.0	- -	- -
Field beans	22,2[1]	- -	10.0	- -
Soy beans[2]	17.4	- -	- -	- -
Wheat flakes	22.0	- -	- -	- -
Soy cake	- -	14.3	4.8	- -
Rape cake	- -	- -	5.0	- -
Whey, dried powder	- -	5.0	- -	- -
Skim milk powder	6.0	- -	- -	- -
Sunflower oil	1.0	0.5	0.5	- -
Minerals[3]	3.4	2.7	2.7	- -
Diet ingredients (% of original substance)				
Dry matter	89.0	86.4	85.2	25.2
Crude protein	19.5	18.4	15.5	5.2
Lysine	1.09	0.94	0.81	0.18
Feed energy (MJ Metabolizable Energy / kg)	13.9	12.9	12.7	2.1

* HID (High-external-Input Diet), MID (Medium-external-Input Diet),
LID (Low-external-Input Diet), GCS (grass-clover-silage)
[1] extruded, [2] toasted, [3] including premix

Results

Table 2 shows the results concerning growth performance, health status, losses, and the amount and the costs of the offered concentrates.

The high-external-input feeding strategy (HID) caused the significantly highest daily weight gain in the suckling period (+14%) and in the whole trial period (+15%) compared to the average of the medium- and the low-external-input feeding strategies which were statistically similar at a lower level. After weaning, HID advantage was only numerical. Piglets' health status was good and not affected by the four feeding strategies. Only a maximum of 3.3% of the piglets (HID group) had been treated. Animal losses were on a low level and also unaffected by the four feeding strategies. Diet costs for a standard-20kg-piglet increased by factor 1.3, 1.4, and 3.1 for group 3, 2 and 1 respectively, compared to group 4 piglets.

Discussion

The high-external-input diet (HID) has the smallest amount of farm grown diet components and the highest amount of technologically processed diet components of farm-external origin, the opposite way around to the low-external-input diet (LID) (Table 1). Hence, HID feeding strategy is not fully consistent with organic agriculture which is defined as a low-external-input-system. On the other hand the question has to be answered whether and how it is possible to fulfill the high feed quality demand of piglets within a more or less extensive agricultural system. The results (Table 2) show that even a LID feeding strategy with straw as roughage source seems to be able to generate sound piglets of proper growth performance and good health status without negative effects on animal losses but with positive effects on economy. However a verification of the results is necessary (mainly by use of higher number of piglets and differing seasons) before communicating a final suggestion. This will be realized in the EC-wide Core-Organic-II project ICOPP (Improved Contribution of local feed to support 100% Organic feed supply to Pigs and Poultry).

Table 2. Growth performance, health status, losses and diet costs of piglets according to four different feeding strategies

Feeding strategy	1	2	3	4
Type of concentrates	HID*	MID*	LID*	LID*
Roughage source	- grass–clover–silage -		straw	
Animals at onset of trial [n]	90	91	83	97
Growth performance				
Live weight (LSQ-Means ± SE)** at the …				
… onset of trial [kg]	4.8 ± 0.11	4.8 ± 0.11	4.4 ± 0.12	4.5 ± 0.11
… day of weaning [kg]	$17.0^a \pm 0.24$	$15.5^b \pm 0.24$	$14.8^b \pm 0.25$	$14.9^b \pm 0.24$
… end of trial [kg]	$23.2^a \pm 0.33$	$20.9^b \pm 0.34$	$20.9^b \pm 0.36$	$20.0^b \pm 0.33$
Daily weight gain (LSQ-Means ± SE)** in the …				
… suckling period [g]	$356^a \pm 6.6$	$318^b \pm 6.6$	$318^b \pm 7.0$	$302^b \pm 6.6$
… rearing period [g]	454 ± 14.3	396 ± 14.6	398 ± 15.7	380 ± 14.3
… trial period [g]	$381^a \pm 6.8$	$335^b \pm 6.9$	$340^b \pm 7.4$	$321^b \pm 6.7$
Health status				
Treated piglets [n]	3	2	1	2
… related to …				
… cough [n]	0	0	0	1
… diarrhea [n]	1	1	1	
… lesions [n]	1	0	0	1
… other reasons [n]	1	1	0	0
Losses				
Died piglets [n]	1	3	0	2
… caused by …				
… crushing [n]	0	1	0	1
… debility [n]	0	1	0	0
… other reasons [n]	1	1	0	1
Diet costs				
Amount of concentrates per …				
… group [t]	2.225	1.827	1.992	1,674
… piglet [kg]	25	21	24	18
Costs of concentrates per …				
… piglet	30.00 €	11.97 €	11.28 €	8.46 €
… 20-kg-piglet	25.86 €	11.45 €	10.79 €	8.46 €

* For abbreviations compare Table 1
** LSQ-means with different letters within a row differ significantly ($p < 0.05$)

Suggestions to tackle the future challenges of organic animal husbandry

The present paper should be understood as a mosaic stone in the ambition to implement sustainable low-external-input livestock production systems for generating high product quality, high process quality, and economic success.

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Alternatives to piglet castration without pain relief – Acceptance and willingness-to-pay of organic consumers in Germany

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Abstract

An important aspect of the ongoing discussion on the adequacy of alternatives to piglet castration without pain relief is consumers' acceptance. This explorative study with 89 consumers of organic pork in Germany examined participants' attitudes towards and willingness-to-pay for three alternatives. Participants strongly rejected castration without pain relief. The practice was contrary to their image of animal friendly husbandry in organic farming. The criteria animal welfare, health/food safety, taste, organic farming and costs were important for participants' evaluation of the alternatives. Hereby, participants were aware of the need to trade-off these criteria, e.g. animal welfare and taste. The relevance of the criteria differed between alternatives. The results of the Vickrey auctions reflected the previous discussions with the highest willingness-to-pay for castration with pain relief, followed by fattening of boars, immunocastration and castration without pain relief.

Key words: organic consumers, piglet castration, animal welfare, Vickrey auction, focus group discussion

Introduction

With the beginning of 2012 surgical castration of piglets in organic farming in Europe is only allowed if "adequate anaesthesia and/or analgesia" are applied to minimize the suffering of the animals (Commission Regulation (EC) No 889/2008). Piglets are castrated to avoid the occurrence of boar taint, an unpleasant odor and flavor of pork. Until recently castration was usually performed without any kind of pain relief. Hence, organic pig production needs to implement alternatives to this practice which meet animal welfare requirements and ensure sensory meat quality. An important aspect to include in the still ongoing discussion on the adequacy of alternatives is consumers' acceptance. This paper examines German organic consumers' attitudes and willingness-to-pay for alternatives to piglet castration without pain relief combining qualitative (focus group discussions) and quantitative (Vickrey auctions) consumer research methods.

Material and methodology

Nine focus group discussions combined with Vickrey-Auctions were conducted in three German cities in autumn 2009. Participants' attitudes towards and willingness-to-pay (WTP) for three alternatives, castration with anesthesia and analgesia, immunocastration, and fattening of boars were examined. Focus groups are moderated group discussions with six to twelve participants. They are used to gain insights into participants attitudes and opinions towards a specific topic (Burns and Bush 2010). Vickrey auctions are also called "sealed-bid second-price auctions" because all participants place their sealed bids simultaneously and, while the highest bid wins, the price payable is determined by the second highest bid (Lusk and Shogren 2007; McAfee and McMillan 1987).

Before each focus group discussion began, participants received standardized information on the issue of piglet castration without pain relief, castration with anesthesia and/or analgesia, immunocastration and fattening of boars. In the following discussions consumers were asked to express their opinions on these issues and the implementation of the alternatives in organic farming. Afterwards four packages (80 g) of organic smoked salami were auctioned. The only difference between the salamis was the method of castration used. Consumers were informed about the bidding mechanism of a Vickrey auction and told that the “winner” had to buy the auctioned package. If participants did not want to buy one of the salamis at all, they could place a bid of zero. The focus group discussions were audio- and videotaped and transcribed verbatim. Qualitative content analysis following Gläser and Laudel (2006) was applied. The auction data were analyzed using descriptive statistics (SPSS 19).

89 consumers of organic pork participated in the study. 62 % of the participants were women and 50 % each were 18 to 44 or rather 45 to 75 years old. Most participants (80 %) were intensive consumers of organic food.

Results

Perception of the alternatives

Participants strongly rejected castration without pain relief. The practice was contrary to their image of animal friendly husbandry in organic farming. Altogether, knowledge and awareness of the issue of piglet castration was low among participants. The criteria animal welfare, health/food safety, taste, organic farming and costs were important for participants’ evaluation of the alternatives.

Animal welfare was particularly important for the evaluation of castration with anesthesia and analgesia and fattening of boars. While castration with pain relief was predominantly considered as positive with respect to animal welfare, opinions were divided with regard to fattening of boars as on the one hand there is no pain due to surgical interventions and on the other hand there are possible problems with increased aggressive behavior of the animals. Immunocastration was mainly seen as positive for the pigs.

Food safety was a mayor issue with immunocastration and with castration with pain relief due to suspected residues and negative health effects for consumers. Possible food safety risks of immunocastration were seen as more severe than of castration with anesthesia and analgesia because immunocastration was associated with hormones. In contrast, many participants regarded the risk of residues of anesthetics and analgesics as low. The food safety issue dominated the discussion on immunocastration and other criteria seemed less important in comparison.

The discussion on taste focused on boar meat. This criterion did not play a role for the other alternatives. The discussion was characterized by great uncertainty regarding odor and flavor of boar taint and the use of tainted meat. With exception of a few persons, none of the participants had personally experienced boar taint in meat before.

As regards organic farming the use of drugs for castration with anesthesia and analgesia as well as for immunocastration was considered inappropriate. Fattening of boars was the only alternative deemed explicitly as suitable for organic farming due to its supposed naturalness.

Costs of castration with pain relief and fattening of boars were regarded as supposedly high and increased meat prices for consumers were feared. In this context, some participants criticized the sorting out of tainted carcasses without an appropriate use as wastefulness which not only presents an economical but also an ethical problem.

Willingness-to-pay for the alternatives

The results of the Vickrey-Auctions reflected the previous discussions. Table 1 shows the average willingness-to-pay for the different methods and the corresponding share of zero-bids. Average willingness-to-pay for castration with anesthesia and analgesia was highest with 2.17 € for 80 g of salami and the share of zero-bids was lowest. Considering the focus group results, it can be assumed that consumers preferred this alternative because of the improved animal welfare and the avoidance of boar taint. Average willingness-to-pay for fattening of boars was only slightly lower (2.12 €) and the share of zero bids a bit higher. Here, particularly uncertainty about taste may have influenced bidding behavior. For immunocastration, the share of zero-bids was with almost 50 % the highest of all methods, while at the same time average willingness-to-pay was lower than for the other alternatives but still higher than for the standard procedure of castration without pain relief. This suggests a polarization of opinions towards immunocastration. On the one hand, some participants placed relatively high bids for this alternative, maybe due to animal welfare considerations. On the other hand, some participants did not want to buy the product at all, which may be due to the intensive discussion on food safety issues. Castration without pain relief resulted in the lowest average WTP (1.19 €) with a high share of zero-bids which reflects the clear rejection of this castration method expressed in the focus group discussions.

Table 1. Average willingness-to-pay for the 80 g packages of salami and share of zero-bids (n=88)

Method	Average willingness-to-pay (Euro)	Share of zero bids (%)
Castration with anesthesia and analgesia	2.17	13.6
Fattening of boars	2.12	20.7
Immunocastration	1.33	47.7
Castration without pain relief	1.19	40.9

Discussion

The results suggest that for organic farming castration with pain relief and fattening of boars may be acceptable alternatives to consumers while opinions towards immunocastration were rather ambivalent. In other studies attitudes towards immunocastration were rather positive (e.g. Hofer and Kupper 2008; Vanhonacker et al. 2009). This discrepancy may be explained by the fact that our sample consisted of organic food consumers, who are particularly sensitive to health and food safety issues (Hughner et al. 2007).

Consumers used different criteria to evaluate the alternatives. Hereby, they were aware of the need to trade-off these criteria, e.g. animal welfare and taste, and individual preferences depended on the weight given to a certain criterion. The relevance of the criteria differed between the alternatives, which should be considered in communication efforts regarding the implementation of the alternatives.

Suggestions to tackle the future challenges of organic animal husbandry

Animal welfare is one of the most important reasons for buying organic products in Germany (fischerAppelt relations 2012; Pleon 2010). Organic consumers have high expectations regarding animal welfare standards, even though they often do not know much about specific animal husbandry practices. Therefore, it is crucial for the organic sector to balance consumer expectations and reality of animal husbandry in order to avoid great discrepancies which could disappoint and appall consumers.

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Variation in sow and piglet performance in organic production: influences of herd and sire bree

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Abstract

The present study aims to assess the influence of herd and sire breed on variation in gestation length, number of piglets born alive and number of piglets stillborn. 79 Yorkshire x Landrace sows in three organic herds were inseminated with semen from either Hampshire or Duroc sires with known identity. In all herds, 50 % of the sows were inseminated with Hampshire sires and 50 % with Duroc sires. The results indicate that the gestation length of sows inseminated with Duroc boars are on average two day longer than for sows inseminated with Hampshire boars. The delay in the onset of the farrowing may partly be explained by less mature foetuses/piglets. The total number of piglets born was on average lower in litters with Hampshire sire. The results of the preliminary analyses indicate important effects of sire breed on sow and piglet performance in organic herds.

Key words: sire, breed, swine, litter size, gestation length

Introduction

The production environment for pigs partly differs between organic and conventional production systems. Some of the major differences are related to the nutrient composition of the feed, outdoor access, space allowance, pathogen load, length of the nursing period and pig group composition. However, the pigs used in organic production in Sweden today are of the same breeds as used in conventional production. These breeds have been selected for high production in conventional environments. One important step in the development of sustainable organic pig production is to investigate how these ‘conventional’ animals manage, and produce in these herds. For example, increased incidence of reproductive failures among sows, and high piglet mortality rates have been observed in organic piglet production (Wallenbeck et al., 2009). Previous studies have shown that the genetic background of the sire may affect both dam fertility and piglet performance early in life, also before birth (Knutsson, 2011).

This study is part of a larger research project investigating impact of sire breed on performance and health in pigs kept in organic herds. The specific aim of this study is to investigate the effect of piglet sire breed and herd on gestation length, litter size and still birth in organic herds.

Material and methodology

In this research project, 200 sows from four organic herds were inseminated with semen from the two commercial sire breeds available in Sweden; Hampshire and Duroc. The sows included in the study were inseminated from October 2011 to April 2012. In each herd and batch, the aim was to inseminate 50 % of the sows with non-mixed semen from individual AI (Artificial Insemination) Hampshire boars and 50 % of the sows with non-mixed semen from individual AI Duroc boars. Each sow was inseminated with semen from the same boar during all inseminations during one oestrous period. Sows were inseminated maximum three times during two subsequent days (e.g. insemination before and after noon day 1 and before noon day 2). Herdsmen registered date of insemination, identification of the boar that the sow were inseminated with, farrowing date, number of piglets born alive and number of piglets stillborn. Gestation length was estimated as the number of days from first insemination until farrowing. Total number of piglets born was estimated as number of piglets born alive + number of piglets stillborn.

The statistical analyses were performed with the SAS package, version 9.2 (SAS Institute Inc., 2011). Associations between sow and piglet performance and sire breed and herd were analysed with the following model in PROC GLM:

y = sire breed + herd + parity + month of insemination + total number of piglets born + residual

where the response variable '*y*' is gestation length, number of piglets born alive, number piglets stillborn, proportion of piglets stillborn in the litter and total number of piglets born alive. The predicting factors were *sire breed* (Hampshire or Duroc), *herd* (A, B or C), parity (not known, parity 1-3, parity >3), *month of insemination* (October, November, December) were included as fixed class effects. *Total number of piglets born* was included in the statistical model as a continuous covariate in all analyses except the analysis where total number of piglets born was the response variable '*y*'.

Results

These preliminary analyses include information from the first 79 sows that farrowed in this study (from three different herds). 54 % of the sows were inseminated with Hampshire sires and 46 % with Duroc sires. The gestation length of sows inseminated with Duroc boars was on average two days longer than for sows inseminated with Hampshire boars. There was a tendency for a lower total number of piglets born in litters after Hampshire sires (Table 1).

Table 1. Least square mean differences in gestation length, litter size and stillbirth between Hampsire and Duroc sires

	Hampshire		Duroc			
	LSM	StErr	LSM	StErr	F-stat	p-value
Gestation length (days)	114.2	0.79	116.2	0.79	4.3	0.041
Number of piglets born alive	13.9	0.36	14.1	0.36	0.3	0.622
Number of piglets stillborn	1.4	0.36	1.2	0.36	0.3	0.622
Percentage of piglets stillborn in the litter (%)	7.7	2.15	6.6	2.16	0.2	0.652
Total number of piglet born	13.5	0.81	15.2	0.83	3.4	0.070

There were no significant differences between herds in gestation length, number of piglet born alive, number of piglets stillborn or percentage of piglets stillborn. However, there was an effect of herd on the total number of piglets born ($p=0.047$). Total number of piglets born had significant effect ($p<0.05$) on both number of piglets born alive, number of piglets stillborn and the percentage of piglets stillborn in the litter. In order to adjust for this effect, total number of piglets born was included in the statistical models.

Discussion

The results indicate that the gestation length of sows inseminated with Duroc boars was on average two days longer than for sows inseminated with Hampshire boars. The delay in onset of the farrowing may partly be explained by less mature foetuses/piglets in Duroc litters, possibly due to larger litters. The total number of piglets born was on average lower in litters with Hampshire sire. The preliminary results of the present study indicate important effects of sire breed on sow and piglet performance in organic herds.

Suggestions to tackle the future challenges of organic animal husbandry

The choice of sire breed affects performance of both sows and piglets. Mapping of appropriate traits and breeds for pigs in organic production environments, and development of breeding strategies for different conditions is lacking. Appropriate animal material is the basis of all animal husbandry and it is essential for the development organic animal production.

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Effect of different pastures on backfat fatty acid composition in organic Cinta Senese pig

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Abstract

The objective of this study was to assess the effect of different pastures, applied during the finishing period, on backfat fatty acid composition from organic pigs. Sixty Cinta Senese pigs were slaughtered from May 2010 to July 2011, during their finishing period they grazed on different types of pasture: 1) mixed grass (Vicia sativa L., Trifolium alexandrinum L. Avena sativa L.) and sorghum (Sorghum vulgare), 2) gleaning of barley (Hordeum vulgare L.) and horse bean (Vicia faba minor L.), 3) old alfalfa field (Medicago sativa L.) and 4) mixed grass (Avena sativa L., Hordeum vulgare L.. Vicia faba minor L.) and sorghum. Animals were fed with 2.5 % D.M. live weight of farm feed, but during the period of access to pasture the diet was decreased and the availability of crops was ad libitum. The different availability of fatty acids coming from pastures brought a change regarding fatty acids composition of the pig backfat, in particular green pastures enrich fat deposits in n-3 linolenic acid.

Key words: organic pig, pasture, backfat fatty acid composition, gleaning.

Introduction

In Italy organic pigs are generally reared outdoors using local breeds best suited to this type of farming (Edwards, 2002). Grazing is essential to the welfare, the health and the fertility of pigs and it represents, if well managed, a valid tool to preserve and increase soil fertility. Feeding pigs with forage is a way to partially replace the supply of concentrate, in particular the proportion of protein, this can make the diet more sustainable and economically convenient. Fresh pastures are rich in essential fatty acids, vitamins, antioxidants and minerals and they improve the healthiness of pork (Costantini et al, 2003). In Italy the Mediterranean climate, characterized by long periods of drought and hot weather limits the use of pastures.. This limit can be overcome with a correct management of paddocks and crop selection. The aim of this study was to assess the effect of different pastures, applied during the finishing period, on backfat fatty acid composition from organic Cinta Senese pigs.

Material and methodology

A herd of 50 pigs (including, lactating sows, suckling piglets, weaned, growing and finishing pigs) had access to 10 hectares of pastures divided as: 1) May-July 2010 the pastures were, 3 ha of mixed grass (*Vicia sativa L., Trifolium alexandrinum L. Avena sativa L.*) and 1 ha of sorghum (*Sorghum vulgare*), 2) August-October 2010 on 2 ha of gleaning of barley (*Hordeum vulgare L.*) and 1.5 ha of gleaning of horse bean (*Vicia faba minor L.*), 3) February-April 2011 on 2.5 ha of an old alfalfa field (*Medicago sativa L.*) and 4) May- August 2011 on 5 ha of mixed grass (*Avena sativa L., Hordeum vulgare L.. Vicia faba minor L.*) and 1 ha of sorghum (Table 1). Animals were fed with 2.5 % D.M. live weight of farm feed (PG 12.3 %, ED 3031 Kcal/kg) (20 % wheat, 20 % barley, 20

% white horse bean, 20 % maize, 10 % white oat, 9.6 % sunflower seed, 0.2 % salt, 0.2 % calcium bicarbonate). During the period of access to pasture the diet was decreased by 30 % on D.M. during the first, second and fourth periods and 15% during the third period. All pastures were offered to the animals in sequence through the use of mobile fencing. The production of dry matter was estimated by sampling the vegetation in each pasture before the animals entrance. The availability of crops was *ad libitum*. The samples of concentrate feed and forages were collected and analysed (AOAC, 1990) for dry matter, crude protein, crude lipids, ash and fatty acids content (Folch et al. 1957, Stoffel et al. 1959). From May 2010 to July 2011 sixty finishing Cinta Senese pigs were slaughtered (15 for each period of pasture, Table 4). Every week a few pigs were slaughtered, the animal live weight was between 110 and 150 Kg and the average age was 15 months. A sample of backfat of each animal was collected and analyzed for fatty acid percentage (Stoffel et al.1959, De Pedro et al., 1997). Data regarding backfat fatty acid composition were subjected to variance analysis with GLM procedure (SAS, 2008)

Results

The daily availability of dry matter of pastures for pigs is presented in Table 1, it is from 1 kg /*capo* / *die* (old alfalfa field 2011) to 5 kg / *capo*/ *die* (mixed grass 2011). Table 2 shows the nutritional characteristics of pastures and feed and Table 3 shows the fatty acid composition of pastures and feed. The percentage of linolenic acid (C18:3) is higher in grassland than in gleaning. In Table 4 the statistical analysis underlines the higher percentage of linoleic and linolenic acid in backfat fatty acid composition of pigs finished on grassland (grassland 2010, old alfalfa 2011 and grassland 2011) than on gleaning, contrariwise pigs finished on gleaning presented a higher percentage of oleic acid in backfat than pigs finished on grassland.

Table 1. Use of pasture.

	Grassland 2010		Gleaning 2010		2011		Grassland 2011
	Mixed grass	Sorghum	Horse bean	Barley	Old alfalfa	Mixed grass	Sorghum
Period / use	May June	July	August	September October	February April	May July	August
Days / use	56	38	30	60	90	75	30
Area / ha	3	1	1.5	2.0	2.5	5	1
DM[a] q / ha	37.5	26	36	31	20.2	41.3	24.3
DM[a] Kg / head / die	> 4	> 1.3	> 3.5	> 2	> 1	> 5	> 1.6
Percentage of feed replaced by grazing	30%	30%	30%	30%	15%	30%	30%

[a] DM: dry matter

Table 2. Chemical composition of the forages and concentrate (s.s.).

	Grassland 2010		Gleaning 2010		2011	Grassland 2011		Concentrate
	Mixed grass	Sorghum	Horse bean	Barley	Old alfalfa	Mixed grass	Sorghum	
DM[a] %	23.30	24.77	51.55	35.9	32.44	25.5	23.29	88.37
CP[b] %	9.30	10.30	6.31	8.77	14.80	8.89	8.10	12.32
CL[c] %	1.98	1.70	0.66	2.10	1.45	1.99	1.88	4.52
CF[d] %	21.53	30.62	29.48	31.21	26.78	24.97	28.88	3.48
Ash %	9.30	6.17	9.10	7.80	9.02	8.44	8.30	2.60

[a]DM: dry matter, [b]CP: crude protein, [c]CL: crude lipids, [d]CF: crude fiber

Table 3. Fatty acid composition (%) of forages and concentrate.

	Grassland 2010		Gleaning 2010		2011	Grassland 2011		Concentrate
	Mixed grass	Sor-ghum	Horse bean	Barley	Old alfalfa	Mixed grass	Sorghum	
Palmitic (C16:0)	13.56	15.10	20.46	13.72	12.46	16.01	17.38	14.26
Palmitoleic (C16:1)	1.47	1.57	0.71	0.89	1.48	0.08	0.08	0.16
Stearic (C18:0)	1.06	1.15	6.99	1.66	2.03	1.45	1.57	2.15
Oleic (C18:1)	1.79	3.14	7.77	3.66	5.26	2.15	2.60	29.31
Linoleic (C18:2)	12.60	15.85	16.75	13.93	15.00	13.96	13.75	49.07
Linolenic (C18:3)	43.28	39.15	20.06	30.59	37.63	45.17	35.86	2.23

Table 4. Fatty acid composition (%) of backfat from pigs.

	Grassland 2010	Gleaning 2010	Old alfalfa 2011	Grassland 2011
Myristic (C14:0)	1.26	1.31	1.30	1.24
Palmitic (C16:0)	20.88	20.96	21.32	21.05
Palmitoleic (C16:1)	1.77	1.81	1.93	1.77
Stearic (C18:0)	13.42 ^{a}	13.39 ^{a}	12.15 ^{b}	12.90 ^{ab}
Oleic (C18:1)	43.98 ^{AB}	46.09 ^{A}	42.84 ^{B}	42.63 ^{B}
Linoleic (C18:2)	13.37 ^{a}	11.78 ^{b}	13.87 ^{a}	13.81 ^{a}
Linolenic (C18:3)	1.50 ^{a}	1.11 ^{b}	1.44 ^{a}	1.54 ^{a}
SFA	36.57	36.60	35.99	36.44
MUFA	48.34	50.35	48.54	48.04
PUFA	15.09 ^{a}	13.04 ^{b}	15.47 ^{a}	15.52 ^{a}
Samples (N.)	15	15	15	15

$^{A, B}$ = $P \leq 0.01$; $^{a, b}$ = $P \leq 0.05$

Discussion

The rotation of the pastures was organized to provide feed in a continuous manner to pigs. The use of gleaning, in particular the horse bean in August, was the solution to make possible grazing even without green grass. The amount of feed was significantly reduced (from 15 % to 30 % Table 1) to increase the use of pastures by pigs. A diet rich in green pastures (grassland and old alfalfa) determined an increase of linolenic acid in backfat, essential fatty acid particularly interesting for human nutrition, while the high percentages of linoleic acid in adipose tissue resulted from concentrate feed. The use of pastures (grassland and gleaning) is a good source of nutrients for pigs and it allows to include pigs in crop rotation and in general in an agricultural system less energivorous then more sustainable.

Suggestions to tackle the future challenges of organic animal husbandry

The use of pastures isn’t only an opportunity to increase the welfare of the pigs, to decrease the use of concentrate feed and energy (both manpower and fossil fuels) but also to increase the percentage of n-3 fatty acids in the adipose tissue.

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Organic C and total N dynamics in soil in an organic pig farm

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Key words: organic pig, soil, fertility, pasture, C, N.

Abstract

One of the challenges of including pigs in a sustainable farming rotation is to preserve soil fertility. In fact, without a correct rotation of the paddocks, grazing pigs cause, with their normal feeding behaviour, excavations, destruction of the sward and soil structure damage, with negative influence on soil fertility. The aim of this study is to investigate soil fertility dynamics throughout one year in an organic outdoor pig farm. An on-farm study was carried out in the south of Tuscany, in Italy. The experimental design included 6 plots hosting different crop sequences. Grazing pigs were periodically moved among the plots. Soil organic C (SOC) and total N (Ntot) were selected as fertility indicators, and their contents were measured in the top 0-20-cm soil layer, in 12 dates, in the period between June 2010 and September 2011. Mean SOC and Ntot contents were remarkably different depending on the plot. However, for a given plot, they increased or did not vary during the sampling period, with exception of the sorghum plot, where a slight decrease in C content was observed. These preliminary results support the hypothesis that soil fertility is not negatively affected by outdoor pig grazing, with the cropping system adopted by the organic farm hosting this experiment.

Introduction

According to the European organic regulation (EC N. 834/2007) organic stock farming is a land-related activity and animals should have, whenever possible, access to open air or grazing areas. At the same time, organic production should contribute to maintaining and enhancing soil fertility as well as preventing soil erosion. One of the challenges of including pigs in a sustainable farming rotation is to preserve soil fertility. Without a correct rotation of the paddocks grazing pigs cause, with their normal feeding behaviour, excavations, destruction of the sward and soil structure damage (Quintern and Sundrum 2006). Consequently these actions may negatively affect soil fertility. The aim of this study is to investigate soil fertility dynamics throughout one year in an organic pig farm. An on-farm experiment was used for this purpose (S.S.C. 1998).

Material and methodology

An on-farm experiment was carried out in the south of Tuscany, in an organic outdoor pig farm, at Paganico (GR) 20 m a.s.l. The experimental design included 5 side by side strip plots hosting different crops or crop sequences (Table 1): polyfita meadow (*Vicia sativa* L., *Trifolium alexandrinum* L., *Avena sativa* L.); barley (*Hordeum vulgare* L.) followed by meadow; forage sorghum (*Sorghum bicolor* L.); vegetable crops (*Solanum lycopersicum L.* and *Solanum tuberosus L.*); old lucerne stand (*Medicago sativa* L.). The thermal regime is mediterranean. Annual temperatures vary between -3 and 35°C. Mean annual precipitation range is 711 mm. A herd of 50 pigs (including lactating sows, suckling piglets, weaned, growing and finishing pigs) were periodically moved among the plots, during the experimental period, using electric fences. As a rule, pigs were let to graze in plots free from growing crops, with exceptions for plots with crop re-growth (Table 1). Soils were a silty loam (meadow and barley plots), a sandy loam (sorghum and vegetable plots) and a loam (old lucerne stand). Soil sampling was carried out in 12 dates, in the period between June 2010 and September 2011. Thirty three samples were collected in total (Table 1). A higher number of samples (13) was collected from the meadow plot, due to the periodical moving of pig grazing along the plot area. Organic C and total N were selected as fertility indicators. Soil organic C (SOC; Walkley & Black method) and total (Kjeldahl) N (Ntot) were measured in the top 0-20-cm soil layer according to the Italian official methods of chemical analysis (MiPAAF 2000).

Table 1. Experiment details: date of soil sampling, crop sequence and other sources of variation in the experimental device during the experiment period.

Plot no.	Crop sequence	Date of sampling and code	Number of samples	Crop cover	Pig pasture[1]
1	Meadow	22/06/10 - 1	3	No	Yes(21,38,56)
		28/10/10 - 4	1	No	No
		17/11/10 - 5	1	Yes[2]	No
		07/12/10 - 6	1	Yes[2]	No
		26/01/11 - 7	1	Yes[2]	No
		12/05/11 - 9	1	Yes	No
		06/07/11 - 10	2	No	Yes (13, 50)
		06/07/11.- 10	1	Yes	No
		27/07/11 - 11	1	No	Yes (26)
		07/09/11 – 12	1	No	No
2	Barley	22/06/10 -1	1	Yes	No
		28/10/10 - 4	1	Yes[2]	Yes (28)
		17/11/10 - 5	1	Yes[2]	Yes (48)
		07/12/10 - 6	1	Yes[2]	Yes (68)
	Meadow	26/01/11 – 7	1	No	No
3	Sorghum	22/06/10 - 1	2	Yes	No
		21/07/10 - 2	1	No	Yes (6)
		28/10/10 - 4	1	Yes[2]	Yes (28)
		17/11/10 - 5	1	Yes[2]	Yes (48)
		07/12/10 - 6	1	Yes[2]	Yes (68)
		26/01/11 - 7	1	No	No
		27/07/11 – 11	1	Yes	No
4	Vegetables	26/08/10 - 3	1	Yes	No
		28/10/10 - 4	1	No	Yes (28)
		17/11/10 - 5	1	No	Yes (48)
		07/12/10 - 6	1	No	No
		26/01/11 - 7	1		No
5	Old lucerne	26/01/11 - 7	1	Yes	No
		21/04/11 – 8	1	Yes	Yes (79)

[1] In parentheses, the actual number of days of grazing, at the soil sampling date

[2] Crop re-growth

Results

Mean SOC and Ntot contents in soil were remarkably different depending on the plot (Table 2). In particular, SOC and Ntot contents were on average higher in soil of the mixed grass and ex-lucerne crops. For a given plot, the SOC and Ntot contents tended to increase or did not vary during the sampling period, with exception of the sorghum plot, where a slight decrease in C content was observed in the last sampling date. Pig grazing did not seem to influence the mean SOC content, during the sampling period (Table 3).

Table 2. Mean organic carbon (SOC) and total nitrogen (Ntot) contents in soil of the experimental plots during the sampling period. Standard deviation (SD) is also reported, when available. For date code meaning see table 1.

Date codes	1	2	4	5	6	7	8	9	10	11	12	Mean/SD
Plot N	SOC (g C kg-1 dry soil)											
1-Meadow	15.6		16.2	15.6	17.5	18.5		14.2	14.2	13.9	10.6	15.1/2.30
2–Barley +me.	14.0		12.3	16.3	14.8	17.3						14.9/1.98
3-Sorghum	11.8	10.4	9.8	10.5	9.8	9.2				7.8		9.9/1.24
4-Vegetables			12.2	12.4	12.5	10.3						11.9/1.03
5-Old lucerne						18.3	17.5					17.9/0.58
Mean	13.8	10.4	12.6	13.7	13.6	14.7	17.5	14.2	14.2	10.8	10.6	
SD	1.9		2.6	2.7	3.3	4.6				4.3		
	N tot (g kg-1 dry soil)											
1-Meadow	1.50		1.63	1.58	1.76	1.74		1.55	1.56	1.55	1.25	1.6/0.15
2-Barley +me.	1.39		1.37	1.54	1.43	1.57						1.5/0.09
3-Sorghum	1.27	1.22	1.16	1.22	1.09	1.10				1.22		1.2/0.07
4-Vegetables			1.19	1.28	1.22	1.06						1.2/0.09
5-Old lucerne						1.90	2.12					2.0//0.15
Mean	1.38	1.22	1.34	1.41	1.38	1.47	2.12	1.55	1.56	1.38	1.25	
SD	0.12		0.21	0.18	0.29	0.38				0.24		

Table 3. Mean organic C content in soil (SOC) of the meadow and sorghum plots during the sampling period, in the presence (yes) or absence (no) of pig grazing.

Date codes		1	2	4	5	6	7	9	10	11	12	*Mean*	*SD*
Plot	SOC (g C kg-1 dry soil)												
1-Meadow	no			16.2	15.6	17.5	18.5	14.2	15.3		10.6	*15.4*	*2.56*
	yes	15.6							13.7	13.9		*14.4*	*1.04*
3-Sorghum	no	12.2					9.2			7.8		*9.7*	*2.26*
	yes	11.4	10.4	9.8	10.5	9.8						*10.4*	*0.68*

Discussion

The inclusion of leguminous crops and grasses into the cropping system of this on-farm experiment has permitted an overall enrichment of the soil organic matter reserve. In fact grasslands and legume-cropped soils have usually higher C and N content than soils under arable crops (Conijn and Taube 2003). SOC and Ntot content may have been influenced by the length of time the pigs were allowed to graze in the plots, before sampling. In outdoor husbandry, pig manure supplies to soil large amounts of organic matter, especially N. In fact, higher amounts of C and N were observed in the autumn 2010 under barley (Table 2), in the presence of pig pasture (Table 1). Piñeiro et al (2010) studied effect of grazing on SOC stocks in grasslands, and found that SOC increased, decreased, or remained unchanged under contrasting grazing conditions across temperature and precipitation gradients, which suggests that grazing influences the factors that control SOC accumulation in a complex way. These preliminary results support the hypothesis that soil fertility is not negatively affected by outdoor pig grazing, with the cropping system adopted by the organic farm hosting this experiment. However, greater data availability is required, in order to establish the significance of the effects of these treatments. Further sampling will be carried out to check fertility differences in the long-term.

Suggestions to tackle the future challenges of organic animal husbandry

The future of organic pig husbandry is connected with a sustainable use of soil, which is feed source and manure sink. The challenge is to study thoroughly the connections between pigs, soil and crops in order to correctly include pigs into the crop rotation.

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Future organic breeding

(Foto: BLE 2004)

Organic Animal Breeding 2012 - a Position Paper from the European Consortium for Organic Animal Breeding, Eco AB

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Abstract

The Europan consortium for Organic Animal Breeding (www.ecoab.org) wrote this overview on organic animal breeding, showing differences between organic and conventional breeding, pointing out arising problems and possible solutions, and introducing several organic animal breeding projects that had been carried out in different European countries over the past 15 years.

Key words: organic animal breeding, low input, biodiversity, reproduction technologies

Introduction

Livestock selective breeding has made a major contribution to farming productivity in recent decades. Improvements mainly concerned production characteristics (e.g., quantities of milk, meat and eggs per animal and speed of production and growth). Recently, more attention has been laid on health and functional traits. The development and application of reproductive techniques like AI, and multiple ovulation plus embryo transfer (MOET) in cattle, are the main catalysts for these increases. Breeding programs are becoming more efficient, the accuracy of breeding value estimates is high and the focus is on shortening of the interval between generations to speed up genetic progress. Nowadays, genomic information is used to predict breeding values of young animals. This shortens the generation interval and thereby increases the genetic progress (Brascamp et al., 1993; De Roos, 2011).

Organic farming is a low input production system based on the use of local resources and on outdoor- and free range animal husbandry. Production does not focus on maximum output from maximum input (regardless of the source), but on natural processes and cycles and ecosystem services where ever possible. Animals in organic farming should be able to adapt to the local conditions and local breeds should be used (EU, 1999).

The gap between conventional and organic production systems is increasing. Many years of improving production capacity of the animals resulted in dairy cows (mainly Holstein Friesian) with annual productions of 10,000 kg milk and more, sows producing 26 piglets per year, slaughter pigs gaining almost 1 kg of body weight per day, broilers reaching 1.5 kg body weight in 5.5 weeks and laying hens producing up to 330 eggs per year. All this is possible with maximum feed supply (sometimes including antibiotics and feed additives).

There are increasing concerns about fertility, health and welfare of high producing animals, even in conventional farming (Rauw et al., 1998; Augsten, 2002; Knaus, 2009). Health problems common in conventional production are also found in organically managed dairy cows, such as poor udder health, low fertility and claw disorders (Ahlman et al., 2010). However, the magnitude of different diseases may differ to some extent (Fall et al., 2008; Sundberg et al., 2009). Involuntary culling rates are also high on organic farms: many cows only fulfil 2-3 lactations, but productive life is still slightly higher than in conventional herds (Knaus 2009). Under organic conditions high producing animals cannot always be fed properly and encounter a range of problems known from underfeeding. This can become an animal welfare issue. In organic production systems the greatest emphasis in animal selection and breeding has to be placed on functional characteristics (health, fertility and efficiency of production). In dairy cows health, longevity and a milk production level that is adapted to local characteristics have high priorities. This corresponds to the desires and demands of consumers who prefer healthy high-quality products from healthy animals with good welfare (Harper and Makatouni, 2002; Padel and Foster, 2005).

Pigs bred for conventional production and housing systems suffer under organic conditions due to more leg problems (Wallenbeck, 2009). Also reproduction results are lower. Even if more piglets are born (Ten Napel et al., 2009), mortality is higher in organic than in conventional production (Ten Napel et al., 2009; Wallenbeck et al, 2009b). Many piglets do not survive the first day because the sows, which are not selected for good maternal behaviour in a loose housing system, crush their piglets after farrowing (Damm, 2005; Weary et al., 1998; Edwards, 2002; Vermeer and Houwers, 2008). Piglets also have difficulties during the weaning period because of a lack of robustness and nutrition problems. Chickens are bred for a much higher production rate (up to 330 eggs per year) than what is possible in organic production, with organic feed. More hens die during the laying period in organic systems compared to conventional systems (Zeltner and Maurer, 2009; Leenstra et al., 2012). The reason for that is that they cannot adapt to the organic environment (Bestman and Wagenaar, 2003).

These facts indicate that animals selected for high input conventional systems cannot always cope with organic environments. There is a discrepancy between breeding goals and reproduction techniques of conventional breeding and the organic production system. The aim of the organic sector is to produce food and other products with organisms reared under the label of organic production: from the seed to the final product (EU, 1999). Should this also include the animals needed for replacement and the breeding process? In this position paper we are describing the current situation in different species and propose possible solutions towards better adapted organic breeding.

Animal Breeding, state of the art

Animal breeding techniques have been developed in the last decades - from systems based on natural mating and farm based breeding schemes towards large world-wide breeding schemes based on artificial reproduction technologies, mass data collection and genetic evaluation carried out by breeding companies.

Cattle breeding

Cattle breeds have been developed by different small and larger national and international breeding companies in two separated lines; dairy cattle and beef breeds. Dairy-cattle breeding has become a worldwide business focusing mainly on the Holstein Friesian breed. This breed shows the highest milk production capacity when fed with an appropriate ration in a temperate climate. For the large commercial breeds, like Holstein Friesian, breeding programs are based on AI and testing schemes. Bulls are tested on the bases of their daughters' performances and are ranked according to their estimated breeding values. Large populations of daughters milking in several different herdsare needed for more accurate selection of the best bulls. Current breeding programs are operating worldwide with up to millions of animals in a population. The genetic evaluation performed by the global Interbull organization (Interbull, 2012) provides breeding values that are comparable between member countries. Cattle breeding schemes of today use genomic data for a first selection (De Roos, 2011). Correlations between breeding values and single nucleotide polymorphisms (SNP) at DNA level are used to predict the first breeding values of new young bulls. This way bulls do not have to be progeny tested anymore before their first breeding value can be put on the market. Their breeding value is usually based on both genomic data and progeny testing.

Cattle breeding schemes are open schemes. As soon as new offspring are born from a breeding bull the farmer or a breeding company can select this animal for its own breeding program. Breeding companies compete for the best bulls on the market. Reproduction techniques like super ovulation and ova-collection and in vitro fertilisation (IVF) for female animals (often young heifers) are used to speed up the process (Dekkers, 1992; Gordon, 2004). Each year hundreds of donor heifers and young cows are selected and used for routine super ovulation and IVF and the embryos are transplanted in recipient cows.

Today reproduction technology makes it possible to separate X- and Y-sperm cells in cattle (Garner and Seidel, 2008). By buying sex-sorted semen dairy farmers can better select their animals for breeding the next generation and inseminate the rest of the herd with semen from bulls of beef breeds. This way they are able to maximise selection intensity at the farm level, reduce the production of young stock not suitable for dairy production and increase the income from young stock suitable for meat production. The use of sexed semen in conventional production herds also aims to avoid the practice of killing newborn male calves which have a very low market value when raising them for meat production .

Most organic farmers use AI bulls from conventional breeding schemes, and these bulls are commonly of the Holstein breed, or of another high producing dairy breed (Nauta, 2009; Sundberg et al., 2009). Farmers that search for more robust (dual purpose) breeds for low input organic system often use local breeds or breeds from smaller populations that are more robust like the Original Swiss Brown breed and Montbéliarde. These breeds can also be used for crossbreeding with Holsteins (Nauta, 2009). A growing group of organic dairy farmers in the Netherlands uses a bull at the farm for natural mating. These bulls are mainly purchased from other organic farms (Nauta, 2009).

Pig breeding

Pig production has been in the hands of large multinational breeding companies for many years. They also provide organic farmers with hybrid animals. The base lines of these hybrids are pure bred mother lines (Large White, Landrace) selected for high reproduction and lean growth rate. These lines are crossed and the F1 gilts are mated with a sire breed boar (Duroc, Hampshire, Pietrain) to produce finishing pigs. These sire breeds are selected for optimum meat production traits like lean growth rate and a high proportion of valuable cuts.

Breeding of pure bred lines is done in closed schemes. F1 gilts are produced at so-alled 'multiplier' farms and sold to the farms that produce piglets or pigs raised for slaughter. The pure bred lines are kept indoors under conventional conditions. AI is used to disseminate the genetic progress from the nucleus herds via the multiplying herds to the herds producing pigs raised for slaughter. Selection is based on data collection of the animal itself, full- and half-sibs and all other relatives. The main traits important for organic production are similar as in conventional production; lean growth rate maternal behaviour, piglet survival (Wallenbeck, 2009). However, these animals have to be effective under organic conditions: organic feed, no sow crates, outdoor systems, less use of antibiotics etc. That means behaviour and robustness is even more important on organic farms. In the UK where outdoor-reared pigs is commonplace, breeds that are better suited to outdoor systems are used (e.g. Duroc), regardless whether they are organic or conventionally- reared.

Poultry breeding

Poultry breeding is mainly controlled by three multinational companies. These companies have their pure lines that they use for crosses to create different "products" (hybrids) for production of eggs (layers) or meat (broilers). In the top-breeding lines AI is sometimes used for getting offspring of selected breeding cocks from specific hens. The further multiplication of breeding stock is normally based on natural mating Selection in the top lines is based on data collection from the animal itself and full- and half-sibs, and increasingly, data are collected from commercial farms to inform selection decisions to increase robustness of their elite breeding stock to produce offspring that are adapted to a range of different rearing environments.

Many organic poultry farmers use hybrids that are more suited for free range systems. The organic sector is too small to set up specific breeding schemes. Over the last 15 years different hybrids were produced for free range systems with names like Silvernick, Amberlink, Lohman Braun and Bovans Black. The main goals these hens have been selected for are brown eggs, low feather pecking, efficient production on less concentrated diets (i.e. approximately 260 eggs per year) and low stress. For meat production specific broiler hybrids have been bred for growth to 1.5 kg body weight in 12 weeks (instead of 5.5 weeks in conventional systems). Organic egg producers have more variation in mortality rates and in average higher mortality rates than conventional producers (Sparks et al., 2008; Thiele and Pottgüter, 2008; Anderson, 2010). The environment during rearing of the young hens was found to be very important for the behaviour and survival of the hens during the laying period (Bestman and Wagenaar, 2003).

Sheep and goat breeding

A large part of the breeding of small ruminants is still in the hands of relatively small local breeders that mainly use natural mating and farm-based breeding schemes. In some countries, the collection of data for genetic evaluation and selection of breeding bucks and rams is often not very well organised, selective breeding is only ongoing on a small scale, and sometimes semen is collected for AI (www.ELDA.nl). The method of AI is relatively expensive for small ruminants. Farmers usually inseminate only a small number of ewes to breed males that are then used as breeding bucks by natural mating in the herd. For cervical and laparascopic AI, groups of females need to be synchronised by treatment with the follicle stimulating hormone (FSH)so they can be inseminated together on the same day to reduciethe costs. Synchronisation with hormones, however, is not permitted in organic farming and the costs for AI per ewe or goat are therefore too expensive. In the UK, the number of farms using AI has declined in recent years due to the high costs associated with using it, coupled with the relatively low level of return form the sale of lambs. However, in Norway as well as the UK, recognised group breeding schemes with common breeding goals have been operating since the 1970s, using breeding goals designed to accelerate growth and meat quality as well as maternal ability, both for organic and conventional systems. Breeding indices for meat and maternal sheep (Conington et al., 2001; 2006) expanded to include additional traits such as lambing ease and resistance to parasites. A new project to design a breeding programme for milking goats started in 2012 in the UK, where a few large herds produce half of all goat milk sold in the UK. As sheep and goat systems in the UK nearly always are based out of doors, there is often very little tangible difference between organic and conventional farming with the exception of prophylactic drug usage and use of laparascopic AI.

Often, breeding stock for sheep and goats are mainly owned by some 'elite breeders' that provide most of the breeding bucks and rams to other farmers.. This situation can result in high inbreeding levels which may be problematic in some dairy goat populations (Borsten, 2011) although was not found to be significant in others (Conington et al., pers.comm).

Results from research and development

As organic animal production became a more important and recognised business the first research projects started on selection and breeding of animals for organic production. Back in the 1980s, some dairy cattle farmers and researchers started to look for possibilities for specific breeding schemes and traits especially for organic farming. At the University of Munich, Prof. Bakels promoted a crossbreeding scheme with three different Holstein Friesian lines from the USA already in the 1960s and he promoted selection for lifetime production (Bakels, 1982). In the Netherlands, Baars discussed with farmers about the possibility of farm based breeding based on kinship breeding schemes (Baars and Endendijk, 1990). In these years Postler (1998, 1999) and Bapst (2000) worked out a first alternative breeding value estimation (Eco-Breeding value) with more emphasis on 2nd and 3rd lactations to stimulate selection for lifetime production. These activities focussed on a specific selection for organic producers out of the mainstream supply of breeding bulls. Approximately five years later, discussions and surveys about organic breeding started with farmers and other stakeholders in Switzerland and the Netherlands (FiBL and Louis Bolk Institute). These discussions showed a concern about the selection of the right type of animals and in the field of animal welfare, animal integrity, natural procedures of reproduction and also the image of organic products (Nauta, 2009; Bapst and Zeltner, 2002, Haas and Bapst, 2004; Idel and Mathes, 2004). Data on the performance of dairy cattle on organic farms were collected in different countries showing that animals originating from conventional breeding schemes were weak in production, longevity, health and fertility (Hardarson, 2001; Hovi et al., 2003; Margerison et al., 2002). Some studies on genotype-environment interaction (GxE) indicated that there were interactions between organic and conventional farming, but only when environments differed strongly (Nauta et al., 2006, Simianer, 2007, Sundberg et al., 2010, Wallenbeck et al, 2009). This means that the selection of animals from conventional systems results in a lower reliability of breeding values for organic farms (Nauta, 2009). These interactions are different for different traits and for different species. For milk production in most countries relatively small effects of GxE were found. For health and fertility traits, important traits for organic farms, larger effects were measured (Bapst and Stricker, 2007; Simianer, 2007) indicating that selection within the organic environment would be more effective. It was questioned whether organic agriculture needed own specific traits to select for? (Spengler Neff, 2011). In general animals should be selected for disease- and parasite resistance (IFOAM, 2003), not least because these have higher economic values in the organic environment influenced by given organic regulations. Other traits that have been suggested as especially important in organic production are longevity, vitality, fertility, milk production persistency, roughage converting efficiency, foraging ability, temperament and body condition (Bakels, 1982; Haiger 1998; Pryce et al., 2001; (Spengler Neff 2011) and, especially in pigs, strong legs (Wallenbeck, 2009).

For setting up distinct organic breeding schemes over more farms or on (inter-)national bases, complex challenges have to be overcome (Nauta, 2009). An overall breeding program meets problems like the size and diversity of populations, costs, inbreeding, biodiversity, and social as well as economic differences (Pryce et al., 2001; Harder et al., 2004; Pryce at al., 2001; Rozzi et al., 2007; Schmidtko, 2007; Nauta, 2009). In Switzerland and in the Netherlands the first breeding schemes are set up for dairy cattle in co-operation with existing companies and structures (Nauta, 2012, Spengler Neff, 2012, pers. com.). Also individual farmers set up their farm-based breeding, by purchasing bulls or selecting bulls from within their own herd. Their reason for doing this are to become more closely associated with the ethos of organic production and to work with ‘closed cycles’, for breeding (Nauta, 2009).

For pig production the first attempts towards organic breeding programs are currently underway. Nauta et al. (2003) showed that Dutch pig farmers wanted to develop organic breeding. GxE interactions were found between organic and conventional pig production in Sweden (Wallenbeck et al., 2009a). As organic rules state that new gilts should be raised under organic conditions, pig farmers need to breed their own replacement females. In 2009, a so-called ‘flower breeding’ project started in the Netherlands with a rotation breeding scheme, led by IPG and the breeding company Topigs (Merks and Leenhouwer, 2010). This is similar to the principles of Norwegian ‘ram circles’, and sheep ‘sire reference schemes’ that have been operational in the UK for decades, whereby either male rams or their semen are rotated among a group of co-operating farms thereby increasing the scale of comparisons for genetic evaluations. In some countries, many organic farmers with small scale pig production use native breeds like Bunte Bentheimer and British Saddleback (ADAS, 2002).

In the UK, a new project aims to breed a new broiler-poultry line with high levels of functional fitness including legs and robustness. In the Netherlands, poultry farmers said they would like to set up organic breeding, although they knew that this would be difficult since margins are small and supplied hybrids are very productive (Nauta et al., 2003). The importance of breeding on organic farms seems to be well recognised in this sector. In the regular production of layers, for every laying hen that is produced, a male chick is killed right after hatching because these roosters do not show good growth rates for meat production. Discussions in society about the killing of male one-day chicks have stimulated various initiatives towards dual purpose breeding. Lohman geneticists have started a project with some biodynamic farmers in Germany where they set up rotational breeding to “bring the breeding back to the farm environment” (Willy Baumann, pers. com., 2011 and Baumann, 2012). In the Netherlands a project was started on testing more dual purpose hybrid laying hens and their brothers for meat and egg production (Leenstra et al., 2009). Also an on-farm breeding system was set up in 2009 based on a kinship breeding scheme. This is a breeding scheme with at least 5 different family lines that are bred on farm and crossbred in such a way that inbreeding is minimized (Nauta et al., 2010). First results show that the hens that are bred on farm are more robust. It is known that there are very strong genotypexenvironment-interactions between laying hen lines and cage or outdoor production systems (Kjær and Sorensen, 1997). Breeding at farms with outdoor systems may be a solution.

