Organic livestock farming: potential and limitations of husbandry practice to secure animal health and welfare and food quality

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Edited by
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Sustaining Animal Health and Food Safety in Organic Farming (SAFO)

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Foreword

Sustaining Animal Health and Food Safety in Organic Farming (SAFO) is an European Commission funded project, with the objective to contribute to improved animal health and food safety in organic livestock production systems in existing and candidate member countries of the European Union. Workshops form a central part of the SAFO activities. This volume, with the contributions to the 2nd SAFO Workshop in Witzenhausen, Germany in March 2004, is one in a series of five proceedings published during the lifetime of the project (2003-2006). Electronic version of the proceedings will also be available at the SAFO web-site at http://www.safonetwork.org/.

The 2nd SAFO workshop focussed on the impact of farm level practices on animal health and quality aspects of organic livestock production. While most farm assurance schemes, including the organic farming certification, are primarily concerned with regulating the production system, the outcomes of the system, in terms of animal health and welfare, are particularly important in livestock production. The status quo assessments presented in the Workshop suggested that animal health and welfare outcomes of the organic production systems do not necessarily fulfil high consumer – or indeed animal – expectations. It was also suggested, that there may be particular problems in relation to the quality and safety of animal products, particularly in situations where regulations to achieve wider objectives – e.g. animal welfare - could have negative impact in relation to zoonotic diseases. Some of the speakers highlighted the inadequacies of the current inspection and certification systems, in terms of securing high levels of health and welfare in organic livestock systems. – Improved health planning, combined with a structured assessment of health and welfare outcomes, as part of certification, was suggested as a potential solution to these problems.

Perhaps the most valuable offering of the 2nd SAFO Workshop was the wealth of information on husbandry, feeding and breeding techniques that are being developed for organic livestock production systems all over the Community. In spite of some formidable problems, marked strides forward are being taken by the farmers and their advisers in areas like improving the poultry husbandry, identifying suitable feeding and breeding strategies for dairy cows and controlling parasites with minimal medicine inputs. – One of the important tasks of the SAFO Network is to ensure that the messages from these projects are taken into consideration in the development of the EU Regulation on organic livestock production.

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Part A:
Organic animal health management and food quality at the farm level: Current state and future challenges

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Organic livestock production and food quality: a review of current status and future challenges

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Introduction

Animal production is an important part of organic farming that aims at achieving a balanced relationship between the soil, the plants and the animals in a farming system. Each component is as important as the other in contributing to the overall effect and in fulfilling the key values of naturalness, harmony, local circulation of resources and the principle of precaution. Consumers expect the food from organic production to be of a certain quality that makes it different from conventionally produced food. Acknowledged consumer interests cover a wide range of issues, from the nature of farming as a whole (environmentally friendly, socially just, animal welfare friendly) to the concern over own health (buying organic food based on a perception of organic food being more healthy).

The organic farming values and the consumer expectations form a complex concept of quality, which is explored in this paper. Current knowledge and understanding of food quality from organic livestock production is reviewed, with special focus on defining such quality and outlining the main farm level challenges.