In the last decade new technologies were developed for breeding (sperm sexing, genomic selection), and therefore in 2009-2010 organic dairy farmers and researchers were asked again about the use of different breeding technologies ((Spengler Neff and Augsten 2009); Nauta, 2010, pers. com.). A concern was found about the introduction of more technology into organic farming in particular for sexed semen. Sexing of sperm was not wanted by most of the organic farmers (80%) in the Netherlands because they were afraid of decreased fertility in cattle in the future and other unknown effects on the animals. But, perhaps more important was the risk of damage to the image of organic farming. Genomic selection was seen as both positive and negative for organic use. The farmers thought that it could be useful for traits that have a low heritability but it could promote more inbreeding at a global scale (Nauta, 2010). The recognition that genomic technologies have a big part to play in the selection against deleterious alleles associated with diseases will enhance both conventional farming as well as organic production.

Discussion

Organic animal breeding became a real issue when the organic sector grew fast in the 1990s. At that time there were no possibilities for organic breeding unless farmers started selecting their own male and female animals and used natural mating (Baars et al., 2005; Haiger, 1999; Metz and Spengler Neff, 2007). At the same time, breeding did not seem to be a topic many organic farmers were interested in (Nauta, 2009). It was easier to use conventional breeding stock from the breeding companies they were members of. But times are changing fast for animal breeding and for organic farming. Conventional dairy cattle breeding programs evolved from a progeny testing system based on AI towards breeding based on modern reproduction technologies (MOET, IVF), genomic selection and also in some cases, sperm sexing. Genetic progress for production traits in high-input production systems increased fast in cattle, pigs and poultry. This development increased the gap between organic intentions and conventional breeding practices, which in turn increases the need for animal breeding on a completely organic basis.

On the other hand, modern dairy cattle selection has now turned to include broader breeding goals taking a range of functional traits into account, and thereby better meet the objectives for organic producers (Miglior et al., 2005, Buch, 2010). There are also large differences between countries regarding differences between conventional and organic farming environments. Attitudes regarding breeding techniques are likely to differ between countries due to history, traditions and culture. For example, conventional dairy cattle breeding in Nordic countries faced challenges similar to those of organic farming, namely high cost of disease treatment, demands for good fertility, and robustness to harsh climatic conditions. That led breeding organisations to record disease treatments and fertility events as well as a range of other functional traits, and to include those in a multi-trait selection index with low weight on productivity and high weight on disease resistance and fertility, in comparison to those used in other countries (Miglior et al., 2005). By taking this approach organic dairy farmers in Nordic countries have so far not demanded separate breeding schemes but joined efforts with the conventional farmers as their goals were more alike than different. Furthermore, realised production levels for organic dairy herds are at around 90% of the conventional (Trinderup & Enemark, 2003) and thereby differences between systems are much smaller than differences between farms within each system. But in a country like The Netherlands, converting to organic farming means that the ration of concentrated feed fed to lactating cows will drop because of large differences in price. In that country, conventional concentrated feed is relatively cheap because of large and cheap imports of ingredients and high land prices. In Switzerland organic rules allow only 10% of concentrates in the yearly rations of ruminants. This causes larger environmental effects on cattle compared to countries where dairy farms generally grow more of their concentrated feed and do not have stringent restrictions in organic systems. Such differences between countries have large impact on decision making for organic breeding at a European level.

The rules of organic farming do not include clear directions for animal breeding. Animals should be able to adapt to the local environment, local breeds should preferably be used, natural processes should be followed as much as possible and the use of MOET is restricted (EU, 1999). It is also stated that organic production should include the whole production chain, including breeding practises (EU, 1999; IFOAM, 2003). A new issue for discussion is the introduction of cloning and genetic modification (GM) in animal breeding (Brophy et al., 2003). So far, no GM farm animals are used in European agricultural production. Cloning has been introduced as a breeding tool but has not yet become a very common practice in conventional breeding. Cloning and GM are strictly forbidden in organic animal farming. If cloning and GM would become more widely performed by breeding companies this would close the doors for organic farmers to use such breeding stock. This leaves us with the question what to do for organic production without the supply of conventional breeding stock. If needed, how can organic breeding programs become organised? A number of aspects must be considered.

First of all, do organic farms have large enough animal populations to initiate distinct organic breeding schemes? More generally, how can we better utilise the existing evaluation systems in place (e.g. for dairy cattle) to meet the needs of organic producers? Organic farming is diverse in its nature. Due to it being a low input system by definition, , a strong link to soil and climate and a dependence on local or regional markets, different types of animals are needed to meet the different farm environments (Bapst, 2003; Spengler-Neff, 2011). Breeding for a larger group of farms will also put up the question "How to breed for everyone?" It will be a challenge to find large enough groups of farms that have more or less the same farm environment and management, maybe even in an international setting (Nauta, 2009) However – if dairy farms were known and classified accordingly then this information could be used to extrapolate more suitable bulls for breeding in organic systems. A determination is needed to facilitate such a system in the dairy sector. Alternatively, genotypes or breeds that can adapt to a large range of environments and farm conditions would offer a useful compromise. As genetic biodiversity is a goal of organic farming, to create one 'European organic population' is not the spirit of organic farming. Furthermore, it would not be in accordance with the Interlaken declaration about animal genetic resources for food and agriculture (FAO, 2007).

Secondly, the type of animals required for organic farms should be defined and documented. This may differ according to different countries but the basics of key attributes should be agreed.. When the aim is known, the next step is to evaluate whether there is a chance to get this type of animal from conventional breeding programs or not. The organic rules are in some cases putting demands on livestock that have been removed in conventional systems. In general, organic dairy cows have to produce on diets based more on roughage (Thomet and Steiger Burgos, 2007). Another example is the access to open range for organic hens, demanding social skills that have not been selected for during years when cage layers were the predominant conventional production method (Kjær and Sorensen, 1997). Animals selected for highest possible production are more sensitive for changes in environment than animals with a lower production potential (Kolmodin et al., 2002; Strandberg, 2007; Ravagnolo and Misztal, 2002). Thus dual purpose breeds or local native breeds, with lower genetic merits for production traits, could fit better to organic farms than more specialised high producing breeds, also when they are purchased from conventional breeders. Low-producing native breeds are mainly used in organic niche production or for hobby farming (Wanke and Biedermann, 2005; Rahman, 2006).

Cross breeding with dual purpose breeds is another solution chosen by organic dairy farmers (Nauta, 2009; Heins et al., 2006, Spengler Neff et al., 2012).

Thirdly, there is the question which breeding- and selection systems and reproduction-distribution technologies can be used in organic production. Even if the tools themselves are not problematic for welfare or environment, they can be questioned by some farmers and consumers due to 'unnaturalness' (Baars and Nauta, 1998). Should such methods (like sperm sexing or selection based on genomic data) be allowed in organic production? Genomic information could become very useful for small populations and for traits that are difficult and expensive to record, e.g. health traits and other traits important for welfare. Another concern is that technologies like sperm sexing and genomics could lead to increased losses of genetic variation in general (Bapst and Zeltner, 2002; Spengler Neff and Augsten, 2009; Nauta, 2010). However, if locally-adapted breeds are used then the likelihood of this being realised in the short term is small. Every technology used in breeding has its good and bad sides and responsibility of farmers and breeding companies in how to apply such technologies is of great importance for the organic sector.

Another important aspect is the amount of direct and indirect costs of dedicated organic breeding for different species. Direct costs are the costs for selecting and breeding the animals themselves. These costs are very high because of several European rules in the area of preventing disease from spreading (EU, 1992). In a testing scheme of bulls the whole procedure for one bull will cost about 30,000 euro. This will be difficult to cover where the organic sector is small. However, for example in small populations a 'young bull system' (Bichard, 2004) can be used instead. It is a more realistic and cheaper alternative. A young bull system is based on an annual selection and supply (through AI) of a group of young bulls from the best animals of the population based on their estimated breeding value and phenotype. By using a group of 10-20 young bulls, always the best genetics will be used in average and risks are spread. This system is also coming up for breeding based on genomic selection (Veeteelt, 2008).

The indirect costs reflect the production capacity of the animals. Many organic farmers have concerns about the loss of genetic input if they refuse stock from conventional breeding schemes (Nauta, 2009). For example, laying hens from conventional programs may lay up to 300 eggs per year on some organic farms. Can hens from organic breeding schemes compete with that? If not, producers need much higher prices for the eggs and therefore organic breeding will have a strong impact on market prices. Or the other way around; the market prices will have a strong impact on the possibilities of setting up an organic breeding scheme, and use organic breeding stock with lower merit for production. So, evidently there is a dilemma between strong intentions and staying in business and market.

Finally, some social aspects are also important to consider. Natural mating may have a negative image. It can be regarded as an old fashioned way of breeding with large risks when it comes to transmission of diseases and farmers working conditions and safety. The power of breeding companies could also become an influencing factor. Will they feel threatened by organic farmers trying to start their own breeding schemes? Or will they see an additional market and provide their knowledge and service to these farmers?

Many organic farmers want to be in charge of decisions concerning selection of breeding stock and they do not want to be forced to use 'certified organic' breeding stock (Nauta, 2009). Breeding is also a matter of trust. Farmers first want to see the results before they chose a new breeding program and stock. Therefore an organic breeding scheme would have to be introduced step by step, providing learning by doing (Østergaard, 1997). In the Netherlands an increasing interest is seen in the setup of rotational breeding systems for pigs (Merks and Leenhouwers, 2010) and the supply of some organic AI bulls that farmers can start using now (Nauta, 2012; Spengler Neff, 2011). Surprisingly, newly converted farmers seem to be more open to using organic breeding stock (Nauta, pers. com., 2012).

It is clear that for some species, in some organic systems, the use of animals bred for higher input, conventional systems is inappropriate. In these circumstances, taking on board the responsibility to breed locally-adapted livestock will bring benefits to farmers if collective breeding goals and shared ideals are realised. However, in other situations, particularly where there are relatively small differences between organic and conventionally reared animals, adjustments to existing sources of livestock for organic systems may be sufficient. This could be simply a matter of placing greater emphasis on functional fitness traits by the individual when choosing potential bulls or boars – or it could mean customising indices to better suit the needs of organic farming systems.

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Udder health status of cows in early lactation – a comparison between a dairy and a dual purpose breed

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Abstract

The aim of organic farming to produce forage-based milk and to lower the amount of concentrate fed leads to an increased risk of metabolic disorders, especially in early lactation when the demand for energy often oversteps the energy provided. The use of breeds with a lower genetic merit for milk yield might offer a solution. Our study compared a dual-purpose and a dairy breed kept under the same management conditions and two herds consisting of the same dairy breed, but managed differently, to test the effect of the breed or the management on the metabolic status and on udder health of the cows during the first five weeks of lactation. The analyses of the udder health status revealed that the German Holstein (GH) cows at both farms had a better udder health than the German Red Pied (GRP) cows: Nearly 50% of the GH cows did not show any sign of an udder infection while only 27% of the GRP cows were not infected. This is reflected in the number of cows which showed symptoms of clinical mastitis: 15% and 25% of GH and GRP cows, respectively. Thus, our study showed that a local dual purpose breed not necessarily shows a better udder health due to a lower metabolic load, and maybe in this case the breed is more important than the management.

Key words: mastitis, dual purpose breed, early lactation

Introduction

During the transition period cows are subject to increased risks of developing production diseases, such as mastitis or metabolic disorders, due to a more or less physiologically normal negative energy balance. Organic dairy farming aims to reduce the amount of concentrates fed to cows and produce forage-based milk. Especially at the beginning of lactation, this might exacerbate the situation. Knaus et al. (2001) calculated a milk yield in organic farming up to 7,000 kg per year without exceeding the tolerable restrictions for suboptimal energy supply. However, the genetic potential of the breeds used in organic dairy farming is much higher and using breeds with a lower genetic merit for milk yield to solve the problem is still under discussion. After an initial study investigating the effect of breed and management on the metabolic status of a dairy and a dual-purpose breed (Barth et al. 2011) the present study addresses the udder health status in early lactation.

Material and methodology

The study was carried out on two research farms working according to the standards of organic farming. On Farm1 84 German Holstein black and white cows (Farm1-GH, 21 primipar, 63 pluripar) were analyzed. On Farm2, two breeds (German Holstein black and white and the local dual-purpose German Red Pied – GRP) are kept under the same management conditions (barn design, milking technique and routine, feedstuff, bedding material as well as farm staff). 49 GRP (18 primipar, 31 pluripar) and 46 GH (19 primipar, 27 pluripar) were analyzed on Farm2. Feeding management at Farm1 and Farm2 differed, resulting in better fulfillment the energy needs of the cows on Farm1 than on Farm2 (for details see Barth et al. 2011). Animals were sampled weekly during the first five weeks of lactation, gaining fore-milk samples according to the standards of the DVG (2000). Cyto-bacteriological analyses were carried out by the Department of Safety and Quality of Milk and Fish Products (MRI, Kiel, Germany) following the recommendations of DVG (2000). Cows were classified as shown in Table 1.

Table 1. Classification of cows according to their results of cyto-bacteriological analyses of fore-milk samples gained during the first five weeks of lactation

Class	Description
Healthy	no pathogen isolated during the five sampling weeks
Newly infected	the first sample/s *p.p.* was/were negative but pathogens were isolated later
Self-healed	the first sample/s *p.p.* contained pathogens but the following samples were negative
Changing results	results were not consistent
Clinical/ treated	cow showed clinical symptoms and was treated if necessary

Statistical analyses used R 2.15.0 (The R Foundation for Statistical Computing, 2012), especially the package "vcd" (Meyer et al. 2010).

Results

Due to missing results caused by contaminated samples, 20 cows (Farm1: 13 GH, farm2: 2 GH, 5 GRP) had to be excluded from analyses.

The analyses of the udder health status revealed that the German Holstein cows at both farms had a better udder health than the German Red Pied cows: Nearly 50% of the GH cows did not show any sign of an udder infection while only 27% of the GRP cows were not infected (Figure 1). This is reflected in the number of cows which showed symptoms of clinical mastitis: 15% and 25% of GH and GRP cows, respectively.

The direct comparison between the GH and GRP at Farm1 showed an increased risk for the GRP to be infected by a pathogen (OR= 2.4, Odds-Ratio-Test: z=1.929, p=0.027) whereas the risk of GH at Farm1 and Farm2 did not differ significantly (OR=1.07, Odds-Ratio-Test: z=0.184, p=0.427).

Discussion

Compared to the results concerning the metabolic status of the two breeds respectively the herds at the two differently managed farms, the breed was more important than the management for the udder health status of the cows. Although all animals at Farm2 are kept under the same management conditions, a clear difference between the GH and GRP cows could be observed indicating a higher susceptibility to udder infections of the GRP. The intensive breeding activities aiming to improve the milkability and udder characteristics of dairy breeds might be an explanation for the advantages of GH cows in this study.

In addition, the study revealed – when considered at farm level - that a higher metabolic load does not necessarily lead to an increase of udder infections. High quality standards in milking and housing may protect cows with high genetic merits for milk yield to be affected by other production diseases while they are subject to negative energy balance in early lactation.

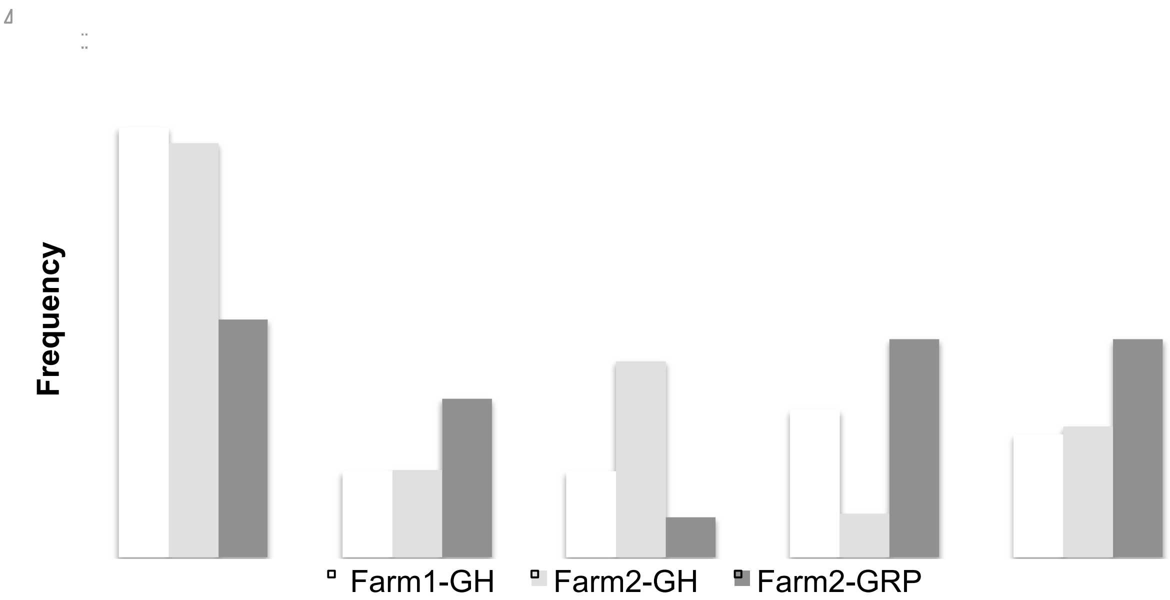

Figure 1. Frequencies of cows in classes of udder health status depending on farm and breed (GH = German Holstein black and white, GRP = German Red Pied)

Suggestions to tackle the future challenges of organic animal husbandry

Organic animal husbandry should focus on improving farm management and animal welfare on the farms. The origin of a breed does not guarantee its appropriateness for an organic farm in the same region. Thus, the selection of a breed should be based on the conditions and the management of the farm instead of rules such as "local breeds are to be preferred". Nevertheless, the biodiversity of farm animals has to be conserved but under conditions of intensive agriculture as in Europe, special programs might be required.

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The influence of farm and herd factors on the health status of organic dairy cattle under low concentrate feeding considering an assessment-tool for site-related breeding

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Abstract

The objectives of this study were to examine influences of farm and herd factors on the health status of Swiss organic dairy cattle and to evaluate if an existing estimation tool is suitable to express impacts of not-site-related breeding on herd health and reproduction indicators in 72 organic dairy farms with low concentrate feeding. Farm and herd factors were body condition scores, milk recording data, and farm management characteristics. Data from an existing estimation tool to describe farm and cow 'types' and the site-relatedness of breeding was also included. Health status was assesses by herd means of calving interval, fat-to-protein ratio, somatic cell score, veterinary treatments, culling rate, and number of lactation. A relation between the site-relatedness of cow type and calving interval was found. Further factors influencing the herd health status were mainly related to feeding. Also cow type factors had an effect, which is why strategies for improving animal health should include both feeding and breeding practices and consider sight-relatedness of breeding.

Key words: dairy cow, fertility, site-relatedness, breeding

Introduction

Ruminants do not depend on concentrates as they are experts in digesting forage (Hofmann 1991). Given that the use of food crops for livestock drives up world food prices due to competition (Bruinsma, 2003) utilizing grass for ruminant production is vital in the context of food security (Hopkins and Holz 2006). Re-linking ruminant production to grassland resources can improve animal health (Winsten et al. 2010) and is a basic component of organic farming (Rosset et al. 1997).

With only 10% of all dairy cattle having been selected under grazing conditions (Steinfeld and Mäki-Hokkonen 1995), most genotypes may not be well suited to organic systems. The objective of this study was to examine influences of farm and herd factors on the health status of organic dairy cattle in low-concentrate systems, which can be used for developing site-relatedness criteria needed to define breeding goals and management tools for different farm and cow types under low-concentrate conditions in organic farming.

Material and methodology

A total of 72 organic dairy farms were assessed, ranging from 0% to 10% concentrates with respect to the total yearly dry matter intake of their herds. Participation depended on farmers' willingness to participate and availability of milk recording data. This study observed the 12 months period from November 2009 till October 2010. The range of farms included in the project is not fully representative for Swiss organic dairy farms, but it was emphasized that in regard to several factors the whole bandwidth was portrayed. Farms from the mountainous and lower regions of Switzerland were taking part in the study as well as five German farms near the Swiss border. As a consequence of farmers' voluntary participation in the "Feed no Food" project abundant information was available. Body condition score (BCS) of all cows had been assessed during four farm visits. Farm and herd factors were assessed by means of an estimation tool established and evaluated in a previous FiBL project (Spengler et al., 2010) between January and March 2010. The estimation tool consisted of two fact sheets. The first fact sheet covered farm factors, such as farm size, concentrate use, and grazing management (Table 1). The second fact sheet covered overall herd data (Table 2), like the estimation of size, weight, muscling, and temperament of cows related to the herd average. The fact sheets were filled in by one of five researchers in the Feed no Food project, who had been trained in assessing these data in collaboration with the farmers. Further data, such as basic farm information, treatments and milk recording data were retrieved from the project database (which is based on data of the breeding companies and of the national statistics office BfS). Wherever possible, data assessed by the estimation tool were replaced by more detailed farm data from the project (including milk recording data, body condition score, and farm statistics).

Table 1. Farm factors and variable values

Farm factor[2]	Variable values[1]
Farm area (ha)	numeric
Livestock units dairy cows	numeric
Dairy cow livestock units on all roughage feeding livestock units (%)	numeric
Feed purchase	no feed purchase, ≥ 5% of ration, ≥ 10% of ration, ≥ 15% of ration
Cadastral zone	mountain zone II-IV, mountain zone I, pre-alpine hill zone, valley zone
Frequency of use of main forage area	1 to 2, 2 to 3, 3 to 4, > 4
Precipitation per year (mm)	1800 - 2100, 1400 - 1790, 1000 - 1390, 700 - 990, < 700 mm
Irrigation	no, yes
Percentage of ley	0 - 9%, 10 - 39%, 40 - 79%, 80 - 100%
Hay conservation	ground drying, ground drying and ventilation, ventilation of all hay, hot air ventilation
Protein based roughage (winter)	≤10%, >10% medium-quality, 10-40% high-quality, >40% high-quality
Additional energy based roughage	none, partly / little, in winter, all year
Feeding management	all cows alike (roughage), dry cows, concentrate, roughage, concentrate
Concentrate per cow and year (kg)	numeric
Concentrate per kg ECM (g)	numeric
Dimensions of housing	narrow spacing, partially generous spacing, generous spacing
Lightness of housing	dark, light
Spring and autumn grazing system	continuous grazing, rotational grazing, strip grazing
Spring and autumn grazing quantity	< 50%, 50% - 75%, > 75%
Summer grazing system	continuous grazing or alpine pasture, rotational grazing, strip grazing
Summer grazing quantity	< 50%, 50% - 75%, > 75%
Labour units per 25 livestock units	< 0.7 or frequent change, 0.7 - 1, 1.1 - 1.5, 1.6 - 2
Quality of farm labour	no special interest, great interest in cows
Percentage of natural mating	numeric
Seasonal calving	no, partly, yes

[1] all variable values are listed in ascending order
[2] ECM: energy-corrected milk

The estimation tool calculated a farm score and a herd score for each farm by summing up values attributed to the answers and comparing the achieved net score with the total achievable points. The comparison of farm and herd score, expressed as percentage, allows a rating of the analogy between cow and farm type. Differences between both scores lower than 6 percentage points are regarded as site-related, which means that cow and farm type fit to each other (Spengler Neff et al. 2007). If the farm score is more than 10 percentage points higher than the cow score, it is assumed that the full potential of the farm is not tapped. If the cow score is more than 5 percentage points higher than the farm score, the cow demand is regarded as exceeding the possibilities of the farm environment. In this case, cows may not be well adapted to their environment and thus likely to be in stress and prone to disease. The difference between both scores was included in the statistical analysis as an explanatory variable.

Health status was assesses by means of eight health and reproduction indicators. These were herd means of calving interval (CI), risk of acidosis, risk of ketosis, somatic cell score (SCS), veterinary treatments (udder treatments and all treatments), culling rate, and number of lactations. Risk of acidosis was determined by a fat-to protein ratio < 1.1 whilst risk of ketosis was determined by a fat-to protein ratio > 1.5, according to Čejna and Chládek (2005).

Herd and farm factors were reduced by univariate analyses as recommended by Dohoo et al. (1996). Relationships between explanatory variables were examined by nonparametric rank correlations (Spearman's rho). Independent variables strongly correlating with $r_s > 0.6$ (Brosius, 2008) or overlapping with regard to their meaning were not simultaneously included in one model. Scale and ordinal independent variables were tested for associations with the dependent variable via rank correlations. ANOVA was used to find relationships between one nominal independent variable (breed) and the dependent variables. Explanatory variables univariably associated with $p < 0.2$ with the dependent variable were included into initial models of multivariable analyses as described by Dohoo et al. (1996). After pre-selection, multivariate linear regression models with stepwise backwards selection were used to explore effects on health and reproduction indicators. The acceptance and rejection criteria 'probability of F-to-enter' (PIN) at 0.05 and 'probability of F-to-remove' (POUT) at 0.1 were applied.

Table 2. Herd factors and variable values

Herd factor[2]	Variable values[1]
Age at first calving (months)	numeric
ECM per day (kg)	numeric
ECM per kg live weight (kg)	numeric
Mean minimum BCS of all cows	numeric
Difference between BCS minimums and maximums of all cows	numeric
Percentage of horned cows	numeric
Height at withers (cm)	< 135, 135 - 140, 140 - 145, > 145
Weight (kg)	< 600, > 600
Feet and legs	rather big-boned, rather fine-boned
Muscling	rather heavy, rather light
Temperament	rather calm, rather spirited
Breed	Fleckvieh, Holstein-Friesian, Braunvieh (BV), BV and Original Braunvieh, mixed breeds

[1] all variable values are listed in ascending order; factors without variable values were interval-scaled
[2] ECM: energy-corrected milk; BCS: body condition score

Results

Factors influencing CI are presented in Table 3. CI was longer when BCS range was higher in the course of lactation. The difference between farm and herd score was negatively associated with calving interval. Age of first calving showed a trend to be higher for herds with longer CI.

Factors influencing the risk of acidosis are presented in Table 4. Lower minimum BCS values were associated with less cows showing a risk of acidosis. Where cattle housing was lighter more cows showed a risk of acidosis. Higher grazing quantities in spring and autumn were associated by tendency with a higher risk of acidosis, as was strip grazing in summer as opposed to continuous and alpine grazing.

Table 3. Regressions of influences on the calving interval ($R^2 = 0.190$; adj.$R^2 = 0.154$; $F = 5.315$; $p = 0.002$)

Variable¹	Estimate	Standard error	t	p
(Constant)	305.550	36.003	8.487	<0.001
DiffBCS	73.580	22.662	3.247	0.002
DiffScore	−0.919	0.330	−2.707	0.009
AFC	1.875	1.069	1.755	0.084

¹DiffBCS: difference between minimum and maximum BCS; DiffScore: difference between farm and herd score; AFC: age at first calving

Table 4. Regressions of influences on the risk of acidosis ($R^2 = 0.203$; adj.$R^2 = 0.155$; $F = 4.206$; $p = 0.004$)

Variable¹	Estimate	Standard error	t	p
(Constant)	−82.275	33.191	−2.479	0.016
MinBCS	31.971	12.227	2.615	0.011
LigHous	6.633	2.844	2.332	0.023
GrazSAqu	3.438	1.899	1.810	0.075
GrazSUsy	2.803	1.651	1.698	0.094

¹MinBCS: minimum BCS; LigHous: lightness of housing; GrazSAqu: spring and autumn grazing quantity; GrazSUsy: summer grazing system

Table 5: Regressions of influences on the risk of ketosis ($R^2 = 0.166$; adj.$R^2 = 0.141$; $F = 6.671$; $p = 0.002$)

Variable¹	Estimate	Standard error	t	p
(Constant)	4.787	4.045	1.183	0.241
PctCows	0.130	0.048	2.729	0.008
GrazSAqu	−2.495	0.957	−2.606	0.011

¹PctCows: percentage of cows of all roughage feeders, GrazSAqu: spring and autumn grazing quantity

Factors with an effect on SCS are presented in Table 6. Herds characterized by high BCS fluctuations showed higher SCS. Lighter housing showed a trend to be associated with higher SCS. Herds kept by farm labour interested in cows had lower SCS by tendency.

Table 6. Regressions of influences on the Somatic Cell Score ($R^2 = 0.125$; adj.$R^2 = 0.087$; $F = 3.251$; $p = 0.027$)

Variable¹	Estimate	Standard error	t	p
(Constant)	1.965	0.335	5.859	<0.001
DiffBCS	0.907	0.437	2.078	0.042
LigHous	0.261	0.145	1.794	0.077
FLqual	−0.287	0.165	−1.740	0.086

¹DiffBCS: difference between minimum and maximum BCS; LigHous: lightness of housing; Flqual: quality of farm labour

Factors influencing the risk of ketosis are presented in Table 5. In herds with more roughage feeders other than dairy cows risk of ketosis was lower. If higher quantities were grazed in spring and autumn this was associated with a lower risk of ketosis.

Table 7 presents factors influencing the categorized number of udder treatments. On farms where more concentrate was used to produce 1 kg of energy-corrected milk (ECM) significantly more udder treatments were done. More intensive grazing in summer was associated with fewer treatments. Braunvieh (BV) cows received more udder treatments than other breeds. The number of udder treatments was lower in herds where feeding management was more advanced. More precipitation was related to more treatments.

Table 7. Regressions of influences on udder treatments ($R^2 = 0.387$; adj.$R^2 = 0.338$; $F = 7.938$; $p < 0.001$)

Variable[1]	Estimate	Standard error	t	p
(Constant)	4.389	1.174	3.737	<0.001
ConcECM	0.017	0.006	2.881	0.005
GrazSUsy	−0.805	0.288	−2.796	0.007
Breed (BV)	1.179	0.438	2.694	0.009
FeedMgt	−0.596	0.280	−2.132	0.037
Precip	0.411	0.198	2.069	0.043

[1]ConcECM: concentrate per kg ECM; GrazSUsy: summer grazing system; BV: Braunvieh; FeedMgt: feeding management; Precip: precipitation

Table 8. Regressions of influences on all treatments ($R^2 = 0.36$; adj.$R^2 = 0.30$; $F = 5.80$; $p < 0.001$)

Variable[1]	Estimate	Standard error	t	p
(Constant)	0.203	0.071	2.873	0.006
FeedPch	0.037	0.012	3.060	0.003
FL25	0.030	0.014	2.196	0.032
EnergBas	0.024	0.011	2.199	0.032
GrazSUsy	−0.032	0.015	−2.166	0.034
ProtBas	−0.032	0.015	−2.090	0.041
DimHous	−0.024	0.013	−1.883	0.064

[1]FeedPch: feed purchase; FL25: farm labour per 25 livestock units; EnergBas: additional energy based roughage; GrazSUsy: summer grazing system; ProtBas: protein based roughage in winter; DimHous: dimensions of housing

Table 9. Regressions of influences on culling rate ($R^2 = 0.62$; adj.$R^2 = 0.57$; $F = 12.15$; $p < 0.001$)

Variable[1]	Estimate	Standard error	t	p
(Constant)	58.968	8.149	7.236	<0.001
GrazSUqu	−8.689	1.363	−6.373	<0.001
FeedPch	5.299	1.156	4.584	<0.001
ProtBas	5.178	1.455	3.558	0.001
Area	−0.094	0.034	−2.740	0.008
FeedMgt	−3.541	1.352	−2.620	0.011
Tempmt	−5.955	2.296	−2.594	0.012
GrazSAsy	−4.384	1.869	−2.346	0.022
LigHous	−4.561	2.422	−1.883	0.065

[1]GrazSUqu: summer grazing quantity; FeedPch: feed purchase; ProtBas: protein based roughage in winter; Area: farm area; FeedMgt: feeding management; Tempmt: temperament; GrazSAsy: spring and autumn grazing system; LigHous: lightness of housing

Factors influencing the logarithmized number of all treatments are presented in Table 8. Feed purchase had the most significant effect, followed by farm labour and additional energy based roughage. All those factors had a positive influence on treatments. Animals grazing continuously and alpine pastures in summer received more treatments than animals in intensive grazing systems. Herds having been fed more protein based roughage in winter were treated less. More spacious housing was associated with fewer treatments.

Factors associated with the culling rate are presented in Table 9. On farms with higher grazing quantities in summer the culling rate was lower. Higher feed purchase was associated with a higher culling rate. Where more protein based roughage was fed in winter, more animals were culled. Larger farms and farms with a more advanced feeding management had lower culling rates. The same accounted for herds of more spirited cows and herds that grazed in more intensive systems throughout spring and autumn. By trend herds with lighter housing showed lower culling rates.

Factors influencing the number of lactations are presented in Table 10. Cows grazing in more intensive systems during spring and autumn had more lactations. If more concentrate was fed per kg ECM fewer lactations completed. Herds with lower minimum BCS values had less lactations. There was a tendency of taller cows having fewer lactations.

Table 10. Regressions of influences on number of lactations ($R^2 = 0.280$; adj.$R^2 = 0.237$; $F = 6.507$; $p < 0.001$)

Variable[1]	Estimate	Standard error	t	p
(Constant)	−0.004	1.632	−0.002	0.998
GrazSAsy	0.337	0.110	3.054	0.003
ConcECM	−0.004	0.002	−2.222	0.030
MinBCS	1.320	0.600	2.201	0.031
Height	−0.172	0.099	−1.731	0.088

[1]GrazSAsy: spring and autumn grazing system; ConcECM: concentrate per kg ECM, MinBCS: minimum BCS; Height: height at withers

Discussion

The results presented indicate that dairy cattle characterized by stable BCS values might be better suited for grazing systems with low to zero concentrate supplementation than cows with highly fluctuating BCS. This supports findings of Thomet and Steiger Burgos (2007), Coleman et al. (2010) and Piccand et al. (2011b) that angular, high genetic merit cattle might be less suitable. No pronounced breed impacts could be determined, but suitability of individuals for zero concentrate supplementation seems to vary within breeds. The current study confirms a major influence of feeding and feeding management on the health status of dairy cattle. The importance of feed and feeding management is higher with higher performance (Clark and Kanneganti 1998). Site-relatedness was strongly associated with fertility, confirming a previous study (Spengler Neff 2010). Low fertility is one of the main reasons for culling (Burren 2011) and can be directly linked to dairy cow nutrition. The estimation tool can be regarded as a useful tool for improving the compatibility between cow and system.

Suggestions to tackle the future challenges of organic animal husbandry

Site-relatedness can be achieved by two measures: the adjustment of the cow type, for example by breeding for robustness, or the adjustment of the environment, for example by improving feed quality and management. Since changing the environment in organic systems is limited farmers, breeders, farm advisors and veterinary surgeons may use site-relatedness parameters to improve and maintain health and reproduction in organic dairy cows.

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Organic animal husbandry of Achham cattle, worlds smallest cattle breed

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Abstract

Achham cattle are the smallest indigenous cattle breed of the world with population 863 (DLSO Achham) and less than 1m tall, registered in Food and Agriculture Organization (FAO) found only in Khaptad buffer zone, Achham district of Nepal. The major constraints regarding these precious and important breeds are; low level of management, lack of appropriate breeding strategy, cross breeding, least emphasis on research and exploration, decreased interest of the farmers towards livestock farming, illegal trade to Tibet for slaughter, etc, due to which the breed is in critically endangered condition. This disease resistance milch breed can be reared in low input system in wide range of climatic conditions (5-40^{0}C). These constraints have left opportunities for the organic farming of the Achham cattle. Different activities that can be undertaken are; selection of the superior individuals for the milk yield, provision of balanced organic feed supplement, sanitation, administration of the conventional herbal and ayurvedic medicines for disease management, disease resistance and abiotic stress tolerance, in-situ conservation of the breed, policy to reduce the illegal trade to Tibet, commercialization of the breeds and its organic products in the national and international market. Another virgin topic that has to be done is its publicity and advertisement and best suitable breed for the organic farming. This breed can be improved as the organic breed as work has to be done from root level.

Key words: Achham cattle, organic animal breeding, in-situ conservation and ex situ conservation

Introduction

Sustainable animal husbandry is considered as positive future way out (Lin *et al*., 2003), that stresses on the resilience ability of ecological biodiversity. In the hills fodder trees and straw along with negligible concentrate comprises the diet of these animals (Kaphle and Devkota, 2000), while concentrate feed is available to high producing animals. Twelve percent of this is exotic (pure and cross bred) and the rest indigenous (Neopane *et al.*, 2005). In Nepal there are most notably seven indigenous cattle breeds identified. They are Terai cattle, Lulu, Pahadi, Siri, Khailia, Achham and Yak (Neopane *et al.*, 2005).

Achham cattle (*Bos indicus*) are considered as rare breed of cattle (FAO online, 2008) and smallest breed of cattle in the world (NARC, 2008). Achham cattle provide food (milk) to farmers, power for agricultural operations and manure for maintaining and enhancing soil fertility (FAO et al, 1993/1994). These indigenous Achham cattle represents a small proportion of total cattle population and are mostly found in Achham, Bajhang, Bajura, and Doti Districts of Western Nepal mid and high hills (Neopane, 2002).They are known as *Sano Gai* (*Sano*= small and *Gai* = cattle in Nepali) or *Naumuthe Gai* meaning Small cattle (Neopane *et al.*, 2005). This can be a suitable breed for low input system mainly in hills (Shrestha *et al.*, 1996).

Achham cattle as being the smallest breed are less than 1 meter in height at withers. They are suitable for hill conditions and low input system. Body color varies from black to white i.e. black, brown, grey, white, spotted black and white. Ear is straight with an average length of 17 cm. Its temperament varies from docile to wild. The wither height of Achham cattle was 90.8 ± 0.96 cm at the age of 9 years. Similarly maximum body weight and body length were 149.38 ± 5.1 kg and 98.07 ± 1.52 cm respectively at the age of 8 years (ABD, 1995).

Table 1. Phenotypic characteristics of Achham Cattle (means ± standard errors in cm)

Parameters	Achham Cattle
Body length	92.10 ± 1.23
Heart girth	118.60 ± 1.40
Height at wither	90.80 ± 0.96
Height at hip bone	88.50 ± 0.76
Head length	33.20 ± 0.54
Tail length	72.42 ± 1.26
Horn length	3.0
Ear length	16.80 ± 0.28
Neck length	30.80 ± 0.66
Loin length	115.40 ± 1.65
Barrel height from ground	44.80 ± 0.72
Four legs above knee	32.10 ± 0.46
Four legs below knee	26.70 ± 0.42
Rear legs above knee	34.80 ± 0.53
Rear legs below knee	32.80 ± 0.46
Adult body weight (Kg)	125.00 ± 7.46

Source: Neopane *et al.* (2005); Shrestha *et al.* (1996)

Table 2. Productive and reproductive performance of Achham cattle (means, ± Standard errors)

Parameters	Achham Cattle
Age at 1st service	(Months) 48(36-60)
Age at 1st calving	(Months) 60(48-72)
Gestation length	(days) 285 ± 1.80
Calving intervals	(Months) 17(12-24)
Average daily milk yield	(Liters) 1.5 ± 0.22(1-4)
Lactation length (days)	225(180-270)

Source: Neopane et al. (2005); Shrestha et al. (1996)

Though it has manifold valuable traits that are better than other cattle breeds, its number is declining day by day. It is sure that in near future these cattle will remain only in papers. So, it is the time for the every stakeholder of livestock and conservationists to think and take actions towards the conservation of this breed. Population declining rapidly due to cross breeding while grazing with other breeds, out- migration/ export to Tibet for slaughter and socio economic reasons.

Methodology

Following measures should be undertaken to conserve Achham cattle like other endanger cattle breeds:

Survey on the status of breed:

First step that should be taken is to conduct survey on the real status of the cattle in the pocket areas. Data should be generated on the various factors like the number of the cattle, number of pure breed, number of cross breed, diseases that mostly responsible for their reduction in number and quality, existing farming practice, and other factors.

Selection of the genetically pure stocks and breeding strategy:

From the breed population of Achham cattle, prolific pure breeder bull and cow should be selected on the basis of the physical and reproductive characters. About 5-10 bull and 50 cows can be selected according to their superiority over other individuals. These all selected individuals should be managed in a farm.

In the farm, focus on the natural breeding should be given and should be avoided the cross breeding/ out breeding with other breeds. Parents of previous cross should be culled out from the herd. Among the progenies, again selection should be done to obtain the pure breeds; this can be done for 2-3 generation. Finally we select pure breed of Achham cattle for the purpose of breeding purpose with another breeds to get the hybrids which can benefit important characters of the Achham cattle.

At the same time, focus should be given to maintain this important cattle genotype. The AI and ET should be avoided during the breeding process to retain totally organic cattle breed of achham cattle.

When pure breed of Achham cattle will be obtained, then there will wide range of opportunity to take consideration in its improvement in productivity. Crossing with other superior varieties in respect to productivity or milk yield will eventually give hybrid, of Achham cattle and crossed breeds, with perfects traits like disease resistance, small in height, high milk yield, and so on.

In-situ and ex-situ conservation:

For its conservation, the local environment of Achham, Doti, Bajhang and bajura should be primarily utilized. In addition to this, similar environment can be used to conserve this breed anywhere of Nepal and in foreign countries. These approaches of conservation not only conserve the declining population of the cattle but also help in the dissemination of this breed in variable environments of the world.

Feeding:

Feeding arrangement should be done so that cow gets enough nutrients required for different stages of developments. Generally, pasture feeding should be encouraged, besides to this feeds like straw, silage, cereals, concentrates can be supplemented. This is because most of the cattle in the population are now malnourished so gives bad performance.

Stop the illegal trade:

From various studies, it is found that this breed of cattle is traded to Tibet illegally. This practice should be discouraged to conserve the infinitesimal number of remaining Achham cattle. There should be the provision of law to the illegal trader.

Awareness program and dissemination of its importance

One of the major factors behind the decrease in the number of this cattle from the Far western region of Nepal is due to the socio economic reasons. Local cow raisers are discouraged because of its low productivity and due to the low income from this breed. These necessities the awareness program simultaneous to the improvement of this cattle breeds with desired characters. The importance of this breed should be made clear to the local raisers and also this information should be disseminated to various conservationists and related stakeholders.

Conclusion

Review of the different papers and the real status of the Achham cattle seek its conservation from us because its number and genotype is in great risk. If any measures towards its conservations and improvements are not undertaken, Achham cattle will be limited to the pages of the journals and in history. Local farmers of its native habitat were continuously working for its conservation but their efforts are not working effectively. So, it's our time to take a way to conserve it now. The best way

to conserve them and utilize the genotype for the breeding program can be effectively achieved by the organic breeding method and in-situ and ex-situ conservation approach. Organic breeding should include selection of the superior individuals, crossing among themselves and again selection within progeny; cross progeny to obtain pure breed. But there should be taken equal consideration to avoid out breeding. Final progenies should be maintained and multiplied. These afterwards should be used to get the superior breeds including the high milking character of the another breed and disease resistance, short height, tolerance to extreme environment characters of the Achham cattle.
Conservation in its natural or native environment can significantly help to increase its number. In addition, another approach for conservation i.e. ex-situ conservation should be done in the diverse climatic condition around the world. Dissemination of the breed to the different environment around the world will itself aid to its conservation.

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Comparison of two different dairy cow types in an organic, low input milk production system under Alpine conditions

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Key words: dairy cow, breeds, comparison, seasonal, Alps

Abstract

The core task of sustainable milk production is the conversion of forage into milk, dairy products and, as a by-product, into meat. In Europe and North America, for decades dairy cows were selected for a high genetic merit for milk production under high input farming conditions. It is therefore questionable whether these "high input genotypes" are suitable for forage-based, organic farming systems. The objective of this study was to compare two cow types concerning their suitability for an Alpine organic, low input dairy production system. The cow types used were conventional Brown Swiss (BS) on the one hand and a specific strain of Holstein Friesian (HFL), selected for lifetime performance, on the other. Both cow types were managed within one herd in an organic, pasture-based system with seasonal calving. Data from 89 lactations showed that BS animals were heavier and superior in milk production. HFL cows lost less body weight during lactation and showed a higher reproductive performance, which may indicate a greater suitability for low-input dairy production systems.

Introduction

Alpine dairy farming suffered severe changes during the last fifty years from traditional, small scale, forage based dairying towards larger and more specialised non seasonal dairy systems with strongly reduced pasture reliance and a marked increase of concentrate supplementation. To reduce costs of production and to meet consumers´ expectations, the implementation of a seasonal, site adapted, pasture based milk production system similar to those applied in New Zealand and North Western Europe might be an alternative for the near future in Alpine regions also (Thomet et al. 2011; Steinwidder et al. 2011). It is questionable whether animals selected under high-input conditions are most suitable for low input systems, in which fertility and reproductive performance rather than individual milk yield are of key importance (Veerkamp et al. 2002; Dillon et al. 2003). Therefore the objective of this study was to compare two cow types concerning their suitability for an Alpine organic, low input dairy production system.

Material and methodology

Data was recorded during a four year period from 2008 to 2011 at the organic dairy farm of the Agricultural Research and Education Centre Raumberg-Gumpenstein, Trautenfels, Austria (680 m altitude, 7°C average temperature, 2000 mm precipitation year^{-1}; latitude: 47° 31‘ 03‘‘ N; longitude:

14° 04‘ 26‘‘). The dairy herd was managed in a pasture based, low input system with block calving and consisted of conventional Brown Swiss (BS) and a specific strain of Holstein Friesian (HFL). While the BS cows represented the average breeding goal of the Austrian BS population, the HFL animals were selected for superior lifetime performance and fertility for more than 30 years. In total, data from 89 lactations were collected (40 lactations from 19 individual BS and 49 lactations from 23 individual HFL cows). Average lactation numbers were 3.3, 3.0, 2.3 and 2.6 in experimental years one, two, three and four, respectively. For BS and HFL mean numbers of parities were 2.5 and 2.9, respectively. Calvings were aspired between November and March and breeding started after 30 days in milk (DIM). Animals which did not conceive until June 30 were culled after 305 DIM or were newly inseminated after January 15 of the following year. Mean calving date was balanced between years and breeds. Individual rations were calculated throughout the experimental period, taking into account individual milk yield, milk composition and body weight. Detailed ration composition during dry period and lactation, as well as during barn and pasture feeding period was reported previously by Steinwidder et al. (2011). During the barn feeding period, the diet consisted of 5 kg of hay and grass silage ad libitum. Concentrate supplementation was increased until 21 DIM and depended on milk yield afterwards. Grazing period lasted from the beginning of April until the end of October (± 15 d). Cows had free access to a continuously grazed sward (height Ø 4.0-5.5 cm, estimated with Filip´s Folding Plate Pasture Meter). Pasture yield and botanical composition has been reported previously by Starz et al. (2010). At the beginning of grazing, a gradual transition from barn to pasture feeding was done. At the beginning of day and night grazing (end of April), silage feeding in the barn was stopped. During the grazing period cows received 1.5 kg hay per day and only cows yielding more than 28 kg per day received concentrate supplementation. At the end of October daily grazing time was constantly reduced and the grazing period was terminated at the beginning of November. In parallel, the quantity of hay and grass silage offered in the barn was increased. Individual milk yield was recorded twice daily. Milk samples were taken three times per week for determination of milk fat, protein, lactose and urea content as well as somatic cell count. Cows were weighted weekly after morning milking. Rations were provided in Calan gates and daily feed intake was recorded during the barn period. During the grazing period, herbage intake was estimated taking into account hay and concentrate intake, milk yield and composition, live weight and live weight change. The dataset was analysed using the MIXED procedure of SAS 9.2. The model contained breed, year, parity and barn feeding regime within year as fixed effects and days in milk at the beginning of the grazing period as a covariate. Animal within breed was included as a random effect. P-Values <0.05 were considered to be significant.

Results

Table 1 shows the least square means and the effect of dairy cow breed on milk production and composition, life weight and reproductive performance over the four experimental years. Lactation length for BS cows was significantly longer than for HFL animals (294 and 285 days, respectively). In terms of milk production, BS was superior. It produced significantly more milk, milk solids and energy corrected milk. Comparing milk yield and energy corrected milk yield differences between breeds tended to increase as HFL had lower contents of fat and protein than BS, but only the difference in protein content was statistically significant. No difference between the two breeds was found for somatic cell count and persistency. Body weight of HFL cows was about 60 kg significantly lower than that of BS. Comparing the breeds in terms of live weight development during lactation BS animals reached nadir about 50 days later than HFL animals. Conversely, HFL animals started to regain live weight significantly earlier than BS cows. Moreover, HFL animals lost significantly less weight (18 %), comparing pre calving measurements and live weight at nadir, than BS cows (23 %). HFL animals were superior for compared parameters of reproductive performance. Interval from calving to conception was about one month shorter for HFL, but not statistically significant. Calving intervals were 395 and 353 days for BS and HFL, respectively, the difference being statistically significant.

Table 1. Effect of breed on milk production and composition, life weight and reproductive performance 2008 - 2011

	Breed		SED[c]	P value
	BS[a]	HFL[b]		
Lactation length, d	294	285	16	0.029
Milk yield, kg	6,082	5,490	476	0.020
ECM[d] yield, kg	5,764	5,040	419	0.001
Fat and protein yield, kg	438	378	31	<.001
Fat content, %	3.99	3.86	0.14	0.110
Protein content, %	3.24	3.05	0.08	<.001
Somatic cell count, n	125,970	126,160	108	0.733
Persistency[e]	0.78	0.75	0.06	0.148
Average LW[f], kg	599	536	15	<.001
Day of LW[f] nadir, days in milk	178	126	64	0.002
LW[f] change from calving to nadir, %	23	18	5	0.013
Calving to conception, d	124	93	76	0.226
Calving interval, d	395	353	43	0.002

[a] Brown Swiss, [b] Holstein Friesian Longevity, [c] Standard error of difference, [d] Energy corrected milk
[e] Ratio of milk yield of 101-200 days in milk and milk yield of 1-100 days in milk, [f] Live weight

Discussion

The results illustrate the impact of the alternative breeding objectives of HFL as compared to BS and the trade off between breeding for high milk production and selection for high longevity. BS cows achieved higher milk yields, but mobilised more body reserves over a longer period of time as compared to HFL cows. This indicates that HFL animals went through a less pronounced period of negative net energy balance, which lasted not as long as for BS. Dillon et al. (2003) and Roche et al. (2007) stated the positive effect of a lower degree and shorter duration of body tissue mobilisation on reproductive performance. Animals with high genetic merits for fertility tend to partition nutrients towards reproduction and not milk production (Cummins et al. 2012). Comparing both breeds, HFL seems to be more suitable for a pasture-based dairy system, particularly if block calving is involved. It meets the goal of high reproductive performance and therefore ensures an optimal use of pasture, which is a key factor for sustainable, low-input dairying. Taking into account the topographic conditions in the Alps, the lower live weight of HFL can also be an additional advantage.

Suggestions to tackle the future challenges of organic animal husbandry

Seasonal, pasture based systems of milk production will be of crucial importance in the future of (organic) dairy farming. If managed adequately, these systems guarantee a highly efficient and environmentally friendly conversion of forage into milk, low use of concentrate supplementation, high standards of animal welfare and elevated consumers' acceptance. To achieve this aim, dairy cow breeding needs to be adapted towards an increased importance of fertility and other fitness traits, resulting in animals which are more suitable for organic, low-input systems.

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Breeds and breeding strategies for sustainable and organic production from livestock and poultry

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Abstract

One major input to organic production from livestock is the choice of the breed or strain of livestock. Local strains (not defined as a breed yet), in general, are more amenable to organic production as these do not depend on support from external resources and are, by default, more sustainable as well. In addition to organic production of milk and meat, the by-products like dung and urine are superior as organic bio-fertilizer and bio-pesticide for the soil to produce organic forage and feeds. Recent attempts at surveying the local breeds and strains of livestock in India revealed the presence of undisturbed organic production systems which are continuing and have the innate capacity to sustain by themselves e.g. Banni buffalo and Nari cattle. While transition of conventional system to organic is under active consideration, a planned support is also needed for maintenance/continuation of the organic production systems represented by livestock strains notably in the developing countries.

Key words: Breed, Defined-population, Organic-by-default, Buffalo, Case-studies, Survey

Introduction

In the developing countries, and the countries in transition, the livestock are easily classified into four categories: breed animals, strains (uniform population but not yet defined as a breed), synthetic populations including crossbreds, and all the rest; the last group is often termed as 'non-descript'. Breeding strategies that would enhance organic system in each of these categories would be different. Based on a long-term survey of breeds/strains, this paper highlights the case for livestock strains vis-à-vis livestock breeds in following organic production system and avenues to maintaining such organic systems as a natural recourse.

Material and Methodology

Recently there has been an upsurge in the study of livestock breeds and strains in terms of field survey and documentation. This has also been prompted by the FAO of the United Nations by way of preparing a comprehensive '*State of the World Animal Genetic Resources*' [FAO, 2007a] whereby many individual countries prepared their respective '*Country Report on Animal Genetic Resources'* [AnGR]. Several of the Country Reports made a mention of organic animal husbandry practices being followed for the local livestock (FAO, 2007b). Preparation of India's Country Report on AnGR (FAO, 2007c) also prompted field survey of livestock populations that appeared to be uniform and located in defined geographic regions. Some case studies of such field surveys were conducted during 2002-2009. Only the case studies that belong to strains and do not belong to defined breeds have been dealt in this paper. Compared to defined breeds, these cases are loosely termed as Strains or Defined Populations or, sometimes, as 'Lesser known Breeds'.

As per FAO, a **Breed** by definition is a sub-specific group of domestic livestock with definable and identifiable external characteristics that enable it to be separated by visual appraisal from other similarly defined groups within the same species or a group for which geographical and/or cultural separation from similar groups has led to the acceptance of its separate identity [FAO, 2007a]. A **Defined Population** would be a largely uniform population that generally breeds true, is prevalent in a geographically defined expanse of land, has identifiable unique traits that distinguish it from other breeds/populations in the vicinity but has not been defined as a breed yet. Such populations, after recording and documentation, get into the pipeline to be defined as a distinct breed in due course. In general, the need for defining a population to a breed leads to increased attention to saving the breed from extinction and enhancing its utilization – bringing benefits to the communities maintaining the population/breed. Some of the case studies made during 2002-09 makes the 'Material' for this paper.

Methodology followed was simple. Individual cases of local defined populations were surveyed and documented. Details on production system were recorded along with the extent to which organic practices were followed and whether the organic practices were planned (i.e. transformed from conventional) or just by default. Details of individual case studies are given below. Similar cases have been noted for poultry, sheep and goat but not detailed herein.

A. Chilika Buffalo Population of Odisha state

Survey and study of locally prevalent buffaloes in the islands and surrounding areas of Chilika lake in Odisha state during 2002 revealed following two aspects:

(i) Although Chilika buffaloes were more or less uniform from morphological point of view and were distinct from other buffalo types found in Odisha or surrounding states, yet, these were not recognized as a breed.

(ii) This set of buffaloes had a typical and unique production system: by the evening the buffaloes move towards the lake into knee deep waters; stay overnight in the lake and come back to the owners where their young ones are tended by the owners. With the owners these buffaloes stay for the day time, and again move to the lake by the evening.

Without any use of chemicals like fertilizers or pesticides, the whole production and management system is organic by default.

B. Banni Buffalo of Kachchh area in Gujarat state

Survey of locally prevalent Banni buffaloes in Gujarat during 2004 showed that the buffaloes were typical, phenotypically distinct from other buffalo populations and were uniform. Not yet defined as a 'breed' the whole production system was organic by default. Traditionally, no chemical fertilizer or pesticides were used in the region. A detailed Bio-Cultural Protocol (BCP) prepared by the community maintaining the Banni buffaloes also narrated the organic status of the local buffaloes (BPUMS, 2010).

C. Nari Cattle of Rajasthan

Nari is another strain of cattle estimated to be around 10 thousand in number and located in Sirohi and surrounding areas towards south of Rajasthan state. The cows give small amount of milk and are maintained mainly for cow-dung which is sold for livelihood. Young calves for sale is another source of income. The herd grazes on open common land in the nearby jungle. This system – organic by default – continues without much intervention from outside. Dung collected is largely used as Bio-fertilizer. Fertilizers or pesticides or even veterinary medicines are unheard of by the community members maintaining Nari cattle.

D. Assamese Buffalo

Located along Brahmputra river in Kamrup and surrounding areas in Assam, the local Assamese buffaloes are maintained in traditional manner. Livelihood is made by the sale of milk, ghee and calves. Feeding is by grazing alone. Only salt is provided at the temporary housing also known locally as '*Khunti*'. At the Khunti, the young ones are kept in bamboo enclosures and safe from predators. Upto 6 kg milk is produced by elite buffaloes [Mishra *et al*. 2010]. In the absence of ready market, milk is turned into ghee (clarified butter) and sold. Entire operations in the whole process are organic by default.

E. Manipuri and Mizoram Buffaloes

The buffaloes in these adjoining states are reared for draught and meat purpose. During the cropping season, buffaloes are kept in and around villages. During the agriculturally lean season, buffaloes are taken to the nearby jungle where they stay on grazing in the open for 3-6 months. There is no use of chemical fertilizers or pesticides in agricultural or animal-husbandry operations and the entire production system is organic.

Comparative scenario for Breeds vs. Defined-populations of livestock

Comparative study can be made for any of the species of livestock. For instance, cattle in India has 34 defined breeds and another 31 defined populations (not defined as breeds). The breed animals (e. g. Sahiwal, Gir, Ongole) produce higher amount of milk and have been subject to intensive management. Intensive or industrial management makes higher demands on production levels which is achievable only by providing higher input levels. This leads to higher requirement of feed/fodder which in turn attracts chemical fertilizers to meet the demand. Management levels are raised to maintain the high producing animals with the inevitable help of veterinary medicines for animals and the pesticides for fodder crops. Unless efforts are sustained in favour of 'following-the-organic', it is difficult to maintain husbandry practices in organic manner.

In comparison to the high producing breeds, the 'defined populations' generally tend to follow the organic system as there is no relevance to using chemicals to boost production. In many a case, the use of veterinary medicines is denied in place of herbal and ethno-veterinary practices and the organic system gets maintained.

Discussion

Many countries (especially the developing, and the ones in transition) are attempting to define the hitherto undefined livestock populations by increasing documentation and infusing some conservation schemes in order to save the breeds from loss or extinction. This is a positive step so far as saving the dwindling breeds is concerned and systematically supported by FAO as well. Care is however needed, in altering the very utilization of such breeds. Increased exposition and increased pressure on utilization is likely to vitiate their organic being. Additional attention is needed to save the organic nature of defined populations which are a better bet to continue as organic. There is a need to pay higher attention to maintaining the organic nature of the strains of livestock.

Suggestions to tackle the future challenges of organic animal husbandry

In the developing countries, the strains of livestock are the promising sites where organic animal husbandry is practiced in a natural way. Increased attention and planned efforts are warranted for such population groups for retaining and sustaining their organic nature.

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Organic producers' preferences regarding traits important in dairy production

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Abstract

Much effort has been put on the development and promotion of organic dairy products, but little attention has been paid to the foundation of the production, i.e. the animal material. The process of developing sustainable breeding strategies, in agreement with the goals for organic production, should involve identification of traits especially important in organic production. The aim of this study is to identify organic and conventional producers' preferences regarding traits important in dairy production. A web based questionnaire has been developed and answered by 468 dairy farmers in Sweden (26 % organic producers). The results show that organic producers rank traits related to resistance to diseases higher than conventional producers, while milk production, lactation curve, temperament and claw and leg health were ranked higher by conventional farmers. This indicates a need for breeding goals adjusted to satisfy farmers with different type of production.

Key words: breeding, animal material, farmers' attitudes, cattle, disease resistance

Introduction

The animals used in organic production in Europe are generally the same as in conventional production. They are traditionally bred for high profitability with main focus on production traits, a breeding objective that is not in agreement with the goals for organic production. The need for a defined breeding strategy in organic production has been emphasised during the last decades. It has been suggested that the traits of interest differs between organic production and conventional production, as well as the relative importance of breeding goal traits, due to differences in production environment and farmers' values (Verhoog et al. 2004).

This study is part of a research project which overall objective is to develop a sustainable and realistic breeding strategy for organic dairy production in Sweden. The specific aim of this study is to investigate and compare organic and conventional producers' preferences regarding traits important in their herds.

Material and methodology

All dairy farmers with e-mail addresses registered in the Swedish Dairy Association's or the Swedish organic certification organization KRAV's databases were invited to answer an advanced web based questionnaire about traits of importance for cattle in dairy production. This represented 1481 farmers, i.e. one fourth of all dairy producers in Sweden. The questionnaire developed consisted of five steps:

1) The producers state which traits they intuitively consider important in their herd.
2) The producers rank 15 given traits (randomly presented) against each other. Rank 1 = most important, rank = 15 least important (Table 1).

3) The producers weigh traits against each other given the estimated genetic gain. The genetic gain was calculated based on selection index theory within the questionnaire and the input parameters were based on the literature.
4) The producers indicate to what extent they consider traits to be related to productivity, animal welfare and environmental impact (not at all, little or much).
5) The producer answer general questions about herd characteristics (e.g. production system, herd size, breed, housing system), herd performance (e.g. production level, calving interval and disease incident), and questions about the respondent (e.g. role at the farm, involvement in breeding, sex and age).

This paper includes result from step 1 and 2. The statistical analyses were performed with the SAS package, version 9.2 (SAS Institute Inc., 2011). Descriptive statistics were analysed using PROC MEANS and PROC FREQ. Associations between herd characteristics and the rank given by respondents were analysed with the following model in PROC GLM:

y = production system + herd size + production level + calving interval + housing + sex + mastitis per cent + disease per cent + birth year + residual

where the response variable '*y*' is rank for each specific trait, and the predicting factors *production system* (conventional or organic), *herd size* (≤49, 50-74, 75-99, 100-149, ≥150 number of cows), *production level* (≤8499, 8500-9499, 9500-10499, ≥10500 kg ECM per cow per year on average), calving interval (≤12.4, 12.5-12-9, 13.0-13.4, ≥13.5 months on average), *housing* (loose housed, loose housed with automatic milking system or tied stall), and *sex* of the respondent (female or male) were included as fixed class effects. Average *mastitis percent* and *disease percent* in the herd and *birth year* of the respondent were included in the model as continuous covariates.

Results

The number of farmers that started to fill in the questionnaire was 772 (49 %) and 468 of these finished and thereby got their answers registered (32 % of the invited). A majority of these were conventional farmers (N=346) and the rest were farmers organically (KRAV) certified production (N=122).

The traits that the farmers intuitively mentioned as important in their herds differed to some extent between organic and conventional production (Figure 1). In general, the organic producers more often mentioned meat production, feed intake and conversion, general and udder health, fertility and calving ability compared with conventional farmers. In conventional production, on the other hand, claw and leg health, cow behaviour and the amount of fat and protein in the milk were more commonly mentioned.

Respondents from organic herds ranked the 15 given traits different than the conventional farmers. Traits related to resistance from diseases were considered more important in organic production, while respondents from conventional herds ranked milk production, lactation curve, temperament and claw and leg health higher (Table 1).

Discussion

Broad breeding goals including both production and functional traits have been implemented in the Nordic countries for decades and have been suggested to suit the organic production very well (Rozzi et al., 2007). However, the results of this study show that organic farmers value traits different than the conventional, despite small differences between the production systems in Sweden (Sundberg et al., 2009). Organic producers rank traits related to resistance to diseases higher than conventional producers (except claw and leg health), at the expense of milk production and lactation curve. Also the temperament of cows had a lower rank in organic production which may be due to a less stressful environment or different attitudes among the farmers.

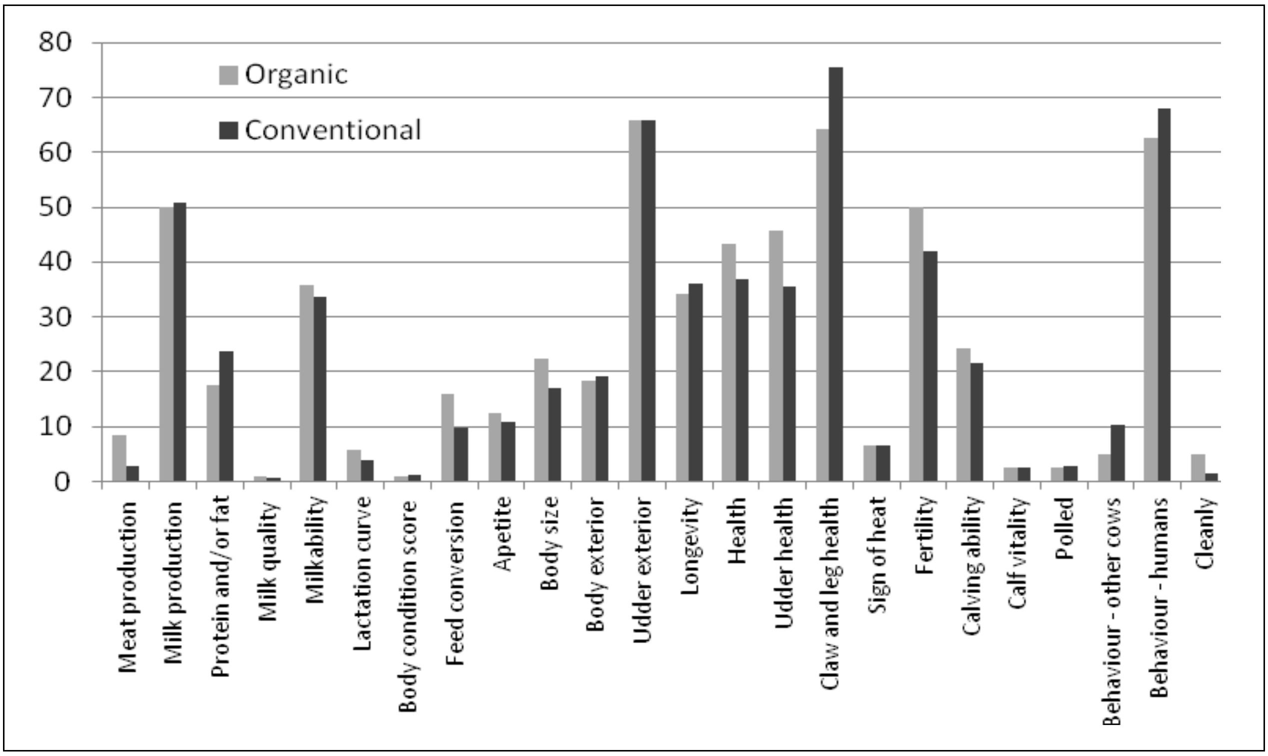

Figure 1. Traits intuitively mentioned as important by organic and conventional dairy farmers. Proportion of farmers (%) that mentioned the trait on the y-axis

Finally, our results show higher interest in traits related to profitability and animal welfare than traits related to the environment, such as methane production and dual purpose animals, i.e. combined milk and beef production.

Table 1. Least square mean differences in rank between respondents from conventional and organic herds (low values indicate high ranking)

	Conventional		Organic			
Trait	LSM	StErr	LSM	StErr	F-stat	p-value
Calving ability	6.7	0.19	7.0	0.31	1.1	0.297
Claw and leg health	4.7	0.20	5.3	0.32	3.1	0.078
Milk production (ECM)	4.6	0.23	5.4	0.38	3.6	0.059
Disease resistance	7.9	0.23	6.6	0.38	8.9	0.003
Feed conversion	7.3	0.21	7.2	0.35	0.2	0.639
Longevity	3.3	0.20	3.4	0.32	0.0	0.918
Methane production	14.3	0.10	14.2	0.17	0.4	0.518
Lactation curve	7.6	0.23	8.7	0.37	7.2	0.008
Mastitis resistance	5.2	0.21	4.4	0.34	4.8	0.030
Beef production	13.0	0.11	12.8	0.19	1.3	0.260
Parasite resistance	12.5	0.16	11.7	0.27	7.1	0.008
Fertility	4.7	0.18	4.7	0.30	0.0	0.833
Temperament	7.4	0.24	8.2	0.39	3.0	0.085
Carcass classification	12.7	0.11	13.0	0.18	2.1	0.145
Roughage intake	8.0	0.22	7.5	0.37	1.3	0.250

Suggestions to tackle the future challenges of organic animal husbandry

A breeding strategy for organic production needs to be defined, that is in line with the goal for organic agriculture and practically possible to implement. Different strategies can therefore be expected to be developed for different production conditions.

Consideration of different preferences between organic and conventional farmers in the genetic evaluation would be valuable for the development of organic dairy production in Sweden.

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The birth of an organic dairy breeding programme

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Introduction

Organic animal breeding is not clearly described in legislation on organic production. Generally, organic production must be in harmony with natural processes, animal-friendly, animals must be able to express their natural behavior. The use of hormones and multiple ovulation and embryo transfer (MOET) techniques are prohibited in organic farming and animals must be able to adapt to the local environment (EU, 1999). The use of a bull for natural service on individual farms can be considered the purest organic and natural form of organic breeding. However, since bulls are dangerous and pose risks on the farm, many farmers continue to use AI services for breeding as this is permitted under EU legislation. Conventional breeding schemes are based heavily on AI, MOET, and other modern reproduction techniques like IVF. Conventional breeding schemes also focus on the selection of animals for high input systems, i.e. requirement feeding with high inputs of purchased concentrated feed and standard use of medication like antibiotics and anti-anthelmintics. It is questioned if such animals can adapt to low input organic systems.

In the Netherlands organic farmers preferred organic breeding without the use of modern reproduction technologies and supported the development of organic breeding (Nauta, 2009). Therefore, a distinct breeding programme within the organic dairy population of about 25,000 animals would need to be set up. The need for a distinct breeding programme was also supported by the findings that animals from conventional breeding did have problems with coping to organic environments (Nauta, 2009).

Dairy cattle breeding is based on large testing schemes (Falconer and Mackay, 1996). The question is whether a small specific organic breeding programme is feasible in a world where animal breeding has become a worldwide business based on number-crunching and large databanks. At national level, several hundred promising bulls are tested each year at an estimated cost of €30,000 per bull. Only about 10 percent will become a breeding bull. Clearly such a programme is impossible for a relatively small organic cattle population. New, smart and cheaper ways of organizing organic cattle breeding will have to be found. When AI was introduced some 50 years ago, the first ‘breeding companies’ were satisfied with a breeding programme based on 20,000 to 100,000 animals. This is the size of organic populations. Would combining old and new technologies, be the answer?

Material and Methods; Bricks for an organic breeding programme

Organic farming is diverse by nature. Organic dairy farmers use many different breeds and crossbreeds (Nauta et al., 2005), and indeed, variation is the basis for selective breeding. Data on animal performance from Dutch organic farms was used to select cows with high lifetime productions (>70,000 kg milk). Many cows could be selected with a lifetime production over 70,000 kg of milk and high milk contents (fat and protein).

A young bull breeding system was used to set up a breeding scheme (Bichard, 2002). In the young bulls scheme, a number of young bulls (up to 1.5 years old) are selected from the best dairy cows in the population, based on their breeding values and that of their parents, and phenotypic value. Five bulls have been selected and existing structures for cattle breeding have been used to set up the scheme. Sperm (1000 doses of semen) is collected and frozen at an EU-certified AI station. The bulls are registered with the national herd book as breeding bulls. Marketing by the foundation Bio-KI (Organic AI) is primarily by e-mail, and augmented by meetings with farmers, glossy flyers and newsletters. When semen is purchased and used, the calves that are born and kept for production will be registered. In this way estimated breeding values will automatically be calculated and published by the Dutch herd book organization.

The direct cost of the procedure until the semen is frozen is €2500. These costs are paid by the owner/farmer who receives €5 per straw for the first 500 doses sold. The total price per straw is €8. For the first 500 doses sold, €2 goes to distribution and €1 to promotion and marketing by Bio-KI. For the second 500 doses, the farmer is paid €3, the distributor €2.50 and Bio-KI €2.50.

Results

The organization and set up of this breeding programme with five organic AI bulls and first sales is our first result. Table 1 shows the performance of the bulls' (grand)parents and their (expected) breeding values. Up to June 2012, a total of 2,430 doses have been sold – 1,360 of the first bull Opneij Wytze and an average of 268 doses of each of the other bulls – to some 100 organic farmers and also some conventional farmers. The total number of doses sold will yield about 245 daughters. One bull, Bio NB Jeroen already has 11 lactating daughters from natural mating at three farms. His first breeding values for production can be found in Table 1, and he has positive breeding values for fertility, claws, udder health, character and calving ease when used on Holsteins, although the reliability of those breeding values are still low. The bull, Opneij Wytze will currently get many daughter lactating and has already a positive estimated breeding value of 105 for calving ease.

Discussion

Initial results are the set-up, selection and sale of bulls plus the first breeding values for calving ease results. Setting up a distinct breeding programme was described as 'very complex' due to the many stakeholders involved (Nauta et al., 2009). The current scheme shows us that, by using existing facilities and working with a small group of dedicated people, a breeding scheme can be achieved. A growing group of farmers, also newly converting farmers, is getting interested in buying semen from organic bulls. It is becoming clear that personal contact is important for selling semen. Breeding companies often work as a cooperation with member farmers and invest in personal contacts (meetings, farm visits) to stimulate the sales. In a scheme such as we have developed, we miss these personal contacts. More time for contacts is needed but will increase the costs.

The price of semen is relatively low. Per bull, 500 straws need to be sold to recoup farmers' direct investment. The market is formed by some 250 farms that use AI every year on some 20,000 organic milking cows plus female young stock. Pregnancy rate with AI are 50-60% so that in total > 40,000 doses would be needed for this population. However, many organic farmers breed a specific cattle breed (Nauta, 2009) and do not need semen from other breeds. About 25% of organic farms does breed purebred Holstein cows. The actual market for organic AI is thus smaller, but it should be possible to sell up to 10,000 doses per year.

Selling semen is also a matter of trust. Most farmers have been members of a breeding cooperation for a long time, often following in their parents' footsteps, and are loyal to their organisation. They are accustomed to the testing schemes and high reliabilities of estimated breeding values of conventional breeding bulls. The young bull system does not have such reliable breeding values based on statistics yet. We also select the bulls based on lifetime production. More than three lactations are needed to establish that a cow is genetically predisposed to a high lifetime production and that her performance is not due primarily to environmental factors (Haiger, 1998). To see such reliability takes time and is therefore not used as a selection criteria by most conventional breeders. Farmers have to

Pedigree, Triple-A code and life time yield of bull mother line (mother + grandmother)

Name	Breed	aAa*	Pedigree (father line)	Kg milk	% MF	% MP
Bio Opneij Wytze P (RHF)	Red-HF	231	Lawn Boy x Kian x Stadel	**65.200**	4,51	**3,68**
Bio Proostmeer Henkie Boy (HF)	HF	342	Kelstein Dolman x Sunny Boy x Omar	**137.834**	4.03	**3,32**
Bio Nieuw Bromo Jeroen HFxGB)	HFxGB	462	Italië's Paul x Kelstein Crosby x Tops	**159.880**	4.06	**3,35**
Bio Arkemheen 110 (FH)	DF	531	A 92 x A 57 x A 47	**94.254**	4,25	**3,64**
Bio Classic Jaap (100% RHF)	Red-HF	623	Classic x Stadel x Koerier 104	**114.242**	4,90	**3,62**

HF= Holstein Friesian, GB = Groninger Blaarkop (native Dutch breed), DF = Dutch Friesian,

Expected breeding values	**Yield**			**Conformation**					**Functional traits**						
	Kg Milk	% MF	% MP	Inet	Frame	Rob.	Udder	Legs	Tot. Conv.	SCC	F	UH	CH	CE	Char.
Bio Opneij Wytze P (RHF)	+447	-.12	+.03	+85	102	103	107	104	106	100	99	102	104	105*	105
Bio Proostmeer Henkie Boy (HF)	-264	+.06	+.06	-32	102	103	101	99	101	101	104	102	103	106	98
Bio Nieuw Bromo Jeroen HFxGB)	-1007	+.06	+.02	-221	93	97	92	100	93	101	105	102	103	101	100
Bio Arkemheen 110 (FH)	-738	+.38	+.09	-116	98	99	102	97	98	104	103	105	97	104	--
Bio Classic Jaap (100% RHF)	-98	-.06	-.06	-42	108	107	108	105	110	99	97	103	96	102	104

Inet = Dutch index for milk production, Rob.=robustness, SCC = somatic cell count in milk, F = fertility, UH = udder health, L = Claw health, CE = calving ease, Char.= character.

Milk production of bull mothers and farmers opinion.

	Mother	# lact	days	TMY (kg)	%MF	%MP	Farmers opinion on cow
Bio Opneij Wytze P	Martha 3733	3	873	21036	5.01	4.00	Cow has good conformation, very robust animal.
Bio Proostmeer Henkie Boy	Eentje 30	11	3581	88856	4,00	3,33	Strong Holstein cow for organic production from grass.
Bio Nieuw Bromo Jeroen	Nanny 57	5	1797	52002	3,76	3,34	Mother has 100.000 kg milk, also possible for her.
Bio Arkemheen 110	Sofie 104	9			3,94		Cow from excellent cow family that stayed after con-
			2780	56932		3,53	version.
Bio Classic Jaap	Dora 69	7		47458			Strong cow with good performance in organic en-
			1892		4,66	3,56	vironment.

TMY= total life time milk yield, %MF= % milk fat, %MP = % milk protein.

Table 1. Breeding information of Bio AI bulls.

get used to that too. Bichard (2010) also pointed out that a young bull system can achieve similar genetic progress as a testing scheme and setting up such a system needs time. This situation can be compared to farmers' trust needed for breeding values based on genomic selection (Veerkamp, 2008).
Cloning, genomic modification and biopatents of animals are slowly gaining ground in agricultural industry (Brophy et al., 2003; Tvedt, 2007). Such practices can make distinct organic breeding programmes very important in the near future. Experiences with organic breeding schemes are needed if the sector is to hold its own in the fact of such developments. Current animal-unfriendly practices in cattle breeding conflict with one of the most important reasons for consumers to buy organic products: the perception of greater animal welfare (De Wit and Van Amersfoort, 2001). Organic AI can be an important step towards more organic breeding, not only in the Netherlands but also elsewhere. It is possible, but it will not happen without effort. Can organic AI in the Netherlands pave the way for other countries? A concerted international effort also depends on the development of rules on organic breeding. This is important to close the organic production chain completely, including the use of breeding stock.

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The present state and future of Organic Farming in North-Serbian region in view of genetic resources

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Key words: organic livestock, Vojvodina, farm-stead

Introduction

The organic livestock farming in Vojvodina – Northern region of Serbia, is at its very beginnings, The essential systemic unit is the farmstead, which presents a base for organic farming, *(Széll and Lengyel 2010).* On the other hand farming on farmsteads is specific for the region. This form of agricultural activity means that the farmers, their stock and cultivated plants coexist in their natural environment. This type of farming makes ideal conditions for producing organic food of extra quality, *(Pavlovski and Masic 1990).* Animal husbandry on farmsteads has hundreds of years of tradition, but as old farmsteads were left behind and intensive systems appeared in all branches of agriculture, that type of farming reached its critical minimum *(Yamada 1996).* Nowadays, trends that promote environment and health oriented products and looking for sources of sustainable energy get more and more popular, and open new horizons for the few farmsteads left in our region *(Pavlovski et al. 1992)*. From the environmental point of view there are several factors like a surroundings and landscape which determinate the way of farming. In some ways big differences could be observed in the region, especially on the right and left side of river Tisa. The quality of soil is determinative. In Banat we could find mostly pastures and meadows which are suitable for grazing, while the Backa is the intensive agricultural region with good arable land. The third part of Vojvodina - Srem is an rolling area used mostly for fruit and wine production.

Results and Conclusions

Vojvodina is an autonomous region within the Serbia, located at the northern part and it shares borders with Romania, Hungary, Croatia and Bosnia and Herzegovina. The 1.747.000 ha arable land with pastures and meadows which are 141.000 ha, presents appropriate conditions for both agricultural farming: conventional and organic.

Organic pig breeding possibilities – Mangulitsa, the spiny pig. In the middle of the 19th century various breeds of curly pigs were raised in the Balkans as far as the mountain region of Hungary. This breed grew into Mangulitsa pigs which became the exclusive breed int the region where corn was grown. Primarily the forests full of acorns and beech nut and spread on the vast area where these pigs were being fattened, *(Horn 2000).* As a result of widespread use of corn that resulted in turning forests and pastures into fields, the conditions for keeping and feeding this breed has been dramatically changed. So today in northern Serbia we have nearly 160 Mangulitsa in three varietes: Blond, swollow bellied and red mangalitsa. Extremely strong constitution, resistance to weather conditions and conditions of keeping and strong hair are characteristics of this breed. Analysis on meat quality of Mangulitsa breed showed that it contains rather high amount of proteins, acceptable amount of fat and that it belongs to the group of meat with the lowest amount of cholesterol.

Nutritious value of samples showed that 100g of meat contained 14,99-21,84% of proteins, the percentage of fat in fresh meat was 13,44-33,25%. Mangulitsa meat belongs to the kinds of meat containing higher amount of proteins compared with the samples taken from pigs from our area. The amount of proteins goes from 9,5-18,3g with the exception of steak where it is 21,5g. When cholesterol is in question the research showed following results: 42,5 mg in pork chop, 45,07 mg in leg, 47,36 mg in neck, *(Vuckovic 2006).* Similar results were reported by *Hollo et al (2003),* when in two experiments, the meat and fat quality as well the fatty acid composition of 22 hungarian Mangulitsa pigs (barrow) were examined.

Organic sheep production – Tsigai breed the Pannonian sheep. According to the organic farming in Vojvodina the most popular breed is Tsigai. The lowland sheep breed originates from Asia Minor, from where it spread to Eastern Europe. In Serbia expanded from Rumania in the 18th century. Because of good adaptability to the lowland conditions, Tsigai as the Pannonian Plain breed, is grown in Rumania, Hungary, part of Bulgaria, and in our country in the flat regions of Vojvodina and Serbia. They are also valuable for milk, meat and wool, *(Könyves 2011).* The sheep production are concentrated in north and central Banat region, where the semi-extensive system are in use. Until March the animal are kept indoors, feeding with fodder, forage and hay. From April they are on the pasture. The length of the suckling period is approximately 50-55 days. After this the ewes are housed in large groups, and milked twice daily. Milk production per lactation period also varied. *Mitic (1984),* recorded production of 110 – 120 litre. Ewes are milked mostly by hand. Tsigai lambs at the age of 90 days reach the weight of 30 kg. Number of Tsigai sheep in Vojvodina are between 14000 – 15000.

Autochtonous cattle breed - the Podolian cattle. Belong to a group of grey, long-horn cattle, with large body size, good strength and robustness and are intended primarily for work; Body weight of cows is between 420 and 550 kg, and of bulls from 650 to 900 kg. Until recently in Serbia there were no breeding programmes for indigenous cattle breed, since the major method of breeding is cross-breeding with more productive, imported animals, *(Bogdanovic et al. 2011)* The Podolian cattle are very important as a resource of genes for disease resistance, robustness and other important traits that are not characteristics of exotic breeds. In addition, Podolian cattle may have significance for low input or traditional beef production systems.

Potentials for Raising Organic Poultry on Farmsteads. The breeding of indigenous poultry breeds can only provide the raising of genetic resource for poultry farming. These are breeds which have kept some important characteristics that enable allow them living under their natural environment. Thus, poultry raising on farmsteads adds to the scale of organic products, plus this type of farming represents the most efficient way of gene preservation. Genetic resources of domestic poultry are threatened by the decreasing of living area due to the decreasing number of farmsteads, but, in this respect, hybrids and artificial breeds pose a threat, too – being that the latter can cause the disappearance of some characteristic features. The most important threatened features of autochthonous breeds in our region are listed below: ability for natural incubation, flying ability, offspring protection, hiding at night, protection of territory, and laying eggs in nests and their protection. As the above mentioned characteristics disappear, the potential for organic production decreases as well, because animals in their natural environment become get more easily preys of predators or they cannot bear the natural conditions (wind, rain, snow, extreme temperatures, diseases *(Pavlovski et al. 2006).* Sorts and breeds of poultry still present in our region *(Supic et al.1997).*

Domestic chicken: In Serbia an indigenous sort is the Somborska kaporka (crested chicken from Sombor), Banatski golosijan (naked neck from Banat), Svrljiska kokos (chicken from Svrlje), Kosovski pevac (longcrower from Kosovo).

In farmsteads there are crested chicken, easter egg chicken and naked neck of mixed genetic origin. Characteristic colours are red, white, speckled, while black is rare and buff is almost extinct, so preservation of the latter is a very challenging task – to save genetic resources. Thanks to Brama

Sussex sorts, columbian coloring is quite often. Todays Vojvodinian consumers prefer yellow skin colour, though earlier white skin sussex breeds were also widespread.

Guinea-fowl: Their number has been growing recently, thanks to their tasty meat and good food absorbing ability, they are useful as “organic pesticides”, they can hide and protect themselves – thanks to all these characteristics, they are popular poultry on farms. In our region the grey, the blue-grey and the white coloured is more frequent, black type is rarer, its genetic resource should be saved. One of the “musts” of the gastronomy throughout this region is about the wedding soup, which has to be made of domestic chicken and guinea-fowl.

Turkey: The domestic turkey has a very good disposition for natural incubation, and it raises its offspring with great care. This is why sometimes they serve as natural incubators for other breeds of poultry on farmsteads. The classical domestic turkey`s sexual dimorphism makes possible natural mating, which means that on farmsteads natural reproduction is possible, too. The most frequent colour is red and dark brown, but there are grey, white and mixed coloured turkeys, as well. The smaller, but very resistent and brisk red turkey can also be found, but in a terribly small population. The latter is called indigenous Bosnian turkey in our region.

Domestic goose: In our region the Hungarian, the Slovak and the Rumanian national communities all have their own indigenous breeds of goose, but these can be found only in small villages, in old households. White frilled type is extinct in our region, but in Transylvania (Rumania) they are present in sustainable populations. Traditional breeds are almost totally replaced by meat-feather or meat-liver breeds, only well experienced poultry raiser can notice the slight differences between the traditional and the new breeds on farms. However, genetic differences considering the above mentioned characteristics are huge.

Domestic duck: Nowadays, domestic ducks are present in a very small number on farmsteads, crested and whiskered sorts can be found rarely, and their genetic protection is a priority. In a healthy environment, its raising is easy, it is a resistant breed, its meat is very tasty, it is a delicacy on festal tables.

Muscovy duck: duck breed typical for farmsteads. It is very useful for catching flies around stalls and hutches. Thanks to its good nesting, incubating, hiding and offspring raising capacity, it is a popular breed on farmsteads, where its extensive raising is possible with minimal loss and feeding costs.

Combined farming is characteristic for ecological farmsteads, where poultry of mixed genetic origin can be found. There is no official data on poultry breeds regarding their number, but according to observations in the field one can state that the most numerous poultry breed is domestic chicken, then guinea-fowl, turkey, domestic duck and muscovy duck follow, while goose is the least common poultry of our farmsteads.

According to the review that have been carried out, it could be concluded that the organic livestock farming in North-Serbia, is not a production method to solve all problems in livestock production. But first and last it could be summarised that the autochthonous breeds in Serbia have a good biological base not only for the genetic improvement but also for sustainable farming and utilisation. On the other hand the breeding, keeping and utilisation of the indigenous cattle, sheep, pig and poultry can be interesting for those farms which are determined not only for low□input livestock production systems but also for some other additional forms of activity such as, among others, the rural tourism.

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Performance of commercial laying hen genotypes on free range and organic farms in Switzerland, France and The Netherlands

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Abstract

Free range and organic systems provide different circumstances for laying hens than closed houses or cages, where most hens are selected in. An enquiry and farm visits were done in The Netherlands, Switzerland and France in order to find out what genotypes are being used and how they perform. There are differences between countries, systems (organic vs free range) and groups of breeds. There is not just one genotype suitable for organic and free range systems.

Key words: laying hens, organic, free range, genotypes

Introduction

Due to increased mobility and reduced temperature control in free range and organic systems compared to cages and closed houses, free range and organic hens probably have a higher energy requirement (Ketelaars et al., 1985; Anderson, 2010). Testing of genotypes of hens that have to perform in free range and organic conditions is preferably done in free range and organic conditions. The aim of our study was to obtain information on how different genotypes or groups of genotypes of laying hens perform under organic and conventional free range conditions and if certain genotypes or groups of genotypes thus are more suitable for these systems. In the first stage the information was collected by an inquiry and in the second stage by farm visits among a part of the farms in the inquiry. During the visits we collect information on management practices and score the birds to get uniform information on physical condition of the hens. Here we present the results of the judgement of the birds.

Material and methodology

Switzerland, France and The Netherlands were selected as being representative for different European situations, because these countries were expected to differ with regard to general climate, farm size, preference for specific genotypes and housing systems. In each country totally approximately 100 organic and conventional free range farms were sampled from a national data base available to resp. FiBL for Switzerland, WUR-LR and Louis Bolk Institute for The Netherlands and ISA for France. An identical questionnaire was sent by (e-)mail to all farmers, but most questionnaires were completed by telephone interviews. Data collected on flock level comprised genotype, rearing system, specific treatments (e.g. beak treatment, vaccination, medication), feeding regimes (e.g. roughage, additional grain), and performance data (egg production per hen housed and mortality at 60 week of age). Additional questions were on causes of mortality and feathering condition of the hens and estimates of the use of the outside run. The genotype was classified according to 'brand-name' i.e. specific cross. These crosses were later summarised in genetic groups: 'white' i.e. white hens laying white eggs, 'brown' i.e. brown hens laying brown eggs, 'silver' i.e. white hens laying brown eggs, or 'mixed' i.e. birds of different genotypes in one group. The results of this survey are described by Leenstra et al (2012).

From the 100 farms per country a subset was chosen for visits. The farms were visited when the hens were between 45 and 50 weeks old. Per farm 50 animals were caught, scored, marked and left free again. The animals were scored according to the protocol developed in the LayWel project (Tauson et al., 2005). According to this protocol neck, vent/cloaca, back, wings, tail, belly wounds, wounds on combs and feet pads were scored on a scale of 1(bad) to 4 (good). The keel bones

Results of the enquiry

The results of the enquiry are published in British Poultry Science and therefore will only be briefly discussed here. In Switzerland, France and The Netherlands in total 273 farmers with free ranging laying hens (organic and conventional), having 318 flocks with data for analysis, were interviewed. In total, almost 20 different genotypes (brands) or mixtures of genotypes were present on the farms. In France only 'brown' hens were housed. In Switzerland and The Netherlands there were 'brown', 'white' and 'silver' hens. In Switzerland also mixed flocks were present. The overall effect of system (organic vs. conventional) on egg production and mortality was significant, with higher mortality and lower egg production for organic flocks. In pair wise comparisons within country the difference was highly significant in The Netherlands and showed a non-significant tendency in the same direction in Switzerland and France. White hens tended to perform better than brown hens. Silver hens appeared to have a higher mortality and lower production per hen housed at 60 weeks of age. There were no significant correlations between production, mortality, feather condition and use of outside run on the one hand and flock size on the other. There was more variation in mortality and egg production among farms with a small flock size than among farms with a large flock size (Leenstra et al., 2012).

Table 1. Genotypes used on Dutch and Swiss organic and free range farms

Genotype	Group	NL organic	NL free range	CH organic	CH free range
Hyline Brown	Brown				1
H&N Brown Nick	Brown	1		5	1
Lohmann Brown Lite	Brown	6	6		
Lohmann Brown Classic	Brown	2	2	3	5
Lohmann Brown	Brown	1		1	
ISA Brown	Brown	2	6		
LSL	White		2		
LSL Classic	White			4	4
Hyline White	White				1
H&N Super Nick	White				3
Dekalb Amberlink	Silver	6			
Hyline Silver	Silver	3			
Mixed	Mixed	1		10	7
To be confirmed				1	
Total nr of flocks		22	16	24	22

Results of the farm visits

The farm visits are still being done, which means that here we can present only preliminary results from the visits until February 2012. In Switzerland 14 organic farms with 24 flocks and 5 free range farms with 22 flocks were visited. In The Netherlands 20 organic farms with 22 flocks and 13 free range farms with 16 flocks were visited. The farm visits took place between March 2011 and February 2012. Table 1 gives an overview of the genotypes and the type of farms where they are being kept.

Because we can only present preliminary results concerning the farm visits, we don't want to give results per genotype. Therefore in table 2 the results of the animal scorings* per country and system (organic or conventional free range) are presented.

Table 2. Results of animal scorings on Dutch and Swiss organic and free range farms

	Netherlands organic	Netherlands free range	Switzerland organic	Switzerland free range
Total nr of flocks	22	16	24	22
Comb wounds	3.1	3.4	3.4	3.3
Keel bone	3.0	3.0	3.6	3.4
Belly wounds	3.8	3.9	4.0	3.9
Foot pads	3.4	3.4	3.2	3.1
Neck feathers	3.4	2.7	3.8	3.4
Belly feathers	2.9	3.1	3.7	3.6
Back feathers	2.6	3.1	3.6	3.5
Tail feathers	2.8	2.7	3.5	3.3
Wing feathers	3.4	3.2	3.6	3.4

* 1 = bad, 4 = good; average of all flocks scored, scoring 50 hens per flock

Discussion about results of the enquiry

As we aimed for a 50/50 distribution between conventional free range and organic farms, organic farms are overrepresented compared to the general situation in the 3 countries. The distribution of genotypes across countries and systems in the survey mirrors the general picture in the three countries: in France only brown hens and in Switzerland and The Netherlands more variation in types. In Switzerland the number of mixed flocks was high compared to the other countries. White hens are rather scarce in organic and free range systems, although less so in Switzerland than in The Netherlands. This might be due to the preference for brown eggs in the North-western part of Europe (Arthur and O'Sullivan, 2005), the main market for The Netherlands and/or the association among consumers between brown egg shells and free range systems and/or healthier eggs (Johnston et al., 2011). Silver hens were introduced some years ago as more suitable genotypes for non-cage housing systems, as they were expected to combine the advantages of the good feathering of a white hen with the desired brown egg shells. Today, they are mainly present in The Netherlands. The introduction of silver hens and the increase in free range and organic systems more or less went together. However, our results do not indicate that silver hens are specifically suitable genotypes for free range and organic systems. Our finding that mortality is on average higher in organic than in free range systems supports findings of Hovi et al. (2003), Zeltner and Maurer (2009), Lambton et al. (2010), and Anderson (2010). From our enquiry among farmers we could not get clear indications on causes of mortality. However, from another study among 30 Dutch organic laying hen farmers it seems that 50% of the dead animals had *E. coli* or chronic gut infections, 10-15% of the dead hens died because of smothering and other 'accidents' and in 25% of the cases the cause of death was not clear or other than mentioned above (J. Wagenaar, 2011, personal information). There was no relation between mortality and flock size, except that variation in mortality was higher among small flocks than among large flocks.

Egg production per hen housed at 60 weeks of age is related to mortality. Differences in production between countries, systems and genotypes follow almost completely differences in mortality. While the number of flocks of white hens is rather low, their production in organic and free range systems is high compared to the other genotypes. Silver hens, in contrast, show relatively high mortality and consequently low production per hen housed. Genotype on the one hand and country and flock size on the other are to some extent confounded (more white hens and small flocks in Switzerland and more silver hens and large flocks in The Netherlands). In the enquiry white hens were reported to have a better feather cover than brown hens, while feather scores for silver hens were lowest. Despite the difference in combination of the grandparent lines, silvers apparently are not different from brown hens in feather quality.

Discussion about the results of the farm visits

Since our dataset is not complete yet and too small to do statistics on, we would not like to run the risk to draw wrong conclusions concerning characteristics per genotype, system or country. Therefore we have presented only the rough results that are available up until now.

Conclusions from the enquiry

- From the large number of different genotypes present on free range and organic farms we conclude that there is no preferred genotype for free range systems and that no genotype seems to be best suited for those conditions.
- Organic and free range farms housed a wide variety of genotypes in Switzerland and The Netherlands. In France only brown hens were housed, in Switzerland and The Netherlands brown, white and silver hens. In Switzerland also mixed flocks were present.
- There was a tendency for slightly higher mortality and lower egg production per hen housed at 60 weeks of age in organic flocks compared to conventional free range flocks in Switzerland and France and a significant difference in the same direction in The Netherlands.
- White hens tended to perform better than brown hens, while silver hens appeared to have a higher mortality and lower production per hen housed at 60 weeks of age compared to white and brown flocks.
- There were no significant correlations between production, mortality, feather condition and use of outside run on the one hand and flock size on the other.
- There was more variation in mortality and egg production among farms with a small flock size than among farms with a large flock size.

Conclusions from the farm visits

- Still a large number of genotypes is being kept, which supports the conclusion from the enquiry that there is no preferred genotype.
- In the Netherlands mainly brown and silver genotypes were kept. In Switzerland also white genotypes and mixed flocks were kept.

Suggestions to tackle the future challenges of organic animal husbandry

In order to guarantee an acceptable level of animal health and welfare, as well as an economically and environmentally sound organic animal husbandry, the best suitable genotypes or breeds should be used. To identify which genotypes are suitable, the performance of the available genotypes should be monitored on farms on a regular base. For egg production and mortality this might be possible through contributions of farmers in an (international) database. Professional control on such a database is in our opinion a necessary condition. To learn more about possible causes of differences in performance farm visits by experienced observers is required.

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Assessment of Site-related Breeding of Dairy Cattle on Organic Farms in a Swiss Mountain Region

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Abstract

On organic farms animals (in particular ruminants) should be nourished from farm own forage. Ruminants on organic farms in Switzerland have to feed on 90% roughage. It is essential that ruminants fit well to forage growing on their organic farm. Therefore organic dairy cow breeding has to be site-related. In 2006 FiBL developed an estimation tool for site-related dairy cow breeding for farmers and consultants (Spengler Neff et al., 2007). In 2008 the tool was amended by livestock consultants of the agricultural school LBBZ Plantahof. From 2008 to 2010 FiBL, LBBZ Plantahof and the organic farmers' organization "Bio Grischun" carried out a corporate research- and consulting project on 99 organic dairy farms. It was investigated whether animal demands (resulting from their production level) fit well to feed supply on their organic farm. Additionally the relation between animal health and site-relatedness was examined. Each farm was visited by one consultant. Farmers and consultants examined together feed stocks, livestock, and the barn. They used all available animal data to fill in the questionnaires of the estimation tool. This tool estimated the relation between farm conditions and animal demands calculating a "site-relatedness-score". If site-relatedness was assessed deficient, farmers got advice on how to ameliorate the situation.
Results: Site-relatedness was assessed as good on 50% of the 99 farms. 12 % of the farms did not exploit their potential. On 38% of the farms site-relatedness was not sufficient: animal demands were higher than farm potential. Consultants proposed several measures to improve the situation on those farms: better feed harvesting and stocking and optimized feeding and breeding management. On farms with a good estimation for site-relatedness longevity was better and less veterinary treatments were necessary. Calving interval was lower in herds with higher body condition scores.

Key words: dairy cows, animal health, site-related breeding

Introduction

In Swiss mountain regions dairy cow breeding and milk production are most important branches. Many organic farms in Switzerland are located in mountain regions. In the Grisons (a canton in the Swiss alpine region) 56% of all farms are organic; around 15% or 500 farms are organic dairy farms. They keep around 8'700 dairy cows (Rudmann *et al.*, 2005; BFS, 2007). After conversion most farms went on breeding their often high yielding *Brown Swiss* cow type, called *Braunvieh*. But they were no more allowed to feed more than 10% concentrates (*Bio Suisse* rules) or to buy any conventional components (Swiss and EU organic rules). Therefore farm own feed and feed production conditions were suddenly playing a greater role than before conversion. Organic farms in mountain areas often experience limited conditions for feed production. If they are keeping high producing animals anyway, risks of undersupply and animal diseases are increasing.

Therefore site-related dairy cow breeding is important on organic farms: Daily milk yield should never exceed the milk production potential of farm own feed (+10% concentrates). The organic farmers' organization in the Grisons, *Bio Grischun*, wanted to know about the situation on organic farms in their canton and to improve it, if necessary. Therefore *Bio Grischun* and the agricultural school of the Grisons, *LBBZ Plantahof* as well as *FiBL* started this corporate project. The aim of the project was to examine 100 organic dairy farms in the Grisons for their site-relatedness and to provide advice concerning feed production and site-related breeding, if necessary. Additionally the hypothesis that site-related breeding is correlated to animal health had to be proven.

Material and methods

99 organic farms participated voluntarily in the project. Three consultants from *LBBZ Plantahof* and one consultant from *FiBL* visited the farms during winter seasons between January 2008 and May 2009. Each farm was visited once by one consultant. Farms were assessed with the "*FiBL-estimation-tool for site-related breeding"* (on www.biorindviehzucht.ch: free download in German and French). It consists of two questionnaires (*excel*-sheets) and a report. The first questionnaire covers all important farm factors influencing the environment of dairy cows (table 1). The second one covers overall herd data influencing the demands of cows (table 2).

Table 1. Farm factors and categories in the questionnaire

farm factors	units / categories
agricultural surface	ha
livestock units dairy cows and other roughage feeding animals	LU
dairy cow livestock units on all roughage feeding livestock units	% =LU dairy cows / (LU dairy cows + LU other roughage feeding animals)
feed purchase	none; ≥ 5% of yearly ration; ≥ 10%; ≥ 15%
cadastral zone	mountain zone II-IV; mountain zone I; hill zone; valley zone
frequency of use of main forage area	1 to 2; 2 to 3; 3 to 4; > 4
precipitation per year	>2100mm; 1800-2100mm; 1400-1790mm; 1000-1390mm; 700-990mm; <700mm; <700mm+irrigation <30%; <700mm+irrigation ≥30%; <700mm+irrigation 100%
percentage of ley in crop rotation	0-9%; 10-39%; 40-79%; 80-100%
hay conservation	ground drying; ground drying and ventilation; 100% ventilation; hot air ventilation
protein based roughage (winter)	≤10%; >10% medium-quality; 10-40% high-quality; >40% high-quality
energy based roughage	none; partly / little; in winter; all year
feeding Management	all cows alike (roughage); dry cows separate; concentrate individually; roughage and concentrate individually
concentrate per cow and year	none; <150 kg; 151-400 kg; >400 kg
housing	dark and narrow spacing; light and narrow spacing; dark and partially generous spacing; light and partially generous spacing; light and generous spacing
spring and autumn grazing system	continuous grazing 100%; continuous grazing 50-75%; continuous grazing 25%; rotational grazing 100%; rotational grazing 50-75%;; rotational grazing 25%; strip grazing 100%; strip grazing 50-75%
summer grazing system	continuous grazing 100%; continuous grazing 50-75%; continuous grazing 25%; rotational grazing 100%; rotational grazing 50-75%;; rotational grazing 25%; strip grazing 100%; strip grazing 50-75%
labor units per 25 lifestock units	<0.7 or frequent changes; 0.7-1.0; 0.7-1.0 and great interest in cows; 1.1 - 1.5; 1.1-1.5 and great interest in cows; 1.6 – 2.0
Interest in dairy cow breeding	not much interested; interested; very interested; dairy breeding is most important
feed purchase	none; 5%; 10%; 15%; 20% (on dairy cow forage for one year)

For each answer scores from 1 to 4 are given. Answers applying best to the farm and to the animals had to be ticked. After both questionnaires were filled in the program calculated an overall farm score and an overall herd score, expressing the ratios of the possible maximum scores, respectively. In addition it calculated a site-relatedness-score expressing the difference between the overall farm score and the overall herd score. If the herd score exceeded the farm score by more than five points (difference was <-5), animals' demands were assessed to be too high for the possibilities of the farm and breeding was interpreted as not site-related. If the farm score exceeded the herd score by more than four points (difference was ≥+5) points, the potential of the farm was interpreted as not exploited.

Farmers and consultants examined together feed stocks, livestock, and the barn. Additionally they used herd and animal based data from the breeding companies to fill in the questionnaires. They filled them in together, discussing each point. If site-relatedness was found to be deficient, farmers and consultants searched for solutions, checking farm factors with the lowest points first. Breeding strategies were always discussed as well. The consultants wrote a report with the conclusions of the discussions for the farmers.

Table 2. Herd factors and categories in the questionnaire

herd factors (averages)	units / categories
height at withers	< 135 cm; 135-140 cm;140-145 cm; >145 cm
weight	≤ 500 kg; 501-600 kg; 601-700 kg; >700 kg
feet and legs	big-boned; rather big-boned, rather fine-boned; fine-boned
muscling	heavy; rather heavy, rather light; light
temperament	calm; rather calm, rather spirited; excitable
milk yield per year	kg (from breeding company database)
milk per day	kg (from breeding company database)
milk per kg live weight	<8.5 kg; 8.5-9.5 kg; 9.6-10.5 kg; >10.5 kg (calculated by consutant)
mean BCS of all lactating cows	>3.0; 3.0; 2.75; ≤ 2.5 (assessed by consultant)
age at first calving	>34 months; 30-34 months; 25-29 months; <25 months
original brown cattle (OB) blood	% (farmers' declarations)

Data from all participating farms were analyzed to explore effects on health and reproduction indicators. Multivariate linear regression models with stepwise backwards selection were calculated. To reduce the great number of assessed variables, independent variables strongly correlating with $r_s>0.6$ or overlapping with regards to meaning were not simultaneously included in one model. Explanatory variables univariably associated with $p<0.2$ with the dependent variable were included into models as described by Dohoo et al. (1996). Dependent variables were: Calving interval (months); Somatic Cell Count (SCC; % of all samples of one year <150'000); longevity (average lactation number of the herd); veterinary treatments (average number of treatments per cow per year). Factors were checked for normal distribution by "Q-Q-plots" and, if necessary, were transformed. Statistical analyses were calculated with SPSS 20.

Results

50% of the 99 farms were estimated as site-related. 12% of the farms did not exploit their potential. On 38% of the farms herd demands exceeded the potential of the farm: the site-relatedness-score was lower than -5. The consultants gave the farmers individual advices. For 46 farms advices concerning feeding management were given, aiming at portioning farm own feed well targeted, referring to animals' production. For 12 farms they recommended more energy feed during the first months of lactation, for 44 farms they suggested not to increase milk production per cow anymore, but rather increase blood of the *Original Brown (OB)* breed in the herd. For 8 farms they recommended to increase milk production, for 18 farms they suggested a better choice of sires, considering functional traits. Analyses of farm data showed that animal health parameters can be partly explained by the site-relatedness-score (table 3).

Table 3. Final regression models of influences on calving interval, veterinary treatments, and longevity

dependent variables	explanatory variables	standardized coefficient	p-value	adjusted R²	F	p-value of the model
Calving interval				0.067	6.611	<0.05
	BCS	-0.281	<0.05			
Veterinary treatments (log10)				0.257	7.824	<0.001
	agricultural surface	-0.212	<0.05			
	precipitation	0.301	<0.01			
	housing	-0.304	<0.01			
	site-relatedness-score	-0.186	<0.1			
Longevity				0.198	10.649	<0.001
	frequency of use of main fodder area	-0.356	<0.01			
	site-relatedness-score	0.317	<0.01			

Higher calving intervals were influenced by lower body condition scores (BCS). BCS was highly and positively correlated to the site relatedness-score (r_s= 0.613; p<0.001). High amounts of veterinary treatments were influenced by small agricultural surface, high precipitation, narrow housing, and by trend by a low site-relatedness-score; high longevity (high number of lactations) was influenced by low frequency of use of main fodder area and a high site-relatedness-score. For udder health no model could be calculated.