Quality and organic livestock products

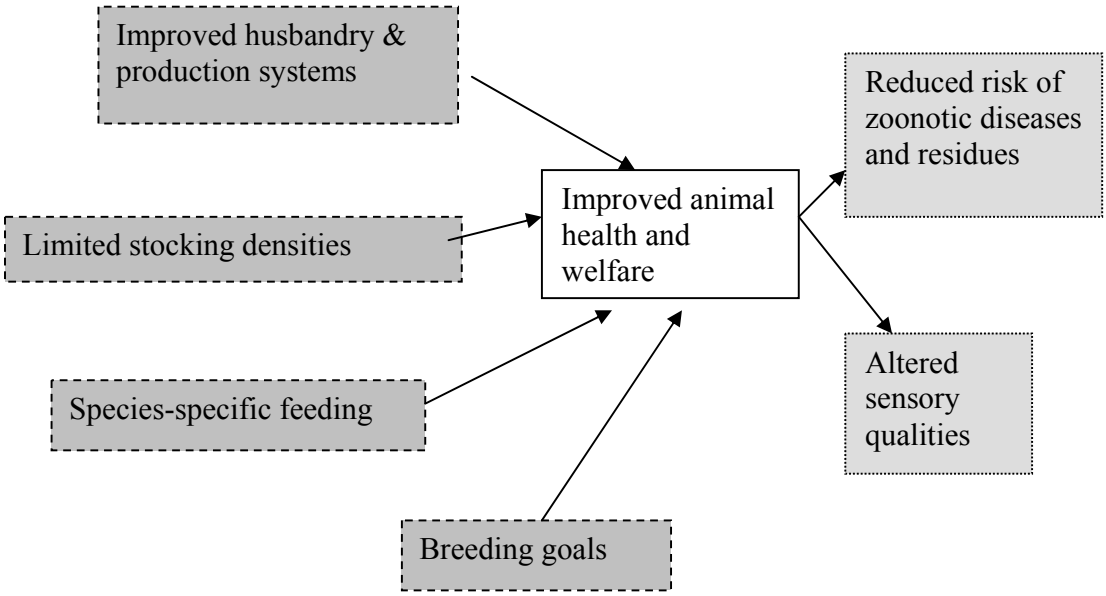
Organic farming movement has traditionally embraced a 'holistic' food quality concept that includes all aspects of food, from soil management and environmental and social impact at primary production level through processing to sales and distribution of food. For analytical purposes in this paper, this holistic quality concept is divided into process quality, referring to the whole process of organic food production and including primary production, processing and distribution, and product quality, which is limited to the qualities of food as it is consumed (Table 1).

Process and product quality are linked together through, amongst other things, the animal health and disease status at farm level: improvement of the living conditions of the animals is expected to improve their lives and, subsequently, both the product and the process quality. Furthermore, improved living conditions are expected to minimise the risk of disease (including zoonotic diseases) and disease treatment with medicines, creating a reduced risk for contagion and residues and development of antimicrobial resistance (Figure 1).

Table 1: An analytical framework for the examination of food quality in organic livestock production.

Process quality	Product quality
• Animal husbandry and its impact on animal health and welfare • 'Naturalness' • Food processing • Impact of the primary and processing level on environment, social balance, human culture, global and local ecological and social justice etc.	• Limited to food as it is consumed • Includes: - Food safety (residues, toxins, zoonotic diseases, contamination etc.) - Sensory quality (taste, smell, texture, colour etc.) - Nutritional quality (composition, ingredients)

Figure 1: An illustration how animal health and disease influences product quality, linking product and process quality.



Potential impact of organic livestock production on food quality

Organic farming standards are designed to reduce the environmental impact of food production, to encourage socially and ethically just food production and to guarantee safe and healthy food. These aspirations are complex and may, in certain situations, be conflicting. Livestock production, with its ethical dimension, is particularly difficult to regulate with solely input-based standards, and situations may arise where organic rules can have a potentially negative effect on

product quality. Both positive and negative potential impacts of organic livestock production at farm level are explored in Table 2.

From farmer to consumer

Historically, organic farmers have taken a strong 'ownership' of the potential positive qualities of organic products. For many, the primary reason for converting to organic production systems was to improve both process and product quality of the food they produced and the systems they worked in. These farmer aspirations were supported, in many countries, by private, organic research and advisory organisations that combined the farms' own goals with the overall organic goals in a close-knit circle of shared interest and ambition.

With the development of organic certification and legislative development of the organic standards, the control of quality of organic produce has shifted away from the farmers and producers to certification bodies and the legislative controls of certification in general. It has been suggested that the development of goals and principles has also shifted away from farmers, with the onus now being on the consumers (Lockeretz and Lund, 2003). We also suggest that, alongside this shift, there is a divide in the ownership of the two quality areas of organic products. The farmers are, expectedly, more focused on the process quality. The primary consumer interest is in the product quality, although surveys of consumers' interests have found that consumers have some interest in process issues, like the environment and animal welfare (Sanders and Richter, 2003). While a considerable amount of work has been carried out, particularly on the product quality aspects of organically produced fruit and vegetables, little published information is available on the process or product quality of organic livestock products.

Divided control of process and product

As legislative control of standards and official certification systems have developed, a clear division has been established between the control of process and product quality, both in organic and other farm assurance systems. While process quality is determined by the certification system that focuses on the production inputs, the control of product quality, apart from some voluntary testing schemes by organic food chain, is based on testing regimes that are stipulated by conventional legislative mechanisms, such as food safety legislation and environmental health regulations.