Discussion

This study showed that it is interesting and necessary to assess site-relatedness of breeding on organic dairy farms. Animals on farms with a good balance between farm conditions and animal demands, showing a high site-relatedness-score were healthier than animals on farms with a low site-relatedness-score. Especially in mountain areas it is important to take account of those facts, since conditions for feed production are limited compared to valley regions. Ameliorations can be achieved by adjustments of the cow type, for example by breeding for robustness and dual-purpose instead of focusing on milk production. Possible adjustments of the environment are improvements of feed quality, feed stocking, and a targeted roughage feeding management, taking account of individual yields. Since changing the environment is often difficult, farmers, breeders, and farm advisors are advised to breed animals in a site-related way: using BCS, persistency and feeding behavior on the female side as traits to select good roughage feeders and high breeding values in functional traits as selection criteria for sires. Dams' and sires' breeding values for milk production have to fit to the milk production potential of farm own feed.

No economic analyses were carried out in this project, but another recent Swiss study showed that roughage based feeding of dairy cows lead to lower milk production, but also to lower veterinary costs and lower costs for buildings, man power, and mechanization leading to better incomes compared to high yielding dairy systems (Gazzarin *et al*., 2011).

For farmers and consultants the use of the estimation tool is a good opportunity to think and talk about breeding strategies. It is recommended to develop similar estimation tools in other countries.

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Sahiwal and Gir cattle: treasure for small holder organic dairy farming?

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Abstract

Sahiwal and Gir are two important breeds of dairy cattle in India. Due to indiscriminate cross breeding their population are decreasing rapidly. However, some provincial governments have taken some initiatives for preservation of these breeds and up-gradation of native non-descriptive cattle with these breeds. A study was conducted in five different agro-climatic zones of the state to study their adaptability, production and other economic parameters. The average lactation yield of 1st generation graded -up Sahiwal and Gir are 1812.8±23.08 and 1854.2±21.09 kg respectively, which is far better than non-descriptive cattle i.e., 803.9±17.8 kg. Though the average lactation yield and age at 1st calving are better in cross-bred but they require more veterinary attention. Average number of veterinary intervention per year are 0.6, 0.75 and 2.5 for Sahiwal, Gir and Cross Bred Jersey respectively. Average cost of treatment per animal per year are $ 2.07±0.3, $2.380±0.2 and $10.45±0.3 for Sahiwal, Gir and Cross Bred Jersey. Average annual return per milch animal is $ 240 for Cross Bred Jersey, $ 235.8 for Sahiwal and $ 226.9 for Gir. These graded-up Sawihal and Gir cattle thrive well in crop residue based rural dairy units. High resistance to diseases, low input cost and comparatively good returns make these breeds suitable for organic herds. The possibilities of small holder organic dairy could be explored with these breeds in tropical and sub tropical countries particularly in rain fed areas where agriculture is less intensive.

Key Words: Sahiwal, Gir, organic, dairy, farm

Introduction

Though most of the livestock breeds in India belong to the category of draft or dual purpose but few breeds are categorized as milch cattle. The cattle breeds like Sahiwal and Gir are some of the excellent milch breeds of India. These breeds have considerable milk production potential. These breeds are heat tolerant, thrive well on crop residues and highly resistant to diseases. Unfortunately, the exotic breeds like Jersey and Holstein- Friesian have been used for improving the milk productivity in Indian cattle. Due to indiscriminate cross breeding population of these breeds are decreasing rapidly. As ray of hope, some provincial governments have taken some initiatives for preservation of these breeds and up-gradation of native non-descriptive cattle with these breeds. Govt. of West Bengal, a provincial government of eastern India, use these two breeds for up-gradation of Non-descript (ND) cattle, which constitute about 80% cattle population of the state. Two bull mother farms have been established for preservation of pure bred Sahiwal and Gir cows and production of good quality pure Sahiwal and Gir bulls for production of Frozen Semen Straws (FSS). These FSS are used for up-grading of ND cattle, with a hope that after five to six generations the genetic make of the future generations of these non-descript cattle will be as good as pure Sahiwal or Gir. The study was a small attempt to evaluate the production potential of these graded up cattle, their adoptability and their suitability for organic production.

A brief description of these two breeds of cattle are given below for reference:

Sahiwal: Sahiwal breed of zebu cattle (*Bos-indicus*) symbolizes the best germplasm in India and Pakistan as far as dairy merits are concerned. Though the original breeding tract of this breed lies in Sahiwal district of Pakistan, yet some herds are found in India along the Indo-Pak border in Ferozepur and Amritsar districts of Punjab and Sriganganagr district of Rajasthan. Some Muslim community called 'Joiay' or 'Gujar' who reared them in large herds. However, unfortunately, this convention vanished with the transformation of irrigation and farming system in recent years. Sahiwal have docile temperament, operate extremely well under drought condition, need little feed and are heat and tick resistant. In addition to being tick resistant, Sahiwal cattle show a general resistance to all internal and external parasites (NBAGR, 2005). This makes them ideal for tropical, arid, or sub-tropical dairy farmers. This breed has been utilized for the production of strains like Jamaica Hope, Australian Milking Zebu and Australian Friesian Sahiwal.

Gir: The Gir breed (*Bos-indicus*) is a well known milch breed of cattle in India and famous for its best potential for milk in village condition. Gir breed is mainly found in Sourashtra region (22°-24°N and 68°-72°E) of Gujarat state of India. It has been used in the development of the Brahman breed in North America. The Gir cows and bulls may weigh 400-425 kg and 525-550 kg respectively. The Gir cattle can be easily diffentiate from other breeds of cattle because of its massive bulging forehead with curved horns and long pendulous ears. Under village condition 1st lactation milk yield is 2215.6 kg, lactation length varies from 257 days to 378 days. The heat tolerance and diseases resistance of the breed make it fit for draft purpose (NBAGR, 2006).

Materials and Methods

The state of West Bengal is divided into six agro-climatic zones. Except from Hilly zone data were collected from all five zones through semi-structured, pretested interview schedule. Regarding production data of farms the records of Bull Mother Farms were collected. Production and other data at farmers' level were collected by direct interview. The farmers were selected randomly having at least two graded up or cross bred animals which have completed at least one lactation. For data on disease occurrence and treatment health card of the animals were checked during interview. All the data were pulled and analyzed by simple statistical test like mean and percentage etc.

Result and Discussion

Production and reproduction parameters of both graded up Sahiwal and Gir are depicted in table 1 and these are compared with performance of pure Sahiwal and Gir at Bull Mother Farms.

Table 1. Production and reproduction performance of Sahiwal and Gir cattle and their graded-up progenies

Sl. No.	Parameter	At farmers' level		At farm level	
		Graded-up Sahiwal (N=60)	Graded-up Gir (N=50)	Pure Sahiwal (N=93)	Pure Gir (N=41)
1.	Age of Maturity (1st heat) in days	926 ± 17.3	1043 ± 12.20	807.5 ± 13.4	928.6 ± 10.25
2.	Age of 1st Calving (days)	1256 ± 9.5	1348 ± 8.5	1112.6 ± 3.29	1288.4 ± 5.23
3.	Calving Interval (days)	498 ± 4.6	515 ± 5.23	466.9 ± 6.7	481 ± 7.2
4.	1st Lactation Yield (kg) corrected to 305 days	1812 ± 23.08	1854 ± 21.09	2574.2 ± 18.056	2445.6 ± 21.70
5.	Lactation Length (days)	290 ± 8.8	281 ± 9.6	282 ± 7.5	276 ± 5.9
6.	Best yield reported in a day (kg)	11.8	10.9	14.4	14.2

Table 2. occurrence of different diseases, required veterinary attention, expenditure involved for treatment and prophylaxis, which are summarized below.

Sl. No.	Parameter	Graded Sahiwal	Graded Gir	Cross-bred Jersey	Remarks.
1.	Different diseases reported	Calf dysentery, indigestion & tympani, epimeral fever, mastitis	Calf dysentery, indigestion & tympani, epimeral fever, *trypanosomiasis*	Calfscours, FMD, pneumonia, red urine, *trypanosomiasis, amphistomiasis,* milk fever, retention of placenta	No case of tick borne disease in Sahiwal and occurrence of mastitis is very low in Gir.
2.	Average no. of illness in last one year per cow	2.0	2.2	6.8	
3.	Ave. no. of Dewormer used per animal per year	1.7dose	1.5 dose	3.8 dose	
4.	Ave. no of call for veterinarian	0.6	0.75	2.5	
5.	Ave. cost of treatment per animal per year	$2.07	$2.380	$10.45	One $ = INR 50
6.	Ave. return per cow per lactation	$235.8	$226.9	$235.8	

Under Central Herd Registration Scheme, Govt. of India, 1st Lactation yield of pure Gir was recorded in village condition as 2215.64 kg. (Mathur and Khosla, 1994) but the 1st Lactation yield of Sahiwal at village level is 1756 ± 47.61 kg (Raja, 2004). Milk yield of both the breeds both in farm and filed condition is encouraging. However, the reproduction parameters of both pure and graded up animals are far below compared to the breeds of temperate region.

Apart from the production and reproduction parameters farmers were also asked about the occurrence of different diseases, required veterinary attention, expenditure involved for treatment and prophylaxis, which are summarized below (Table 2).

From the above table it is evident that occurrence of diseases is much less in Sahiwal and Gir compared to Cross-bred Jersey. Prophylaxis measures also requires less. In Cross-bred Jersey farmers reported incidence of FMD even after vaccination by polyvalent FMD vaccine. Cost of treatment is comparatively much lower as farmers give some traditional medicines initially, which costs very low. Though the production level is fairly high in cross-bred but due to high feeding and management cost average return per cow per lactation is fairly good in Sahiwal and Gir.

Suggestions to tackle the future challenges of organic animal husbandry

Occurrence of different disease and their treatment in organic way is the main challenge for organic dairy herds. So, breeds to be choose which are much resistant to common parasitic and other disease like mastitis. Sahiwal and Gir animals have some specific attributes which suit them with the organic production system like-

- Easy of calving
- Excellent mothers
- Resistant to ticks
- Drought resistant
- Fairly resistant to external and internal parasites
- Thrive well in low feed and on crop residues
- Lean meat with even fat

To meet the challenge of small holder organic dairy in tropic and sub-tropic the breeds like Sahiwal and Gir to be encouraged. Though their production performance is lower compared to exotic breeds like Jersey and Holstein- Friesian but overall performance of these breeds are very good and to be used in organic dairy.

Research to be directed to evolve new strain of cow using these breeds which will perform better and will adopt better in organic farm.

Initiatives to be taken both in Govt. Sector as well as by other agencies for conservation of these superior germplasm for future use.

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Future organic feeding

(Foto: Rahmann 2006)

Sainfoin seeds as protein source for weaned piglets – a new utilization of a long-known forage legume –

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Abstract

Sainfoin (Onobrychis viciifolia) has been used as a forage legume for centuries and is also popular for use as green manure in some Austrian regions, but so far the protein-rich seeds have not been utilized as a feedstuff. As part of the EU Core Organic ll research project ICOPP (Improved contribution of local feed to support 100% organic feed supply to pigs and poultry), sainfoin seeds have recently been tested as a protein source for weaned piglets. The protein-rich components of the control diet were peas and soybean cake, which were substituted by sainfoin seeds in the experimental diets H (10% sainfoin seeds), D 10 and D 16 (10 and 16% dehulled sainfoin seeds, respectively; as fed basis). Neither feed intake and body weight gain nor feed conversion ratio differed between treatments. This leads to the conclusion that sainfoin seeds can be used as a protein source for piglets just as well as peas and soybean cake.

Key words: Sainfoin, protein, piglets, legume

Introduction

On January 1, 2012 the obligation to feed all organic pigs in the EU with 100% organic feed should have come into effect, but the temporary arrangement allowing 5% conventional feedstuffs was extended. Nonetheless the challenge of ensuring adequate supply of high-quality protein feeds for organically reared pigs needs to be addressed.

As part of the EU Core Organic II research project ICOPP (Improved contribution of local feed to support 100% organic feed supply to pigs and poultry), a feeding trial was conducted in which sainfoin (*Onobrychis viciifolia*) seeds were fed to weaned piglets. Sainfoin as a tanniniferous and therefore non-bloating forage legume for ruminants and horses has been used for centuries in Europe, but the high-protein seeds have only been fed in times of feed shortage. In several Austrian regions organic farmers plant sainfoin as green manure, therefore seed surpluses could be fed to pigs, given that the results of relevant feeding trials are satisfactory.

Animals, materials and methodology

Sainfoin seeds were purchased from an organic farmer in the Austrian province of Burgenland, and a centrifugal dehulling machine was used for dehulling.

The feeding trial took place at the Institute of Biological Agriculture and Biodiversity of Farm Animals in Wels, Austria (LFZ Raumberg-Gumpenstein) between November 2011 and May 2012. The experimental design was a complete 4 x 4 latin square with 4 diets, each fed to one group of piglets per replicate, and four replicates. Diets were fed to a total of 137 piglets (crosses of [Landrace*Large White]*[Pietrain*Duroc]) during the 4-week rearing phase which started immediately after weaning. Piglets were weaned at an age of 43 ± 2.0 days and divided into four groups of 9 piglets each (except in replicate 3 where each group consisted of 8 piglets) based on body weight, sex, sow and blood haptoglobin level. Throughout the feeding trial a total of 3 piglets died, two of them because of severe diarrhoea and one of unknown reasons. The piglets were housed in groups, in straw bedded pens of 5 x 1.7 m equipped with a creep area, drinkers and an outdoor area of 3 x 1.7 m.

Piglets were restrict fed using an automatic feeding system that was programmed to supply feed 5 times a day, in amounts slightly increasing every day. Four experimental diets were compared: A control diet (C), one diet containing 10% sainfoin seeds with hulls intact (H) and two diets with completely dehulled seeds (10 [D 10] and 16% [D 16], respectively; as fed basis). The protein-rich components of diet C that were substituted by sainfoin seeds were peas and soybean cake. Nutrient contents of the diets are summarized in table 1. Among the collected data were body weight (piglets were weighed weekly) and feed intake (automatically documented by the feeding system). Whenever symptoms of diarrhoea were observed, all piglets were given tea of Cortex quercus, dry peat and an electrolyte solution. Persisting diarrhoea in individual piglets was treated with antibiotics (Baytril).

Table 1. Nutrient contents of the diets, g kg^{-1} (as fed) unless stated otherwise

	C	H	D 10	D 16
Crude protein	182	191	191	197
Lysine	9.6	10.0	9.5	9.6
Lys:Meth+Cyst:Thr:Try	1:0.63:0.67:0.21	1:0.63:0.66:0.21	1:0.69:0.71:0.23	1:0.70:0.69:0.23
NDF*	157	171	164	162
ADF**	63	73	65	67
Energy, MJ ME***	13.8	13.6	13.9	13.8
g Lys / MJ ME	0.70	0.74	0.68	0.70
Calcium	12.4	11.9	10.3	9.9

* NDF: Neutral detergent fiber; ** ADF: Acid detergent fiber ***ME: Metabolizable energy

Statistical analysis of body weight was performed using proc mixed of SAS 9.1, with a model including the random effect of piglet nested within treatment and the fixed effects treatment, pen, replicate, sow nested within replicate, day and body weight at weaning. The covariance structure UN (unstructured) was used. Feed intake and feed conversion ratio (FCR) were analysed using proc glm, with a model including the fixed effects of treatment, pen, replicate, day and day*day. Pairwise comparison of means was done using the Tukey Test. Statistical differences were considered to be significant at $p < 0.05$. Tables 2-4 show ls-estimates for treatments from regression analysis, p values for the effect of treatment and R^2 or residual standard deviation (s_e).

Results

The sainfoin seeds with hulls intact/dehulled contained 279 and 388 g crude protein, 295 and 136 g NDF, 238 and 111 g ADF, 11.1 and 15.3 MJ ME and 15.4 and 20.8 g lysine (as fed basis), respectively. The proportion of lysine:(methionine+cysteine): threonine: tryptophan was 1:0.57:0.60:0.17.

Neither feed intake and body weight nor feed conversion ratio of weaned piglets were significantly influenced by treatment, although slight numerical differences were observed. Pairwise comparison of treatment means with the Tukey test did also not show any significant differences (Tables 2 to 4).

Table 2. Average feed intake of piglets, g d-1 (as fed)

	Dietary treatment				P value	R^2
	C	H	D 10	D 16		
Week 1	325	315	314	316	0.765	0.95
Week 2	545	535	535	537		
Week 3	816	806	805	807		
Week 4	1137	1128	1127	1129		

At weaning, piglets weighed on average 12.9 ± 1.7 kg, and reached an average body weight of 24.4 ± 4.4 kg at the end of the 4-week rearing phase (see table 3).

Table 3. Average body weight of piglets, kg

	Dietary treatment				P value	s_e*
	C	H	D 10	D 16		
Day 8	13.7	13.7	13.8	13.5	0.349	2.11
Day 15	16.1	16.1	16.2	15.9		
Day 22	19.7	19.6	19.8	19.5		
Day 29	24.3	24.3	24.4	24.1		

*s_e = Residual standard deviation

The feed conversion ratio during the first week after weaning was considerably higher than during the remaining three weeks of the rearing phase. On average, 2.11 kg of feed were needed to achieve 1 kg of body weight gain.

Table 4. Average feed conversion ratio of piglets, kg feed intake/kg body weight gain

	Dietary treatment				P value	R^2
	C	H	D 10	D 16		
Week 1	3.05	3.20	3.08	3.30	0.677	0.55
Week 2	1.83	1.98	1.86	2.09		
Week 3	1.40	1.54	1.42	1.65		
Week 4	1.75	1.90	1.78	2.01		

Discussion

Back in 1947 Woodman and Evans published a digestion trial testing sainfoin seeds as feed for sheep. The idea behind it was that especially during times of severe feed shortage - World War ll was just barely over - seed quantities that were discarded due to unsatisfactory germination should not go to waste. Because of the hulls crude fiber content of the seeds was 178.6 g kg^{-1}, but still crude protein content was as high as 263.8 g kg^{-1} (as fed basis). Sainfoin seeds were found to be palatable and the authors concluded that seed surpluses could be successfully utilised as feed.

The present experiment is the first published work since then, and it allows the conclusion that sainfoin seeds can be a valuable feed for piglets. The lack of difference in feed intake was of course the result of restrict-feeding of the piglets. But since the ensuing body weight gains did not differ as well no significant differences in feed conversion ratio could be found, proving that sainfoin seeds provided protein just as well as the protein-rich peas and soybean cake which they were substituted for. The observed growth level is in accordance with findings of Vielhaber et al. (2010) who examined the effect of plant-derived feed additives on diarrhea in organic piglets.

In organic animal husbandry phytotherapeutic products shall be used in preference to antibiotics, therefore phytotherapy measures were taken when symptoms of diarrhoea were observed and only individual piglets were treated with antibiotics unless their condition improved. Most of the piglets recovered without administration of antibiotics, but one of the consequences of this approach was that on average the piglets showed a growth depression in the first week after weaning. This is reflected in a considerably higher feed conversion ratio in week 1 as compared to the remaining three weeks. Similar observations have been reported previously, e.g. Officer et al. (1995) found feed conversion ratios of 2.44 during the first week after weaning and 1.76 in the following three weeks in the control ration of a feeding trial supplementing diets of early-weaned piglets (29 days at weaning) with enzymes.

Suggestions to tackle the future challenges of organic animal husbandry

Utilizing locally available surpluses of unconventional feedstuffs is only one out of several options to master the challenge of the currently existing protein deficit in organic pig nutrition. Sainfoin seeds are a promising protein source for pigs and other non-ruminants. However, in order to avoid potential bottle necks in the feed supply of organic livestock, other options (e.g. optimized feeding management, channeling high protein feedstuffs towards livestock categories with the greatest demand) need to be addressed simultaneously.

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Improving consistency in quality of organic milk throughout the year

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Abstract

Organic milk provides relatively high levels of beneficial unsaturated fatty acids (FA) in our diet but this advantage over conventional milk diminishes if cows cannot graze. This study investigates if linseed can mimic FA supply in fresh grass on a commercial organic dairy farm, in an attempt to maintain milk fat quality in winter. Milk collected daily from the bulk tank milk was found to contain more (p<0.001) alpha linolenic acid (39%), conjugated linoleic acid (48%) and vaccenic acid (73%) with less (p<0.001) total saturated FA (3%) during supplementation. Linseed supplementation of silage diets for organic cows can lead to fat quality comparable with summer milk.

Key words: milk, fatty acids, linseed, silage

Introduction

Organic milk differs in its fatty acid (FA) and antioxidant profiles compared to conventional dairy produce, although differences are inconsistent throughout the year (Butler *et al.,* 2011, Butler *et al.,* 2008, Ellis *et al.,* 2006). Higher concentrations of unsaturated fatty acids (known to be beneficial for health) and antioxidants in organic dairy produce originate from greater reliance on grazing and other forages in organic dairy diets; this explains why benefits diminish when cows consume preserved forage (especially silage) if weather conditions prevent grazing. Fresh, and to a lesser extent conserved, herbage is high in the mid-chain omega 3 fatty acid; alpha linolenic acid (ALA: C18:3, c9,12,15) which can be transferred directly or acts as a precursor for conjugated linoleic acid (CLA9: C18:2 c9t11) or vaccenic acid (VA: C18:1 t11) in milk (Chilliard *et al.,* 2007). We investigate the scope to supplement dairy diets with linseed as an alternative winter source of ALA.

Material and methodology

This study was carried out over 42 days on a commercial organic dairy farm (certified by the Soil Association) in North East England in January and February 2007. At this time, 178 cows of varying breeds and crosses were milked; the breed contribution was estimated to be: 15 % Holstein/Friesian, 45 % Shorthorn, 35 % Scandinavian Red and 5 % MRI. Calving was spread throughout the year resulting in cows and heifers (19 %) at all stages of lactation, giving an average daily milk yield of 19.7 litres per cow with 40.1 g fat and 33.9 g protein per kg milk during testing. Winter feeding was typical for organic dairy farms in this area, based on a mixed ration with average daily intakes of 42 kg silage from grass and white clover leys (320 g/kg dry matter) and 4.5 kg of a proprietary compound feed (Hi Peak Feeds).

Between days 3 and day 30 (inclusive) of the study, 2 kg of the compound feed was replaced with a blend of rolled wheat and linseed (1:2) aiming to supply 0.6 kg of linseed oil per cow per day. Milk samples, representing 24 hours production, were collected daily from the stirred bulk tank throughout the study and stored at -20 °C until accumulated for analysis. Sample preparation and fatty acid analysis by gas chromatography was carries out as outline by Butler *et al.,* 2011. Analysis of variance in the resulting fat profiles was assessed in Minitab using the General Linear Model and Tukey's honestly significant difference test used to identify variation between time periods (before, during and after supplementation)

Results

Linseed supplementation had a highly significant impact on the fatty acid profile in milk with the relative proportions of most fatty acids changing throughout the study (see Table 1).

Table 1. Fatty acids concentration in milk (means and standard errors of means - g per kg total fatty acids); before, during and after linseed supplementation

	Mean values			Standard errors of mean			ANOVA
	before [2]n=2	during [2]n=28	after [2]n=12	before	during	after	values
[3]Individual fatty acid							
C4:0	16.9	24.6	24.0	1.4	1.6	2.3	ns
C6:0	22.6	23.3	23.6	1.0	0.2	0.5	ns
C8:0	14.3	14.0	14.6	0.7	0.1	0.3	ns
C10:0	34.4[a]	30.7[b]	34.1[a]	0.1	0.2	0.2	***
C12:0	40.6[a]	32.2[c]	37.1[b]	0.1	0.3	0.6	***
C14:0	122.9[a]	107.5[c]	113.7[b]	0.6	0.7	0.8	***
C14:1	9.1	7.3	8.0	0.1	0.4	0.2	ns
C15:0	13.7[a]	11.0[b]	12.3[a]	0.2	0.2	0.2	***
C16:0	351.2[a]	289.1[b]	334.2[a]	4.1	1.8	3.3	***
C16:1 c9	17.3[a]	12.4[b]	17.1[a]	0.1	0.3	0.5	***
C18:0	120.6[b]	168.7[a]	131.0[b]	3.0	0.9	1.5	***
OA	192.5[c]	223.3[a]	207.2[b]	1.3	1.0	2.4	***
VA	11.9[b]	20.2[a]	11.5[b]	1.3	0.4	0.3	***
LA	17.8[a]	14.3[b]	16.2[a]	0.4	0.4	0.3	**
ALA	9.4[b]	13.0[a]	9.4[b]	0.1	0.2	0.3	***
CLA9	5.3[b]	8.4[a]	6.1[b]	0.7	0.3	0.2	***
Calculated fatty acid groups							
[4]SFA	769.0[a]	736.8[b]	756.3[a]	3.0	1.2	2.4	***
[5]MUFA	231.0[b]	263.2[a]	243.8[b]	3.0	1.2	2.4	***
[6]PUFA	32.4[b]	35.7[a]	31.7[b]	0.4	0.4	0.4	***

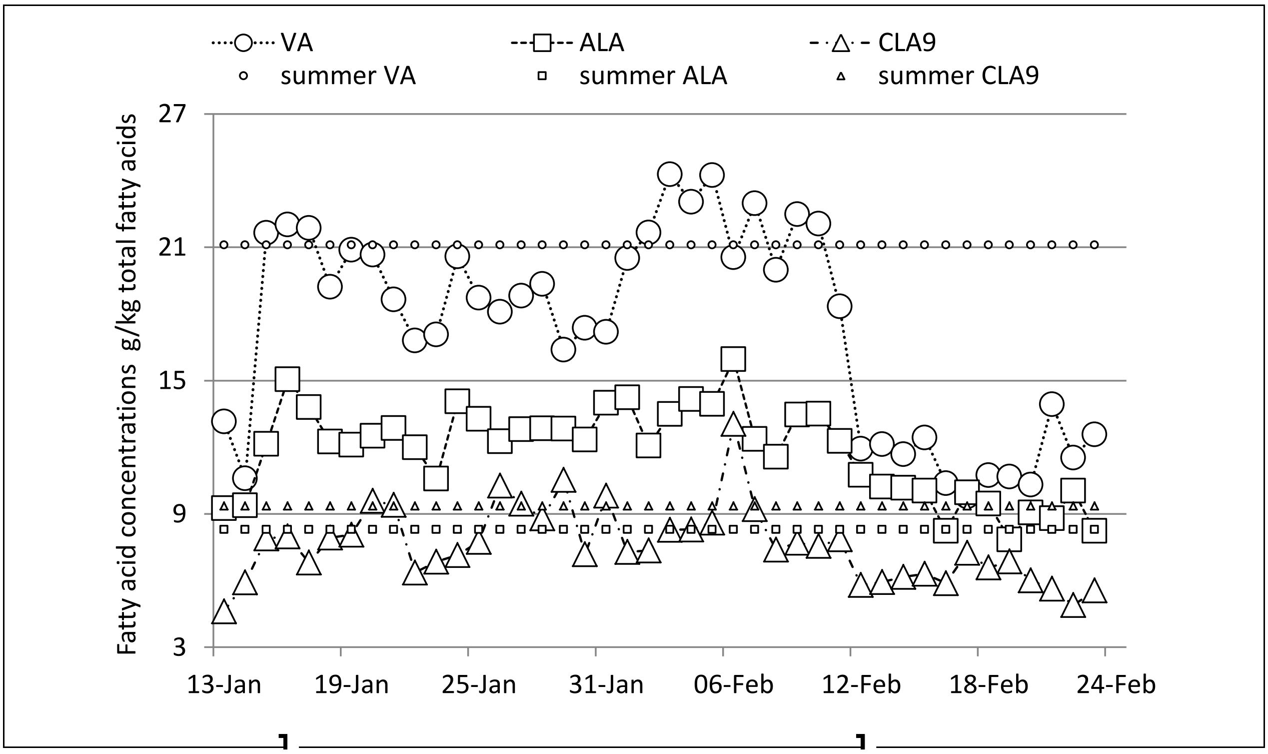
[1] Significances were declared at ***: P < 0.001, ** : P < 0.01, ns: P > 0.10.
Means values in the same row with different letters are significantly different (P < 0.05) according to Tukey's honestly significant difference test.
[2] n=number of samples
[3] OA = C18:1 c9; VA = C18:1 t11; LA= C18:2 c9, 12; ALA= C18:3 c9, 12,15; CLA9= C18:2 c9t11
[4]SFA: C4:0, C6:0, C8:0, C10:0, C12:0, C14:0, C16:0, C18:0, C20:0, C22:0, C24:0
[5]MUFA: c9 C14:1, c9 C16:1, c9 C18:1 (OA), t11 C18:1 (VA), c11 C20:1
[6]PUFA: c9c12 C18:2 (LA), c9c12c15 C18:3 (ALN), c9t11 C18:2 (CLA9), t10c12 C18:2, c8,c11,c14 C20:3, c5c8c11c14 C20:4, c5c8c11c14c17 C20:5 , c13c16 C22:2, c7,c10,c13,c16,c19 C22:5

Short chain FA (C4, C6 and C8) and C14:1 were the only identified FA unaffected by supplementation. In general mid-chain fatty acids and linoleic acid (LA) were depressed whereas a group of longer chain, mostly unsaturated, fatty acids increased in concentration with linseed feeding, to the extent that the start and end of supplementation can be identified in milk fat profiles in figure 1.

Discussion and conclusions

Despite relatively high levels of beneficial fatty acids in milk without supplementation at this farm, these results agree with others who found linseed increased unsaturated FA in milk (Akraim *et al.*, 2007, Collomb *et al.*, 2004, Fuentes *et al.,* 2008, Gonthier *et al.,* 2005, Hurtaud *et al.,* 2010). The greatest increase was seen in VA (+73 %) and CLA9 (+48 %), which is perhaps not surprising; they both originate from dietary ALN and LA of which linseed oil supplies 54 % and 16 % respectively (Glasser *et al* 2008). The response in ALA was disappointing (+39 %) but background levels were high, exceeding 8.3 g/kg FA in summer UK organic milk reported by Butler *et al.,* (2011), and 0.6 kg oil is a moderate feed rate. Later unpublished work shows greater increases in ALA from higher rates. This work shows linseed supplementation of silage based diets for organic cows can lead to fat quality comparable with summer milk; reducing saturated fats and increasing concentrations of beneficial fatty acids.

Figure 1 Concentrations of beneficial fatty acids compared with typical levels in summer milk (Butler et al., 2011) (linseed fed on days between arrows)



Suggestions to tackle the future challenges of organic animal husbandry

There is plenty of evidence organic milk supplies higher levels of beneficial fatty acids than conventional milk but it can also be higher in saturated fats, especially in winter. This work clearly shows linseed supplementation of winter silage based diets for organic dairy cows can produce fat comparable with summer milk; reducing saturated fatty acids and further increasing concentrations of beneficial fatty acids.

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Cold-pressed rapeseed cake or rapeseed to dairy cows – milk production and profitability –

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Abstract

Some cases in Sweden have shown that feeds grown on the own farm contributes less to environmental problems than imported feeds. Rapeseed and its co-product cold-pressed rapeseed cake (CORC) can both be locally produced and CORC has been proven to be suitable for dairy cows. In both feeds the fat content is limiting the amount that can be used in the diet. In a study with scenario calculations, using CORC was, however, found to give a lower financial output than using rapeseed. The aim of the study was to find out how milk yield, milk composition, cow health and fertility were influenced by feeding rapeseed compared to CORC in organic diets, and to calculate the profitability outcome. The study was performed during the indoor period 2009-2010 on 56 Swedish Holstein cows. The diet was 100 % organic and included a mixed ration (silage, grains and minerals) fed ad libitum and a restricted amount of concentrates (CORC vs. ground rapeseed, and field beans that were fed in both treatments). Based on results on milk production and feed consumption and prices of milk and feeds, the financial outcome for each treatment was calculated. There were no significant differences found in milk yield and composition between the feed treatments. However, cows fed rapeseed had a higher intake of the mixed ration than the cows fed CORC, which led to a higher profitability for cows fed the CORC compared to cows fed rapeseed, especially in later lactation.

Key words: rapeseed, cake, organic milk production, dairy cow, profitability

Introduction

Home-grown feeds cause less environmental problems (Strid, 2010) and result in less greenhouse gas emissions (Flysjö et al, 2008) than imported feeds. It may also be economically beneficial for the farmer to increase the proportion of home-grown feed in the diets. The protein in locally produced protein feeds, such as legumes and oilseeds, contain relatively large amounts of rumen degradable protein, which may contribute to decreased milk yield (Wu & Satter, 2000). However, if the cow is simultaneously supplied with carbohydrates for the microbe synthesis, a good production result can be achieved (Børsting et al, 2003). Rapeseed and its co-product cold-pressed rapeseed cake (CORC) can both be locally produced and CORC has been proven to be suitable for dairy cows (Johansson & Nadeau, 2006). The fat content of rapeseed and CORC limits the amount that can be used in the diet (Johansson & Nadeau, 2006). However, rapeseed has a relatively slow release of fat and can be fed in amounts of 1-2 kg per day with only small effects on cow metabolism (Murphy et al, 1987). In a study with scenario calculations, diets including CORC were found to give a lower financial output than diets including rapeseed (Mogensen, 2004). The aim of the study was to investigate the effect of replacing CORC with rapeseed in organic diets on milk yield and composition, cow health and fertility and to calculate the profitability of these feed rations.

Material and methodology

The study was performed during the indoor period 2009-2010 on 56 Swedish Holstein cows in different lactation stages at Tingvall Organic Farm, Sweden. The rolling herd average was 10842 kg milk per cow and year. The cows were housed in two treatment groups in a loose housing system. Cows were paired according to their expected calving date, lactation number and also breeding index for the heifers, and then randomly allocated to the two treatments. The diet was 100 % organic and included a mixed ration (silage, grains and minerals) fed *ad libitum* and restricted amounts of concentrates: CORC (treatment C) vs. ground rapeseed (treatment RS), and field beans that were fed to cows in both treatments. Cows were fed a minimum of 50 % roughage during the first three months after calving and thereafter a minimum of 60% roughage according to the standards for organic diets. Minerals and vitamins were fed according to Swedish recommendations. The dietary fat content was used as a limiting factor for amount of rape that was used (ca 5 % crude fat of dry matter (DM)). At diet formulations the higher fat content and lower crude protein (CP) content in rapeseed did not result in totally equal crude protein and energy contents between treatments. However, the consumed amounts of feeds gave marginally lower CP and higher fat content in the RS diet than in C (Table 1). Nutrient composition in DM of the silage (10.6 MJ ME, 135 g CP, 479 g NDF) and concentrates were analysed by conventional methods. Feed intake of the mixed ration was registered on group level (with the assumption that cows in early and later lactation had the same consumption of the mixed ration), whereas the concentrate intake was registered individually. Calculations on nutrient intake were performed manually and in the computer programme Typfoder (Swedish Dairy Association, 2011). Milk yield was recorded and milk composition (fat, protein and urea) was analysed. Fertility of the cows was determined as number of artificial inseminations (AI) per conception, number of days between calving and the first AI and as calving interval. All veterinary input was registered continuously as a measure of cow health. Statistical analyses of variance on the 56 cows were made using the Mixed Model procedure of SAS (2003). Production parameters were calculated for the first three months of lactation and later lactation. Results with a *P*-value less than 0.05 were regarded as significantly different, whereas $0.05 < P < 0.10$ indicated that the results tended to be significant.

Table 1. Average concentrations and standard deviations of nutrients in consumed feeds in C and RS treatments, in early (< 3 months) or later lactation (> 3 months), n=75

	< 3 months		> 3 months	
	C	RS	C	RS
ME1, MJ/kg DM	12,1 (0,3)	12,3 (0,4)	12,0 (0,4)	11,9 (0,4)
CP, g/kg DM	169 (2,6)	162 (4,7)	161 (4,2)	154 (4,8)
Starch, g/kg DM	174 (9,3)	182 (10,3)	171 (7,4)	176 (8,0)
Crude fat, g/kg DM	4,0 (0,1)	4,8 (0,3)	3,4 (0,1)	3,9 (0,2)
AAT2, g/MJ	6,6 (0,1)	6,4 (0,2)	6,6 (0,1)	6,5 (0,2)
PBV3, g/kg DM	38 (3,4)	32 (4,0)	29 (3,8)	23 (4,0)
NDF4, g/kg DM	350 (6,5)	352 (3,0)	360 (4,5)	363 (3,1)
RDP5, % of DM	13,5 (0,2)	12,8 (0,3)	12,7 (0,3)	12,2 (0,4)
RUP6, % of DM	3,6 (0,1)	3,4 (0,1)	3,4 (0,1)	3,2 (0,1)

1ME = Metabolisable energy
2AAT = amino acids absorbed in intestine
3PBV = protein balance in rumen
4NDF = neutral detergent fibre
5RDP = rumen degradable protein
6RUP = rumen undegradable protein
7n monthly consumption

The profitability was calculated as income of milk less cost of feed for Central Swedish conditions 2011. Quantities of milk and feed were taken from the experiment, fat- and protein-content adjusted milk prices from Arla Foods (2011), price of locally produced CORC from the supplier, and cost of other feeds from The County Administrative Board (2011). The latter prices corresponded to long-term cost of production on rationally managed farms in the region. Organic milk and feed prices were used in the basic calculation but prices of conventional production were used in the sensitivity analysis.

Results and discussion

Despite the higher fat content and lower protein content in rapeseed than in CORC, and thereby more difficult to compose a balanced diet, there were no significant differences found in milk yield and composition between the RS and C diets (Table 2). However, cows fed rapeseed had a numerically higher intake of the mixed ration than the cows fed CORC (20.1 vs 16.9 kg DM; Table 3) and might thereby have fulfilled their nutritive intake (Table 1) to their capacity for milk production. The energy balance was a bit low for C-cows (NEL-balance 92 and 95 % for cows in lactation < 3 months or > 3 months, respectively), which is normal for cows in early lactation. The RS cows had, however, enough consumption to have a high energy balance also in early lactation (NEL-balance 103 and 112 % for cows in lactation < 3 months or > 3 months, respectively). There were no large differences found in cow health or fertility (data not shown).

Table 2. Average milk yield and milk composition with standard error of means (SEM) from cows fed CORC (C) and rapeseed (RS) diets, in early (< 3 months; n=15) and later lactation (> 3 months; n=27)

	< 3 months				> 3 months			
	C1	RS2	SEM	P	C3	RS3	SEM	P
Milk yield (kg)	37,2	38,3	1,77	0,687	31,1	29,9	0,92	0,366
Milk fat (%)	4,17	4,12	0,15	0,786	4,09	4,20	0,08	0,353
Milk protein (%)	3,10	3,14	0,08	0,749	3,34	3,32	0,05	0,782
Milk urea (mmol/l)	4,81	4,84	0,24	0,920	4,49	4,53	0,13	0,839

1 DIM (days in milk, mean): 54, 2DIM: 51, 3DIM: 195

Table 3. Milk yield income minus cost of feeds in cold-pressed rapeseed cake (C) and rapeseed (RS) diets. Swedish crown (SEK) per cow and day in early (< 3 months) and later lactation (> 3 months). 1 SEK = 0.11 EUR (May, 2012)

	C			RS		
	Kg	SEK/kg	SEK	Kg	SEK/kg	SEK
Early lactation						
Milk (kg milk)	37.2	4.38	162.90	38.3	4.39	168.10
CORC (kg feed)	2.40	6.00	14.40			
Rapeseed (kg feed)				1.32	6.02	8.00
Field bean (kg feed)	3.50	3.33	11.70	4.43	3.33	14.70
Silage (kg DM)	12.37	1.50	18.60	14.74	1.50	22.10
Grains (kg feed)	4.78	3.18	15.20	5.68	3.18	18.10
Other feed			4.30			5.00
Milk income-feed cost			98.80			100.20
Later lactation						
Milk (kg milk)	31.1	4.50	139.90	29.9	4.53	135.50
CORC (kg feed)	1.48	6.00	8.90			
Rapeseed (kg feed)				0.88	6.02	5.30
Field bean (kg feed)	2.43	3.33	8.10	2.95	3.33	9.80
Silage (kg DM)	12.37	1.50	18.60	14.74	1.50	22.10
Grains(kg feed)	4.78	3.18	15.20	5.68	3.18	18.10
Other feed			4.30			5.00
Milk income-feed cost			85.00			75.10

During early lactation RS had slightly better profitability than the C diet. In the later part of the lactation, which includes the main part of the total lactation, C had 10 SEK better profitability per cow and day than the RS diet (Table 3). The main reasons for the differences between the periods were that RS had the numerically highest milk yield during early lactation whereas C had higher yield during the late part. The C diet had the highest profitability during the total lactation due to both higher milk production and lower consumption of the mixed ration (silage and grains). This conclusion was valid also in the sensitivity analysis using conventional milk and feed prices. Cost of production and, thus, price of cold-pressed rapeseed cake depends on price of rapeseed and price received for the rapeseed oil. Also the processing cost influences the price of the cake (Knutsson, 2007). However, the conclusion that C was more profitable than RS during both the late and the total lactation was valid at all plausible prices of cake and seed.

Suggestions to tackle the future challenges of organic animal husbandry

Both diets resulted in a high production, probably due to feeding rumen degradable protein and sufficient amounts of carbohydrates simultaneously for the energy supply for the microbial protein synthesis that could be utilized for production. Microbial protein has an amino acid composition better suited for the cows' need compared to amino acids in feeds. Results from the profitability calculations imply that producing CORC can be of great interest.

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Effects of two different feeding concepts on reproductive performance of lactating sows fed 100 % organic diets

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Abstract

The aim of this study was to analyse dietary concepts for lactating sows which were suitable according to EC-Regulation 889/2008. Therefore, in a feeding experiment, the effects of two different types of diets were investigated on performance and physiological indicators over a two years period. The treatments differed in the expected amino acid supply (treatment U=unbalanced amino acid pattern; treatment C=well balanced). Data from 118 litters showed a high feed intake of sows in both treatments with a tendency towards a higher feed intake in sows of treatment C (P=0,071). Live weight and back fat thickness did not show significant differences neither at the time of transition to the farrowing pen nor at the time of weaning. Serum concentration of urea and NEFA were significantly lower in treatment U (P=0,018; P=0,005). Litter size and weight of weaned piglets did not differ significantly, but daily weight gain of piglets was slightly lower in treatment U (P=0,088).

Key words: nutrition, lactating sow, amino acids.

Introduction

High milk yields of modern sows require a sufficient supply with essential amino acids and energy (Whittemore 1998, Clowes et al. 2003). Especially the high lysine content of sow milk stresses the importance of a sufficient dietary lysine concentration in lactating sows (Jeroch et al. 2008). Particularly with regard to conditions of organic production, it is rather difficult to meet amino acids requirements. To formulate a diet consisting exclusively of organically produced components is difficult because suitable feedstuffs are lacking and are expensive (Zollitsch et al. 2004). The main goal of the present study is to contribute to the development of feeding concepts for lactating sows and to support advisors in the implementation of a feeding concept which is in accordance with the concepts and regulations of organic farming.

Material and methodology

During a workshop with advisors, feed manufacturers, organic farmers and scientists, information was collected in order to define diet concepts for lactating sows which are in line with EC-Regulation 889/2008 and which are suitable under the conditions of Austrian organic agriculture. In a feeding experiment two of these diets were investigated in terms of their effects on animal performance and selected physiological indicators. One diet represented a situation in which rations were based on home-grown feedstuffs and would therefore be lower in their protein content and somewhat unbalanced in their amino acid pattern (treatment "U"). The other diet represented a situation in which either a complete feed or protein concentrate was purchased and imported into the system; this diet contained a fairly well balanced amino acid pattern (treatment "C"; Tab. 1). In both diets barley, triticale, pea (*Pisum sativum)* and faba bean (*Vicia faba)* were used. Diet C also contained sunflower seed cake and steam-heated soybeans.

Table 1. Nutrient content of experimental diets

Nutrient and energy content	C	U
ME[a] (MJ kg^{-1} [b])	13,02	12,84
Protein (g kg^{-1} [b])	180	152
Lysine (g kg^{-1} [b])	9,1	7,9
Methionine + Cysteine (g kg^{-1} [b])	5,4	4,0
Threonine (g kg^{-1} [b])	6,1	5,0
Tryptophan (g kg^{-1} [b])	2,0	1,5
Lys:Meth+Cyst:Thr:Try	1:0,59:0,68:0,23	1:0,51:0,63:0,19
Lysine/ME (g MJ^{-1})	0,70	0,62

[a] ME: metabolizable energy
[b]as fed basis

35 crossbred sows (Large White x Landrace) were used in the experiment. They were kept in 8 groups of 4 or 5 sows each in accordance with EC-Regulation 889/2008. The sows were allocated to one of the two treatments at the time of farrowing. Each sow received the same diet for a period of 2 years (i.e. for a maximum of 4 lactations). The following parameters were recorded: individual feed intake (daily) and body weight (four times per lactation), ultrasound measurements of back fat depth (three times per lactation); during lactation three times blood samples were taken to determine the concentration of urea, NEFA and γ-GT2 of serum.

Furthermore, litter size, litter weight, individual body weight of piglets (once a week until weaning) and consumption of creep feed by piglets were recorded.

All statistical analyses were computed using the MIXED procedure of SAS 9.1. For performance levels of sows the model included the random effect of the sow nested within treatment, the fixed effect of treatment, housing system, season and the continuous effect of duration of suckling period. For blood parameters the model consisted of the fixed effect of treatment, season, parity number, date of blood sampling and also the interaction treatment x date of blood sampling. Data are reported as least square means.

Results

Data from 118 litters showed the following results: No significant differences were found between treatments for feed intake, body weight and back fat depth of sows (Table 2). Serum urea concentration was significantly higher (P=0,018) and NEFA content was significantly lower (P=0,005) for treatment U.

Table 2. Feed intake, body weight and back fat depth of sows

	Treatment		S_e	P
	C	U		
Total feed intake (kg d^{-1})	7,4	6,9	1,05	0,071
Body weight at farrowing (kg)	278	279	19,9	0,830
Body weight at weaning (kg)	251	247	13,7	0,600
Back fat depth at farrowing (mm)	13,6	14,7	4,89	0,248
Back fat depth at weaning (mm)	11,8	12,7	3,84	0,286

As shown in Table 3 there were no significant differences in numbers of born and weaned piglets and litter weight. Nevertheless, piglets in treatment U showed a slightly lower weight gain.

Table 3. Selected parameters of piglets

	Treatment		S_e	P
	C	U		
Piglets born alive (n)	10,6	11,1	2,80	0,475
Piglets weaned (n)	7,7	8,4	1,77	0,152
Litter weight after farrowing (kg)	15,2	15,7	3,64	0,484
Litter weight at weaning (kg)	89,6	91,7	21,93	0,641
Daily weight gain per piglet (g/d)	247	232	37,6	0,088

Discussion

Due to the high feed consumption of sows, their energy intake is in line with the recommendations (GfE 2006). In relation to the relatively high body weight losses given here in, serum NEFA contents were lower than reported in an earlier study (Rojkittikhun et al. 1993). This could be an indicator of a sufficiently high supply of sows with nutrients (Neil 1996). Blood urea is within the range of established reference values (Verheyen et al. 2007), but was significantly higher for treatment C. This could be explained by the fact that sows of treatment C consumed considerably more feed and therefore had a higher overall protein intake (Neil 1996). The higher body weight and daily weight gains of weaned piglets in treatment C have to be seen in connection with the smaller litter size in this treatment. The comparatively low number of weaned piglets in treatment C is probably related to the smaller litter size rather than to a treatment effect.

Suggestions to tackle the future challenges of organic animal husbandry

The study shows sows can compensate for reduced dietary energy and amino acid contents. An important prerequisite for this is an optimized feeding management which includes the possibility of high feed intake and analysing feedstuffs for their nutrient contents. Moreover, good care must be taken to maintain a proper body condition of sows before farrowing.

Optimizing the feeding management is therefore seen as a main factor for a successful implementation of diets consisting of 100 % organic feed components for lactating sows.

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Supplementation *Sacharomyces cerevisiae* and *Leucaena leucocephala* of rice straw based feed in beef cattle diet

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Abstract

Rice straw is the predominant dry season feed for cattle, despite its low nutritive value. It is deficient in readily fermentable energy, nitrogen, minerals and vitamins, and cannot provide for optimum microbial growth in the rumen or tissue development of the host. Sacharomyces cerevisiae has been used to improve the nutritive value and utilization efficiency of low-quality roughages. Leucaena leucocephala characterized by its high digestibility and good bypass protein content, has great possibilities for use in animal feeding, both for ruminants and for monogastrics. The aim of this experiment was to study the effect of adding S. cerevisiae and leaf of L. leucocephala in diet rice straw-based of nutrients digestibility and body weight gain of cattle. The experiment was conducted in Ruminant Nutrition Laboratory of the Faculty of Animal Science Andalas University, Padang. Experimental design used is a Latin Square Design (LSD) with four treatments and four periods. This experiment used 175. ± 10.53 kg male ongole crossbreed. The treatments were (A) grass + concentrates, (B) rice straw + concentrates, (C) was the treatment of B plus 0.5% S. cerevisiae and (D) was the treatment C + 15% L.leucocephala. The results showed that the dry matter digestibility of treatment B (61.03%) were significantly lower than treatments A, C and D respectively (68.05, 63.01 and 68.15%) and supplementation of S. cerevisiae was able to improve nutrient digestibility and body weight gain of cattle, but still low compared to control (A). Addition of L. leucocephala in treatment D (850.7 g / day) was able to provide digestibility and body weight gain similar to the control ration (775.7 g / day). It can be concluded that the use of rice straw as a substitute for grass would give the same results with the grass when added 0.5% S. cerevisiae and 15% L. leucocephala.

Key words: rice straw, digestibility, S. cerevisiae, L. leucocephala, bypass protein

Introduction

Agricultural by-products such as rice straw are carbohydrate-rich residues representing a large potential source of dietary energy for ruminants. It has been well recognized it have poor nutritional value because of their low nitrogen and high fiber content (Tang *et al*, 1995). Low productivity rates of animal production are observed in cattle with use this diet in tropical areas such of Indonesia. Direct-fed microbial products with *Saccharomyces cerevisiae* have been used to improve fiber digestibility (Zain, *et al*, 2011) and animal production (Tang *et al*, 2008). The beneficial effects of these microbial compounds are associated with an increase in cellulolytic bacteria (Wallace, 1994; El- Waziry *et al*,2000; Marghany *et al*,2005). They have been considered as a potential fed additive to improve NDF digestion in low quality forages (Zain *et al*, 2011). Beside that protein supplementation may be other alternative to increase beef production in the tropics. Ruminally degraded protein and escape protein are the two limiting nutrients for growing ruminants feed these type of diet (Ramos *et al*., 1998).

Therefore, the objective of our experiment was to determine whether growing steers with rice straw respond to supplemental *Sacharomyces cerevisiae* and legume (*Leucaena leucocephala)* as source bypass protein, could improve fiber digestibility, intake and animal performance.

Methods and materials

Four ongole cross breeds (175 ± 10.53 kg BW) equipped were randomly distributed in a 4 x 4 Latin square design. Treatments were (A) grass + concentrates, (B) rice straw + concentrates, (C) the treatment of B plus 0.5% *S. cerevisiae* and (D) the treatment C + 15% *L. leucocephala*. Basal diet contained (dry basis) 50% grass and rice straw and 50% concentrate. The Composisiton of feeds including concentrate is given in table 1.

Table 1. Ingredient composition and nutrition of experimental diet (DM)

Item	Diet			
	A	B	C	D
Rice straw	-	50	50	50
Grass	50	-	-	-
Rice brand	28	28	28	28
corn	10	10	10	10
Coconute cake	11	11	11	11
Salt	0.5	0.5	0.5	0.5
Mineral	0.5	0.5	0.5	0.5
Total	100	100	100	100
Suplementation				
S. cerevisiae	-	-	0.5	0.5
L. leuchephala	-	-		15
Nutrition (%)				
Protein	12.59	11.37	11.87	12.02
TDN	65.33	64.83	64.83	65.48
Lemak	3.60	3.95	3.55	3.15
BETN	49.91	48.66	48.01	47.36
NDF	43,14	46,75	46,77	46,85
ADF	35,24	37,55	37,58	37,65

Digestibility trials conducted using four animals for each treatment which were separated in individual pens. Cattles were fed ad libitum during the adaptation period (15 days) and then restricted during the collection period (6 days) at 90% of the intake feed that was offered at 7:00 and 16:00 h. the last 15 days of each preliminary periods animals were equipped with bags fitted to the animals with harness for total collection. During the collection period accurate records were kept for individual feed intake. Total fecal excrection was collected once daily and 10% representative samples were dried at 60 0C over night and kept in sealed bags until analysis. Feed and fecal were ground to pass through a 1-mm screen and composited. Dry matter, organic matter and nitrogen were analyzed by standard methods (AOAC, 1990). Neutral detergent fiber (NDF), acids detergent fiber (ADF), cellulose were determined by procedures outlined by Goorieng and Van Soest (1970). Data were analyzed by anova for a 4 x 4 Latin square design (Steel and Torrie, 1980) and means were compared using the Tukey test (SAS Institute Inc., 1985).

Results and Discussions

Effects of *S. cerevisiae* and *L.leuchephala* supplementation on feed intake, nutrient digestibility of rice straw and daily weight gain of cattle are presented in Tables 2. Effects of treatments were significant ($P<0.05$) for nuntrient intake, nutrient digestibility and daily weight gain.

Sacharomyces cerevisiae supplementation increased of nutrient intake, nutrient digestibility and daily weight gain when compared with no *S. cerevisiae* supplementation but still lower compared control diet. Supplementation *L.leuchepala* in treatment D could increased the nutrient intake, nutrient digestibility the same as with control diet and could improve animal the performance.

The positive effect of *S. cerevisiae* in increasing the nutrient in digestibility and nutrient intake of cattle may be attributed to the increase of numbers of rumen total viable bacteria and cellulolytic bacteria as reported by Marghany *et al*., (2005). More ever, the stabilization of ruminal environment could to be the reason for increase of numbers of rumen bacteria also may be related to pH modulation via reductions in lactic acid concentration as reported by Williams *et al*., (1991).

Table 2. Feed intake, digestibility and daily weight gain of cattle with experimental diet.

Items	Diet			
	A	B	C	D
Dry matter intake (kg day^{-1})	6.50^{a}	4.05^{c}	5.22^{b}	6.75^{a}
Organic matter intake (kg day^{-1})	4.84^{a}	3.42^{b}	3.70^{b}	4.92^{a}
Dry matter digestibility (%)	68.05^{a}	61.03^{b}	63.01^{b}	68.15^{a}
Organic matter digestibility (%)	71.43^{a}	63.99^{b}	66.20^{a}	70.91^{a}
NDF digestibility (%)	63.80^{ab}	49.64^{c}	58,40^{b}	66,30^{a}
ADF digestibility (%)	51,02^{bc}	41,10^{c}	53,92^{ab}	64,17^{a}
Live weight gain (g day^{-1})	775.7^{a}	542.7^{c}	687.5^{b}	858.7^{a}

Means in the same row with different in theis superscript differ ($P<0.05$)

Response to protein supplementation confirm that cattles growth in rice straw is limited by the supply of metabolizable protein to the animal (Ramos et al., 1998). In other studies, supplements with *L.leuchephala* improved ADG compared to no supplements. Amino acid balance in the escape protein mixture is important to obtain maximum growth (Knaus *et al*., 1998).

Conclusion

According to the results of this experiment, the addition of *S. cerevisiae* and *L.leuchepala* could improve nutrient digestibility and cattle performance in low quality roughage.

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Local feed in organic animal production: a market opportunity?

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Key words: preferences, animal feed, consumer, discrete choice, organic animal products

Introduction

In recent years, organic animal production in Germany has been increased from year to year (AMI 2010). This growth was driven by a strong growing demand for organic animal feed which could not be satisfied by the supply of German organic farmers, especially with regard to protein feed. Thus a high amount of protein feed had to be imported. Due to the new EU Regulation 889/2008 (Öko-Basis-VO 2007), which from 2015 on requires the use of 100% organic feed in organic farming, even more organic animal feed will be needed in the coming years. However, the high amount of imported organic feed is opposed to a growing consumer demand for local food products (e.g. Adams and Salois 2010; Bernabéu et al. 2010) Local origin is one of the most important additional food attributes on top when buying organic food products (e.g. Zander and Hamm 2010; Sirieix et al. 2009; Mennecke et al. 2007). Due to several food scandals in the conventional sector, many consumers ask for more transparency (Hobbs 2003). If consumers have a preference for local feed in organic animal production, a new market segment of local organic animal products from animals which have been raised with local feed could be established.

Methods and materials

Discrete-Choice (DC) Tests and Computer Assisted Personal Interviews (CAPI) with 597 organic consumers were conducted in two Germany cities in 2011 to analyse consumers' preferences for feed origin. Consumers were asked randomly in front of organic food shops or supermarkets. The sample composition with regard to gender and age correspond to the German average. The DC experiment was based on a D-efficiency design. Each participant had to choose three times organic eggs, organic pork cutlets und organic milk. All products varied between four attributes: product origin, feed origin, existence of the slogan "Without GMO, as organic" and price. In Table 1 all product attributes with their characteristics are presented. The preferences were analysed with Logit Models which were constructed using the software N-Logit 4.0. All models were estimated by simulated maximum likelihood using Halton draws with 1.000 replications.

Two Mixed-Logit (ML) Models (I and II) were built for each product (organic eggs, organic milk and organic pork cutlets) to analyse consumers' preferences. The other product attributes were defined as random parameters. In the ML-Model II, the influence of additional information about organic feed import to Germany on the purchase decision was analysed. Half of the participants received an information sheet about organic feed import before taking part in the DC test. So in ML-Model II the effect of this information (INFO) on the preference for a specific labelling of feed origin was identified. All ML-Models II had a better model fit than the ML-Models I as the Log-Likelihood Functions reveal. All models were statistically significant. All coefficients of the attributes were positive, expect the PRICE, and significant. The PRICE was taken as fixed parameter as recommended in the literature (Revelt 1998).

Table 1. Products attributes in the Discrete-Choice experiment

Product attributes		Specifications of the product attributes 1	2	3	4
Product origin	(Dummy-Coded)	From North Hessian/South Lower Saxony [C]	Local [LOC]	From Germany [GER]	
Feed origin	(Dummy-Coded)	Local [FEED_L]	From Germany [FEED_G]	None [FEED_N]	
Slogan "Without GMO, as organic"		With [G]	Without [NN]		
[PRICE] in €	Organic milk (1l)	0,79	0,99	1,19	1,39
	Organic eggs (6 pack)	1,39	1,59	1,79	1,99
	Organic pork cutlets (200g)	2,09	2,39	2,69	2,99

Results

The results of the CAPI showed that organic consumers are interested in the origin of feed in organic animal production. However, consumers counted animal friendly feed, GMO-free feed and hormone-free feed to the three most important attributes of feed in organic farming. Therefore, feed origin played a subordinated role compared to other feed attributes. Nevertheless, 71.3% of all participants (n=557) had a positive association regarding local feed and just 4.4% had a negative view. They associated local feed origin mostly with short transport distances, support of local agriculture and economy, transparency and traceability.

Table 3. Mixed-Logit (ML) Models

		ML-Model I	ML-Model II	ML-Model I	ML-Model II	ML-Model I	ML-Model II
Products		**Organic eggs**		**Organic milk**		**Organic pork cutlets**	
Attri-butes	**Para-meters**	**Coefficient (Standard error)a)**					
PRICE	Fixed	-2,097 (0,22)**	-2,223 (0,23)**	-2,902 (0,31)**	-3,053 (0,35)**	- 1,717 (0,19)**	-1,656 (0,19)**
C	Random	1,248 (0,13)**	1,305 (0,21)**	1,533 (0,17)**	1,409 (0,25)**	1,531 (0,16)**	1,177 (0,21)**
LOC	Random	1,638 (0,14)**	1,856 (0,24)**	1,817 (0,19)**	1,865 (0,27)**	1,580 (0,17)**	1,441 (0,25)**
FEED_G	Random	0,898 (0,11)**	0,745 (0,19)**	1,473 (0,16)**	1,052 (0,22)**	0,903 (0,13)**	0,771 (0,18)**
FEED_L	Random	1,648 (0,15)**	1,378 (0,21)**	2,390 (0,23)**	2,008 (0,29)**	1,943 (0,19)**	1,658 (0,24)**
G	Random	0,357 (0,11)**	0,471 (0,17)**	1,455 (0,17)**	1,354 (0,23)**	0,933 (0,13)**	0,994 (0,17)**
Interactions							
INFO*FEED_G		0,119 (0,26)	-	0,719 (0,31)*	-	0,229 (0,25)	
INFO*FEED_L		0,684 (0,27)**	-	1,000 (0,36)**	-	0,681 (0,32)*	
Model specifications							
N		1610		1591		1340	
Log Likelihood		-1.405,0	-1.378,3	-1.321,8	-1.306,5	-1.143,4	-1.127,9

a) Significant on a *99%-, **95%-level

The results of the three models for each product were very similar, as table 2 shows. Positive coefficients of product attributes mean that the presence of the product attribute caused a higher disposition to buy the product. The higher a coefficient is the higher was consumers' preference for an attribute. Therefore, a negative PRICE coefficient signifies that higher prices had a negative influence on the buying decision. Organic milk had a particularly high negative PRICE coefficient, what means that consumers were more price-sensitive when buying organic milk compared to buying organic eggs or organic pork cutlets.

As the product coefficients show, there was no difference between consumers' order of preferences. For example, all coefficients for the product attribute LOC were higher than for the attribute C. That indicates that organic consumers preferred products which were of local origin over products from a defined region as North Hessian or South Lower Saxony. Both origins were preferred over a German origin. Furthermore, the models showed that organic consumers had a preference for animal products (organic milk, organic eggs and organic pork cutlets) on which feed origin was labelled, both coefficients for FEED_G and FEED_L were positive. The differences between the preferences for a labelling with feed from Germany or local feed was surprisingly high. Consumers preferred considerably local feed over German feed.

The ML-Models II revealed that providing additional information about organic feed import to Germany has an impact on the preference for the labelling of feed origin. Especially the impact on the preference for local feed was highly significant. The interactions INFO*FEED_L were significant and positive for all three products.

Conclusions

The findings of the Mixed-Logit Models let reason that consumers prefer products which were produced with local feed, what could open up a new market niche for organic animal producers. Especially for small scale farmers it will be an interesting market opportunity, because closed production cycles or local supply chains are easier to implement for small and diversified farms. Such a product differentiation holds a high market potential in a time of globalisation, international agricultural food trade and complex supply chains where increasing numbers of organic consumers ask for more transparency and safety in food production.

However, the production of organic animal products with local feed is expected to be more cost intensive, compared to importing organic feed, due to difficulties and high costs in the production of high-protein feed in Germany. In order to implement local supply chains, consumers need to have a higher willingness-to-pay for these products to ensure cost-effective production. As the study results showed providing consumers with additional information about organic feed imports influences the preference for products produced with local feed. Communicating the additional values of organic animal products produced with local feed is the basis to justify price premiums. Feed origin is currently not a well-communicated theme in consumer education and so far organic consumers are not aware that a high amount of organic feed is imported. An extensive consumer education is necessary to ensure the success of a new product launch with organic animal products produced with local feed. Positive associations as short transport distances, support of local agriculture and economy, transparency and traceability are suitable for future marketing concepts. Moreover, by providing consumers with information, organic animal production becomes more transparent and traceable, what could counteract the loss of trust which occurred due to recent food scandals.

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Effects on vitamin status and health in dairy cows fed without synthetic vitamins

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Abstract

Synthetic vitamin supplementation is not consistent with organic production and it is important to investigate how dairy cows manage without synthetic vitamin supplementation. The study aimed to compare the performance of cows given no synthetic vitamins (NSV) with cows (control; C) fed synthetic vitamins according to Swedish recommendations. Swedish Holstein cows (n=28) fed a 100 % organic diet were studied during two lactations. Vitamin status in cow plasma and milk, milk yield and composition, health and fertility were measured. From each cow, five blood and five milk samples were collected during lactation. In first lactation, C cows tended to have a higher concentration of α-tocopherol and their β-carotene concentration was higher compared to NSV cows. The C cows tended to have fewer cases of mastitis than NSV cows in the second lactation. No differences were found in production and fertility. In conclusion, dairy cows need vitamin A and E supplement, at least around calving when the requirements are high.

Key words: α-tocopherol, β-carotene, retinol, organic milk production, dairy cow

Introduction

Synthetic vitamins are not applicable with the principles in organic production. Consequently, it is important to investigate whether dairy cows can maintain their production and health without synthetic vitamins A and E added to their diets. The most important function of vitamin E is the antioxidant effect and, thereby, its positive effect on the immune system (Politis, et al, 1996), and its action in maintaining oxidative stability and flavour of milk (Vagni et al, 2011). Vitamin A (retinol) is not found in plants, and is mainly fed as β-carotene which is converted to retinol in the intestine. However, β-carotene concentrations in feeds are highly variable (Calderon et al, 2007; Lindqvist, 2012). The study aim was to find out if high producing organic dairy cows could secure their needs of vitamins A and E during two lactations, without any supplementation of synthetic vitamins, but when fed organic feeds chosen for high vitamin contents.

Material and methodology

The experiment was conducted during two complete lactations at Tingvall Organic Research Farm, Sweden. The herd consisted of Swedish Holstein dairy cows with a rolling herd average of 9873 and 10383 kg energy corrected milk per cow and year during year 1 and 2, respectively. The two experimental groups, including 14 cows each, were housed in separate loose housing pens. Cows were on pasture from the beginning of May until the middle of October. Cows were paired according to their expected calving date, lactation number and their previous 305 days milk yield or breeding index for the heifers, and then randomly allocated to the two treatments: 100 % organic feed ration containing a mineral feed without vitamins (NSV - no synthetic vitamins), and the same 100 % organic ration containing the same mineral feed but including the synthetic vitamins A, D3 and E (C – control). The experimental vitamin treatment started at least one month before expected calving. All cows calved between November and February.

Cows were fed a partially mixed ration of grass-clover silage and rolled barley *ad libitum*, which was supplemented with a barley/pea mixture, cold-pressed rapeseed cake and mineral feed in automatic feeders. Cows were fed a minimum of 50 % roughage during the first three months after calving and thereafter a minimum of 60 % roughage according to the standards for organic feeds. Minerals and vitamins were fed according to Swedish recommendations. Control dry cows and control cows in later lactation in year 1 were supplemented with 450 IU α-tocopherol and 60000 IU vitamin A per day in the diet. Control cows in early lactation both years and in later lactation year 2 were supplemented with 600 IU α-tocopherol and 80000 IU β-carotene per day in the diet. Nutrient composition in DM of the silage (67 mg α-tocopherol, 56 mg β-carotene, 9.7 MJ ME, 140 g CP, 548 g NDF in year 1 and 51 mg α-tocopherol, 48 mg mg β-carotene, 11.4 MJ ME, 129 g CP, 488 g NDF in year 2) and concentrates were analysed by conventional methods. All vitamin analyses were performed in the laboratories at Aarhus University, Research Centre Foulum, Denmark.

Five blood samples were taken from each cow and lactation at 3 weeks before expected calving (BEC), within 24 hours after calving (PC – post calving) and at 3 to 4 weeks PC. In addition, samples were taken 3 to 5 months and 7 to 9 months PC. Five milk samples were collected during lactation, from colostrum (within 15 hours after calving), 4 days PC, and thereafter at morning milkings on the same day as blood were collected. Milk yield was recorded and milk composition (fat, protein, urea and somatic cell count) was analysed. Fertility of the cows was determined as number of artificial inseminations (AI) per conception and number of days between calving and the first AI as well as calving interval. All veterinary input was registered continuously as a measure of cow health.

Statistical data on the 28 cows from year 1 and year 2 were analysed separately as there were no interactions between year and treatment, with the exception of health parameters. Statistical analyses of variance were made using the Mixed Model procedure of SAS (2003). The first three vitamin samples were treated as repeated measurements. Values for somatic cell count (SCC) in milk were logarithmically transformed (natural logarithm) to obtain a normal distribution of the data. For each treatment group (NSV and C) and year, the number of animals with no diseases was counted, as well as numbers of cows treated for mastitis, paresis and other diseases. Statistical analyses were done (comparisons between treatments within each category, within each year and between years) with Fischer´s exact test. Results with a P-value less than 0.05 were regarded as significantly different, whereas $0.05 < P < 0.10$ indicated that the results tended to be significant.

Results

In both treatment groups the plasma α-tocopherol concentrations were low during the transition period, especially at calving (1.73 and 1.66 mg/l plasma year 1 and 2, respectively), when it was significantly lower ($P < 0.001$) than at 3 weeks BEC and 3 to 4 weeks PC (year 1: 3.17 BEC and 3.35 PC, year 2: 3.02 BEC and 3.58 PC). The concentration of β-carotene at calving was 2.86 and 3.08 mg/l plasma and the retinol concentrations were 0.21 vs. 0.30 mg/l plasma year 1 and 2, respectively. A tendency for a lower level of β-carotene in plasma from C cows than in plasma from NSV cows at 3-5 months PC was found in year 1 (NSV: 10.81; C. 8.28 mg/l plasma, P=0.068). No other differences were found in α-tocopherol and β-carotene in blood plasma between NSV and C cows.

Control cows had higher β-carotene and a tendency for higher α-tocopherol concentration in colostrum than the NSV cows in year 1 (Table 1). There were no other differences found between treatments in vitamin concentrations in milk.

Table 1. Mean concentrations (and standard error of means, SEM) of α-tocopherol, β-carotene and retinol in milk (mg/l) at 3 sampling occasions; colostrum, 4 days post calving (PC) and 3-4 weeks PC for year 1 and 2, n=14

	Sampling time							*P*
	Colostrum		4 days PC		3-4 weeks PC			Treatm. x Time
	NSV	C	NSV	C	NSV	C	SEM	
Year 1								
α-tocopherol	2.61	4.72(*)	1.22	1.47	0.66	0.72	0.51	0.098
ß- carotene	0.94	1.70*	0.37	0.51	0.12	0.13	0.16	0.036
Retinol	2.55	2.92	0.52	0.84	0.24	0.25	0.30	NS
Year 2								
α-tocopherol	4.50	4.28	0.81	1.23	0.85	0.60	0.65	NS
ß- carotene	2.01	2.23	0.31	0.58	0.30	0.16	0.31	NS
Retinol	2.36	2.24	0.44	0.80	0.48	0.38	0.30	NS

(*) significant within row and time at $P = 0.056$ and * at $P < 0.05$, NS = not significant ($P > 0.10$)

The NSV cows had a lower lnSCC than C cows after 3 months of lactation in year 1 (4.31 and 4.74/ml, respectively, *P*=0.017). In year 2 the situation was the opposite when NSV cows tended to have higher lnSCC in the same lactation period (5.59 and 5.19/ml, respectively, *P*=0.086). Also, there was a tendency for a higher mastitis incidence year 2 in NSV cows than in C cows (Table 2). In NSV cows, a higher mastitis incidence and fewer healthy cows were found in year 2 than in year 1. No differences were found between treatment groups in milk yield, milk composition or fertility parameters.

Table 2. Number (and percentage) of healthy or treated cows fed without synthetic vitamins (NSV) or with synthetic vitamins (C), n=14

	NSV	P		C	P		P NSV/C	P NSV/C
	Year 1	Year 2		Year 1	Year 2		Year 1	Year 2
Healthy	11 (78)	2 (14)	0.001	7 (50)	6 (43)	NS	NS	NS
Paresis	0 (0)	3 (21)	NS	2 (14)	4 (28)	NS	NS	NS
Mastitis	1 (7)	9 (64)	0.002	2 (14)	4 (28)	NS	NS	0.060
Other	2 (14)	4 (28)	NS	4 (7)	3 (21)	NS	NS	NS

NS not significant (P > 0.10)

Discussion

Organic diets with high levels of grass-legume silages are expected to have a high level of natural vitamin E and β-carotene (Lindqvist et al, 2011), but apparently not enough to secure sufficient α-tocopherol and retinol concentrations in plasma around calving. The higher β-carotene and tendency for higher α-tocopherol concentrations in colostrum in C cows in year 1 agrees with other studies (Lindqvist et al, 2011). A relationship has been shown between feeding cows no vitamin supplement and calf mortality (Waller et al, 2007), and low serum levels of α-tocopherol and β-carotene in the calves (Torsein et al, 2011). The tendency in year 2 for higher SCC after 3 months of lactation in NSV cows agrees with other experiments e.g. showing 25 % lower SCC in cows supplemented with synthetic vitamin E than unsupplemented cows (Politis et al, 2004). It is also in accordance with the tendency for higher mastitis incidence year 2 in NSV cows than in C cows. The shown long term effect in NSV cows with higher mastitis incidence and less healthy cows in year 2 compared to year 1 might be due to depressed immune status in NSV cows year 2 because of no vitamin supplement.

Suggestions to tackle the future challenges of organic animal husbandry

As supplementation of synthetic vitamins resulted in higher vitamin levels in colostrum and influenced cow health, dairy cows need vitamin A and E supplements, at least around calving when the requirements are high. However, vitamin status in late lactation can be upheld without supplementation. The varying vitamin concentrations in silages contribute to insecurity of the supply from natural vitamins in feeds. More studies on vitamin contents in different grasses and legumes are needed.

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100% local and organic: closing the protein gap for poultry in the ICOPP Project

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Abstract

A key challenge in improving the sustainability of organic poultry production is meeting the required levels of nutrients from locally sourced organic feeds. 100% organic diets for monogastrics will become compulsory in the EU from 1st January 2015. The ICOPP project brings together knowledge, from 10 EU countries, of local feeds for monogastrics and their wider impact on growth, health and welfare and the environment to identify feeding strategies which comply with organic principles. This poster will report on feeding trials carried out with broilers in the UK by FAI and ORC to investigate the impact of algae, peas and lupins on broiler performance and welfare.

Key words: poultry, broiler, feed, algae,

Introduction

A key challenge in improving the sustainability of organic poultry production is meeting the required levels of nutrients from locally sourced organic feeds. 100% organic diets for monogastrics will become compulsory in the EU from 1st January 2015. There is concern that a move to a 100% organic diet may not supply sufficient essential amino acids, lysine and methionine. Very little soya is grown in the EU, due to climatic conditions, and there are environmental, GM and social concerns about using soya imported from South America, China and India. The ICOPP project brings together knowledge from 10 EU countries of local feeds for monogastrics and their wider impact on growth, health and welfare and the environment to identify feeding strategies which comply with organic principles. Novel concentrates and the use of roughage are investigated in feed trials. This poster will report on feeding trials carried out with broilers in the UK by FAI and ORC to investigate the impact of algae, peas and lupins on broiler performance and welfare.

The Project

This project is important because of the requirement to base the feeding of organically produced poultry and pigs on feed of 100% organic origin from the 1st January 2015, an extention from a previous derogation to 1st January 2012. The derogation was extended due to members states declaring that neither of the poultry or pig industries was in a position to be able to make the move to 100% organic feed. To address these concerns the aim of the project is to produce economically profitable feeding strategies based on 100% organic feed across Europe, which will supply poultry and pigs the required level of nutrients in different phases of production and support high animal health and welfare. This is done on the basis of the following tasks:

- Improved knowledge of availability and nutritional value of underutilized or new organic feed ingredients per animal category with a focus on local feed resources.

- Improved understanding of the possible benefits of roughage inclusion in relation to nutritional and behavioural needs as well as its impact on health and welfare.
- Understanding how direct foraging in the outdoor area can contribute to meeting the animal's nutritional needs.
- Assessing the economic and environmental consequences of increased reliance on local organically produced feed.

The working hypothesis is that it is possible, through an extended knowledge of the characteristics of different local feeds and their wider impact on growth, health and welfare and environment, to produce strategies which comply with the aims for high animal welfare, production economy and environmental concerns. Through co-operation between 15 partners, a range of feeding experiments will be carried out with pigs (sows, piglets and finishers) and poultry (layers and broilers), clustered around concentrate feedstuffs, roughage, and foraging. The insight gained from these activities will be used to analyse and produce feeding strategies, adapted to the differences in local feed supply, the economic impact related to different feed procurement, and variations in production structure in different countries/agroecological zones in Europe.

Up until now organic monogastric production systems have allowed feed ingredients of non-organic origin. There is therefore very little experience and limited information on the implications of a shift in feeding strategy to 100% organic. There is concern that a move to a 100% organic diet may not supply sufficient sources of certain essential amino acids. This is accentuated by the fact that the most obvious and commonly used protein feed source (soybean meal) is not widely grown in Europe due to climatic conditions. There are also concerns about the production systems in, and transport from, the current locations of soya production (primarily South America but also China and India). Therefore it is important that research within the area of organic and innovative monogastric production systems focuses on novel feeding strategies that supply sufficient levels of essential amino acids of organic origin (both bought in and from the production system/range) without oversupply of total protein for poultry and pigs. At the same time it is equally important that the feeds and feeding regimes support the overall health and welfare of the animals and that the environmental impacts of the feed resource is taken into account.

Diet formulation and use of algae, peas and lupins.

In diet formulation, it is generally assumed that diets with the same nutrient contents will lead to similar production results, as far as they are not counteracted by anti nutritional factors (ANF). It has been shown that some new, locally grown protein sources like lupin (*Lupinus albus*, *L. luteus*, *L. angustifolius*) and naked oats (*Avena nuda*) can partly cover nutrient requirements for laying hens and growing pigs. The relatively low methionine content, however, is a limitation and it has been shown that even when accounting for this, inclusion of 25% lupin in the diet reduces daily gain in growing pigs and egg production in laying hens. Thus, before implementing other protein sources there is a need, through digestibility and performance trials, to validate the digestible nutrient content and presence of ANF, respectively. It is also desirable to have a combination of protein sources in order to meet the ideal amino acid profile without oversupply of protein. An oversupply of protein can lead to highly nitrogenous excrement which can in turn lead to welfare problems such as pododermatitis as well as environmental problems including GHG emissions and nitrogen leaching.

Peas are a good seasonal alternate crop for regions not suited to growing soya beans. White flowered varieties do not have high tannin levels and are the most suitable for poultry feed. According to one study, peas appear to be the most promising potential feed ingredient for organic poultry rations. It is likely they can be incorporated in broiler diets at up to 250 to 300 g/kg and in layers diets at up to 150 to 200 g/kg. Some reports suggest that modest levels of sweet lupins (200 g/kg) might also replace soya in layers feeds. Both have high levels of lysine but methionine is still restricted.

Algae is an excellent source of methionine which could replace synthetic amino acids that are used in conventional poultry diet formulation but are prohibited under organic standards.

Local feed suitability

Table 1. Suitability of feed ingredients available in the UK

Feed	UK Total area 2010 Organic & in Conversion		Metabolisable Energy (MJ/kg)	Crude Protein (g/kg)	Methionine (g/kg)	ANF's	Suitability
Wheat	20,959		12.9	135	2.0	N/A	Good
Barley	16,490		11.8	113	2.0	Low levels of β-glucans	Good, more suited to layers than broilers
Oats	12,064		10.7	115	2.2	Low levels of β-glucans	Ok, high fibre and low energy makes them most suitable for pullet diets
		Naked Oats	13.31	98-181		Some β-glucans	Good for all classes of poultry
Rye, mixed corn & Triticale	7,337	Rye	11	118	3.6	β-glucans & arabinoxylans	Significantly reduced due to ANF's
		Triticale	12.7	125	2.0	Low levels	Good especially for home grown and when diet is supplemented with sunflower oil
Maize, Oilseeds & protein crops	2,786	Maize	13.75	83	1.7	N/A	Good for all classes of poultry. High levels of xanthophylls can increase yellow pigmentation of eggs and meat beyond acceptable for some markets. Huge competition from human food and other livestock sectors
		Flax/ Linseed		343	5.8	Linatine and Linamarin	Good particularly for meat birds as meat is healthier. Can cause "fishy eggs". Good especially for home grown when fed as a whole grain
Legumes	1,856	Faba Beans		254	2		
		Field Peas		228	2.1	Many but all at low levels that have little effect	Good for all but very young poultry
		Lupins		349	2.7	Alkaloids and tannins but varieties with low levels available	Good
Other		Algae (*Spirulina platenis*)		490	2.5	N/A	Good for all classes of poultry

Quality of organic legumes – prediction of main ingredients and amino acids by Near-Infrared Spectroscopy

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Abstract

The analytical potential of Near-Infrared Spectroscopy (NIRS) for predicting the chemical composition and the amino acid contents of grain legumes was evaluated. Pea and bean samples from field trials of different organically-managed experimental locations in Germany were analysed with reference methods. The reference data were used for developing calibration equations for the main ingredients and for the estimation of the amino acids. The calibration equations were validated on a remaining sample set. The statistics of NIRS calibrations showed that the predictions were successful or satisfactory for all main ingredients. The predictions of the essential amino acids were successful and respectively, for cystine in beans satisfactory as well. The obtained results indicated that the NIRS could be successfully used for the prediction of the main ingredients and amino acids in field beans and peas and therefore to evaluate the feed quality quickly and easy. The exact calculation of feed rations seems to be possible if the samples are analysed by NIRS directly after harvesting.

Key words: feed quality, legumes, near-infrared spectroscopy, amino acids, main ingredients

Introduction

The quality evaluation of organic feeds, especially the quick and easy determination of the main ingredients and the amino acid pattern in locally grown legumes, is very important to fulfil the requirements regarding the protein and amino acid supply of organically fed animals, especially monogastric animals. The analytical data of organic feeds, as compared with conventional table values, shows a clear deviation of protein and amino acids between conventional and organic feeds. The standard tabular values (DLG 1991) are not sufficient for the calculation of the feed rations in organic monogastric nutrition. Therefore the ability of NIRS to predict the chemical composition and the amino acids of organically grown legumes was tested.

Material and methodology

Pea and bean samples from field trials of different organically managed experimental locations in Germany, collected over two years, were used for the investigations. The main ingredients of the beans were determined according to VDLUFA methods (VDLUFA 1997) and amino acids by HPLC (EG 1998, Cohen and Michaud 2004). NIRS analysis was carried out with the ground samples using the Fourier-Transform NIR spectrometer (NIRLab N-200, Fa. Büchi, Essen) in the spectral range from 1000 to 2500 nm. Spectral data were exported to the NIRCal chemometric software (Fa. Büchi, Essen) and different mathematical pre-treatments were performed. Calibration equations for crude nutrients and each amino acid were developed by partial least square regression (PLS) on about two-thirds of the pea or bean samples using the results from the analytical reference methods. The calibration equations were than validated on the remaining sample sets (1/3 of pea or bean samples). The performance of the calibrations was evaluated in terms of standard error of prediction and coefficient of determination.

Results

The statistical summary of the best calibration and prediction for the main ingredients in peas and beans is shown in Table 1.

Table 1. NIRS calibration statistics for prediction of main ingredients in field peas and beans

	Field Peas (n=350)					Field Beans (n=233)				
	content of ingredient (g/kg DM)			NIRS performance data		content of ingredient (g/kg DM)			NIRS performance data	
Ingredient	mean	min	max	R_K	SEP	mean	min	max	R_K	SEP
crude protein	229	180	267	0.96	3.7	292	247	355	0.98	4.8
crude fat	20.3	16.6	27.8	0.86	0.83	18.3	14.1	25.7	0.86	0.96
crude fiber	69.0	50.3	87.9	0.89	3.3	95.0	79.8	117	0.78	3.9
crude ash	30.9	23.4	36.7	0.94	0.90	38.1	24.3	52.9	0.86	2.1
starch	522	474	553	0.92	5.9	434	360	530	0.91	7.6
sugar	74.2	62.5	86.5	0.93	1.8	53.4	44.4	69.1	0.88	2.1

DM: dry matter

R_K: regression coefficient of calibration, SEP: standard error of prediction

The statistics of NIRS calibrations for the main ingredients in peas showed that the predictions were successful for protein, minerals, starch and sugar. The prediction accuracy for fat and fiber was satisfactory. For field beans the predictions were successful for protein and starch and satisfactory for fat, fiber, minerals and sugar.

The statistical summary of the best calibration and prediction for the amino acids in peas and beans is shown in Table 2.

Table 2. NIRS calibration statistics for prediction of amino acids in field peas and beans

	Field Peas (n=350)					Field Beans (n=233)				
	content of amino acids (g/kg DM)			NIRS performance data		content of amino acids (g/kg DM)			NIRS performance data	
amino acids	mean	min	max	R_K	SEP	mean	min	max	R_K	SEP
lysine	17.2	14.6	19.6	0.95	0.32	19.4	15.9	25.0	0.93	0.61
methionine	2.25	1.85	2.67	0.93	0.065	2.15	1.74	2.44	0.90	0.049
cystine	3.02	2.06	3.78	0.85	0.17	3.40	2.03	4.1	0.94	0.11
threonine	8.75	7.10	9.84	0.96	0.14	10.4	9.08	11.9	0.96	0.15
arginine	18.8	12.3	24.1	0.96	0.55	26.9	20.2	34.9	0.98	0.67
histidine	5.58	4.12	6.47	0.97	0.10	7.33	6.38	8.63	0.98	0.11
isoleucine	10.1	7.76	11.7	0.97	0.16	12.3	10.3	14.9	0.97	0.23
leucine	16.6	12.5	19.4	0.98	0.25	21.2	17.5	25.8	0.97	0.37
phenylalanine	11.2	8.72	13.2	0.97	0.17	12.3	10.9	15.4	0.97	0.20
valine	11.5	8.95	13.0	0.97	0.17	13.7	11.8	16.2	0.97	0.19

DM: dry matter

R_K: regression coefficient of calibration, SEP: standard error of prediction

The predictions of the essential amino acids in peas and beans were successful. The prediction accuracy for the sulphur-containing amino acid cystine is satisfactory and should be improved in further investigations.

Discussion

The deviations in the contents of the main ingredients, described in previous investigations (e.g., Böhm et al. 2007), were confirmed in our study.

The obtained results indicated that the NIRS could be successfully used for the prediction of the main ingredients and amino acids in field peas and bean, and therefore to evaluate the feed quality quickly and easilyy. The exact calculation of feed rations seems to be possible if the samples are analysed directly after harvesting by NIRS.

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Green fodder Cultivation and their Feeding Practices by Indian Livestock Owners: Under climate change conditions

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Abstract

Indian agriculture is oriented towards crop cultivation. Livestock, dairy and poultry farming are the least developed branches of Indian agriculture. Perhaps the reason for lesser attention towards these branches is the character of the season and natural vegetation, which can provide a very small proportion of nutrients to animals in terms of quality and quantity. The optimum grazing season does not extent for more than 4-5 months in a year.

Key word: Profitability, Green fodder, Farmers, Scientist, Perception.

Introduction

Green fodder cultivation is not a new farming practice in Indian perspective. While all the cultivating communities were growing protein-rich nutritive green fodder for their livestock. The perception about green fodder cultivation and its use could be the same as that of the scientists. In order to examine and confirm this view, this study was conducted in Bareilly district of U.P. (India).

The study was carried out a cluster of 6 villages of Bareilly district of Uttar Pradesh. A maximum of 40 minimum of 10 respondents were selected from those who had been using the selected animal husbandry technologies advocated by various agencies since last 5 years (1994-98). Thus, 200 livestock owners constituted the sample size for the study. Simultaneously, 50 scientists were also selected as respondents to obtain their perception for the comparison. Data were collected through personal interviews as well as through Participatory Rural Appraisal Techniques, group meeting and analyzed by different statistical method.

The profitability of FMD vaccination was operational zed as the farmer's or expert's perception of profit occurring or which likely to occur due to this vaccination. The response was taken on a 5 point scale viz., highly profitable, profitable, somewhat profitable, least profitable and not at all profitable.

Profile of the respondents

The majority of house holds (63.00%) had less that 5 animal workers in their family involved performing the animal husbandry tasks in comprehensive way followed by 34.5% respondents who had 5-7 animal workers. Majority of the vaccination users (57.5%) belonged to the middle age group (30-35 yrs) followed by young (23.00%0 and old age (19.50%). Out of which 46% were from OBC category and 33% from General had marginal land holding (≤1) followed by small (36.50%) and large (18.50%) wherein 55.50% respondents had area under fodder crops grown like Barseem and Makcheri less than 4 bigha followed by 33.50% 4-6bigha and 11% more than 6 begha levels covered in fodder production for their good health. The data clearly showed that very few respondents 4.50% had large size of herd (≤8 nos) whereas 51.50% respondents had small size of heard. Majority of the respondents had low cropping intensity i.e. 221-240. Only 2% respondents had low cropping intensity i.e. 220%. The data further depicted that Desi-cattle with majority of respondents (58.50%) were medium producers (4-5lit) of milk per day followed by 34.50% ownerswere producing (less that 4 lit per day and only 7% respondents were producing more that 5 liter of milk per day). Majority of crossbred cattle owners (57%) comes under high milk produces (i.e. 8 lit. per day and above) category while 27.7% fall in medium category (i.e. 6-7lit.) and only 14.90% farmers were having crossbred cattle producing less that 5 lit. milk per day.

The data revealed that majority of the farmers (43.50%) were using the FMD vaccination followed by 29% respondents who were using it occasionally and only 27.50% respondent were fully using the FMD vaccination.

Three inputs were considered essential. Viz, proper vaccine, vaccinator, and the cost (money). Majority of the respondents felt that three inputs were partly assessable to them. Vaccine was also considered to be easily accessible to them. Less than 1/4th of the respondents perceived non-availability of money as a majority constraint for vaccination.

Perception of scientists and farmers about the profitability of green fodder cultivation and their feeding practice

The studies revealed Table 1 that farmers 38.50% had high score on perceived profitability medium 38% and low 22.50%, But, majority of scientists (62%) high score on perceived profitability followed by medium (22.00%) and low (16.00%) level.

Table 1. Categorization of the Respondents According to perceived profitability of Green fodder Cultivation and their Feeding Practices.

Sl.No.	Profitability (Score)	Farmers	Scientists
1.	Low (≤1)	45(22.50)	8(16.00)
2.	Medium (2-3)	76(38.00)	11(22.00)
3.	High (≤3)	79(38.50)	31(62.00)

Figures in Parentheses Indication Percentage.

The profitability of Green fodder Cultivation and their Feeding Practices can be judged by it is their better utilization giving higher net income to the farmers. The extent to which the farmers efficiently and effectively utilize of Green fodder Cultivation and their Feeding Practices under available resources in livestock farming in reflected in the profit with regard to the profitability which are presented in Table 2 respectively.

Table 2. Extent of perceived profitability Green fodder Cultivation and their Feeding Practices

Sl.No.	Extent of Profitability	Farmers	Scientists
1.	Highly profitable	50(25.00)	30(60.00)
2.	Profitable	114(57.00)	15(30.00)
3.	Somewhat profitable	19(9.50)	02(04.00)
4.	Least profitable	17(8.50)	03(06.00)

(Figures in Parentheses Indication Percentage).

The majority of farmers (57%) indicated perceived of Green fodder Cultivation and their Feeding Practices as profitable followed by 25.00% farmers who perceived it as highly profitable. Rest 9.50 of farmers perceived as somewhat profitable while only 8.50% respondents perceived it as least profitable. Dixit and sinha (1993) also reported that majority of the respondent did not had negative view about the. They reported of Green fodder Cultivation and their Feeding Practices d that 98.8% farmers of Animal custodians do not adopt of Green fodder Cultivation and their Feeding Practices their own animals. Majority of the scientists (80%) considered it highly profitable whereas by very low percentage of scientists (4%) perceived it as somewhat profitable and only (6%) perceived it a least profitable vaccination. But none of the farmers or scientists considered it as not at all profitable technology. Based on “t” value the perception of scientist and farmers regarding the profitable indicated to be highly significant ($P \leq 0.01$) in case of scientists than farmers.

Relationship between the farmers' characteristics and their perception of profitability of Green fodder Cultivation and their Feeding Practices.

The relationship between selected independent variables and perception of animal husbandry for profitability were analyzed through contribution of 8.50% respondents perceived it as least profitable. Dixit and sinha (1993) also reported that majority of the respondent did not had negative view about the Green fodder Cultivation and their Feeding Practices. They reported that 98.8% farmers of Animal custodians do not adopt Green fodder Cultivation and their Feeding Practices their own animals. Majority of the scientists (80%) considered it highly profitable whereas by very low percentage of scientists (4%) perceived it as somewhat profitable and only (6%) perceived it a least profitable vaccination. But none of the farmers or scientists considered it as not at all profitable technology. Based on "t" value the perception of scientists and farmers regarding the profitability indicated to be highly significant ($P \leq 0.01$) in case of scientists than farmers (table 3).

Relationship between the farmers' characteristics and their perception on profitability of Green fodder Cultivation and their Feeding Practices

The relationship between selected independent variable and perception of animal husbandry technology for profitability were analyzed through contribution of correlation values which are presented in table 3 respectively. The variables showed significant and positive correlation except cropping intensity with perceived profitability of the Green fodder Cultivation and their Feeding Practices. In other word higher the values on these variables the higher was the profitability as perceived by the farmers. The correlation between the profitability and cropping intensity were not significant indicating that these variables have no influence on the perceived profitability. The variables that were found to have positive and significant relationship with profitability were indicative of the farmer's progressiveness. More the family education more progressive would be the farmer similarly more the milk production betters the accessibility and use/adoption of Green fodder Cultivation and their Feeding Practices.

Table 3. Comparative Analysis of profitability score of Green fodder Cultivation and their Feeding Practices between scientists and farmers.

Sl.No.	Name of the Technology	Max. possible score	Perceived profi tability scientists	Score farmers	t.test
1.	Green fodder Cultivation and their Feeding Practices	4	3.92	2.46	10.314

Conclusion

The data showed that Green fodder Cultivation and their Feeding Practices was not easily accessible to the desired extent to majority of the farmers. Farmers were having low level of perceived profitability score as scientists compared to who were having high level of perceived profitability by the farmers and scientists gives an indication that suitable intervention that suitable interventions are required to improve the perception of the farmers with regards to Green fodder Cultivation and their Feeding Practices. The relationship between selected attributed and profitability was significant with positive correlation, with the perceived profitability of Green fodder Cultivation and their Feeding Practices except one attribute like cropping intensity (r- ranged from 0.00 to 0.11).

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Integrating willow-based bioenergy and organic dairy production – the role of tree fodder for feed supplementation –

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Abstract

Silvopastoral systems that combine livestock and trees offer two main advantages for the animals. First, trees modify microclimatic conditions which can have beneficial effects on pasture growth and animal welfare. Second, trees also provide alternative feed resources during periods of low forage availability. This paper reports on research carried out within the Sustainable Organic and Low Input Dairying (SOLID) project to investigate the multifunctional potential of a novel integrated willow-based bio-energy/organic dairy production system in the UK, especially the role of tree fodder for feed supplementation in organic dairy systems. The nutritional value of two ages (1st and 2nd year re-growth) of short rotation coppiced willow was assessed in two seasons (late spring and late summer) in 2011.

Key words: Agro-forestry, silvopastoral, short rotation coppice

Introduction

Agroforestry, the integration of trees and agriculture, is valued as a multifunctional land use approach that balances the production of commodities (food, feed, fuel, fibre, etc) with non-commodity outputs such as environmental protection and cultural and landscape amenities (IAASTD, 2008). The EU Renewable Energy Directive sets a target for Europe to get 20% of its energy from renewable sources by 2020. The need to increase bioenergy production from biomass crops such as *Miscanthus* grass and short rotation coppice (SRC) has led to concerns that there will be increasing conflict for land between food and energy production. Agroforestry systems integrating SRC bioenergy crops and livestock or arable production can help reconcile these conflicting demands. This paper reports on research investigating the viability and multifunctional potential of a novel integrated willow-based bio-energy/organic dairy production system in the UK, especially the role of tree fodder for feed supplementation in organic dairy systems.

An integrated bio-energy and organic livestock production system

Agroforestry systems integrating SRC bioenergy crops and livestock or arable production can help reconcile conflicting demands for land use. Silvopastoral systems that combine livestock and trees offer two main advantages for the animals. First, trees modify microclimatic conditions including temperature, water vapour content or partial pressure, and wind speed, which can have beneficial effects on pasture growth and animal welfare (Bird, 1998; Karki and Goodman, 2009). Second, trees also provide alternative feed resources during periods of low forage availability, particularly in climates with seasonal droughts such as the Mediterranean (Papanastasis *et al.*, 2008). Browse from trees and shrubs plays an important role in feeding ruminants in many parts of the World, particularly in the tropics, and there has been considerable research into the nutritional potential and limitations of many tropical fodder species (Devendra, 1992). However, comparatively little is known about the potential of temperate browse species. The composition of tree fodder varies depending on a range of factors including tree species and cultivars, season, age of growth, climate, and plant part utilized (leaf vs stem).

Materials and methodology

This work is part of an EU FP7 funded project "Sustainable organic and low input dairying" (SOL-ID, KBBE.2010.1.2-02), which aims at supporting developments and innovations in organic and low input dairy systems to optimize competitiveness while maximising the potential of these systems to deliver environmental goods and biodiversity, and optimising economic, agronomic and nutritional advantages for the development of innovative and sustainable organic and low input dairy systems and supply chains. For more information on the project, see www.solidairy.eu.

This paper reports on research carried out to investigate the role of tree fodder for feed supplementation in organic dairy systems. The nutritional value of two ages (1st and 2nd year re-growth) of SRC willow was assessed in two seasons; late spring (June) and late summer (Sept) in 2011.

Figure 1. Wakelyns agroforestry short rotation coppice willow system with a legume-ley in the 12m wide alleys.

The integrated system is based on an alley-cropping design, with twin rows of SRC willow (*Salix viminalis*) separated by 12m wide alleys of pasture (Fig.1). The tree rows are orientated north/south to minimise shading effects in the alleys. The willow is harvested on a 2-3 year rotation, dried and chipped for use in wood chip boilers. Feed value of the willow is likely to vary depending on the age of re-growth and season of the year, and a better understanding of this variation is necessary in order to identify its potential for contributing to livestock nutrition. We hypothesised that the willow would be of highest nutritional value in spring, declining as plants mature through the summer as fibre and lignin contents and structural carbohydrates increase while crude protein content decreases. We also predicted higher feed value within 1st year re-growth compared to 2nd year re-growth.

Willow samples were collected from Wakelyns Agroforestry, an established silvoarable system in eastern England in June and September 2011. SRC willow was planted in 1998 and is harvested on a 2 year rotation. Samples were collected on 29th June and 14th September 2011 from both 1st and 2nd year re-growths of willow. Samples were taken from 5m long plots, with 4 replicate plots of each age class (total of 8 plots). The samples consisted of leaves and stems up to 8mm in diameter as cattle have been shown to eat willow of 4-8mm diameter (Moore *et al.*, 2003). Samples were oven dried at 60°C until a stable weight was reached.

The feed values of the samples were analysed in the laboratory of MTT using standard methods. The digestibility of the samples was measured *in vitro* using a pepsin-cellulase based method (Huhtanen *et al.*, 2006).

Results and discussion

Table 1. Chemical composition and in vitro organic matter (OM) digestibility of willow samples harvested from 1st and 2nd year re-growth in late spring (June) and late summer (Sept) 2011

	1st year		2nd year		Statistical significance		
	June	Sept	June	Sept	Year	Season	Y*S
n	4	4	4	4			
DM[a] (g/kg)	265	378	359	420	**	**	**
In DM[a] (g/kg DM)							
Ash	70.8	72.5	63.6	63.7	*	NS	NS
Crude protein	167	127	125	99	**	**	NS
NDF[b]	573	492	548	503	NS	**	NS
ADF[c]	410	341	395	357	NS	**	*
Lignin	184	136	168	135	NS	**	NS
In vitro OM digest.	0.41	0.38	0.40	0.37	NS	**	NS

* significant at P<0.05 and ** significant at P<0.01
[a] DM: dry matter
[b] NDF: neutral detergent fibre
[c] ADF: acid detergent fibre

There were significant differences in the chemical composition of the different ages and seasons of willow samples (Table 1). As expected, crude protein levels were highest in late spring and higher in 1st year than 2nd year re-growth. We were surprised to find a statistically significantly higher level of lignin in the late spring samples as we expected lignin content to increase as the willow grew through the season. One explanation is that there was a greater proportion of stems in the late spring samples as the early growth stems would be more likely to be smaller in diameter than the 8mm limit. As expected, organic matter digestibility was higher in late spring than late summer, but overall was rather low at 0.38 to 0.41. This compares poorly with values from the research literature which recorded values for willow of up to 0.74 (Pitta *et al.*, 2007; Musonda *et al.*, 2009). Typically dairy cow forages have a much higher OM digestibility (hay 0.47-67; grass silage 0.52-0.67; grazed grass 0.64-0.75 (Ministry of Agriculture Fisheries and Food, 1990)). The similarity of the feed values in the 1st and 2nd year re-growths could be explained by the fact that branches mainly from the current growing season were harvested as the limit of the diameter of the branches collected was 8mm. While it is apparent that the feed value of the willow within this integrated system is limited, willow as a fodder may have a role to play as a buffer feed when grass is in short supply or of poor quality. In addition, low concentrations of secondary compounds such as condensed tannins found in tree fodder can have a beneficial influence by reducing protein degradation in the rumen and increasing the flow of protein and essential amino acids to the intestine (Rogosic *et al.*, 2006) although at high levels, these compounds may reduce digestibility and availability of protein, palatability and intake (Tolera *et al.*, 1997).

Suggestions to tackle the future challenges of organic animal husbandry

The unpredictability and variability in feed supply from organic agro-forestry systems seems to be one of the biggest challenges to their use at present as there are so many different species available and the seasonal variation is so great. However, fast growing trees provide the potential for a large quantity of material, and can deliver a range of other benefits to animal welfare and the environment, in addition to providing a local renewable resource energy and diversifying farm economies.

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Challenges of organic animal husbandry: promise of grain amaranth

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Introduction

The world faces emerging challenges with potentially disastrous effects on organic animal husbandly which includes food/feed and energy crisis, climate change, biodiversity loss, desertification, water scarcity and natural disasters.

However, the global demand for livestock products will continue to grow, and it will become increasingly challenging to meet that demand. The largest growth in demand is expected in developing countries. But the cost of production could increase if feed and fuel energy become more expensive, water becomes scarcer or livestock value chains are increasingly required to bear the costs of negative externalities they create. There is also a great deal of waste in food systems. Natural resources are not always converted efficiently into meat, milk or eggs, and a great deal of food currently produced does not reach the plate. Improving efficiency and minimizing waste throughout livestock value chains could enormously contribute towards meeting increased demand.

This paper will demonstrate how Strategic Poverty Alleviation Systems- SPAS integrates organic grain amaranth into the interactions between People, Plants, Livestock and Environment (PeoPLE) to increase productivity and efficiency of organic production systems to contribute in meeting increased demand for livestock products and making livestock the basis of renewable energy to impact on food/nutrition security, energy and sustainable livelihoods.

One of the greatest challenges facing the world today is ensuring access to ample, affordable, clean and sustainable sources of energy, (World Bank, 2008). Lack of sustainable sources of renewable energy may lead to degradation and bio diversity depletion which in the long run threatens the livelihoods of the very poor who frequently spend about a fifth of their income on energy, (World Bank, 2007). However, SPAS, through the PeoPLE initiative integrates livestock into farming systems to produce grain amaranth-based electricity which helps communities to save on resources used on energy (usually fossil fuel) and protects forests and natural resources destruction and biodiversity loss, while reducing the contribution of agriculture to greenhouse gas emissions.

The integrated goals of food and renewable energy security and poverty reduction are also inextricably linked with the need to reduce harmful air pollution and address climate change. SPAS also integrates livestock into farming systems and promotes organic grain amaranth based electricity for food and energy security, reduce poverty and harmful air pollution and address climate change.

This PeoPLE model became seductive to SPAS as it could assist these communities to enter a new era of sustainable development, ensuring that benefits are available over the long term because:

It's business viability

Provides a critical link between soils and plants health for improved animal feed production while effectively addressing human nutrition, health and poverty reduction.

Establishes a balance between the need to improve soils fertility and integrity, increase livestock and plants productivity and manage pests and diseases while increasing drought resistance and reducing and/or eliminating the use of chemical fertilizers and sprays

Utilizes locally available resources, farmers and local professional and assists in resource protection, while acknowledging the need for a people to change a whole or part of their traditions and culture, which is a major challenger but must be fully encouraged

Best model to sustain life in dry lands that are most vulnerable to and allows for active participation by communities in a global strategy to mitigate and adapt to climate change.

- Active participation of farmer families and women groups for increased public awareness
- Innovative approaches used to deliver programmes to communities
- Partnerships with stakeholders
- Continuous establishment of new areas of interventions like green energy
- Is a holistic approach to development which advances human wellbeing and ecosystems health

Methodology

This PeoPLE model is a low-cost community based approach to food and feed security and has the potential to place inequality and those who are experiencing vulnerability including women, the poor, and people living with HIV/AIDS, youths, displaced people, Orphans, Vulnerable Children-OVCs and the elderly at the center of sustainable development.

SPAS trains small-scale farmer families and women groups on organic grain amaranth-which is drought, diseases and pest resistant- husbandly, provides them with seeds for planting, and grow it for food/nutrition and income and by products fed to livestock whose dung produce biogas converted into electricity hence reducing the contribution of agriculture to greenhouse gas emissions. Communities are also trained on ideal ratios for making organic grain amaranth-a nutritional powerhouse- based-feed for livestock as an alternative to or to compliment grass cereals based feeds for enhanced food/nutrition security in changing climate.

SPAS also trains communities on natural resource management, composting, silage making, zero-grazing, bio-gas production and conversion into electricity, trees nurseries establishment, organizing field schools and demonstrations on grain amaranth-based crop boosters using organic grain amaranth by-products and livestock waste, while involving the youth and nutrition vulnerable populations including HIV/AIDS infected, and empowering communities to assess, identify and plan, implement and monitor use of locally available resources.

Results

The PeoPLE model can help developing countries to sustainably adapt to the effects of climate change that are now inevitable over the next few decades and reducing emissions at reasonable costs. SPAS strategic intention is to use organic grain amaranth to demonstrate the viability of organic agriculture and sets a pattern here for sustainable livelihoods with enormous contribution towards low greenhouse gas emissions economies. Adaptation to climate change will inevitably mean changing diets and lifestyles to suit new conditions.

By demonstrating ways of improved production, palatability and acceptance of grain amaranth through innovative processing, consumption and marketing of that set of under-utilized food and fodder crops, the PeoPLE model serves to provide one of the best nutrition per unit of land, water, and labor inputs.

Crop types, farming practices and cultivation methods that conserve water could be important tools for climate change mitigation and adaptation in dry lands ecosystems.

Supporting sustainable livelihoods in Kenya through integrating organic grain amaranth into the interactions between people, plants, livestock and the environment to unlock mitigation and adaptation potential of agriculture

Production and sharing of knowledge on agro-climatic tools (what local knowledge is required for the management of seasonal rainfall), Production and sharing of knowledge on the use of local seeds/traditional varieties to deal with the effects of CC, Production and sharing of knowledge on tools for managing soil fertility (CO2 sequestration in soil is an advantage).

This PeoPLE model aims at strengthening the five types of capital in farming communities-human, social, natural, financial and physical. Relying on locally available regenerative resources instead of expensive external inputs reduces vulnerability. Using local resources also has a positive multiplier effect on the local economy by creating jobs and improving incomes and food security in the whole community. This catalytic effect, in particular, when combined with locally deployed renewable energy, breathes new life to rural communities and creates conditions for self-sustaining growth.

This PeoPLE model produces broad based positive impacts and multiple benefits for current and future generations in such diverse areas as income and employment generation, improved nutrition and health, sustainable HIV/AIDS and environment management but also help to shatter the myth that without the traditional nutrients deficient staple cereals like maize, white rice and tubers, countries of Sub-Saharan Africa cannot break from the yoke of perennial food/nutrition insecurity, ill health and poverty.

Discussions

The Promise of the PEoPLE model

What is most significant, perhaps, about this model and which can help turn the Sub-Saharan vision for a food secure future through ecological and organic agriculture-the alternative for Africa-into the region's concrete action for food security, is that it is a local solution, using local resources, designed and carried out by local communities for their children's future. Suffice to mention that most small scale farming systems in the region are mixed.

Indeed, the PeoPLE model perhaps holds the greatest promise for improving livelihoods around the world through tackling the future challenges of organic animal husbandry, besides providing the tools to build a brighter, cleaner and more prosperous future. Besides, it allows nations of the world to open themselves to modernity without losing sight of their traditions and values like herbal medicines.

Besides, the model utilizes locally available resources, farmers and local professional and assists in resource protection, while acknowledging the need for a people to change a whole or part of their traditions and culture, which is a major challenger but must be fully encouraged. This is important because changes in the climate indicate that species with the best chance of survival and prosperity are those which learn to adapt now. IRLI has indicated that even with the availability of water, some crops such as maize (perhaps the most important staple cereal for Sub-Saharan Africa and main source of feeds) may not thrive well in a warming world and changing diseases and pests patterns. Organic Grain amaranth is not only drought tolerant but is also able to withstand high temperatures, and is diseases and pests resistant.

Environmental degradation, low agricultural productivity, high post-harvest losses, limited connections to markets, energy poverty, limited non-agricultural opportunities, hunger and thirst all conspire to make rural areas of poor countries inhabitable, (UNCTAD, 2011).

The PeoPLE model promises to revitalize rural areas of poor countries by checking this vicious circle and transforming them into vibrant places for small-scale farmers' families and young people through integration of organic livestock into these farming systems. The high-external-input-dependent, industrial agriculture route places poor countries in a situation of extreme vulnerability. Indeed, this model promises to provide a revolution in agriculture that is based on inexpensive, locally available inputs hence saving on the huge foreign currency reserves governments in these countries spend on agro-chemicals (synthetic fertilizers, pesticides, herbicides, fungicides).

However, to adequately and sustainably cope with these changes which require major transformations- which must be knowledge and technology-driven, SPAS and partners have worked with communities to produce organic grain amaranth-based integrated crops booster. This is perhaps where scientists should come out boldly and take charge.

Grain amaranth does very well where organic inputs like manures are used so SPAS uses it to convert small-scale farming systems into organic production systems and green energy. It is abundantly clear that while the international economic crisis and climate change are a real threat to organic animal husbandry, in particular, and Sub-Saharan Africa agriculture, in general, integrating organic grain amaranth into the PeoPLE model offers an innovative way to mitigate the negative effects of these challenges and prevent the regions poor from descending deeper into poverty. Indeed, amaranth, once considered a barrier to food security (was regarded as a notorious weed and food for the poor) is now revealed as a rich source of opportunities and possibilities to achieve regional goals and aspirations.

Although substantial work has been done, even more work remains to target and deliver intervention to small-scale mixed farming systems, besides increased successful model development and deployment which will require collaboration among agriculturalists, livestock, health and nutrition specialists, and advocates for the poor.

Besides, in its quest to attain food safety and security, the region can spear head organic agriculture which African peoples are familiar with (the poor of the region grow organically by default) as to become a net producer of organic agricultural products creating a niche market for itself. Since organic grain amaranth is not a transgenic crop and not industrially fortified with nutrients, it is unlikely to be opposed by NGO's and environmental groups. Indeed, these have played a key role in its dissemination to farmers, which may hasten revolutionalization of farming systems and dietary orientation to suit the new climatic conditions.

Hopefully, this paper can contribute to a new approach to tackling the future challenges of organic animal husbandry, one that recognizes the immense promise of organic grain amaranth and the PeoPLE model for developing countries.

Recommendations

The bottom line of this model is to reach a situation in which family farming and herding in the developing countries meet future demands for animal products without environmental damage. Strengthening and/or developing ecological, cultural and socially sound livestock systems is possible in changing climate, but it starts with understanding how to optimize the interactions between humanity and ecosystems.

The PeoPLE model is optimized by organic grain amaranth to create a holistic approach to sustainable development and demonstrates that the vision for enough, nutritious and safe food/feed and green energy secure communities, improved health and environment is certainly possible. However, it will not be attained without the adoption of a more coordinated and strategic approach, based on the support, input and involvement of governments, civil society, communities and the international community.

If integrated into the diets and landscapes of rural communities of sub-Saharan Africa, organic grain amaranth may provide practical tools to address the new challenges for organic animal husbandry and agriculture in the region due to climate change. Pro-active strategies for organic animal husbandry can be adopted by respective governments to increase options to build sustainable livelihoods systems that are in harmony with nature to support food/nutrition safety and security and the pursuit of inexpensive climate management of risks associated with diseases, pests and food safety contaminants.

Initiatives should be undertaken to implement a continental scheme, establish and strengthen model, information, education, and communication and training capacities. Specific strategies should be devised to increase technology development and deployment to create small-holder based African Green Revolution and transform agriculture into a highly productive, profitable and sustainable system to enable the region to be food, nutrition, green energy and livelihoods secure.

Conclusion

Experience by Strategic poverty alleviation systems-SPAS implementing the PeoPLE model has demonstrated that organic grain amaranth-based feeds holds great promise in addressing the future challenges of organic animal husbandry let alone the key global challenges for agriculture in sub-Saharan Africa and all that is needed is to upscale activities to the entire region. To assure energy security and help communities develop in a sustainable way, make the model, which has multiple benefits, available now. This is a model with low external inputs or capital outlays and utilizes existing skills and knowledge which are optimized with existing local community resources.

Experience by Strategic poverty alleviation systems-SPAS implementing the PeoPLE model has demonstrated it holds the greatest promise in tackling the future challenges of organic animal husbandry in Sub-Saharan Africa for food/nutrition security and climate change mitigation and adaptation and all that is needed is to upscale activities to the entire region. To assure energy security and help communities develop in a sustainable way, it is important to make the model, which has multiple benefits, available now. This is a model with low external inputs or capital outlays and utilizes existing skills and knowledge which are optimized with existing local community resources.

Vision for sustainable energy and food/nutrition security is certainly possible, but will only be attained with adoption of a coordinated and strategic approach, based on the support, input and involvement of government, industry and the donor community. Integrating grain amaranth technology into the interaction between crops, animals and the environment provides a dependable path towards food/nutrition, green energy, water and livelihoods secure future in a changing climate. Besides, organic grain amaranth appears to be the most potent tool in our policy arsenal for achieving energy/food security, and rapid development, with an environmental advantage.

But while this model seems to hold great promise in contributing to food/nutrition security and sustainable development in changing climate, countries of Sub-Saharan Africa will need to develop a pan African policy framework on organic agriculture to feed on critical decisions on climate change mitigation and adaptation at low cost and poverty reduction to enhance the quality of life and addressing the needs of communities in their specific circumstances.

And while the PeoPLE model provides a holistic approach to sustainable development, governments will play a critical role in creating enabling policy frameworks on organic agriculture to meet the short term needs of current generation but also provide a framework for long term needs of future generations and sustainability.

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Amaranth seeds are a natural source of nutraceuticals compounds such as bio-peptides and phytochemical compounds. This knowledge will increase their importance as a potential source of potent antioxidants in the human diet.

Novel and underutilized feed resources – potential for use in organic and low input dairy production

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Abstract

This literature review evaluates the potential of a range of by-products from the agricultural, greenhouse, forestry, food processing and bioenergy sectors and agro-forestry systems as feed components in organic and low input dairy systems. The variability of the raw materials further modified by differing processing methods results in wide range of feed materials available. Innovative use of novel and underutilized feed resources has the potential to improve the efficiency of the "green economy".

Key words: agro-forestry, by-product, distillers' grain, oilseed meal, vegetable waste

Introduction

Organic and low input dairy production relies on feeds, especially forages, produced on-farm. To sustain milk production, feed supplements are typically used either for cattle, sheep or goats to balance the rations in terms of e.g. energy and protein supply and intake of essential nutrients. The availability and quality of forages can differ greatly both within and between years due to seasonal changes resulting in differing needs of supplemental feeds. By-products from agricultural, forestry, food processing and bioenergy sectors can be considered sustainable sources to fulfill the need of additional feeds for milk producing animals, and agro-forestry systems may provide additional roughage in the diet. Ruminants are particularly suited for converting fibrous by-products into valuable animal products. This work is part of an EU FP7 funded project "Sustainable organic and low input dairying" (SOLID, KBBE.2010.1.2-02, www.solidairy.eu).

Results and Discussion

The feeds selected to review were evaluated to be novel or underutilized, i.e. having potential to contribute to the future success of organic and low input dairy production. This review showed a wide variability in the potential novel and underutilized feed materials to be used in organic and low input dairy systems. An overview of the reviewed feeds is presented in Table 1.

The **meals obtained after the extraction of oil from Camelina, Crambe or Safflower seeds** are good options for complementing forage-based diets of ruminants within organic and low-input systems. While they can be generally described as protein-rich feeds, they also contain interesting concentrations of residual oil which contributes to their energy value and may have positive effects on milk quality. Camelina, Crambe and Safflower are resilient and rather low-input species which might be cultivated by organic/low input dairy farmers e.g. within business arrangements with oil-extracting factories. Although the available quantities of the by-products are currently small, they are likely to increase according to many authors following the current trends in bioenergy and food industry sectors.

Table 1. A subjective assessment based on literature review of various novel and underutilized feedstuffs as supplements in organic and low input dairy production. A minus (-) includes negative and a plus (+) positive effects whereas a question mark (?) indicates lack of knowledge.

Feed	Quantit. significance	High energy value	High protein value	Effect on milk quality	Effect on animal health	Lack of antinutrit. factors	Ease of processing	Ease of preser-vation	Suitability for organic production	Suitability for low input
Camelina meal	-	+	++	+	?	+	+	+	++	+
Crambe meal	-	+	++	-	-	-	+	+	+	+
Safflower meal	-	+	+	+	?	?	+	+	++	+
Reduced fat distillers grains	++	+	+	+	?	+	--	+	?	-
High protein distillers grains	+	+	++	+	?	+	--	+	?	-
Whole rapeseeds (on-farm)	+	++	++	+	?	-	+	+	+	++
Rapeseed expeller (on-farm)	+	++	++	+	?	-	-	+	+	++
Lupin by-products	-	++	++	+	?	-	+	+	++	++
Pea, bean, chickpea and lentils	+	+	+	+	?	+	+	+	++	+
Buckwheat, mustard, Canary seed	-	?	?	?	?	-	?	+	?	+
Olive leaves	++	+	-	+	-	-	+	+	-	++
Olive cake	++	++	-	+	+	-	-	-	-	++
Tomato pomace	++	++	+	++	?	+	-	-	-	++
Wood by-products	-- / ?	-/+	--	-/+	?	+	--	--	--	-
Agro-forestry	+	-/+	-	?	?	-	+	-	++	++

High-protein and low-fat distillers' grains emerged on the feedstuff market as a result of the processing factories tendency to extract as much as possible from the cereals (e.g. oil) and to diversify and add value to their by-products in order to meet the farmers' requests (e.g. the case of high-protein distillers' grains). These two by-products are likely to be followed by others, as a result of the dynamic evolution of the industry (e.g. secondary fermentation by-products), whose feeding value and effects on animal performance have not yet been properly assessed. High-protein and low-fat distillers' grains are high-protein feeds and might look less suitable for organic and low-input systems (assuming the production level is lower). However, they are good options for complementing the basal diets (e.g. cheaper source of rumen undegradable protein). An issue may be their contamination with harmful substances (e.g. mycotoxins), if the quality control of the cereals is not well regulated.

By-products from the pulse industry are good sources of protein and may by quantitatively important. Legumes are also able to fix nitrogen from the atmosphere giving them an essential role in the nitrogen supply to the organic farming. Moreover, some of these species may be cultivated by the farmer for on-farm use. A general drawback is the high rumen degradability of the protein in leguminous plants and the methods to increase the degradability are not always available to the farmers. The minor species (**buckwheat, mustard and Canary seed**) are scarcely characterized from a nutritional point of view although they may have significance as local feed resources. **Full-**

fat or locally extracted rapeseed cakes offer an on-farm produced high quality energy and protein supplement, which may well fit some organic and low-input dairy production systems. However, if rapeseed varieties intended for biodiesel production are used, the glucosinolate concentration in the cake may be harmful when consumed by livestock.

Olive leaves are collected together with olives at harvesting and are fibrous forage with low digestibility of crude protein in particular, and they promote very poor rumen fermentation. However, if adequately supplemented, they may be successfully used in animal diets. In lactating animals olive leaves result in an improvement in milk fat quality compared to diets based on conventional forages. However, more research is needed to assess the potential toxic effect of the high levels of copper found in olive leaves. The use of **olive cakes** in ruminant diets promotes different responses in rumen fermentation depending on the method of administration and the proportion in the diet. **Tomato wastes** offer a cheap source of energy and protein with high digestibility; however, the high moisture content makes the processing and storing challenging. When tomato wastes are ensiled together with other ingredients that provide easily fermentable carbohydrates (corn, apple pomace etc.), they may replace conventional forages without affecting milk production and composition in dairy cattle.

Carbohydrates from wood are available in large quantities, but because of very low digestibility of intact wood, heavy processing is required to improve their digestibility. The feasibility of using wood derived carbohydrates as energy sources in dairy diets depends on the cost of processing, preservation and logistics as well as on the supply chain acceptance, while there are no legal or biological obstacles in using them.

The unpredictability and variability of the **feed supply from agro-forestry** systems is one of the biggest challenges to their use at present as there are many different species available and the seasonal variation is so large. However, fast growing trees provide the potential for a large quantity of material. Another challenge is the lack of structured processing and distribution, and mechanisation for harvesting/handling - both for preparation and feeding. Valorisation of the silvopastoral systems requires a change in the mindset of the farmer and several practical issues in production system need to be solved. Much of the work to date has been done with tropical trees and information from temperate climates in Central and Northern Europe is limited.

The overview of the reviewed literature demonstrates the wide variation in the potential novel and underutilized feed resources to be used in organic and low input dairy systems, and in many cases also the lack of scientific knowledge which may prevent the efficient use of some feeds. The variation is caused by the diversity of the raw materials and variability in raw material composition, which are further diversified by the processing technologies applied. General assessments of nutritional or economic value are not possible as they vary from product-to-product. The variability in the geographical production of some of the by-products implies that they might have to be managed locally to ensure feasibility of use. Specific local programs would need to be developed to raise the awareness and to build the capacity of local farmers and stakeholders to introduce the use of such products in the feeding of ruminants. On the other hand, the variability in the feed materials may provide opportunities to find suitable supplements in terms of e.g. energy, protein and mineral concentrations to various situations depending on the type of animals and basal feeding. By-product feeds often have a high moisture content and transportation and/or preservation may significantly increase the cost of the feeds, emphasizing the importance of logistics. Preservation also plays an important role in ensuring safety of the whole food-production chain. Harvesting, preservation and transportation questions also need to be solved for agro-forestry based systems before they can be adopted in wider use.

The amount and quality of feeds offered to animals have significant effects on feed intake and milk production, which largely dictates the economics of production, but they may also influence milk quality and health of the animals. This review was unable to draw any clear-cut conclusions on the latter because of lack of information and large variability among and within feed materials reviewed, but some general concepts can be identified. Generally, modifications in the quality of animal products can be achieved through diet manipulation. For ruminants, the microbial activity in the rumen diminishes the effect of diet composition on the quality of the animal products compared to single-stomached animals. Still, several feeds traits, e.g. the residual fat concentration and profile of fatty acids, are relevant enough to influence quality of animal products, e.g. milk fatty acids profile. If the feeds contain some bioactive compounds such as tannins or salicylic acid in fodder trees, or some harmful substances or residues, substantial responses can sometimes occur in animal health or product quality. The key issue in controlling the potential positive or negative effects on product quality and animal health is to know the chemical composition and concentrations of bioactive compounds in the particular feed material used as well as their fate in the rumen. According to EU legislation, the producer of the feed material is responsible for the safety of the product emphasizing the need of knowledge of potential deleterious effects of feeds.

Legislation and public opinion set rather strict rules on the acceptability of feeds, particularly in organic but also in low input conventional dairy systems. Highly processed or globally traded feed materials are likely to be considered undesirable even if they would be nutritionally and economically feasible and this can be an obstacle in using feeds like the new distillers' grain products. Increasing demand of processed organic foods for human consumption gives rise to the availability of organically labelled by-products as well. This may favour the broadening of the feed supply for organic livestock. The possibility to use the by-products as organic feedstuffs should also increase their economic value compared to alternative uses such as consumption as conventional feedstuffs or in bioenergy production.

In some cases, particularly in adopting truly novel feeding practices such as agro-forestry systems in intensive temperate production systems, or including novel industrial by-product feed ingredients, the socio-economic aspects play an important role. The role of biological research in such cases is to provide reliable information of the feeding value and safety of the new feeding methods. It is ultimately up to the whole supply-chain, consumers and authorities to decide which new feeding methods will be taken into use. The innovative and conservative approaches need to find a sound balance, and solutions are likely to vary in different regions. A broad-minded approach to valorise novel or under-utilized feed materials may also be valuable in cases of a crisis situation when availability of conventional feeds would be impaired.

Suggestions to tackle the future challenges of organic animal husbandry

Innovative use of novel and underutilized feed resources has the potential to improve the efficiency of the "green economy". There is a particular chance for increasing the supply of new feed supplements acceptable in organic production, and this would in many cases also allow for an increase in the supply of organic milk.

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Future food safety and security

(Foto: BLE 2004)

Bioactive properties of organic milk fat

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Key words: organic milk, bioactive, antioxidant, functional fatty acids, fat soluble vitamins

Introduction

Cow's milk contains range of biologically active substances with antioxidant properties, which reduce the risk of many diseases i.e. arteriosclerosis, cancer, Alzheimer's, and protect the body against environmental pollutants and free radicals. In milk's fat, tthese are i.e. functional fatty acids (FFA): butyric, transvaccenic, oleic, rumenic (conjugated linolenic acid c9 t11 isomer), omega-3 (α-linolenic, eicosapentaenoic, docosapentaenoic, docosaheksaenoic) and omega-6 FA (linoleic, arachidonic), and fat soluble vitamins: A – α-retinol, E – α-tocopherol, carotenoids (mainly β-carotene).

Researchers from many countries found more bioactive, antioxidative compounds in organic milk, especially from cows fed fresh grass (Bloksma 2008, Butler *et al.* 2008, Steinshamn 2008, Butler 2009, Kusche 2009, Slots *et al.* 2009, Lairon 2010, Larsen *et al.* 2010, O'Donnel 2010, Butler *et al.* 2011, Fall and Emanuelson 2011). In Poland only Kuczyńska (2011) widely compared bioactive properties of milk from organic and conventional system.

TAS (Total Antioxidative Status) dtermine the level of antioxidant compounds in the milk in a very short time, and it is used to monitor general state of the system's prevention to the oxidation processes (Kuczyńska 2011).

The aim of the study was to determine relationships between functional fatty acids (FFA), fat soluble vitamins (A, E), β-carotene and total antioxidative status (TAS) of organic milk in two feeding seasons.

Methods and materials

FFA, vitamins (A, E), β-carotene and TAS were investigated in 382 organic milk samples. Samples were collected every two months in 2009-2011, from 108 Holstein – Friesian primiparous cows, kept on four organic certified farms, in the North of Poland. Cows were kept in the free stall barns and grazed on grass-clover pastures during outdoor season (May to September) and fed grass-legume silages, hay and concentrate during indoor season (October to April). Milk fat was extracted and chromatographic methods were used to determine FFA (by gas chromatography - GC) and vitamins (by high performance liquid chromatography - HPLC) content. TAS was determined in whole milk by Randox kit, using ELISA reader. Statistics were performed using SAS software.

Results and Conclusions

Organic milk from outdoor season had significantly higher protein (P<0.01) and lower free FA (P<0.001) content comparing to indoor season (table 1).

Table 1. Milk performance, cytological quality and chemical composition in feeding seasons and total

	Indor (N=241) Mean (SD)	Pasture (N=141) Mean (SD)	Total (N=382) Mean (SD)
daily milk yield [kg/day]	17.50 (4.77)	17.55 (4.01)	17.52 (4.50)
SCC [103/ml]	250.24	218.41	238.49
fat [g/kg of milk]	41.82 (10.03)	40.78 (9.90)	41.44 (9.98)
protein [g/kg of milk]	30.28 A (4.30)	33.59 B (3.12)	30.68 (3.93)
casein [g/kg of milk]	22.53 (3.15)	23.07 (3.40)	22.73 (3.25)
lactose [g/kg of milk]	47.84 (2.48)	47.45 (1.82)	47.70 (2.26)
DM [g/kg of milk]	128.07 (16.41)	127.68 (15.83)	127.93 (16.18)
urea [mg/l]	191.17 (69.87)	204.68 (65.17)	196.16 (68.40)
free FA [mmol/l]	0.765 A (0.322)	0.580 B (0.354)	0.697 (0.346)

SCC – somatic cell count; DM – dry matter; A, B – differences significant at P<0.01;
a, b - differences significant at P<0.05

Fat from organic milk produced on pasture had significantly higher (P<0.001) content of bioactive substances (by 32% for FFA, by 58% for vitamin A, by 108% for vitamin E and by 88% for β-carotene). TAS in milk from pasture was higher by 32% than in milk from winter, conserved feeds (table 2).

Table 2. Selected antioxidative properties of organic milk in feeding seasons and total

	Indor (N=244) Mean (SD)	Pasture (N=144) Mean (SD)	Total (N=388) Mean (SD)
TAS [mmol/l]	1.54 A (0.49)	2.02 B (0.67)	1.72 (0.61)
FFA [g/100g of milk fat]	26.55 A (4.02)	35.15 B (5.43)	29.74 (6.19)
beta carotene [mg/l]	0.34 A (0.21)	0.64 B (0.43)	0.46 (0.34)
vitamin A [mg/l]	0.65 A (0.44)	1.03 B (0.44)	0.79 (0.48)
vitamin E [mg/l]	0.87 A (0.31)	1.82 B (0.58)	1.22 (0.63)

A, B – differences significant at P<0.01
a, b - differences significant at P<0.05

TAS was significantly (P<0.001) positively correlated (about 0.3) with the content of FFA, vitamin E and β-carotene (table 3).

Table 3. Correlations between selected antioxidative properties of organic milk

	TAS [mmol/l]	**FFA** [g/100g of milk fat]	**β-carotene** [mg/l]	**vitamin A** [mg/l]	**vitamin E** [mg/l]
TAS [mmol/l]	X	0.34***	0.32***	0.07	0.26***
FFA [g/100g of milk fat]	0.34***	X	0.42***	0.28***	0.48***
β-carotene [mg/l]	0.32***	0.42***	X	0.41***	0.47***
vitamin A [mg/l]	0.07	0.28***	0.41***	X	0.57***
vitamin E [mg/l]	0.26***	0.48***	0.47***	0.57***	X

*** – differences significant at P<0.001; ** – differences significant at P<0.01; * - differences significant at P<0.05

Tijerina-Sáenz et al. (2009) also found positive correlation of antioxidant capacity (measured by oxygen radical absorbance capacity assay with fluorescein) with vitamin E ($P<0.05$) in women milk. Di Renzo et al. (2007) found that eating organic food increase human blood plasma total antioxidant capacity, because of its higher antioxidative and bioactive values. In case of milk it was 11% comparing to conventional. Thus obtained results confirm that organic milk from grazing cows from Poland is also a valuable source of bioactive, antioxidative substances, beneficial for human health.

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"Feed less Food"
Low input strategy results in better milk quality in organic dairy goats

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Abstract

More than a third of the world's grain harvest is used to feed animals. According to the environmental agency of the UN, losses of calories by bad conversion factor of grain into animal food could theoretically feed 3.5 billion people. This shows that the production of animal protein is very energy consuming, especially when concentrates are fed to ruminants. Until today, feeding of ruminants even in organic dairy farming is based on concentrates, accepting overexploitation of resources and negative effects on animal health. In contrast to the received opinion of "a lot helps lot", organic dairy production in Western Europe is trying to do the very reverse: Feeding less concentrates. This is in line with the evolution of ruminants to an excellent roughage converter, especially dairy goats are destined to produce high quality milk at a minimum amount of concentrates in their ration. In our study we wanted to evaluate effects of a low concentrate diet of maximum 10 % of the total annual dry matter intake per dairy goat (KF10) compared to a 40 % diet (KF40). As was expected, milk yield of KF10-group was lower, but fatty acid composition was more valuable using less concentrates. Omega-3 fatty acid and conjugated linoleic acid (CLA) were found to be significantly higher in the milk of the KF10 dairy goat group throughout the whole lactation. Thus, less can be more in terms of quality and taste.

Key words: dairy goats, world population, feeding concentrates, milk yield, animal welfare

Introduction

To provide the rising world population with sufficient and high quality food in the future, we must ensure that food production can be increased gradually (Rahmann and Oppermann 2010). According to the FAO, an increase in food production of only 20 % can be achieved through an expansion of agricultural land. The remaining 80 % of food production must be met by increasing yields of agricultural livestock production systems (Rahmann and Oppermann 2010).

Currently 11 % of the global land is arable land. That is a total of 1.4 billion hectares, of which annually about one billion tons of concentrates or one third of the world's grain harvest respectively, are used in animal production (Rahmann and Oppermann, 2010; Notz 2010). According to Steinfeld (2006), this quantity is sufficient to feed about 15 billion chickens, 1.7 billion sheep and goats, 1.4 billion cattle and 0.9 billion pigs. The increasing demand of producing bio-energy on farm land is another deficiency area regarding global food supply. For example, the use of grain and corn for food and feed increased since 2000 by 4 % and 7 %. In contrast, industrial use of cereals for bio-energy production increased at the same time by 25% (Brockmeyer and Klepper, 2008). In the U.S., 30 % of the corn harvest is used for the production of bioethanol (Brockmeyer and Klepper 2008).

Ruminants can be divided into three feeding types: concentrate selector (CS), grass and roughage eaters (GR) and intermediate types (IM) (Hofmann 1989). CS-types include deer and elk, whereas cattle and sheep are all grazers (GR). Goats together with chamois, red deer, fallow deer belong to the IM types. IM-types are able to browse bushes and even trees besides consuming traditional ruminant diets. The additional source of food ingredients also widens up the goat diet by tannins, which cannot be utilized by GR-types. Goats are generally very selective in choosing food with ingredients of the highest quality, thereby optimizing their roughage ration. Due to their anatomical advantages and excellent roughage conversion, goats are destined to produce high quality milk at a minimum amount of concentrates in their ration. Thus, our major goal in this study was to measure effects of a low concentrate diet on fatty acid composition and milk yield of organic dairy goats.

Material and Methods

In 2011, 50 dairy goats of our experimental herd were divided into two homogenous groups of 25 goats each, considering parity, milk yield and body weight of individuals. One group (KF10) was fed according to the Bio Suisse guidelines with a 10% concentrate proportion of annual ration and the other group (KF40) in accordance with the requirements of the EC regulation on organic farming with a 40% concentrate portion of the annual ration fed. The concentrate consisted of 100 % wheat grist. Mineral licks were made available. Part-time grazing was offered to both groups during the growing season. During the entire lactation there was extensive monitoring of the herd. According to the standards, monthly milk recordings and bodyweight controls were made. Every two weeks, feed samples were taken (concentrate, hay and fresh grass) and analyzed. Milk samples were taken weekly and monthly to assess milk composition. Data recordings were statistically analysed using SAS 9.3 (SAS Institute Inc.). Test of normality was done by calculating Shapiro-Wilk-test (proc univariate). Where appropriate, t-test or non-parametric test procedures were used to compare group means, box-whisker plots were created to illustrate data distributions.

Results

Figure 1 shows the annual performance regarding milk yield, fat and protein content. The fatty acid compositions are of monthly samples. Milk yield of KF10 was 68.8 kg, and fat and protein contents were respectively 4.1 and 2.4 kg lower compared to KF40. The annual amount of concentrates for KF10 was 66 kg/goat, whereas it was 259 kg/goat for KF40.

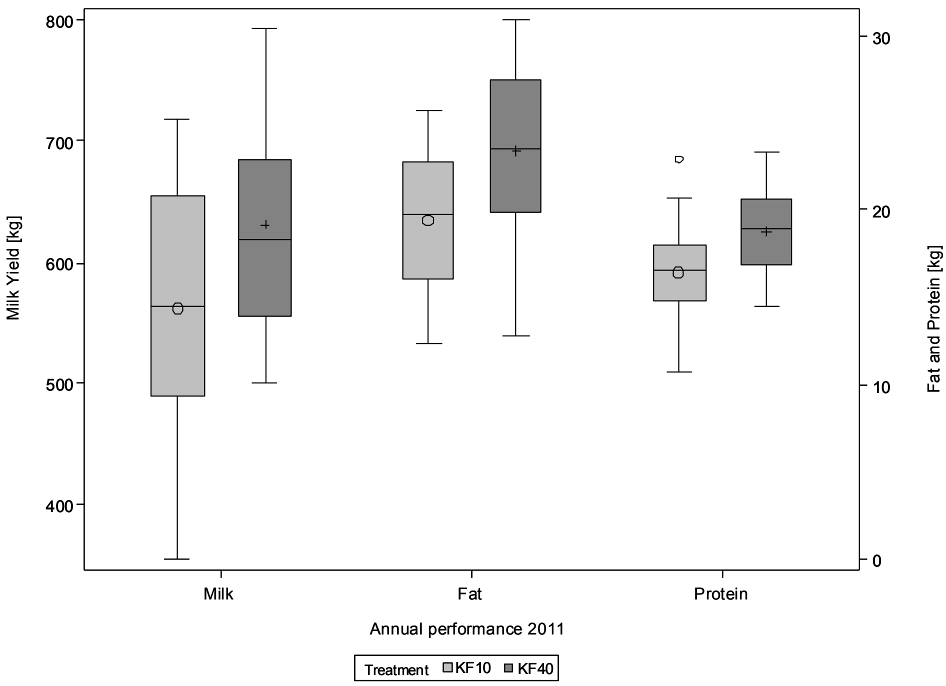

Figure 1. Annual milk, fat and protein yield of goats fed according to Bio Suisse guidelines (KF10) and EC regulation on organic farming (KF40).

The content of Omega-3 fatty acid as described in Figure 2 shows higher Omega-3 values of KF10 at every sampling date. The difference of omega-3 content between KF10 and KF40 was highly significant during the whole lactation period.

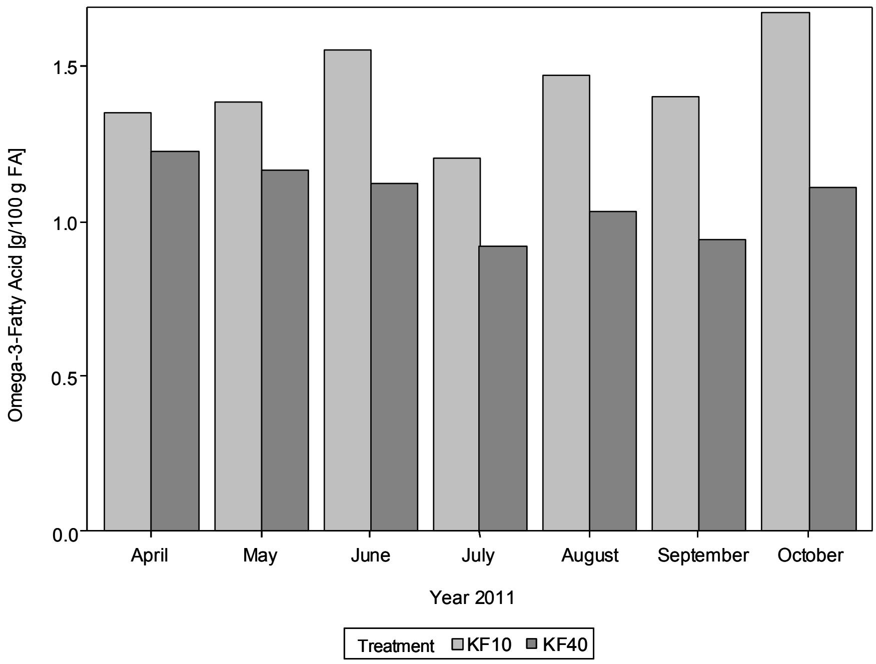

Figure 2. Omega-3 fatty acid content in milk of organic dairy goats fed according to Bio Suisse guidelines (KF10) and EC regulation on organic farming (KF40).

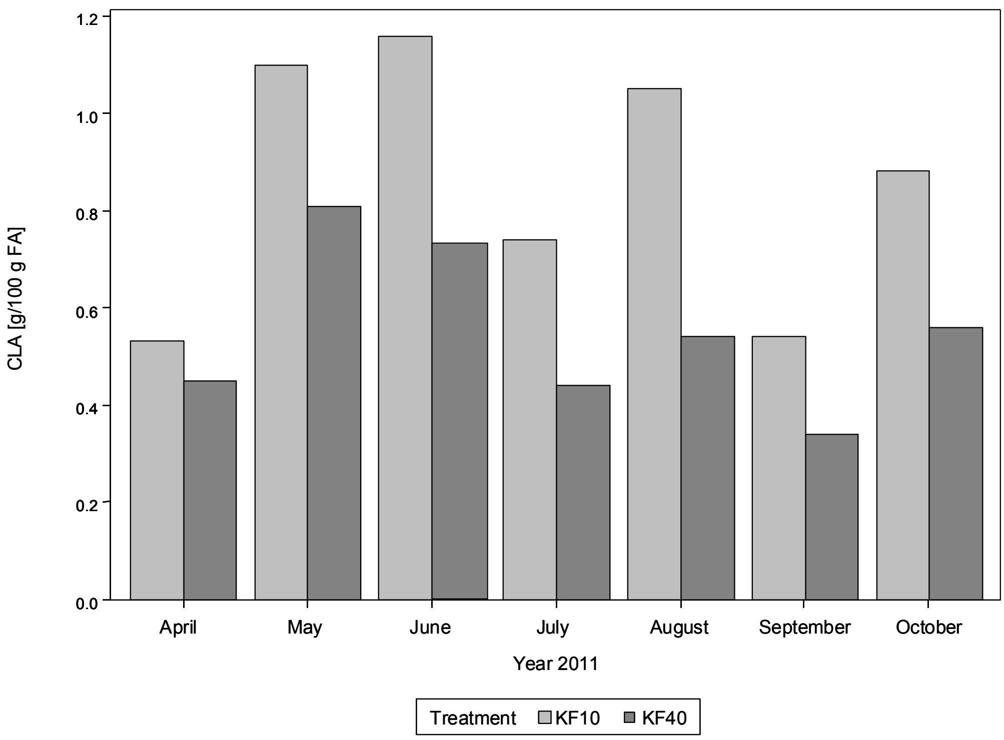

Figure 3. Conjugated linoleic acid content in milk of organic dairy goats fed according to Bio Suisse guidelines (KF10) and EC regulation on organic farming (KF40).

Conjugated linoleic acid content (CLA, C18:2 c9t11), as an example of fatty acids analyzed in this study, was higher in KF10 throughout the whole lactation period (Figure 2). The slight depression for both groups in September was due to indoor housing and hay feeding. Body weight of goats was significantly lower for KF10 during the last three months of lactation. Health status was checked regularly for both groups and did not show any difference.

Conclusions

The results indicate that less concentrate feeding is feasible. Feeding less concentrates results in a better quality of the final product milk regarding favourable Omega-3- and CLA-content.

Suggestions to tackle the future challenges of organic animal husbandry

Future studies should quantify selective abilities of goats as a base of breeding selection. Breeding strategy regarding low concentrate should consider roughage conversion ability of dairy goats, in order to select the best roughage converting goats, not concentrate adopted goats.

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Organic for Whom : the dilemma faced by small livestock producers in developing countries

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Abstract

Till a few decades ago almost all the livestock produce in remote locations of developing countries like India was organic or more precisely free of chemicals. Poor outreach of modern veterinary and agricultural extension services and limited markets ensured that antibiotics, pesticides and other chemicals were outside the reach of small and marginal producers. However, in the recent past, the incisive penetration of rural markets by the chemical and pharmaceutical industry as well as efforts by well meaning but non critical development agencies, has led to the rampant use of antibiotics and chemicals. In our study on practices of small livestock producers we observe that indiscriminate use of chemicals in both farming systems and livestock production has led not only to new animal health problems but also that these livestock products are perhaps no more safe for consumption.

Ironically, quality organic produce has gradually become confined to a few specialized farms which are able to maintain strict controls. Small producers in an attempt to maximize profits and keep their production systems alive use a heady mix of chemicals and poor practices. Produce from these kinds of units while not being rejected are absorbed by an ever growing group of consumers most of whom are either too poor or not informed about issues of food safety posing enormous environment and public health concerns.

The challenge before us is to bring back, safe, ecological and organic farming practices to small farmers. This would require multiple interventions including changes in the current food safety regimes, laws and policies, introduction of food safety and critical public health concerns at the level of veterinary colleges and animal science departments, sensitising NGO's and extension workers and the large scale training of small farmers.

Key words: organic livestock produce, food safety, small livestock producers

Introduction

The nutritional well being of any society is dependant on the farming practices prevalent from where the food is sourced. At present, most of the food that Indians eat is still sourced from within the country including livestock products. However, unlike in the past when it was largely free of chemicals a lot of livestock products today can no more be termed **organic** or even safe as they contain a large number of chemicals, some toxic others not so harmful. This change has largely happened due to the following reasons i) greater use of pesticides and fertilisers in feed sources, the increased penetration of the market with pharmaceutical preparations and chemicals which are used directly in the animal as treatment or to cure a particular condition and finally the addition of chemicals as preservatives or even adulterants to livestock products prior to sale. If one were to trace the organic value chain of different products one would notice that small and ordinary farmers are no more producing safe food. This is the bulk of food consumed by citizens in the country and is likely to get only worse unless critical safety measures are taken.

Material and methodology

For this paper I will analyze four livestock based food products and discuss them in some depth. The livestock food products most consumed in India are Poultry meat and eggs, milk of dairy cows and buffalos and small ruminant meat. Eggs and milk are both considered important for nutrition especially of growing childern, lactating and pregnant mothers, elderly patients. They feature in various nutritional programmes such as mid day meal schemes and other popular schemes to provide nutrition to vulnerable groups. I will analyse these production streams to trace the organic value and safety for consumption especially by poor communities.

Post Independance, malnutrition amongst the poorer sections of society spurred development programmes in the livestock sector to be able to provide protien at a low cost to vulnerable populations. Today, India is amongst the top producers of eggs, milk and small ruminant meat but the quality is questionable. It is not merely bacterial contamination but also the presence of residues. The challenge of safe and sufficient food for our growing population remains.

Value stream 1. Poultry eggs and meat.

Till some years previously, back yard poultry was extremely popular in the country and people in rural areas only consumed fresh eggs and meat produced by local hens.In the past two decades there has been a tremendous spurt in the industrialised poultry sector. India is the fourth largest producer of eggs and 9th largest producer of poultry meat in the world. Integrated operations of a few poultry companies have spread through large parts of the country and a large number of intensive and semi intensive farms starting from small units of 100 – 500 birds to as large as over a million birds dot the rural landscape where once backyard poultry ruled. Today meat and eggs from industrialised farms are available even in small villages and for a lower price than that produced by local back yard chicken. It is estimated that 70% of the produce is from industrialised sources and only 30% from backyard poultry. Indeed many more people today are eating eggs and poultry meat and more often but are obtaining this from industrial sources. Chicken meat is the cheapest meat available in the country and the industry hopes to be able to keep cheap frozen meat accessible to all through the super market chain.

This phenomenal growth has to be matched with phenomenal inputs. Mainly of feed, water and other additives to ensure optimal growth rates. At present the major companies source their feeds from within the country and agricultural land earlier meant for food crops for human consumption is gradually shifting to soya and maize to cater to the upwardly spiralling poultry industry. Poor farmers are shifting to contract farming of maize. It gets them money alright but this money has to be reinvested in maize again and to buy food which has seen inflationary price rises in the past few years. As yet genetically modified soya and Maize have not been approved by the Goverment of India for cultivation but they may still enter as India does not have a firm policy on banning GMO's.

In a detailed study done on egg powder export to Europe we found that antibiotics like tetracycline are still regularly added to feed ingredients as growth promoters. Besides this coccidiostats, anti mycoplasmal drugs are also given regularly upto the age of 8 weeks Many of these are continued under the name of "gut conditioners"or "gut health boosters". While they should normally be withdrawn 72 hours prior to slaughter these norms are often ignored.

While the larger poultry farms are able to provide animals with necessary space the smaller ones tend to crowd their animals into small cages increasing the risk of disease. The anti stress medicines and antibiotics are then increased to ward of disease.

Since material for export to the EU or Japan requires extremely high standards only a few companies in India which can meet those standards acheive that grade. The rest of the produce is managed on the principle of maximising profits. Culled and discarded products are not always diposed off but enter the market place of the poor who do not have a choice over what they eat. Thus meat and eggs which are diseased, discarded or found to contain residue are sold at low prices and consumed by the poor.

Small ruminant meat

Small ruminant production in India is still mainly under pastoral production systems. Earlier, shepherds would graze their animals in remote areas such as forests and fields and thus did not have access to modern medicine. As the commons shrink and grazing lands and forests disappear, sheep are increasingly dependant on agricultural crop residues for nutrition. All manner of residues from those of Bt cotton to wheat and rice sprayed with chemicals to keep away pests form a significant part of small ruminant nutrition. Bt cotton is known to cause various problems in sheep. Sheep are also fed commercial concentrates so they gain weight early. Many of these have additives as preservatives.

The aggresive marketing of pharmaceuticals by companies has ensured that shepherds located even in distant areas are approached by medical representatives and informed about new drugs.They entice shepherds into using their products by offering huge discounts. A large number of shepherds are not literate and tend to recognise medicines merely through the colour, shape and design on labels. Many of these new medicines work like magic the first time and shepherds get into the addictive habit of relying on these medicines next time they have a problem. In those situations their normal practice then is to approach a chemists shop nearest to their area of migration and ask for a medicine either by showing the previous bottle they had or by asking the chemist for advise to address the problem they are facing. The chemist who has no knowledge of animal medicines then prescribes whatever the pharmaceutical companies have recently promoted. Thus, there is unquantified use of deworming medicines like Nilverm -a levamisole based anthelmentic, Closantel and Albendazole. All these are regularaly administered often more times than necessary and shepherds have even reported a close correlation between use of Nilverm and abortions in their ewes. They also regularly use a large number of antibiotics such as Enrofloxacin, ciprofloxacin and Terramycin to cure minor ailments such as non specific fevers, anorexia and non specific diarrhea. For most of these compounds, the dosages are not adhered to and animals are inevitably under dosed or over dosed. As shepherds barely know about antibiotic dosage they have no notion of concepts such as antibiotic withdrawal policy before sale.

Sale of sheep happens on market days or when there is distress or panic due to disease, drought or other stress. Animals are sold to traders or butchers who select animals based on size and perhaps on condition but do not really check other details about past diseases or medication used.

These animals enter butchers shops, large slaughter houses, retail markets, super markets and are even exported to countries whose laws may not be as stringent as Europe or Japan.

Milk

India is amongst the largest producers of milk in the world. production systems vary widely from migratory pastoral production systems of anywhere from 50 – 100 animals to small holders holding of just one or two animals to ultra modern state of the art dairy units with over 3000 cows.

As with small ruminants and poultry, feeding of animals is becoming an issue. Crop residues form the bulk of the diet of dairy animals. Paddy and wheat straw are often full of pesticide residues and the water in these tracts is also contaminated with pesticides residue. Studies done in Punjab state the presence of organic pesticides in butter acquired from different sources.

Cotton seed cake is an important part of the diet of dairy animals in India as it is reputed to increase the fat percent of milk which determines it's price. It is estimated that over 80% of the cotton in India is GM cotton. GM cotton is known to cause problems in cattle too and farmers resort to other medicines such as antibiotics to reduce the symptoms caused by Bt Cotton thereby componding the problem.

Except for the high end farms where cattle are maintained in pristine condition,in most other dairies in India,management of hygiene is a problem. Large quantities of water are required in dairies and the smaller units especially in chronic drought prone areas regularly face water shortages. Mastitis is a common problem. In a study done in Maharashtra it was found that 60% animals tested positive for mastitis. Mastitis is treated with antibiotics and usually there is no withdrawal regime followed. Subclinical mastitis often goes undetected and this milk normally enters the common pool. Since a large portion of the milk entering cooperatives is pasteurised and since Indians normally boil milk before consumption, microbes presnet in milk are often destroyed. However, boiling does not necessarily get rid of other residues. Besides antibiotics, oxytocin,other hormones, steroids, anti allergics also are frequently used to treat dairy animals and these too enter milk.

Milk is marketed both through the formal or organised and informal stream. At the point of sale Indian milk is usually tested for water and fat percentage to determine price but seldom for additives or residues. Milk contaminated with various residues and some adulterants easily finds it's way into a large amorphous market where it is bagged into plastic pouches and retailed through numerous distribution channels. Consumers are aware of the normal adulterants like water, urea sugar etc but are not informed about the problems which could potentially be generated with the presence of pestides and anti microbials

Results

From the examples above it is quite clear that a large number of chemicals and pesticides enter livestock products. Only exclusive farms can truly certify their products as organic. This exclusivity comes at a price. The high standards of welfare, hygiene and production require inputs of extremely high quality. Certification of products either as HACCP or ISO certified also come at a cost and is actually a value addition for the product. The prices of these products thus tend to be high and are therefore only available for export or for exclusive urban markets. The average consumer has to make do with products produced in average conditions of welfare, hygiene and production standards. The worst hit are probably the urban poor who have little choice of locations from where to shop especially when food prices have risen so much in the past few years.

Discussion

The right to food as defined by General Comment No. 12 of the United Nations Committee on Economic, Social and Cultural Rights (the body in charge of monitoring the implementation of the International Covenant on Economic, Social and Cultural Rights in those states which are party to it) is *"the availability of food in a quantity and quality sufficient to satisfy the dietary needs of individuals,* ***free from adverse substances****, and acceptable within a given culture; the accessibility of such food in ways that are sustainable and that do not interfere with the enjoyment of other human rights".* If this right has to be honoured then the present system of food production will have to change at various levels. Firstly, at the food and feed level there will have to be a very strict enforced on pesticide use The use of pesticides in the country has shot up enormously in the past few years and is in fact attributed to be one of the major reasons for rise in food production. In India a major portion of the pesticides used are insecticides which are quite lethal. There has been a recent move in the country to reduce fertiliser use in certain crops but this drive behind the greening of agriculture is not for food for Indian consumption but for food for export.. Despite a clarion call for bans on pesticides like endo sulfan from many environmental groups across the country the government in India has been slow to impose a strict ban. Certain other products like DDT and BHC while being banned across the world still find their way into use in the more mofussil areas and are used in anti malarial drives or to keep insects and pests away. Likewise lethal rodenticides enter granaries and store houses of food and fodder as a protection against rat infestation. Till recently, there was no regulation in India on the use of antibiotics in food animals such as poultry, dairy cows, and buffaloes raised for domestic consumption. Resistance to antibiotics is emerging as a new problem within the country and drug resistant Tuberculosis has been reported in certain parts of the country especially in poor areas. A couple of years back the India working group of the India Global Antibiotic resistance partnership alarmed by the extreme resistance to antibiotics within the country came up with a set of recommendation to regulate antibiotics in veterinary use. Some of their recommendations included :

i. the outlaw of use of antibiotics most important for human health in veterinary practice,

ii. The ban of non-therapeutic use of antibiotics in animals,

iii. the observance of a washout period/ withdrawal period before slaughter.

They also recommended that these be co-ordinated by an inter-sectoral committee. The same paper further mentioned the constraints to enforcement of these guidelines since multiple ministries would have to coordinate activities to make these regulations effective. They also recommended surveillance of antibiotic use and resistance by manufacturers of animal products; the education of stakeholders on appropriate use of antibiotics in food animals and finally reducing the need for antibiotics in animals through improved management. In April 2012 the Union Ministry of Health and Family Welfare in India issued a notification to regulate the use of antibiotics for livestock and aquaculture meant for food production. The amendment, inserted in the rule 97 of the Drugs and Cosmetics Act, has suggested that the antibiotics, which are used for therapeutic purposes in animals, should be labeled with the withdrawal period of the drug for the species for which it is intended for use. This amendment sets a time frame for which products should be kept out of the food chain; also known as the withdrawal period. While this is a welcome first step, implementing this is not going to be easy. Firstly the pharmaceutical companies will have to comply with labelling their drugs meant for veterinary use. Pharmacists and farmers must be educated about extra label use of these drugs along with their long term side effects Policies will also have to be put into place to ensure better livestock management practices including various legislations to do with animal welfare, animal transport, animal slaughter and animal health.

In India the livestock market is not yet a consumers market nor is it completely a producers market.Although the supply chains are short there are numerous areas where there are loop holes in policy which will have to be effectively plugged and stream lined. However, the burden of the cost of producing safe food should not be on the farmer alone as it will only increase the cost of production thereby denying millions of low priced but safe livestock based nutrition.

Suggestions to tackle the future challenges of organic animal husbandry

- Increased investments by the government for **chemical free** farming, organic agriculture and livestock rearing especially in dry land and semi arid areas. Properly managed the agriculture and livestock sector can not only feed the country but also provide jobs in the rural economy.
- Increased investment into research on chemical free farming
- Banning of further import of Genetically modified germplasm into India until proved safe for consumption beyond doubt
- Banning of harmful pesticides and strict controls and regulations enforcing these bans.
- Disincentives to chemical agriculture and industrial livestock farming which are also harmful from the Climate point of view
- Better planning of fodder for the livestock sector as the demand for livestock products goes up.
- Incentives for safe methods of insect and vector control to reduce pesticide use.
- Incentives for ethnoveterinary preparations to reduce antibiotic use
- More coordination between ministries of health, agriculture and commerce.
- Education of extension workers, students of agriculture animal and dairy science, veterinarians about the harmful effects of chemicals in our food and offering safe and viable alternatives.

Aspects of Treatments

(Foto: BLE 2004)

Grazing Strategies to Prevent Parasitism of Organic Dairy Calves

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Abstract

A project comparing the performance of two herds managed as a comparison between organic and conventional seasonal grassland dairy farming systems included an investigation into rearing organic young stock without the use of conventional anthelmintics. The number of infective larvae on pasture in New Zealand is typically biphasic with a high weather-dependent peak in autumn. The aim was to develop grazing strategies to avoid exposure of spring-born calves to this peak. Monitoring was carried out during the risk period using serum pepsinogen as a measure of the level of Ostertagia infestation and Faecal Egg Counts (FEC) with larval culture to assess the presence of Cooperia. All animals were weighed monthly. Monitoring of young stock was extended to 6 commercial organic dairy farms as part of a national project. It was concluded young stock can be reared successfully without anthelmintics by applying a grazing strategy suited to each farm.

Key words: parasitism, organic, Ostertagia, Cooperia

Introduction

Between 2001 and 2011, Massey University set up its Dairy Cattle Research Unit (DCRU) as a system comparison between organic and conventional farming. It was the only comparative grassland-based open grazing dairy study in the world. Although the project has ended, the organic unit continues to operate. The farm is a seasonal producer with calving from early August until mid-October. All cows are dried off by the end of May, the exact date depending largely on pasture availability.

The DCRU was split into two similar units. The organic unit covers an area of 20.4Ha while the conventional was 21.3Ha. There are on average 46 organic cows (2.26cows/Ha) and were 51 conventional (2.39cows/Ha). Both herds were a mix of Holstein-Friesian and crossbred cows. From August 2006, all organic dairy suppliers to Fonterra NZ Ltd were required to meet the standards set by the USDA National Organics Program. The project has been described in detail by Kelly et al (2006).

One of the objectives of the comparative trial was to develop grazing systems to enable minimisation or elimination of the use of anthelmintics during the rearing of young stock. This part of the study commenced in autumn 2006, young stock having previously been grazed off at a private farm. At the time there was also a change in breeding policy with the introduction of Jersey genetics into what had been a pure Friesian herd. The first crossbred calves were born in spring 2005. USDA standards forbid the routine use of anthelmintics, although, in emergencies, animals diagnosed as being clinically affected by parasitism may be treated with ivermectin.

The most important cattle gastrointestinal parasite in New Zealand is *Ostertagia ostertagi*, although *Cooperia* spp. may also have a significant effect in large numbers (Familton 2001). Dry summers and cool winters have a marked inhibitory effect on the rates of larval development. The number of infective larvae on pasture thus tends to be biphasic with a high weather-dependent peak in autumn. Warm, moist conditions are the most favourable for development with larval intake exacerbated if cattle are grazing low in the sward. The most susceptible animals are spring-born calves so it is important to avoid exposure of this group to the autumn peak. (Wilson et al 2007)

Materials and methodology

Monitoring was carried out during the risk period using serum pepsinogen as a measure of the level of *Ostertagia* infestation and Faecal Egg Counts (FEC) with larval culture to assess the presence of *Cooperia*. All animals were weighed monthly.

Management strategies evolved over 3 years. Ultimately calves were grazed on the milking platform until approximately 18 weeks of age then transferred to low-lying river flats that had previously been harvested for grass silage. The flats provided excellent summer grazing. However, when the autumn rains arrived, soil moisture levels rose rapidly and the calves were moved to an elevated terrace, some of which had previously been harvested for hay. Here pasture species consisted of a ryegrass/clover mix with added chicory and plantain. The calves were run at a very low stocking density and given supplementary feed if dry summer conditions had resulted in poor grass growth. By the end of May the milking herd was dried off and moved to the terrace while the calves were returned to the milking platform where they spent the winter grazing new grass and tidying up old pasture.

Monitoring of young stock (weighing, blood sampling and FEC) was extended to 6 commercial organic dairy farms as part of a national project from 2009 to 2011. Farmers were surveyed on management strategies to avoid internal parasitism.

Results

A moderate outbreak of ostertagiosis in 2006-born and a severe outbreak in 2007-born calves at DCRU prompted a review of grazing strategies. This experience demonstrated:

- the importance of preventing infestation in early autumn. Once it occurred, the consequent cycle of inappetance and poor immune response was very difficult to break without resorting to anthelmintics
- clinical effects were most apparent in calves that tended to be phenotypically Jersey
- the timing of the move from the flats to the terrace was found to be critical in prevention of disease. A 2 week delay after the start of the rains was sufficient to result in an outbreak.

From 2008 to 2011, the modified grazing policy as outlined above was strictly adhered to. Anthelmintic treatment was not necessary and growth rates were good to excellent with all animals easily meeting target weights at mating and calving.

Figure 1 charts the liveweights of calves born in 2007, which suffered an outbreak of ostertagiosis in autumn 2008, and the 2009-born calves which were subject to the modified grazing regime. The latter did not stay entirely parasite-free; low numbers of eggs were detected by FEC and there was brief episode of cooperiosis in 4 individuals in early winter 2010. However, there was no effect on growth rates. Note these are mean values – in April and August 2008, half the 2007-born calves were under target weight. Although both groups achieved target weights at mating and were equivalent at 19 months of age, the costs associated with the 2007-born group were significantly higher. These costs consisted of additional labour input, medications, supplementary feed and the death of one individual totalling an estimated extra $NZ55 per animal.

Young stock liveweights and parasite status were monitored on 6 commercial organic farms for 2 years as part of the Grow Organic Dairy (GOD) Project (Djikstra 2011). Changes in growth rates were linked with episodes of parasitism on all farms except two. Of these two, one farm had consistently low FEC and the other excellent growth rates despite a moderate peak in FEC. Three farms improved performance in the second year, two farms already performed well and one did not improve. Two farms (one in the first year and another in the second) contract grazed calves off-farm from the age of 10 months. In both cases, severe parasitism resulted.

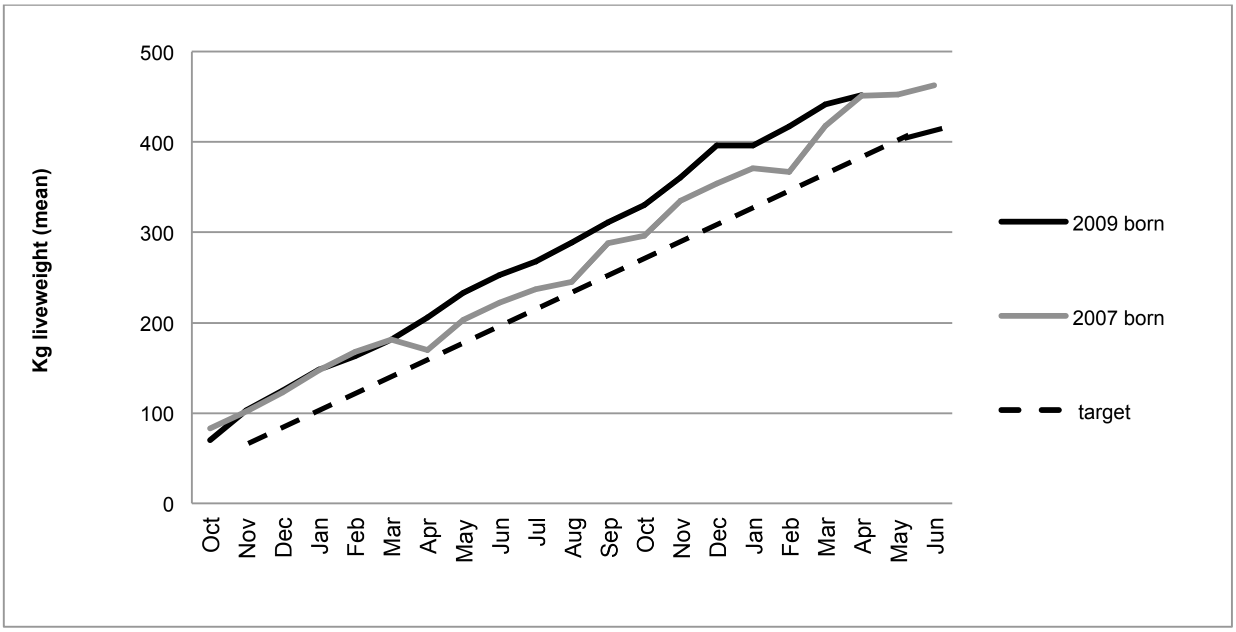

Figure 1. Liveweights of young stock at DCRU

It was noted there was a relatively low prevalence of *Ostertagia* on the monitored farms unless calves suffered a significant feed restriction. This contrasts with DCRU where it was the first species to emerge despite adequate feed availability. This effect may be linked to the geographical location of the commercial farms in the warmer north of the North Island where *Cooperia* larval numbers can be expected to build rapidly. Although every farmer had different grazing regimes, the results of a survey indicated that those with the least parasite problem had a number of strategies in common:

- Calves stayed on the milking platform as long as practicable (either rotated 10 -15 days in front of the cows or stocked 2-3 to a paddock)
- A clean bank of feed was created for autumn, primarily by cutting for supplement
- Older animals were often rotated behind the calves to 'clean up'
- Supplements were used if necessary (as worm-free feed and/or to prevent grazing too low)

Discussion

Management at DCRU revolved around minimising not only exposure to larvae, but also minimising disruption to normal farming grazing strategies. The most significant difference compared to conventional management was stocking densities during autumn and early winter. From late autumn, conventional calves tend to be strip grazed using electric fencing. This strategy enables most efficient use of available pasture as growth slows with cooler weather but also maximises the risk of high larval intakes if pasture is contaminated.

Chicory and plantain were included in the pasture primarily due to their resistance to drought. Additionally, Scales et al (1995) demonstrated a reduction in parasite burden of lambs fed chicory while Hoskin et al (1999) established a similar effect in young deer. However, it was not determined whether the presence of this species had any effect on the level of parasitism in the DCRU calves.

The GOD Project also functioned as a forum for participating farmers where each could benchmark performance against others in the group along with regional conventional farms. This appeared to assist participants in improving aspects of management.

Tackling Future Challenges

It is quite possible to rear good quality young stock without anthelmintics. However, success depends heavily on avoiding early exposure to the autumn larval peak and grazing strategies must revolve around that. This requires a good understanding of the biology of the parasites involved and tailoring that to an individual farm situation. Routine monitoring of serum pepsinogen is probably not practical in a commercial situation. However, blood testing a selection of calves at the critical point in early autumn and following up with FEC throughout the risk period should enable the development of a robust grazing strategy.

Climate change may result in conditions which speed larval development during the autumn. The emergence of widespread resistance by *Cooperia* to the benzimidazole and macrocyclic lactone groups of anthelmintics (which includes ivermectin) reinforces the importance of preventing significant parasitism. This applies not only to organic but also to conventional farms in New Zealand where levamisole may remain the only option for controlling cooperiosis.

Acknowledgements

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The contribution of Māori Traditional medicine to Animal Health on Organic Farms

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Abstract

The maintenance of animal health is often a major barrier to those farmers wishing to adopt organic farming practices. Adapting the principles of Māori traditional medicine (Te Rongoā) to stock health is a novel way to address the problem of supporting animal wellbeing. New Zealand has a large natural pharmacopeia, with a diverse flora comprising over 1,900 species of indigenous vascular plants. Complementing this diversity is a wealth of traditional knowledge as to the use of plants for human health. Te Rongoā is holistic and encompasses the associations between mind, spirit, body and the land, connections that are equally vital for sustainable farm management. Te Putahi, a 450ha sheep and beef farm, links research to reality. Drawing from Rongoā provides the potential for low-cost maintenance of stock health while also addressing environmental concerns, bolstering biodiversity and the resilience of the farm. The diversity of Rongoā species available provides multiple benefits in addition to the promotion of stock health, such as helping to restore the local ecology and enhance the return of native fauna and flora.

Key words: Rongoā, Organics, Sustainable farming, Biodiversity

Introduction

The date of Māori arrival in New Zealand is subject to debate. It is generally taken as approximately 1000 years ago although there is some evidence of earlier arrivals (McGlone & Wilmshurst, 1999). Māori arrived with little but the dog, rat and a range of plant foods, only four of which have survived the cabbage tree or tī (*Cordyline terminalis)* kumara (*Ipomoea batatas*),hue (*Lagenaria siceraria*) and taro (*Colocasia esculenta*)(Cambie & Ferguson, 2003). Māori were acknowledged to be a healthy race when Europeans arrived. Dr Newman commented in 1879: “From a medical point of view the Māori are a singularly uninteresting race” (Brooker, Cambie, & Cooper, 1987).

Within Māori culture there is a wealth of traditional knowledge as to the use of indigenous plants for health and healing (Riley, 1994). The medicinal knowledge, the traditional knowledge of the community, and the wisdom of the community were vested in the tribes Tohunga who was also an arbitrator in local matters (Moon, 2011).

When James Cook arrived he introduced small numbers of pigs, poultry and sheep, and he also traded in potatoes, cabbages and turnips. European settlers and stock followed in increasing numbers and large areas of indigenous bush were cleared for farmland.

Although there is a wonderfully diverse flora in New Zealand and a good tradition of herbal medicine there is little in the way of Ethnoveterinary practice. Most of the literature describes stock poisonings (Connor, 1977), although there are some references to stock health and remedies (Riley, 1994).

Organic agriculture

Organic agriculture is a growing sector in New Zealand with an increasing domestic and export markets(Cooper et al., 2010). Prior to 1990 the sector was small, with few farmers and few consumers. By 1997, exports were valued at NZ $32 million, and by 2009 they rose to NZ$170 million. There is a flourishing Maori organics sector under the aegis of Te Waka Kai Ora. (www.tewakakaiora.co.nz).

Te Rongoā

Traditional healing, or Rongoā, utilises the properties of many plants but, unlike "western" medicine as practiced by many today, rongoā is holistic, and focuses on maintaining health rather than attempting a cure after health has broken down. Several authors have developed models to conceptualise and illustrate the all-encompassing nature of Rongoā Māori. All emphasise the interconnectedness of mind, body, spirit, and human connections, particularly family and genealogy - the sense of knowing one's roots (Durie, 2001; Mark & Lyons, 2010; Pere, 1995). Land plays an important role in each model: tangata whenua, where one belongs. It is not only land that is important in rongoā but the health of the land to which a person relates. Mark and Lyons (2010) quote from healers who "discussed land as a reason clients required healing, but commented that the land itself also sometimes needed healing (not necessarily separately from the client's healing)". Māori identity is closely linked to the land believing we all share a common ancestor with the trees and the plants (McGowan, 2009). Applying the principles of rongoā to the land and stock therefore flows on to the people who walk the land and consume the produce. As rongoā promotes health of the land and those who work on it, the concept sits comfortably with organic farming.

Te Rongoā and Organic farming

The maintenance of animal health is often a major barrier to those farmers wishing to convert to an organic system. Adapting the principles of Te Rongoā to stock health is a novel way to tackle the problem of supporting animal health, while also addressing environmental concerns and contributing to the maintenance of biodiversity. The concept is very feasible - there is an increasing body of literature that surrounds zoopharmacognosy, or the ability of animals to self-medicate if given the opportunity (Clayton & Wolfe, 1993; M. Huffman & Seifu, 1989; M. A. M. A. Huffman, 2003). The literature surrounding the effectiveness of traditional plant remedies and the ability of famed animals to treat themselves is also growing, for example in Africa (Githiori, Hoglund, Waller, & Baker, 2004) South America (Lans & Brown, 1998) India (Sharma & Singh, 1989) and Europe (Pieroni, Howard, Volpato, & Santoro, 2004) and the United States (Villalba, Provenza, & Shaw, 2006).

As Te Rongoā is holistic and envisages health deriving from a balanced state, it aligns well with the four principles of organic agriculture as defined by the International Federation of Organic Agriculture Movements(IFOAM, 2009).The principle of health states that, "the health of individuals and communities cannot be separated from the health of ecosystems". The principle also states, "health is not the absence of illness". Rongoā supports health rather than intervention and emphasises the interconnectedness of mental, physical and spiritual balance. The principle of ecology states, "that production is to be based on ecological processes…should fit cycles and ecological balances in nature…adapted to local conditions, ecology, culture and scale". Rongoā emphasises the importance of local plants and communities providing local solutions as well as the connectedness of all things living. The principle of fairness is addressed directly by Rongoā, in that health is based upon a person feeling well in mind, body and soul, not feeling a victim of injustice or living in poor conditions. By applying Rongoā to the farm and creating on-farm pharmacies using a range of species, not only do stock have the opportunity to self-medicate but they have shade and shelter and the opportunity to live a more natural life. The principle of care speaks directly to the Māori concept of Kaitiakitanga or guardianship. Many rules surround the harvesting of rongoā species so that they are conserved and resources are used wisely. As this principle states: "precaution and responsibility are key concerns…scientific knowledge alone is not sufficient. Practical experience, accumulated wisdom and traditional and indigenous knowledge offer valid solutions."

Te Putahi

Te Putahi farm is located in the Southern Bays of Banks Peninsula in the South Island of New Zealand. The 450ha sheep and beef farm was gifted, on the death of Jim Wright, to the Wairewa rūnanga (tribal council) in 2006. Jim loved the land deeply and applauded the Wairewa 'ki uta ki tai' philosophy: we need to manage our resources “from the mountains to the sea”. Te Putahi has not had any pesticides or fertilisers applied for 20 years and should be certified organic by 2015. The farm carries 800 mixed breed ewes and 300 hoggets, 60 Angus cows and 30 heifers. Four hundred lambs are being carried through to weight, as are 56 calves. There is little fencing and stock range widely. It is the first farm to be accredited under the Ngāi Tahu Mahinga kai system (www.ahikakai.co.nz). The Ngai Tahu accreditation system allows customers to buy traceable produce, often with a story behind the product, from certified producers. Lamb can be purchased from Te Putahi that has been grazed on largely unimproved pasture with access to native species. Wairewa also market ‘tuna’ or eel, which has been caught and smoked in the traditional manner. The farm, to quote chairman of the Wairewa rūnanga Robin Wybrow, “is to be the living embodiment of the Wairewa Rūnanga’s expression of its integrated whole ecosystem - Mahinga Kai Cultural Park that protects the whenua (land), koiora kanorau (biodiversity), wai māori (freshwater) and wai moana (sea) of Papatūānuku (mother earth) ki uta ki tai (from the mountains to the sea)”.

Applying the principles of Te Rongoā on Te Putahi

It is basic tenet of rongoā that the plants are part of the landscape and their medicinal properties relate to the environment in which they are growing. Research into the chemistry of manuka (*Leptospermum scoparium*) across New Zealand bears this out (Maddocks-Jennings, Wilkinson, Shillington, & Cavanagh, 2005; Perry et al., 1997; Porter & Wilkins, 1998). In order to adhere to a principle of rongoā and to maintain a good conservation ethic, planning for plantings on Te Putahi was restricted to species that might have been found growing naturally on the Banks Peninsula.

An informal survey of local vets and farmers identified parasites as being the major animal health problem faced by farmers. After problems with parasites, scour and general ill thrift evidenced by lower growth rates and / or reproductive rates, shaky lambs and pneumonia were of most concern.

Animals that are offered a broad diet and are healthy are less likely to succumb to disease; therefore as a first step plants with tonic properties were identified. Species with a reputation as anthelminthics or used for diarrhea or chest complaints were then searched for.

All plants selected must withstand browsing by stock and regenerate within a reasonable time frame. They should be non-toxic, although consideration might be given to some species with a reputation for toxicity if they are beneficial when lightly browsed and access can be controlled. A selection of species is given in Table 1 as an example of the range of species that could be used to create a living pharmacy on Te Putahi farm.

Table 1. Examples of native species that could be used as part of an on-farm pharmacy at Te Putahi.

Species	Maori name	Common name	Ailment
Myrsine australis	Māpou, Māpau, Matipou, Tīpau	Red Matipo	Parasites
Hebe stricta	Koromiko	Hebe	Scour
Gaultheria antipoda	Pāpapa, Korupuka, Tāwiniwini, Tūmingi	Snowberry	Lactation
Gnaphalium luteo-album	Pukatea	Cudweed	Wounds
Corynocarpus laevigatus	Karaka	New Zealand Laurel	Wounds
Macropiper excelsum	Kawakawa	Pepper Tree	Tonic
Pseudowintera colorata	Horopito	Pepper tree	Tonic
Sonchus sp.	Puha, Pūwhā pūhā pororua, rauriki	Sow thistle	Tonic

It is neither possible nor sensible to simply plant huge numbers of species. A multifaceted approach is required so that plantings address conservation and protection, the historical existence of species, and the aspirations of the community. Local people often wish to see, or have access to, particular plants and have a desire to encourage certain fauna. For example, on Te Putahi, Wairewa would like to attract kereru or New Zealand native pigeon (Hemiphaga novaeseelandiae), tui (Prosthemadera novaeseelandiae), Pīwakawaka or fantail (Rhipidura fuliginosa) and weka (Gallirallus australis). A brief selection of species that are good providers of food and habitat for New Zealand native birds are given in Table 2.

Table 2. Some examples of native plant species which will provide food and habitat to encourage the establishment of native fauna on Te Putahi

Species	Maori name	Common name	Ailment
Cordyline australis	Tī kōuka Tī Kāuka, Tī whanake	Cabbage tree	Food source
Melicytus ramiflorus	Māhoe, Hinahina, Inihina	Whiteywood	Habitat food source
Podocarpus totara	Tōtara	Totara	Habitat

There are many benefits to each species chosen and a plant will contribute to the farm in multiple ways. For example, snowberry is also excellent for wounds, a favourite food of weka and provides good ground cover. Hebe is good for wounds and a tonic, matipo is a tonic and good for wounds and both provide favoured habitat. The cabbage tree is iconic (Simpson, 2000) with many uses from food and weaving to medicine. Totara previously clothed Banks Peninsula (Norton & Fuller, 1994) and there are many old Totara fence posts to be found on Te Putahi. Māori had multiple uses for the wood and bark of the Totara; the berries are good to eat and the tree has medicinal properties. Kawakawa has an important role in Māori culture (Riley 1994), as well as being an excellent tonic - it is antiparasitic, good for wounds and toothache (Porritt, 1967).

The parts of the farm that are robust can be retained in pasture and every effort made to promote productivity on these areas. Other areas of the farm can be planted to different degrees. Densely planted blocks, areas that have been retired for soil conservation, and riparian margins, can be browsed over fences. Direct access can be given to herbaceous plantings and areas with an open canopy. In times of stress such as drought or storm, blocks of trees and shrubs can provide lifesaving feed and shelter.

Conclusion

Each farm is distinctive and its circumstances will be unique. As Te Rongoā encourages a holistic view, the requirements of individual farms will differ. Species of plants selected for each farm should suit the local climate and conditions, the soils and stock and the local ecology. In addition the plantings on any farm should reflect and support the existing ecosystems and the values of the local community. Te Rongoā has much in common with the principles of organic farming and as such can make an excellent contribution to the support of animal health on organic farms.

Suggestions to tackle the future challenges of organic animal husbandry

Farmed animals rely on the land for their sustenance if the land is in good heart animals will be healthy and productive. Stock contribute actively to the resilience of the land upon which they rely and should not be removed from the equation. If we treat the land and our animals with respect we shall all prosper.

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Animal welfare in organic farming legislations and standards – analysis & proposal for a more outcome-oriented approach/tool –

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Abstract

Based on the analysis of animal welfare legislation and private organic and non-organic standards in the EU funded project EconWelfare areas for improvement of animal welfare in organic farming regulations and standards were identified. A more outcome-oriented approach to improve animal welfare for cattle with a checklist for inspectors and farmers was tested and evaluated in Switzerland. Proposals are made how to improve animal welfare on organic farms in standard setting and with complimentary assessment tools. Currently, certification examines in detail whether thresholds have been breached; in future it could rather determine where a farm is along the path to optimisation and what can be further improved.

Key words: animal welfare, organic standards, EU regulation, assessment tool

Introduction

The main focus in this paper is on animal welfare (AW) in organic animal husbandry. The question was, in which areas in EU organic regulation, governmental rules and private organic standards animal welfare could (or should) be further developed. Special attention is given how to improve animal welfare without necessary making standards more detailed (and over-prescriptive). A possible approach is the introduction of complimentary tools for inspection and self-assessment of farmers.

Material and methodology

Within the EU funded project EconWelfare ("Good animal welfare in a socio-economic context") an analysis of Animal Welfare legislation and standards has been made in selected EU-countries (DE, IT, NL, PL, SE, UK) and 8 third (non-EU) countries (Schmid and Kilchsperger 2010). These included also organic regulations world-wide as well as 15 private organic and non-organic standards with animal husbandry requirements beyond the EU Regulations COM 834/2007 and COM 889/2008. The focus was on cattle, pigs and poultry as well as transport and slaughter. The project allowed also identifying areas for improvement of animal welfare in organic farming regulations and standards.

Based on experiences from UK (AssureWel-Project) and Germany (Bioland) as well as the EU Project WelfareQuality a checklist for cattle has been developed, which was tested on several farms in Switzerland. The farmers had to give a feedback with a semi-structured questionnaire. Furthermore interviews were made with standard setters, public and certification bodies in Switzerland, UK and Germany.

Results

The comparison of AW differences in private organic standards and governmental rules in Europe with the EU general and organic legislation on one hand and on the other hand with high-level private non-organic AW standards (like Freedom Food, UK or Neuland, Germany) showed differences on different levels and of different accuracies (preciseness). Some were of major and other of minor relevance (from an ethological point of view). The aspects were grouped into specific aspects like accommodation, feeding and health care. The main differences are summarised below, which were found in at least 5 standards (first number indicates the total number of differences, the second figure the more relevant ones based on literature and expert opinions). Marked with * indicates major weaknesses in organic regulation/standards compared with high non-organic AW standards from ethological expert point of view. Areas for further development of organic rules/standards are written in Italics; some have been found also in few organic standards.

Cattle (70/20): *Areas for further development of organic standards: more space and light requirements*; more specific feeding requirements (e.g. roughage)*; More restricted tethering, adequate anaesthesia for castration and non-allowance of certain surgical practices (e.g. dehorning).* Main differences of EU organic regulation compared with general EU AW legislation: slatted floors forbidden or limited, specific bedding requirements, outdoor access, longer weaning periods and provision of calving pens.

Pigs (51/16): *Areas for further development of organic standards: more space allowance*, slatted floors forbidden or restricted*, possibilities for investigation and manipulating activities, limitation of certain surgical practices, adequate anaesthesia for castration.* Main differences of EU organic regulation compared with general EU AW legislation: availability of litter, provision of roughage, no hormonal treatments,

Poultry (48/17): *Areas for further development of organic standards: lower indoor and outdoor stocking densities*, higher frequency of regular visits*, better defined outdoor run and pasture.* Main differences of EU organic regulation compared with EU AW legislation: more light requirements, more perches and nests, access to dust baths, better access to fresh water and restrictions in breeding (mainly broilers).

Transport of animals (28/9): *more drinking, resting and feeding possibilities before transport*, provision of bedding material for the youngest in transport vehicles,, adequate pathway/ramps design, the separation of unfamiliar groups, reduced length of journey.* Only main difference of EU organic regulation compared with EU AW legislation: interdiction of sedatives/tranquilisers

Slaughter of animals (39/9): *time between stunning and bleeding*, more lairage requirements (start of lairage, space, lighting, floors etc.), the avoidance of group mixing, the, specific education of the staff.* Only main difference of EU organic regulation compared with EU AW legislation: non-use of electric stimulation.

Where and how to improve AW in organic farming?

There are several areas, where animal welfare can be improved in organic agriculture. The most crucial weaknesses in organic standards are related to transport and slaughter, where almost no specific requirements are set..

One of the major challenges of improving animal welfare, not only in organic farming but also generally, is the scepticism of farmers against new (over-prescriptive) rules.

A possibility to overcome this scepticism is to develop complimentary instruments for self-assessment tools for farmers and inspectors how animal welfare can be developed on a farm. For improving AW in organic farming it is desirable to put stronger emphasis on animal-related criteria and indicators. Organic standard setting organisations should take a lead in this approach.

In Switzerland a prototype checklist for cattle was developed in a diploma work at Inforama (HF) in Zollikofen (Knutti, 2012), which was tested on several organic farms in Switzerland. The main aim was to have a simplified system of observational indicators, which both the farmer as well as the inspector could use on a selected minimum number of animals. The following criteria were used: Nutritional condition; degree of dirtiness; injuries and lesions (differentiated in subcategories) and management indicators like state of claws, and kind of behaviour. A simple score of 1-3 is used, which indicates if on a farm the AW situation is good, can be still improved or is not satisfactory and must be changed.

Table 1. Prototype cattle checklist/protocol for organic farmers and inspectors in Switzerland

Animal related indicators	Support tools	Score 1	Score 2	Score 3
Nutritional condition	with body condition score system of FiBL):	good	lean/fatless	too fat
Degree of dirtiness	supported with pictures	none	medium	strong
Injuries and lesions (further differentiated)	supported with pictures	none	little	strong
Lameness		none	little	strong
State of claws	supported with pictures	well-managed	ok	Not well man-aged
Stable-related indicators	Support tools	Score 1	Score 2	Score 3
Hygienic conditions: fodder, water, place		clean	ok	not hygienic
Floor		not slippery	slightly slippery	very slippery
Air quality		good	sticky	very sticky
Use of cleaning brushes		well-used	not well-used	not used at all/none
Overall result	For all selected animals / For whole stable/unit			

Source: Knutti, 2012

The first feedback from farmers, where during inspection visits this checklist was used, as well as from certifiers was positive. The time needed (20 minutes) was seen as acceptable. Different overall assessment systems can be applied; this is up to the certification body: e.g. Knutti (2012) proposes that no score 3 is found. The possibility to compare the self-assessment with the assessment of the inspector was perceived positively. Another positive point was that the main goal of this approach is an improvement of the husbandry practises with the use of observational check-points as opposed to sanctions of non-fulfilment of standards requirements.

Discussion

The authors recommend standard setting organisations to introduce in addition to the more general animal welfare conditions for all animals, some more specific ethological AW criteria for the different main animal groups, e.g. for cattle: social grooming and grazing; for pigs: rooting, separate lying, activity/dunging and feeding areas, free farrowing, group housing and for poultry: nesting, wing stretching/flapping, foraging, dust-bathing, perching and preening.

Furthermore it is desirable to assess and monitor the impact of housing systems and space requirements on animal welfare by using more outcomes/or animal-related parameters. Indicators such as body condition scores (relevant for different animal categories), lameness, skin lesions and injury and prevalence of abnormal behaviour/stereotypies (e.g. feather pecking, tail biting, oral stereotypies in sows, etc.) have to be taken into account.

Paradigm change needed in organic standard setting

A paradigm shift is needed in organic standard setting towards assessing progress rather than defining and "punishing" failure. Assessment systems and codes of best practice should be developed by researchers, advisers and practitioners as complementary tools for re-oriented progress certification. It is important to invest more time in both training inspectors and farmers in order to make such an approach more feasible and acceptable. More experiences are needed, what would be the best approach. It might be a mix of some classical core standards requirements for animal welfare in combination with some key animal related indicators Hopefully this would allow to reduce some over-prescriptive rules and to stimulate the self-responsibility and comprehensiveness of farmers with regard to animal welfare. Currently, certification checks in fine detail whether boundaries have been overstepped; in future it could rather determine where a given farm is making progress in the right direction and what can be further optimised.

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α-Tocopherol in plasma and milk from organically managed dairy cows fed natural or synthetic vitamin E or seaweed

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Abstract

The objective was to compare the effects of supplementing lactating dairy cows with synthetic (All-rac), natural (RRR) all-rac-α-tocopheryl acetate or seaweed with a control on the concentration of α-tocopherol in blood and milk. Twenty four dairy cows in mid lactation, fed an organic feed ration, were randomly allocated to the four treatments in a replicated Latin square design. Plasma and milk α-tocopherol concentrations were higher in RRR and All-rac than in the other treatments and higher in RRR than in All-rac. RRR-α-tocopherol was the predominant steroisomer (> 86%), in both plasma and milk, whereas the remaining part was largely made up by the three synthetic 2R isomers. In cows fed the control, seaweed and RRR, the proportion of RRR-α-tocopherol in plasma and milk constituted more than 97% of the total α-tocopherol. The study demonstrated that dairy cows in mid and late lactation have preferential uptake of RRR-α-tocopherol compared to other stereoisomers.

Key words: Vitamin E, stereoisomer, macro algae, cattle

Introduction

In Northern Europe, ruminants are fed preserved forages, mainly silage, for a long period during winter time. Forage preservation and storage may reduce the content of vitamin E substantially, and supplementation with vitamin E is recommended also in organic production as low plasma levels of vitamin E have been observed in organic managed sheep and cattle (Beeckman et al. 2010, Govasmark et al., 2005). Natural vitamin supplement sources are generally difficult and expensive to derive, and there is currently derogation from the EU regulation on organic production to use synthetic vitamin A, D and E (European Commision 2008). However, there is an aim in organic production to avoid synthetic vitamins and it is therefore important to find alternative sources. It is also well known that the natural vitamin E isomer, RRR-α-tocopherol, has higher bioavailability than synthetic *all-rac*-α-tocopherol that contains equal amount of all eight isomers (Meglia et al. 2006). Seaweed has been used as supplement to ruminants in Norway for centuries, and recent research may indicate that supplementation with seaweed may up-regulate antioxidant responses in animals (Allen et al. 2001). The objective of this study was to compare the effects of supplementing lactating dairy cows with synthetic *all-rac*-α-tocopheryl acetate or natural RRR-α-tocopheryl acetate or with seaweed on the concentration of α-tocopherol and its stereoisomers in blood and milk.

Material and methodology

Twenty four Norwegian Red cattle in mid lactation (164 d in milk, SD=30) were used in a replicated 4 × 4 Latin square design with 28 d periods. The experiment was carried out in agreement with the laws and regulations controlling experiments on live animals in Norway. The cows were fed a basic ration of grass-red clover silage *ad libitum* and 3 kg/d flat rate of a concentrate mixture. The silage and the concentrate were produced according standards for organic production. The ration was supplemented with the following four experimental diets: SW, commercially available dried and ground macro algae *Ascophyllum nodosum* (200 g/d); RRR, natural vitamin E (2280 mg RRR-α-tocopherol/d); *All-rac*, synthetic vitamin E (2280 mg *all-rac*-α-tocopherol/d) and a Control without extra α-tocopherol or macro algae. The RRR, *All-rac* and Control supplements were given at a daily rate of 0.66 kg per cow and consisted of barley (0.75), molasses (0.04), minerals and vitamins A and D (0.21) and the vitamin E sources, whereas the SW was a mixture of macro algea (0.30), barley (0.52), molasses (0.04) and minerals (0.18) in order to be similar to the other treatments with respect to total mineral supplementation and applied at rate of 0.77 kg/d iso-energetically equal to the other treatments. Milk yield and feed intake was recorded and milk and blood samples were taken in the last week of each period. The content of α-tocopherol in feed, plasma and milk were analysed according to Jensen and Nielsen (1996). Data was analysed using the PROC MIXED procedure in SAS with treatment and period as fixed effects and replicate and cow within replicate as random effects. Differences among treatment means were detected using the Tukey procedure. Significance was declared at $P < 0.05$.

Results

The dietary treatments had no effect on silage intake (14.6 kg DM/d, P=0.90), total feed intake (18.1 kg DM/d, P=0.99) or milk yield (16.0 kg/d, P=0.39). The intake of α-tocopherol from the RRR and *All-rac* supplements was 75 % lower than planned (Table 1), mainly due to high temperature during the pelleting process that reduced the α-tocopherol content of the supplements by 50-66 %. Still, the total intake of α-tocopherol on RRR and *All-rac* diets was about 1.6 times higher than on the control and SW. Intake of the RRR-α-tocopherol isomer was about 70% higher on RRR than on *All-rac* and control, whilst the intake of the other 2R and 2S isomers was highest on the *All-rac* diet. The silage contained 39 mg/kg DM α-tocopherol and contributed substantially to the total intake of α-tocopherol (Table 1).

Table 1. Daily α-tocopherol intake (mg/d) in dairy cows fed daily supplements of no vitamin E (Control), RRR-α-tocopheryl acetate (RRR), all-rac-α-tocopheryl acetate and seaweed (SW) (n = 24)

Item	Control	RRR	*All-rac*	SW	SEM	P-value
Silage	570	574	571	562	21.0	0.9328
Concentrate	23.0^{ab}	22.7^{ab}	22.6^{b}	23.6^{a}	0.37	0.0209
Supplement	43.5^{c}	549^{a}	477^{b}	3.2^{c}	14.3	<0.0001
Total	636^{c}	1146^{a}	1070^{b}	591^{c}	16.6	<0.0001
RRR-isomer	624^{bc}	1086^{a}	649^{b}	591^{c}	16.5	<0.0001
Sum RSS, RRS, RSR	4^{c}	28^{b}	177^{a}	0^{c}	2.8	<0.0001
Sum 2S-isomers	8^{c}	32^{b}	244^{a}	0^{c}	4.2	<0.0001

SEM=Standard error of mean
^{abc} Means in same row with different superscripts are significantly different (p<0.05)

Compared to the control diet, RRR increased the total content of α-tocopherol in plasma by 32 % and in milk by 25%, while *All-rac* elevated the content in plasma with 13% but had no effect on milk (Table 2). When the differences in plasma and milk concentrations of α-tocopherol concentrations were adjusted to account for the differences in α-tocopherol intake, the concentration of α-tocopherol per unit of α-tocopherol consumed was 1.09 and 1.12 times greater in plasma and milk, respectively, when cows were fed RRR than *All-rac*. Seaweed supplementation had no effect on plasma or milk content of α-tocopherol. *All-rac* resulted in higher concentration of the synthetic isomers (RSS, RRS, RSR and 2S) in both plasma and milk than the other treatments.

Table 2. Plasma and milk concentrations (mg/L) of α-tocopherol in dairy cow fed daily supplements of no vitamin E (Control), RRR-α-tocopheryl acetate (RRR), all-rac-α-tocopheryl acetate and seaweed (SW) (n = 24)

Item	Control	RRR	*All-rac*	SW	SEM	P-value
α-Tocopherol in plasma						
Total	9.99^{c}	13.17^{a}	11.27^{b}	10.13^{c}	0.632	<0.0001
RRR	9.83^{b}	12.82^{a}	9.69^{b}	10.06^{b}	0.578	<0.0001
Sum RSS, RRS, RSR	0.15^{bc}	0.33^{b}	1.47^{a}	0.07^{c}	0.076	<0.0001
Sum 2S	0.009^{b}	0.017^{b}	0.109^{a}	0.005^{b}	0.0051	<0.0001
α-Tocopherol in milk						
Total	1.20^{bc}	1.50^{a}	1.25^{b}	1.14^{c}	0.052	<0.0001
RRR	1.20^{b}	1.47^{a}	1.09^{c}	1.14^{bc}	0.050	<0.0001
Sum RSS, RRS, RSR	0.00^{b}	0.03^{b}	0.14^{a}	0.00^{b}	0.008	<0.0001
Sum 2S	0.001^{c}	0.005^{bc}	0.019^{a}	0.001^{c}	0.0011	<0.0001

SEM=Standard error of mean
abc Means in same row with different superscripts are significantly different (p<0.05)

The *All-rac* diet had about 61 % of all isomers as RRR, whilst the RRR proportion in plasma and milk in cows on the *All-rac* diet was > 86 % (Table 3). On the other diets > 94 % of the isomers was the RRR-isomer in both diet and plasma and in milk.

Table 3. Relative proportions (%) of a-tocopherol stereoisomers in diet, plasma and milk in dairy cow fed daily supplements of no vitamin E (Control), RRR-α-tocopheryl acetate (RRR), all-rac-α-tocopheryl acetate and seaweed(SW) (n = 24)

Item	Control	RRR	*All-rac*	SW	SE	P-value
Total diet						
RRR	98.1^{a}	94.7^{a}	60.7^{b}	100.0^{a}	0.62	<0.0001
Sum RSS, RRS, RSR	0.5^{b}	1.8^{b}	16.6^{a}	0.0^{b}	0.26	<0.0001
Sum 2S	1.2^{c}	2.8^{b}	22.8^{a}	0.0^{d}	0.36	<0.0001
Plasma						
RRR	98.4^{ab}	97.4^{b}	86.6^{c}	99.2^{a}	0.45	<0.0001
Sum RSS, RRS, RSR	1.5^{bc}	2.5^{b}	12.4^{a}	0.7^{c}	0.42	<0.0001
Sum 2S	0.1^{b}	0.1^{b}	1.0^{a}	0.1^{b}	0.04	<0.0001
Milk						
RRR	99.4^{a}	97.9^{a}	87.4^{b}	99.6^{a}	0.60	<0.0001
Sum RSS, RRS, RSR	0.5^{b}	1.8^{b}	11.1^{a}	0.3^{b}	0.16	<0.0001
Sum 2S	0.1^{c}	0.3^{b}	1.5^{a}	0.1^{c}	0.08	<0.0001

SEM=Standard error of mean
abc Means in same row with different superscripts are significantly different (p<0.05)

Discussion

The study confirms that natural α-tocopherol (RRR) is the pre-dominating form in blood and milk of dairy cows, irrespective of dietary source (Meglia et al 2006; Weiss et al. 2009). The results also shows that dairy cows in mid and late lactation, as periparturient cows (Meglia et al 2006), have a preferential uptake of RRR-α-tocopherol compared with the other stereoisomers of α-tocopherol.

Even in treatments with low α-tocopherol contribution from the supplements (SW and Control), the plasma concentration of α-tocopherol was high compared to other studies and 3 times higher than the level of 3 mg/L that is regarded as adequate (Beeckman et al. 2010, Lindqvist et al 2011). Even though the silage concentration of α-tocopherol (39 mg/kg DM) was not particularly high, but similar to levels observed in other studies (Beeckman et al. 2010, Lindqvist et al 2011), it is clearly adequate when the silage intake is as high as in the present study.

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Suggestions to tackle the future challenges of organic animal husbandry

Do organically managed dairy cows in mid and late lactation on diets with high intake of grass-clover silage need extra supplement of vitamin E?

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Complementary and alternative medicine as a first line therapy in control of clinical mastitis

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Abstract

The researchers collected and analysed clinical mastitis infection data in an udder health improvement programme in 68 Swiss organic dairy farms. Data for 247 non-antibiotic (complementary and alternative medicine; CAM) and 173 antibiotic (AB) treatment cycles were analysed. Animals were placed in the following categories: (AA) clinical cure and somatic cell count (SCC) <100.000/ml, (A) clinical cure and SCC <200.000/ml, (B) clinical cure and SCC >200.000/ml, (Cab) antibiotic re-treatment, (Ccam) complementary or alternative re-treatment after therapy failure, and (D) culling. Animals were assigned to these categories at the second milk recording date. Distribution differences were significant (p<0.01). Improvement (AA+A) was higher after AB treatment compared to CAM (67% vs. 49%). In the CAM group 13% of the cases (n=31) showed complete therapy failure (cull, AB re-treatment) within 100 days observation period. 10 more cases (4%) received AB treatment and 11 cows (5%) were culled after this period not knowing the exact reason. The worst case showed at least 79% of cows treated by CAM could be reintegrated into the herd without any antibiotic therapy. Even without a proof of CAM efficacy, implementation of CAM methods (such as homeopathy) into udder health control of organic dairy cows is a suitable concept to reduce antibiotics.

Key words: mastitis, antibiotics, complementary and alternative medicine, udder health programme

Introduction

Udder health is a major issue in dairy farming. Organic farms are restricted of antibiotic usage in mastitis control, which leads to additional challenges. Preventive programmes may reduce mastitis incidence and thus antibiotic use (Merck et al., 2004, Ivemeyer et al., 2008, 2012, Bennedsgaard et al., 2010). However treatment alternatives are failing to provide sufficient efficacy compared to conventional methods in order to convince veterinarians and also farmers to apply those (Hektoen et al., 2004, Merck et al., 2004). Nevertheless farmers using homeopathy and other alternative methods are satisfied with the effects. Recently the discussion about massive use of antibiotics in livestock husbandry raises the question of development of alternative concepts. Considering this precondition, a couple of programmes have been performed during the last years. One example is the Swiss pro-Q programme consisting of various components, such as farm inspection weak point analysis, milk sample programmes, milk recording analysis and support, and therapy conversion to non-antibiotic (Ivemeyer et al., 2008). The promising effects of these programmes in terms of reduction of antibiotics and udder health improvement is in contrast to expected treatment results by non-antibiotic methods predominantly used in participating farms. Hence, the objective of this study is to evaluate the effects and further health development of cows treated against clinical mastitis by non-antibiotic (predominantly homeopathic) methods within this project.

Material and methodology

Treatment data was collected and analysed in 68 farms from a preventive udder health supporting programme conducted from 2003 to 2009 (Ivemeyer et al., 2008)., A total of 2018 diagnosis items was flagged with the item "udder treatment" including dry cow therapy and constitutional treatments by homeopathy. A treatment cycle was defined as a single or series of treatments according to one diagnosis with a maximum therapy length of 10 days. In particular, clinical mastitis cases had been considered. In total 420 clinical cases finally were enrolled in this analysis.

Because the intent of the project is to improve udder health and to reduce antibiotic treatments, most of the farms implemented a non-antibiotic therapy system based on complementary and alternative medicine (CAM), such as homeopathy, additional milking out, and phyto-therapeutical ointments. Advisors provided therapy recommendations accompanied by analysis of follow-up data, milk records, bacteriological and clinical findings in order to control therapy effects and, if necessary also to change therapy to antibiotic. Depending on the goal of farmers, many cases were treated by antibiotics primarily as well (n=173), but in most of the cases (n=247) non-antibiotic measures were applied.

To assess therapy outcome, the researchers established different outcome categories based on the somatic cell count at the second milk recording after treatment conducted by breeding association. Udder health state was classified as inconspicuous (Category AA) when cows received no subsequent antibiotic treatment and somatic cell count (SCC) was <100.000/ml at the second monthly milk recording after treatment. If no subsequent antibiotic treatment was applied and SCC was 100.000/ml to 199.000/ml when the second milking recorded were classified as Category A, If no re-treatment was necessary and the SCC remained ≥200.000/ml cows were assigned to category B. Cows re-treated before second milk testing were allocated to category C, differentiating between antibiotic [Cab] and non-antibiotic [Ccam] re-treatment., Cows culled after therapy were assigned to category D.

The study focused on the assessment of the amount of antibiotic treatments which can be avoided without the risk of long-term damage and production loss by culling, continuing clinical signs or high somatic cell counts. Effects are compared to, and therefore controlled by antibiotic treatment effects using Chisquare-Test which was calculated by statistic software R, ver. 2.14.

Results

Fifty-nine of the farms used CAM methods at all. Of 247 cases treated by CAM primarily, 104 were of acute and 143 of chronic condition. Of 173 cases treated by antibiotics, 133 were acute and 40 chronic mastitis. Because differentiation of acute and chronic mastitis could not be verified by the project team, it is neglected in the following analyses. The distribution of outcome categories is shown in table 1.

Assessment of treatment effects took place at the 2nd milk recording date after treatment with a mean of 54.6d ±15.8d. As it can be seen in table 1, there was a significant difference in the categorical distribution of the outcome between both treatment groups ($p<0.01$). After antibiotic treatment, 67% of the cows showed an improvement in terms of clinical cure and acceptable SCC (<200.000/ml) at 2nd monthly milk recording after calving. Only 49% of cows treated by CAM methods could be assigned to category AA or A. In category AA with "normal" SCC (<100.000/ml) 38% of antibiotic-treated and only 21% of cows not treated with antibiotics. Defining economically relevant therapy failure as re-treatment by chemicals (antibiotics) and culling (sum of Categories Cab and D), there is only a slight difference between antibiotic-treated cows and cows not treated with antibiotics (11% vs. 13%).

Table 1. Outcome categories at 2nd milk recording after CAM or antibiotic treatment of acute and chronic clinical mastitis.

	Cure Category after Treatment					
	AA	A	B	Ccam	Cab	D
CAM (247)	53 (21%)	69 (28%)	70 (28%)	24 (10%)	17 (7%)	14 (6%)
Antibiotics (173)	65 (38%)	50 (29%)	33 (19%)	5 (3%)	9 (5%)	11 (6%)
Sig.*	p<0.01					
Sum (420)	118 (28%)	119 (28%)	103 (25%)	29 (7%)	26 (6%)	25 (6%)

AA = no antibiotic re-treatment; SCC at 2^{nd} Milk recording <100.000/ml; **A** = no antibiotic re-treatment; SCC at 2^{nd} Milk recording 100.000 to 199.000/ml; **B** = no antibiotic treatment; SCC at 2^{nd} Milk recording ≥200.000/ml; **Ccam** = re-treatment with CAM methods; **Cab** = re-treatment with antibiotics; **D** = culls
* Significance of the category distribution using CHI^2 test.

Discussion

Although the results presented cannot be accepted as a proof of efficacy of complementary and alternative medicine (CAM) methods in udder health, the implementation of non-antibiotic methods such as homeopathy, and locally applied phyto-therapy must be discussed in the context of reducing antibiotics in organic dairy farms. It is not possible to conclude whether the effects observed are the result of the therapy itself, to natural healing processes, and/or specific care of the cows by the farmer. Most of mastitis cases observed would have been treated by antibiotics under conventional conditions. Even if follow-up data of the period beyond 100 days observation time after treatment start are included, only 10 additional cases of the CAM treatment group received antibiotics afterwards without knowing exactly if these cases were represented by recurrences or new infections. Such a scenario is not part of the results, but could complete estimation of the lactation based outcome as a worst case scenario. Finally, 11 cows were culled after observation period, not knowing the actual reason as well. Supposing the worst case that all of these would be not cured primary mastitis cases, the rate of severe therapy failure including all culls and antibiotic re-treatment during one lactation was 51 of 247 cases (21%). Hence the economically important success rate after exclusive CAM application in terms of re-integration to production without antibiotics, was at least 79%. This is close to investigations by Merck et al. (2004) who achieved 75% antibiotics reduction using a similar definition. As a future task of this work, the group analysis of qualitative mastitis findings should be conducted of pathogens, clinical findings, age of cows, and farm parameters. We could not explain the effects of non-antibiotic - predominantly homeopathic - mastitis therapies. Antibiotics could be a secondary therapeutic option in cows not responding to primary CAM treatment. Hence, this programme is able to serve as a relevant contribution to reduction of antibiotics in organic dairy farming.

Suggestions to tackle the future challenges of organic animal husbandry

Because udder health management in organic farms was quite conventional, recent programmes were developed to reduce antibiotics and improve udder health by prevention and complementary and alternative medicine. Due to insufficient effects by CAM methods in clinical trials, farmers and veterinarians had lacked confidence in their efficacy. The results of this study will help to elaborate new concepts considering CAM methods as first line. The integrated action of advisory support on farm management issues and therapy should reduce the use of antibiotics in mastitis control, the primary cause for chemical treatment in dairy farming.

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Traditional Treatment of Cattle Diseases in Sri Lanka

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Abstract

Traditional livestock healers in Sri Lanka have passed knowledge from generation to generation for thousands of years. Agricultural systems have changed rapidly over the past 50 years, and much of this traditional knowledge is now being lost. The purpose of this research was to document and inventory the techniques that traditional healers use to treat cattle disease. More than 500 different botanical preparations made from more than 200 plant species were recorded. These are used to treat 4,448 disease symptoms in cattle and buffalo. The study also documented the use of branding in traditional disease treatments. 179 different brands were recorded. These traditional techniques provide alternatives to the synthetic chemicals and antibiotics prohibited in organic animal husbandry. Further research is needed to scientifically assess the documented techniques and incorporate them into modern organic practices where appropriate.

Key words: ethnobotany, cattle, disease, organic, traditional, Sri Lanka

Introduction

Livestock healers in Sri Lanka have been passing their knowledge from generation to generation for thousands of years. Traditionally, the eldest son in a healing family is trained to carry on the practice and provide services to the surrounding communities. In the same way that ayurvedic doctors collect medicinal plants and prepare botanical formulas for human health, the livestock healers used botanical preparations and other techniques to treat disease in cattle and buffalo. This traditional knowledge could have significant applications in organic animal husbandry. The treatments use natural medicinal plants that are permitted under organic regulatory systems. Unfortunately, this traditional knowledge is rapidly disappearing and the healing practice is not being passed to the next generation. The purpose of this study is to document and inventory the techniques that traditional Sri Lankan livestock healers use to treat diseases in cattle and buffalo.

Material and methodology

This ethnobotanical research was conducted through review of traditional books made from the leaves of the talipot palm (*Coryphaum braculifera)* and a series of interviews with traditional healers, cattle breeders, and herders. The traditional healers were asked to provide all known diseases, describe their symptoms, show examples when possible, and share traditional techniques for treating the identified diseases names or set of symptoms for each disease identified by the traditional healers, the symptoms and detailed descriptions of the recommended treatments were recorded in the traditional vernacular.

When possible, treatments were demonstrated and observations were recorded. A modern veterinarian inspected all of the sick animals, took stool samples, documented observations of symptoms, and provided modern medical terms for the identified diseases and symptoms. In the case of traditional branding, the specified designs were recorded. For botanical preparations, specimens of the required medicinal plants were collected. The scientific name of each medicinal plant was verified using references from the herbarium of the University of Sri Jayawardenepura, the national herbarium in Peradeniya, and scientific texts (Jayaweera 1980).

Results

In total, 4,448 cattle and buffalo disease symptoms described by traditional healers were recorded. It is important to note that the traditional vernacular names and classifications of disease do not correspond with diagnostic classifications used today. Traditional healers did not have access to modern laboratory tests. They relied on observable symptoms for their diagnosis and their prescriptions were based on these observations. Sri Lankan livestock healers that are still practicing say that because of this a single treatment formula may be used for multiple diseases and a combination of multiple treatments is usually prescribed to increase the chance of recovery.

The majority of treatments involve botanical infusions or decoctions that are used topically or administered orally or rectally. More than 500 different formulas were recording using more than 200 different plant species. A few examples are provided in simplified form in Table 1.

Table 1. Examples of treatments used by traditional Sri Lankan livestock healers

Symptom	Examples of Treatments
Teat infection (mastitis)	• Prepare ash from king coconut shell (*Cocos nucifera*,). Mix with komarika leavs (*Aloe vera)*. Apply topically. • Combine ghee and bee honey. Apply topically. • Combine coconut milk (*Cocos nucifera*) and kollankola leaves oil (*Pogostemon heyneanus*). Apply on mouth of nursing calf.
Infected naval	• Prepare clean ash. Apply topically. • Prepare neem oil (*Azadirachta indica*). Apply topically
Maggot infected wounds	• Combine eramudu leaves (*Erythrina indica*) and fireplace ash. Apply topically. • Combine waldunkola (*Lobeliya* sp), panu ala yam (*Typhonium tilobatum*) and calcium carbonate. Apply topically.
Worms	• Combine cannibis leaves (*Cannabis sativa*), neem leaves (*Azadirachta indica*), gotukola leaves (*Centella asiatica)*, maduwell (*Eupatorium sp.*), pineapple (*Ananas Cosmosus*) and cardamom (*Amomum sp)*. Administer orally. • Combine aralu fruit (*Terminalia chebula*), bulu fruit (*Terminalia bellirica*), nelli fruit (*Phyllanthus emblica*), garlic (*Allium sativum*) and Epsom salt. Administer orally.
Stomach problems	• Fill papaya stem (*Carica papaya*) with 2 inches of water and 4 inches of castor seed oil (*Ricinus communis*). Insert into rectum and blow. • Fill papaya stem (*Carica papaya*) with equal parts kireaguna (*Dergea volu-vilis*) and lime juice (*Citrus sp*). Insert into rectum and blow. • Boil asamodagam(*Trachyspermum roxburghianum)* walagasahal, and wadakaha root (*Acorus calamus*). Add Epsom salt and administer orally.
Fever	• Boil coriander leaves (*Coriandrum sativum*) with sesame oil (*Sesamum indicum)*. Administer orally. • Boil garlic (*Allium sativum*), black pepper (*Piper nigrum*), coriander leaves (*Coriandrum sativum*) in water. Administer orally.
Cataracts	• Mix copper sulfate powder, ghee, and water from red rice with an extract of naran seeds (*Citrus sp*) and ginger (*Zingiber officinale*) Apply topically.

Traditionally, this type of branding treatment can only be done by an experienced healer, and the knowledge is passed to the eldest male in the family. It is common to combine treatments. Botanical formulations are often applied topically to the branded area.

Preliminary findings from this study show that traditional and modern livestock medicine can play complementary roles. When traditional healers are unable to differentiate a disease based on observable symptoms, a veterinarian can collect additional data through common laboratory tests like microscopic analysis of stool samples and haematological tests. At the same time, modern veterinarians expressed interest in the use of medicinal plants and botanical formulas to enhance animal health. Since medicinal plants and ayurvedic treatments are still commonly prescribed for human health in Sri Lanka, it should be noted that Sri Lankan veterinarians may be more receptive to these techniques than veterinarians in other regions.

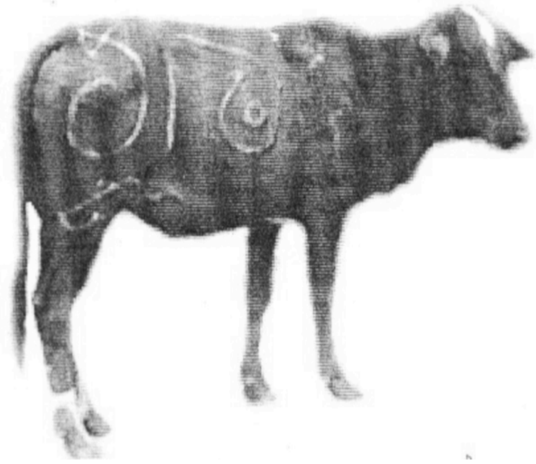

Figure 1. Brands applied by a traditional healer

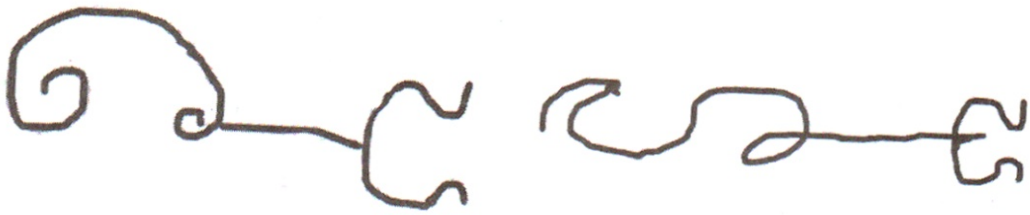

Figure 2. Brand used to control diarrhea (left) and brand used to control high temperature fevers (right)

Discussion

Organic certification standards prohibit the use of most synthetic drugs in animal husbandry. Without access to these treatments, organic livestock farmers tend to focus on holistic health and disease prevention, but still there are times that treatment is required. In this context, it is important to assess all available alternatives. Traditional livestock healing techniques have evolved over generations and survived for hundreds of years because farmers felt they were effective. Priority should be given to ethnobotanical studies that preserve traditional knowledge on animal health and disease management. The medicinal plants used to treat disease in many traditional systems are permitted under international organic regulations. Once these traditional techniques are documented, further veterinary research should be conducted to scientifically assess their effectiveness. Based on these findings, effective techniques should be incorporated into organic extension and certification systems.

Suggestions to tackle future challenges of organic animal husbandry

- Conduct ethnobotanical research to document traditional techniques for treating animal diseases.
- Scientifically assess the effectiveness of documented medicinal plants and traditional techniques.
- Incorporate effective techniques into organic extension and certification systems for organic animal husbandry.

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Strategies to reduce severity of coccidia infections in organic poultry systems by the use of plant extracts

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Abstract

An experiment was performed in a commercial farm in Brazil to investigate potential candidates for botanical coccidiostats to pullets (Isa Brown breed) naturally infected with coccidia (Eimeria spp.). Infection dynamics and performance were investigated in 1400 pullets allocated randomly to six treatment combinations and compared to a group vaccinated with a commercial anti-coccidia vaccine. We investigated dried leaves of cassava and Artemisia annua mixed in the diet for pullets at different ages and ethanolic concentrate extracts of A. annua and A. vulgaris via drinking water supplemented before or after appearance of clinical symptoms of the disease. Performance attributes and oocyst excretion (oocysts per g faeces = OPG) were monitored weekly from 1 to 14 weeks of age. The supplementation of A. annua in the diet (3% inclusion based on feed weight) influenced negatively the growth rates of the pullets (p<0.05) and did not affect OPG. The food supplementation of A. annua at 3% reduced the growth rates of pullets by 27 and 14% in the periods of 0-7 and 0-14 weeks of age respectively (p<0.05) without affecting oocyst excretion (OE). Cassava supplementation markedly suppressed OE by 60-70% at the stage of early infection (weeks 0-7) (p<0.05) without affecting growth rate compared to the vaccine group. Ethanolic extract of A. vulgaris supplemented before appearance of clinical symptoms of disease showed a trend to reduce OE in the late infection. In conclusion, a daily 3% supplementation of cassava in the beginning of the rearing period may be an effective strategy to control coccidiosis in small scale poultry systems while ethanolic plant extracts supplemented in drinking water deserves further investigation.

Key words: Natural anti-protozoa drugs; Ethanolic extract; Artemisia; Organic system.

Introduction

The production of poultry in organic systems is regulated emphasizing animal welfare, health and the quality of its products (Brazil, 2003). The regulation prohibits the use of drugs for preventive treatment of infectious diseases, including parasites. As a result, treatment of coccidiosis depends on vaccines or innovative substitutes to currently-used drugs. The use of live attenuated vaccines is a useful option available in the market, although not always affordable to the small scale farmer. Thus, the use of plants and their derivatives may represent a viable alternative (Abbas et al., 2012). On this background, the objective of this work was to investigate possible benefits of three different botanical products: *Artemisia annua*, *A. vulgaris*, and *Manihot esculenta* as potential feed supplements provided with daily feed or drinking water before and/or after the appearance of clinical symptoms of the disease.

Material and methodology

Isa Brown one-day-old pullets were randomly allocated to one of 14 pens (165 pullets per pen) thus allowing two replicates for each of the 7 studied treatments (Table 1).

Table 1. Description of treatments, supplementation strategy and dosing period.

Group	Treatment	Route of delivery	Supply Period*	Dosing period age in days
Vac	Vaccination[1]	Drinking water	Before	3-8
Aad1	*A. annua* dried leaves	3% of diet	Before	1-56
Aad30	*A. annua* dried leaves	3% of diet	Before	30-56
Ca8d	*M. esculenta* dried leaves	3% of diet	Before	1-8
EAv1	*A. vulgaris* ethanolic extract	Drinking water	Before	48-58
EAv2	A. vulgaris ethanolic extract[2]	Drinking water	After	63-70
EAa1	A. annua ethanolic extract	Drinking water	After	65-72

[1] Livacox® Q (Merial Animal Health Ltd. Brazil) - positive control; [2] farmer's routine.*before or after the appearance of blood on faeces and sadness of young pullets based on the farmer routine.

To monitor effect of treatments on infections, pooled fecal samples from each pen were weekly analyzed (OPG estimation) from week 1 to 14 following Roepstorff and Nansen (1997). Consumption of diet was recorded for each pen every week and feed intake was estimated for individual pullets per pen. Every week (from 0 to 14), 10% of the pullets/pen were randomly selected and weighed. Due to changes in farm management in the end of week 7, i.e. diet was changed and pullets were able to access the outdoor runs, performance attributes were registered for the initial period (week 0 to 7) and for the complete period (week 0 to 14) in which the infection dynamic was monitored. For statistical analyses, the parameters of each treatment were presented as the mean of the two replicated pens. When necessary, data was logarithmical transformed. Analysis of variance was performed using one-way ANOVA in SAS. P-values less than or equal to 0.05 were considered statically significant.

Results

Pullets fed dried leaves of *A. annua* during the first 8 weeks showed lower body weight gain when compared to all other treatment combinations, which in turn did not differ in growth rate. This lower body weight gain was maintained during the entire 14-week period. The feed intake for this treatment was numerical lower in the first 7 weeks and feed conversion rate was significantly impaired compared with all other treatments. No variation was observed for performance among the other treatments.

Table 2. Effect of treatments on performance attributes and oocyst output

Attribute	Treatment Vac	Aad1	Aad30	Ca8d	EAv1	EAv2	EAa1	
BWG[1] (0-7 weeks)	0.45	0.33	0.40	0.43	0.46	0.45	0.43	*
FI[2] (0-7 weeks)	1.4	1.2	1.4	1.4	1.4	1.3	1.5	
FCR[3] (0-7 weeks)	3.2	3.9	3.5	3.3	3.1	3.0	3.4	*
BWG (0-14 weeks)	1.15	0.99	1.06	1.05	1.08	1.12	1.06	
FI (0-14 weeks)	5.9	6.3	5.9	5.8	5.7	5.5	6.0	
FCR (0-14 weeks)	5.1	6.3	5.5	5.6	5.3	4.9	5.8	**
k OPG[4] (0-7 weeks)	179	227	239	63	164	135	208	*
k OPG (0-14 weeks)	57	32	48	40	13	39	25	

* significant at $P<0.05$ and ** significant at $P<0.01$ [1] BWG Body weight gain (kg); [2] Feed Intake (kg diet/period); [3] kg feed supplied/kg weight gain; [4]k OPG = Accumulated oocyst counts (x 1000).

The infection prevalence in the vaccinated controlled group increased from nil to 100% in the first four weeks of pullet's life. Pullets in this treatment acquired resistance to the available species in the vaccine. After accessing the outdoor runs, pullets in this group were challenged like the other groups and this can be observed in the increased oocyst accumulation after week 10 (Figure 1).

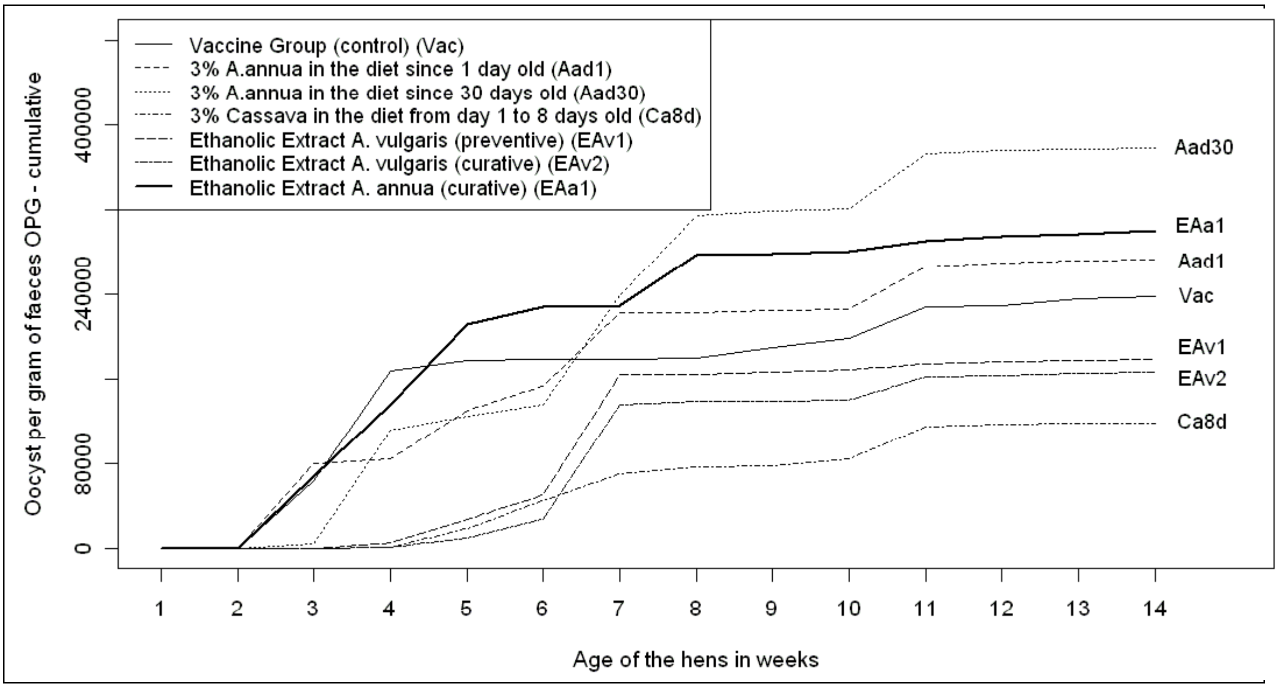

Figure 1. Oocyst accumulated counts per treatment (mean OPG for both replicates)

The infection severity in the studied farm can be observed by interpreting oocyst accumulation of group EAv2 which represents the farmer routine. Pullets in this group were most likely infected around week 4 leading to a high oocyst excretion at week 7. A very early infection was observed for the second group treated after appearance of clinical symptoms (EAa1). Pullets in this group were challenged just after allocated to the pens and a high excretion was observed at week 5. In addition, both groups treated after the appearance of clinical symptoms (EAv2 and EAa1) were challenged later, after accessing the outdoor runs, after week 10 (Figure 1).

In general, the mean oocyst excretion (OE) for the pullets receiving botanical treatments rose to a maximum excretion at week 7 (early coccidia infection). Subsequently, a smaller oocyst excretion after week 10 (late coccidia infection) was observed. During early period (from week 0 to 7), accumulated oocysts were lower for the groups supplemented with 3% cassava leaves ($p<0.05$) (Table 2). Thus, cassava dried leaves supplemented in the diet during the first 8 days of pullet's life suppressed OE to almost one third of what was accounted for the vaccinated pullets (positive control) and half of what was excreted for the EAv2 (farmer routine - negative control) in the end of week 7 (Table 2). By observing Figure 1, one can conclude that pullets supplemented with 3% cassava dried leaves showed smaller oocyst accumulation at week 7 when compared to all other groups in our study and with no effects in growth rate compared to the vaccinated group. During late infection, pullets from the group supplemented with the ethanolic extract of *A. vulgaris* via drinking water (EAv1) presented the smaller accumulated OE compared to the positive control treatment (Vac) however not statistically different from other groups (Table 2).

Discussion

Avian coccidiosis is important in free-range and organic poultry systems worldwide and may result in deaths, nutritional malabsorption and inefficient feed utilization depending on severity of infections (Peek and Landman, 2003). In the conditions we experienced in our on-farm study, the eight days supplementation of 3% cassava dried leaves to pullets naturally infected with *Eimeria* spp.

oocysts markedly suppressed OE in the early phase of disease (from 0 to 7 weeks). Dried leaves of *Artemisia annua*, supplemented at 3% of the dietary inclusion from day one of pullet's life, limited the weight gain and feed conversion rate for the initial and total growing periods under investigation. These results agree with our previous findings where dried leaves of *A. annua* decreased feed intake and growth rates for slow growing broilers (Almeida et al., 2012). However, in our previous study, the botanical supplementation resulted in a lower OE in broilers consuming *A. annua* for two weeks before coccidia challenge, thus using a prophylactic strategy in close agreement with Allen et al. (1997). The strategy of supplementing *A. annua* at two different stages in the current study was an attempt to follow a similar perspective. Nevertheless, in both cases, pullets were challenged before a reasonable period of plant consumption what may have lead to the failure of suppressing OE. The implications of these findings highlight the necessity of targeting strategies for delivering food supplements to reduce severity of coccidiosis without compromising feed intake. At the same time, our results highlighted that management is extremely important during early life of pullets to avoid high level of exposure to parasites that may compromise health status of animals and flocks thus compromising income of small scale farmers.

Suggestions to tackle the future challenges of organic animal husbandry

Supplementation of 3% cassava dried leaves in the first period of pullet's life may form part of a strategy to alleviate the effects of coccidiosis in small scale production systems. In addition to the supplementation of botanical coccidiostats - like cassava dried leaves as a sustainable component in the control of coccidia in developing countries - our results indicated that the rearing period demands special attention in small scale poultry systems. As an example simple prophylactic measures (like cleaning and using brush fire to kill survival oocysts from previous flocks) may be suggested as a first strategy to reduce infection and thus poultry mortality supporting food security for small scale families.

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Integrative medicine treatments can improve the resistance of organic honeybee's families to common pathologies

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Abstract

The aim of this work is testing the efficiency of homeopathy to improve the resistance of bee families. 20 hives was divided at random in two groups: 10 were treated with Calcarea Sulphurica 200 CH (C) and 10 received only water (W). To control Varroasis, the groups were both treated with block brood and Api-Bioxal (based on oxalic acid). We recorded the incidences of Varroa destructor by counting the natural mite fall, and by detecting through PCR the presence of Nosema spp. and virus. We evaluated the honey production by weighing beehives and supers. All data were statistically analysed. After the brood block, natural mite fall diminished in group C, but only after Api-Bioxal this difference became significant. At first, Nosema increased in group C, but after completely disappeared. Some viruses showed significant difference between groups. Beehive weight and honey production didn't' show significant differences between groups. The first results could indicate the efficiency of homeopathic treatments in controlling Varroasis and Nosemosis.

Key words: homeopathy, integrative medicine, beekeeping, Varroasis, Nosemosis, virus

Introduction

Beekeeping plays an important role in organic agriculture. For years health problems caused by parasites and pathologies affect this field, with inevitable beehive death and income decrease for beekeepers. The EU regulation for organic agriculture sets standards for the treatment of diseased animals in the Member states (Commission Regulation (EC) No 889/2008, Article 24). The objective of this regulation is to minimize the utilization of traditional veterinary medicines. Additionally, the EU regulation explicitly promotes the use of holistic oriented therapies, such as homoeopathy and phytotherapy. The ideas and philosophy behind some of these treatments are in accordance with the pillars of organic agriculture. This is evident from the belief that the use of medical substances obtained from natural sources can circumvent, or reduce, the use of chemicals that may be harmful to either the environment or human beings (Vaarst et al., 2004). In many organic farms, methods and practices of alternative medicine are combined with conventional ones (Del Francia, 1985; Pignattelli and Martini, 2007). Nowadays, this combination of practices and methods between alternative and conventional medicine is currently defined as 'integrative medicine'.

Material and methodology

The experimentation tested the efficiency of homeopathic remedy to improve the resistance of honeybee's families towards the common pathologies. The trial was carried out over a whole year. In an apiary of 40 beehives, situated in Florence province. 20 hives were divided *at random* in two experimental groups. At fixed date, 10 families were treated with one monodose of Calcarea Sulphurica 200 CH, dissolved in mineral water and sprayed 20 times over the hive frames (C). On the remaining 10, as control group, only water was sprayed (W). The remedy was selected according skin symptoms, general symptoms (sensitive to cold, wet weather) and literature (Persano Oddo and Marinelli, 2002).

Every beehive was treated with biomechanical treatment against *Varroa destructor* such as brood block and Api-Bioxal (drug based on oxalic acid) dripped over the hive frames. We recorded: natural fall of *Varroa d.* mite (after every treatments we counted for 21 days every 3 days the mite on the hive bottom), number of mite on adult bees (sample of 200 bees for hive), bee family strength (measured by 'Sixth method'), presence of *Nosema Spp.* and its belonging to *N. apis* or *N. ceranae* by PCR-RLFP, the presence of principal virus such as Deformed Wing Virus (DWV), Black Queen Cell Virus (BQCV), Sacbrood Bee Virus (SBV), Israeli Acute Paralysis Virus (IAPV), Kashmir Bee Virus (KBV), Acute Bee Paralysis Virus (ABPV), Chronic Bee Paralysis Virus (CBPV) by RT-PCR and TEM-Microscopy Electron Transmission (Various Authors, 2010). In addition, we evaluated the honey production weighing beehives and supers through a dynamometer directly on apiary. Nominal data (presence of *Nosema spp.* and viruses) were analysed by Contingency analysis. The continuous data (number of natural *Varroa d.* fall, number of mite on adult honeybee, strength of bee family, weight of hive and honey production) were analysed by one-way ANOVA, in which the group was assigned as a fixed factor (SAS, 2002).

Results

After one year of trial, 13 families survived: 7 on C group and 6 on W group. After the block of brood (second part of July), the natural fall mite became different between groups, but only after the Api-Bioxal treatment (early August) the difference between groups resulted significant (71.94 C vs. 134.35 W). Afterward, we didn't observe any difference between groups (Figure 1).

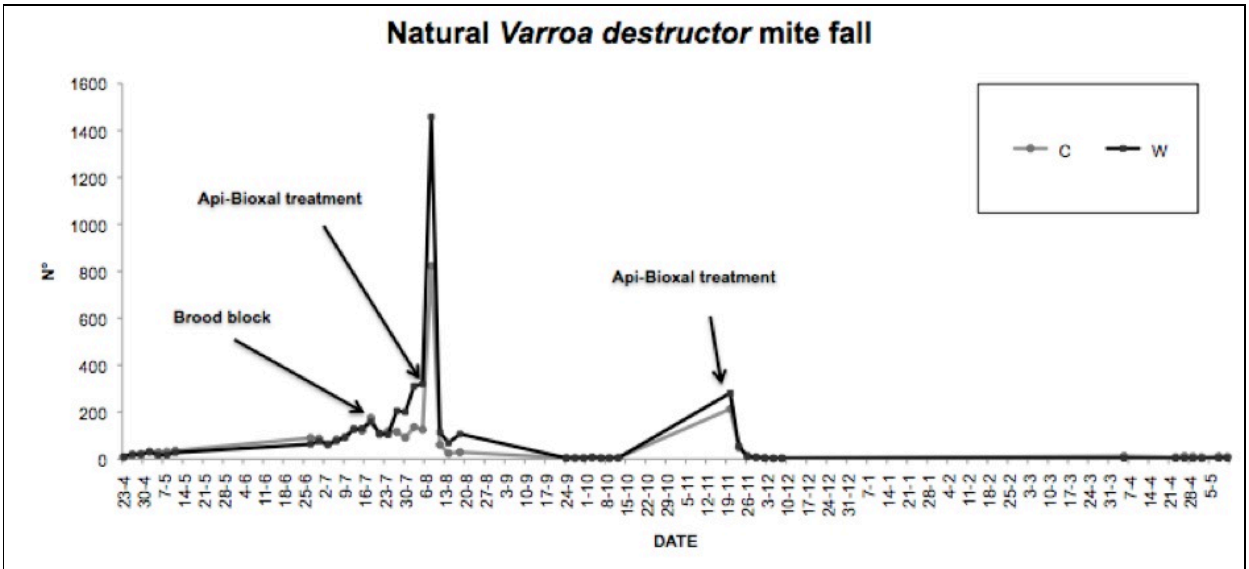

Figure 1. Natural *Varroa d.* mite fall every three days

The number of *Varroa d.* adults and the beehive strength never showed significant difference between groups. Beehive weight resulted significantly higher in July than in April. Honey production was higher in April (Acacia honey) than in July (Chestnut honey) but in both cases there weren't significant differences between groups.

At first, *Nosema spp* increased, and then it completely disappeared on group C (Figure 2). From the genetic characterisation of *Nosema spp*. it resulted that all the samples analysed belonged to *N. ceranae*. It recently spread on large European areas, substituting the indigenous *N. apis*, with completely different symptoms from the classic Nosemosis. Several viruses were detected on beehive in both groups in different times. The KBV virus was never detected.

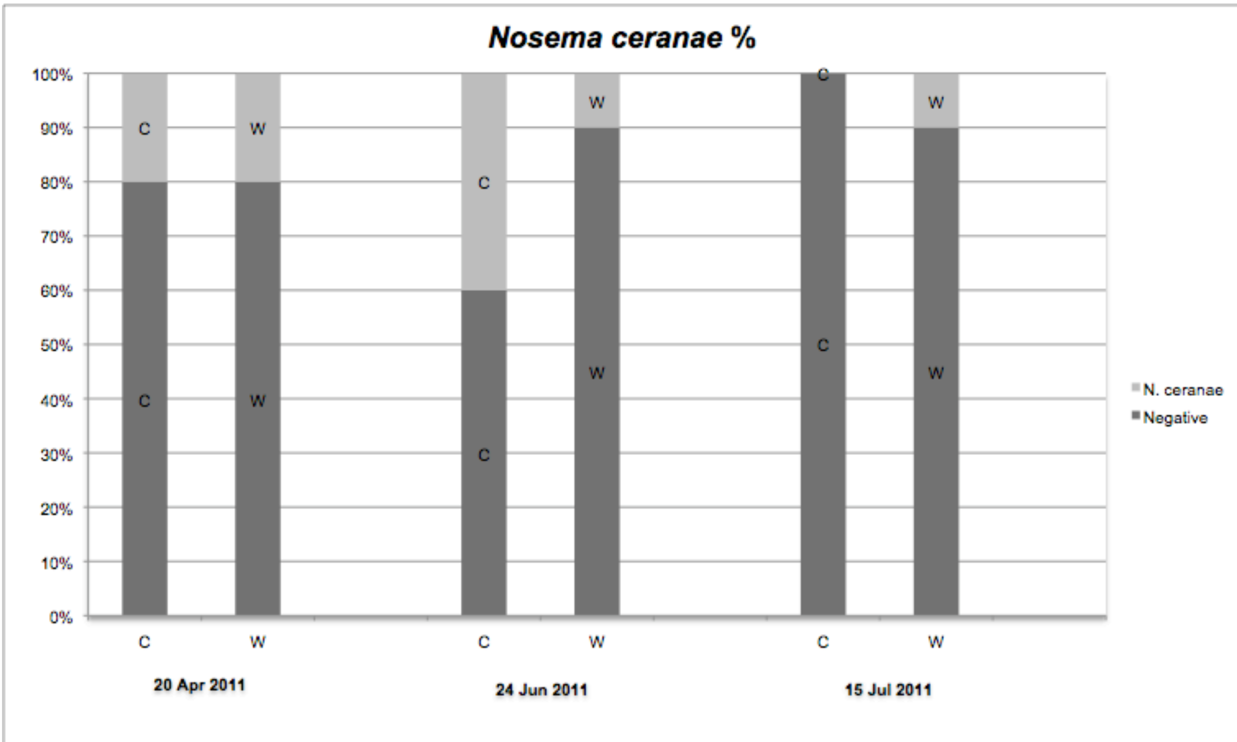

Figure 2. Incidence of Nosema ceranae within the experimental groups

Discussion

There is much research on the efficiency of homeopathy in organic farming, but there is very little work of organic beekeeping. Indeed, the studies of this subject are very few in the international scientific literature (Ruiz Espinoza and Guerrero Salinas, 2003, 2004) and only one at national level (Persano Oddo and Marinelli, 2002).

Group C, after the Api-Bioxal treatment, showed a mite fall lower than group W. This result was similar to those obtained by researchers of Universidad Autónoma de Chapingo of Mexico (Ruiz Espinoza and Guerrero Salinas, 2003, 2004) using Varroa destructor 202 CH nosode and Sulphur 202 CH.

The meaning of the lower mite fall, if confirmed, could demonstrate the positive effect of Calcarea Sulphurica 200 CH on improving the resistance of honeybee's families towards *Varroa d.*

In addition, *Nosema spp.* disappeared on group C and also this effect could be associated to Calcarea Sulphurica 200 CH.

These results should be checked with other further trials. At present, we have just started a second trial, in another apiary, to investigate the efficiency of this homeopathic treatment.

Suggestions to tackle the future challenges of organic animal husbandry

Our work had the worth to develop a holistic study model of an apiary, considering at the same time different aspects such as biological, productive and pathological ones. We used the model to test homeopathy integrated with biomechanical treatments in an organic apiary to control pathologies, but this should be useful to test other remedies or drugs on organic beekeeping.

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The control of Varroa mite in Hungarian organic apiculture

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Abstract

The beginning of organic apiculture in Hungary can be followed since the mid nineties based on 834/2007 EU Council Regulation, 889/2008 Commission Regulation and 79/2009 FVM (MARD) Regulation. We studied the possibilities of Varroa destructor control with accepted materials in the organic system. The successful varroa control is one key factor of organic operation as well. In the paper the experimental results of thymol and oxalic acid treatments are presented with the efficacy values. The results show that the efficacy varied between 47,9-96,4%. The results suggest that the only thymol based control strategy can ensure a limited (1-3 year) sustainability of the treated colonies concerning commercial production. The different, oxalic acid based control resulted in significantly higher mite mortality. Other technological factors may have important role in the control strategy against Varroa destructor especially in organic apiculture.

Key words: organic apiculture, Varroa destructor, oxalic acid

Introduction

The beginning of organic apiculture in Hungary can be trace back to the mid nineties. At present the most important regulations are 834/2007 EU Council Regulation, 889/2008 Commission Regulation and in Hungary the 79/2009 FVM (MARD) Regulation related to organic apiculture.

Formic acid, oxalic acid, lactic acid and thymol represent the frame of natural compounds used for the control of Varroosis (Calderone, 1999; Fries, 1998; Nanetti et al., 2003; Rademacher and Harz, 2006; vanEngelsdorp et al., 2008).

However, there are also some disadvantages of these natural compounds. Lactic acid and oxalic acid have to be applied under broodless conditions. The range between efficacy on the parasite and toxicity for the host is narrow (Higes et al., 1999).

Our aim was to compare two basic types of these acaricides (essential oil and oxalic acid) in different treatments that can be applied in certified organic apiaries as well.

Material and methodology

The experiment was set up in Gödöllő, between 2006-2009, with four treatments in four replications n=16 colonies.

The colonies were managed in the so-called ½ nB hive (frame size: 42 X 18 cm, 10 combs/super). The strength of the colonies was equalized in two supers in spring, 2006. Modified bottom board made possible to monitor mite fall without colony disturbance. The migration of colonies made possible to reach two Black locust (Robinia pseudoacacia) and sunflower (Helianthus annuus) pasture, which was the source of the extracted honey as well.

Treatments were as follows:

1. thymol 2-fold (Apiguard, 25% thymol, 50g)
2. oxalic acid solution 3,5% 1 (Api-Ox, broodless period, trickling 50 ml)

3. essential oils + oxalic acid solution 3,5% 2-fold (Bee-Vital-Hive-Clean, trickling 30 ml)
4. oxalic acid solution 3,5% 2-fold (Api-Ox limited brood and broodless period, trickling 50 ml)

In the first and fourth experimental years (2006, 2009) to calculate efficacy a final control treatment of coumaphos (Perizin) was applied in all treatments. The daily natural mite mortality was monitored before the first treatments. The number of dead mites before and after the treatments was counted using the bottom screen. Efficacy of the treatments was calculated according to *Fries et al*.

Results

In the first year no significant differences within the natural mite mortality could be found. During the whole experimental period high increase in the number of dead mites could be detected in the Treatment 1 in the last year. It shows that mite population could grow due to the limited control.

Figure 1 shows the number of dead mites after the first (blue column) and second treatment (purple column) and in addition the last application of coumaphos (Perizin) as the final control to calculate the efficacy of treatments (green column) demonstrating the percent of efficacy. The results show that the efficacy varied between 47,9-96,4 %, there was significant difference in the number of dead mites as well (P< 0,005). In treatment 1the second application of thymol increased mite mortality, however efficacy did not reach 50%. Treatments 2, 3 and 4 had no significant differences in efficacy in both years, although we could only exceed the 90% in 2009.

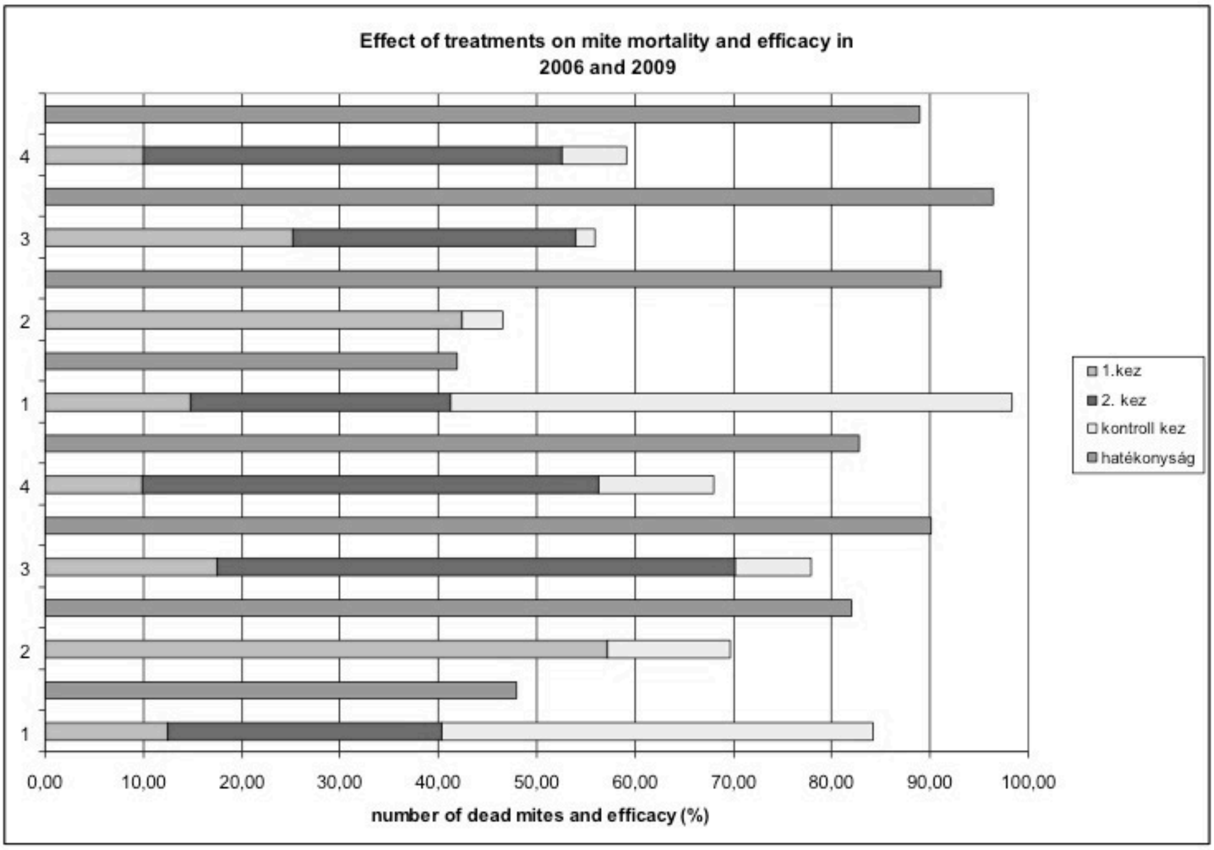

Figure 1. Effect of treatments on mite mortality and efficacy in 2006 and 2009

The results suggest that the only thymol based control strategy can ensure a limited (1-3 year) sustainability of the treated colonies concerning commercial production. The different, oxalic acid based control resulted in significantly higher mite mortality. Other technological factors may have important role in the control strategy against Varroa destructor especially in organic apiculture. Developing drone brood was removed as general recommendation in mite control in organic beekeeping. The Hungarian commercial organic beekeepers need at least 90% of efficacy against Varroa. Oxalic acid solution is effective mainly in the broodless periods. In our case no significant difference was found between the two oxalic acid Treatments No. 2 and 4. If other technological tools are properly applied and there is no reinfestation of colonies one treatment ensured over 80% and 90% efficacy in 2006 and 2009, respectively. In Treatment 4 the lower efficacy was calculated in 2006. The daily mite drop was only 10 during the first application in both years. It seems that the limited brood conditions could not ensure higher mite mortality thus within the brood present mites could survive and propagate.

Discussion

In organic apiculture mite control is different than in the conventional ones. The so-called soft type of acaricides may ensure colony survival and strength with an accepted honey yield level. The decision and application of control materials need wider information and the ability of frequent monitoring of bee and mite population. Colony and environmental conditions may significantly modify control efficacy thus flexibility and the adjustment of technology may be required.

Suggestions to tackle the future challenges of organic animal husbandry

The control of Varroa destructor is a key element of the organic strategy as well. The wider health condition of the colony highly depends on this success. Divers bee pastures may help colony maintenance and honey production too. During the long sealed brood period the lower control efficacy may decrease colony vitality and wintering.

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Miscellaneous

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How to leverage food security through livestock and agri-ecology system

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Abstract

The goal of this project is to manage livestock, cultivation and ecology system conservation in order to generate cash income, food, fibre, fuel and fertilizers through: a) Peasant action research to identify needs with respect to the genetic resources. b) To provide information on issue related to the local breed and livestock diversity. c) To organize appropriate training and capacity building to raise livestock. d) To implement the processes on animal genetic resources.

Key words: livestock, Soil, plants and trees

Introduction

To Kabare and Walungu territories in South Kivu area, the agricultural production has decreased because livestock disappeared, the reason for which it disappeared is because the ecosystem continue to be destroyed and people begun to neglect the traditional breeds and indigenous knowledge and cultural expression of livestock keepers. Now what are we going to do to improve that agro-pastoral production?

Peasant action research

We will organize training of trainers (tot) to share information on issue related to livestock diversity to build the capacity to raise livestock. As we have 20 agro-pastoral cooperatives, each cooperative will send 2 persons and 40 participants will follow courses and after training, they return on their villages to form others target groups. Implementation processes on animal genetic resources and agriculture.

To generate cash income: Fife cows will be given to each cooperative, 10 pigs and 100 goats. A cow will provide 20 litres of milk per day if it gets a good diet and care. 5 cows will provide 100 litres which will be sold on market and generate money. Pig can generate twice a year 10 small pigs, 10 pigs will generate 100 hundred pigs, 100x20 dollarsx 2 turn = 4000 us dollars

To generate food: As we said cows and goats will generate milk and meat and pig will generate meet too.

To generate fertilizer: The concentration of animals leads to accumulation of their wastes which pollute both air and water it will be poured in to the soil as fertilizers.

To generate fuels: The cow dung will be transformed in fuel and used to avoid cutting trees which contribute to destroy the environment.

Result

To access to food security, food safety, food availability, food access and food use.

- Two workshops done
- 40 trainers formed

- One hundred cows, 200 pigs, 400 goats are distributed to cooperative members and after a certain moment every bodies on the village will receive an animal.
- The fields of peasant will begin to produce more because of the cow dung wich will be put into the soil to fertilize /
- Environment will be protect because cutting trees will be avoided by preparing fuel from the cow dungs

Discussion

On the understanding of my work, I can explain that every chapter concerned the organic sector as follows:

- Livestock keepers use traditional breeds depending on the conservation of their ecosystem.
- We will add indigenous knowledge and scientific knowledge
- Cows produce and other animals produce cow dung to fertilize the soil, crops such maize, will provide food to animals, trees associated will fertilize the soil by fixing nitrogen, their roots will protect soil against erosion.Their leaves will either feed animal both fertlise the soil.

Suggestion and recommendation to IFOAM

To sustain the organic agricultural movement in DR Congo through APRODEA, because it will be avoid cutting trees on the forests which is the 2nd in the world after Amazonie. To help smallholders to access to the natural lands as you know that the DR CONGO after Bresil is the second country in the word to have lands(130 000 000 cultivables lands).

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EPOK - Centre for Organic Food and Farming, Sweden

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Key words: research cooperation, knowledge transfer, communication, research agenda

Introduction

EPOK synthesises and communicates current knowledge on organic food and farming and coordinates research and education. The centre, which was established in 2010, currently has a director and two information officers, plus 10 affiliated researchers from different disciplines working on a part-time basis. This provides a wide range of expertise at EPOK in subject areas of current interest for organic food and farming, and ensures that state-of-the-art knowledge is integrated into the academic activities in many departments. EPOK serves as a meeting point for researchers, advisors, farmers, policymakers, the agrifood industry and NGOs, and functions as a hub for communicating knowledge concerning organic production and consumption.

Communication and knowledge transfer activities

EPOK's communication and knowledge transfer activities are intended to contribute to well-documented knowledge from different perspectives in order to assist in the development of sustainable organic food production systems. Examples of activities to achieve the aims are provision of decision support to policymakers through publication of fact-sheets and knowledge synthesis on relevant subjects, promotion of dialogue between researchers and society by arranging workshops, and facilitation and improvement of the dissemination of research results through a number of channels, e.g. newsletters, popular science reports and articles, and seminars.

Priority areas during 2011-2012:

- Organic pig and poultry – management of outdoor systems, feeding strategies including 100% organic feed, animal health and welfare
- Organic food quality and health – nutritional quality, health effects of organic food, health effects of pesticide contamination
- Biodiversity and ecosystem services in organic farming – effects of organic farming on farm and landscape biodiversity, performance of ecosystem services in organic farming systems, e.g. pollination and biological control by natural enemies
- Organic agriculture and climate change – mitigation of greenhouse gas emissions in organic agriculture, effect of current organic practices and future potentials and challenges
- Consumer attitudes and behaviour – valued attributes and willingness to pay, trends in consumer demands
- Sustainable nutrient management – management in horticultural crops, efficient nutrient cycling of agricultural and urban residues (e.g. biogas digestate)
- Plant protection – weed regulation, disease and pest control

Research coordination and initiation – a Swedish research agenda for organic food and farming

EPOK's activities concerning research cooperation aim to ensure relevance and quality in organic food and farming research. These activities also involve promoting cooperation and interdisciplinary research, nationally and internationally. One important coordination activity concerns the development of a research agenda on organic farming and food systems during 2012. The research agenda is being developed in an open process together with stakeholders in the food chain, researchers and research funding agencies. Synthesising knowledge within different research areas (see priority areas above) to present existing knowledge and to identify future research needs is an important tool in this process.

The new research agenda will focus on the main future challenges for the agricultural sector, which includes ecological, socio-economic and food and health challenges, and will specifically address the contribution of organic agriculture to meeting these challenges. It will also include specific topics of high relevance for organic agriculture in Sweden and will emphasise the importance of strengthening interdisciplinary research and international cooperation.

Another aim is to serve as decision support for prioritising topics in research calls and as inspiration for researchers. For around two decades there have been directed research calls towards organic food and farming in Sweden and this research agenda is specifically aimed to be a steering document for coming directed calls.

Future challenges

An important task for EPOK is to fulfil the expectations and needs of scientifically based knowledge about organic food and farming in society and the agricultural sector. New knowledge that contributes to increased sustainability of organic production and organic food systems will also increase the significance of organic farming in forming sustainable future food systems.

A main challenge for EPOK is to develop communication activities and research collaboration, as it is essential to achieve a close dialogue and knowledge exchange between stakeholders, and between practice and research, in order to succeed in solving the future challenges of organic food and farming systems.

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Evaluation of nutrition value of deer meat obtained in Latvia farms and wildlife

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Abstract

In last years diversity of species grown under organic farming system has expanded and consumption and assortiment of game meat products has significantly increased. Deer farms have come in view. Investigations about biochemical composition of game meat are few. The investigations were carried out in different regions of Latvia. The chemical analyses of 45 samples were done wild and farm deer and beef obtained in organic production sistem in Latvia. In the studied samples protein and amino acids, fat and faty acids were determined. Content of protein in samples of game meat was 19.61 – 23.6%. The sum of essential amino acids in game meet samples were determined from 21.7 – 42.6 mg 100 g^{-1}. Concluded that the content of saturated fatty acids was lower in the meat samples of wild deer 33.6%, while in the meat samples of farm deer and beef it was higher 41.2% and 40.3% respectively. Because of the relatively high polyunsaturated fatty acid content and low saturated fatty acid content, wild game meat is more beneficial for human health. From results of our investigation concluded that the content of saturated fatty acids in meat samples of wild deer (33.6%) was lower in comparison with meat samples of farm deer (41.2%). From results of investigation we can see that ratio of polyunsaturated fatty acids nnω - 6 / ω - 3 in deer meat samples were 1,1 – 1,4 and beef – 4,8. It is evaluated that nutrition value of wild game meat is higher than beef from organic farming sistem.

Key words: organic production, meat, chemical composition

Introduction

In recent years, public attention is especially paid to Latvian inhabitants health, and value, through the consumption of wholesome food. One of the most valuable foods are meat, because of its nutritional value is largely determined by the essential amino acids, fatty acids, vitamins, minerals, etc. At the same time caring for the health consumers buy products with less calories, which provide more variety of new species growing of organic(biological) farming system, also deer growing in captivity.

This deer-growing technology allows to obtain high-quality meat and make effective use of grasslands, as well as provide game meat to consumers that it is popular, even outside the hunting season. It is one of the most promising sectors in Latvia that this product offers tremendous opportunities for exports.

Material and methodology

Studies conducted in the Research institute of Biotechnology and Veterinary medicine “Sigra” of Latvian University of Agriculture" from the 2007th by 2010 year. Overall there were analized 30 meat samples of deers (cervus elaphus) and15 samples of beef that was growed in the organic farming system Latvian Brown x Hereford cross breeds.

Protein content was determined as total nitrogen content by Kieldahl method and using coefficient 6.25 for calculation (ISO 937:1974).

Amino acids. Dried, defatted meat samples are treated with constant boiling 6N hydrochloric acid in an oven at around 110°C for 23 h. Amino acids were detected using reversed-phase HPLC/MS (Waters Alliance 2695, Waters 3100, column XTerra MS C18 5 µm, 1x100 mm). Mobile phase (90% acetonitrile:10% dejonized water) $0.5 ml min^{-1}$, column temperature. 40^0C. Intramuscular fat content was made by Sochlet method with hidrolysis procedure (boiling in the hidrocloric acid) using SoxCap 2047 and SOX TEH 2055 equipment (FOSS).

Cholesterol content was detected by Blur colorimetric method using spectometer (Шманенков et al. 1973)

Fatty acid analysis of meat**.** Homogenized meat samples were prepared for GLC (gas-liquid chromatography) analysis using direct saponification with KOH/methanol followed by a derivatization with (trimethylsilyl) diazomethane by the method of Aldai et al. (2006). An ACME, model 6100, GLC (Young Lin Instrument Co.) equipped with a flame ionisation detector, an automatic sample injector, and an Alltech AT-FAME analytical column (fused silica 30m×0.25mm i.d.) was used. As the carrier gas He was used with a flow rate approximately 2 mL/min. Temperature conditions of the oven, injector and detector was the same as in the method of Aldai et al. (2006). Results were evaluated with an conventional integrator program (Autochro-2000, Young Lin Instrument Co.) The individual FAMEs (fatty acid methyl esters) were identified according to similar peak retention times using standard mixture Supelco 37 Component FAME Mix. The statistical analysis was performed using SPSS 17. Statistical significancewas declared at $p<0.05$.

Results

Biochemical composition of meat samples were showed in the table 1. The research demonstrated that there are higher protein and lower fat substance in deer meat than in beef meat samples. Fat content of deer meat samples is approx.

Table 1. Protein, intramuscular fat and cholesterol content of meat samples

Meat samples	n	Protein content, %	Fat content, %	Cholesterol content, $mg 100g^{-1}$
Farm deer	15	1235	317	2774
Wild deer	15	106	81	197
Beef	15	6.0	5.4	7.1

significant at P<0.05 and

1,3%, but in beef meat – 2,8%. Certain differences between wild and farm deer meat fat content in carcasses were found. These differences are most likely due to their different environments.

The nutritional value of meat is determinated mainly by amino acid amount. Data in literature show that amino acid level is higher in deer meat than in beef meat. There are also more optimal acid relation that indicative of better nutritional and possibilities to provide consumers with high quality meat products (Jemeļjanovs 2008). There were compared essential amino acids content of deer and beef samples in research (Fig. 1.).

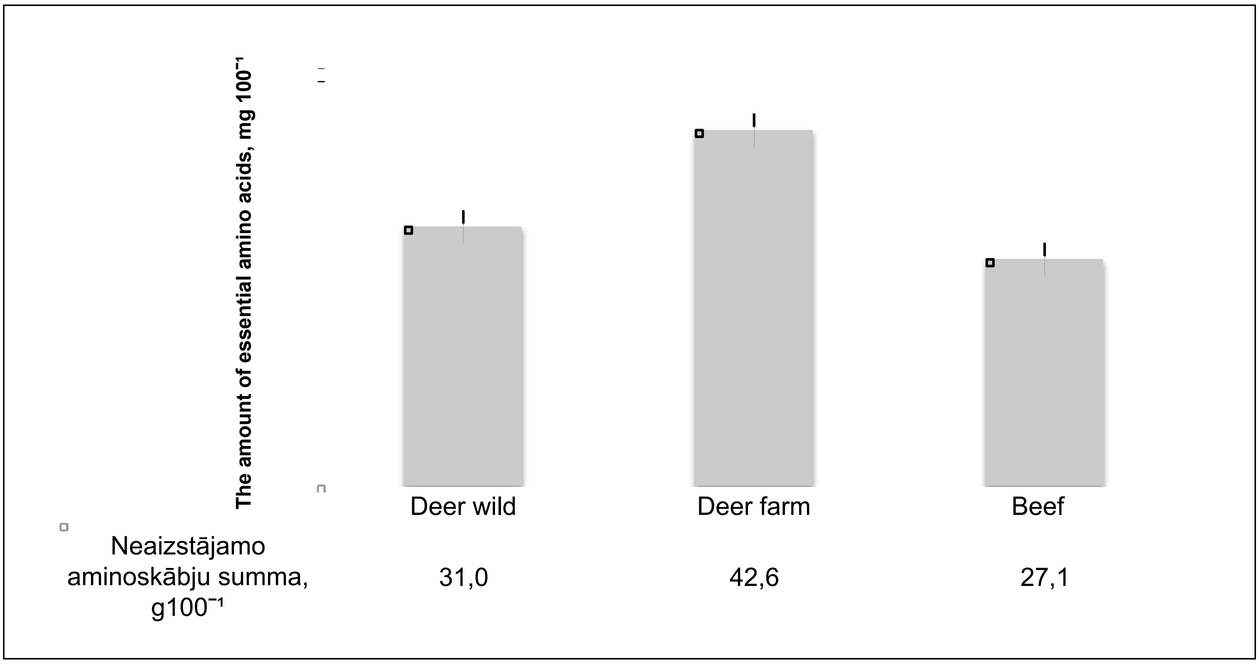

Figure 1. Comparison of essential amino acids in meat samples, mg 100 g-¹

In meat samples of farm deers amount of essential amino acids determined 42.6 ± 1.75 mg 100 g-¹ meat, that is significantly higher ($p < 0.05$) than in wild dear (31.0 ± 2.87 mg 100 g-¹) and beef (27.1 ± 1.51 mg 100 g-¹) samples. Meat quality is highly dependent on fatty acid composition of intramuscular fat. Research defined fatty acid content (Fig. 2.) indicative of a game meat high nutritional value.

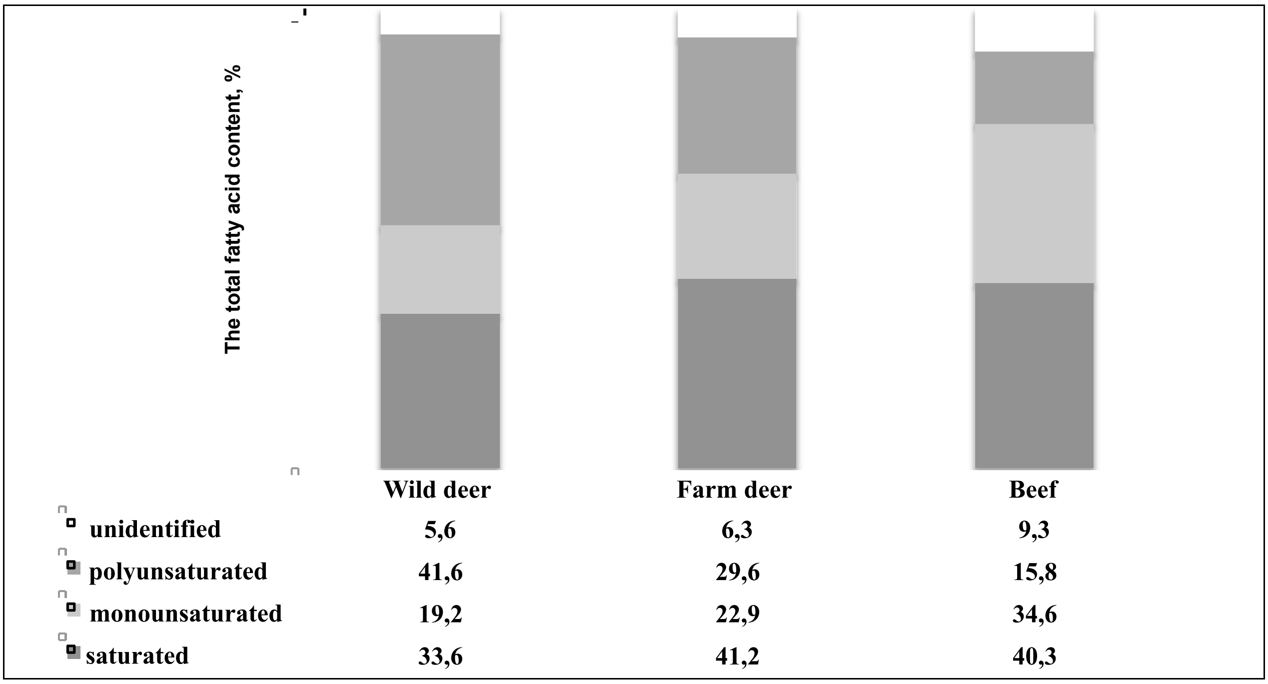

Figure 2. Comparison of fatty acids in deer meat and beef samples, %

Saturated fatty acid substance in farm dear meat and beef meat samles are higher than in wild deer meat; it can be explained with different feeding of wild animals. Farm deer get extra food (for example, rolled oats) in winter season, that promotes the total fat and saturated fatty acid formation.

Monounsaturated fatty acid (MUFA) substance in meat samples determined 19.2 – 34.6% of total fatty acids content. Results show that all kinds of meat is great sources of monounsaturated fatty acids.

Polyunsaturated fatty acid (PUFA) substance in wild deer meat samples is 41.6% that is significantly higher than detected in farm deer (29,6%) and beef (15,8%) meat samples. Similar results have been obtained in researches by foreign scholars (Medeiros, 2002).

In general must be said that there are more favorable fatty acids substance in wild game meat than in the human organism - because it has lower saturated fatty acid (SFA) content but higher content of polyunsaturated fatty acids (Cordan 2002) Wood reported that recommended ratio PUFA/SFA must be higher than 0.4 (Wood 2003). In research this ratio is determined 1,24 – in wild deer and 0,73 in farm deer meat samples, that indicates a high biological value of meat, while in the beef meat that is grown in organic farming system, this relation is lower than 0,4.

Conclusion

1. The highest substance of amin acids - 42.66 mg 100 g^{-1} set in farm grown deer meat samples.
2. Polyunsaturated fatty acids - ω – 3, ω –6 in wild deer meat in much more (41,6%) than in captive grown deer meat (29.6%), which in turn is twice as much in bred beef samples (15.8%) that is grown in organic farming system.
3. Game animal growing in deer farm animals feeding must be provided with food components that gives positive effect on the chemical composition of meat.

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