One of the aims of the SAFO-network is to promote and collate information, which improves the basis for creating and controlling food quality and safety from organic livestock products. At the moment, any conclusions on the quality outcomes of organic livestock production, however, remain limited and, in many cases, based on aspirations rather than researched data. Table 3 summarises some of these aspects.

Table 2: Potential impact of organic livestock husbandry principles at farm level on process and product quality.

Principle	***Process* quality: potential impact**	***Product* quality: Potential impact**
Self-sufficiency, land-based production, integration of crop and livestock production	- Local resource use: impact on local economy - Limited environmental impact - Risk of local soil deficiencies being manifested	- Product composition could be influenced by local conditions; e.g. local soil deficiencies - Local conditions could affect the sensory quality of the product - Potential contamination of home-grown feed by mycotoxins
Limited stocking density	- Less pressure on land: better conditions for good health and welfare management (no poaching, good evasive grazing systems for parasite control etc.) - Limited environmental impact	- Potentially altered sensory quality of products
Loose hosing and/or outdoor life	- Animals have access to natural behaviour and social contact with other stock - Naturalness of the system	- Potentially altered sensory quality of products - Potential risk from zoonoses from contact with wildlife and other livestock
Species-specific feeding	- Naturalness of system - Harmony between animals and system - Decreased disease risk from system-related diseases, such as weaning diarrhoea in pigs, acidosis in ruminants etc.	- Altered sensory and nutritional quality as a result of slower growth rates and forage based diets
Use of suitable breeds	- Harmony between system and the animals	- Potentially altered sensory and compositional quality of product
Limited veterinary medicinal inputs	- Potentially increased risk of suffering if conditions are not treated - Increased focus on disease avoidance	- Reduced risk of antimicrobial resistance and drug residues
Limited mutilations	- Naturalness of system - Increased focus on disease avoidance - Potential risk for suffering in unsuitable production system (e.g. hens in free range system without good quality runs leading to feather pecking damage unless birds beak trimmed)	- Altered sensory quality of product as a result of trauma of or stress

Table 3: Different aspects of process and product quality in organic livestock produce based on the principles and the framework of the standards.

Process quality aspect	Current understanding
Levels of 'production' diseases and consequent welfare	Disease incidence expected to be lower and consequent welfare status to be higher. Existing evidence is contradictory, particularly in dairy cows. Similarly, extensive sheep systems, when converted to organic production, rarely show improvement in general, endemic disease levels.
Naturalness and natural behaviour	Improved with the move to loose housing, outdoor access and more species-specific diets. In dairy systems, problems with mother-offspring contact still unresolved. Poultry breeding and rearing systems are still virtually entirely conventional, with problems in starvations diets of the parent birds and lack of early access to outdoors.
Transport of live animals	Contradictory evidence exists: with closed herds and flocks and limited numbers of brought in stock from conventional systems, transport likely to be reduced, but lack of organically certified abattoirs a problem in some countries, increasing the need to transport live animals over long distances.
Local nutritional deficiencies	Land-based production, reliance on home-grown feed and non-availability of organic minerals at reasonable prices may lead to deficiencies. Only anecdotal data exists: there is a need to collate information on the amount of derogations give by the certification bodies, in order to develop the standards further.
Disease treatment and drug residues	Lower numbers of treatments with conventional medicine reported in many countries. A substantial body of research into alternative approaches of disease treatment and prevention exists but scarce information on drug residues in organic systems.
Harmony between breeds and production conditions	A marked diversity exists between countries and systems in this respect. Tools for breeding 'suitable' stock often missing and, when available, not used by producers. Enforcement of this regulation/aspiration potentially poorly executed. Poultry breeding and hatchery standards are absent from the EU Regulation 1804/99.
Risk from genetically modified organisms	Risk likely to be substantially reduced, but mechanisms of transfer of transgenic material e.g. from feed to livestock products poorly understood. Limited data suggests that contamination of organic crops likely.
Sensory quality	Limited data suggests that sensory quality is improved but also contradictory, anecdotal evidence exists in some cases.
Nutritional quality	Limited data suggests that products from ruminants fed on grass/forage-based diets and eggs from organic systems have advantageous nutritional qualities.
Risk of contamination by mycotoxins	Contradictory evidence as to whether the risk of mycotoxin contamination is greater in organic than in conventional fodder crops. No evidence on contamination of livestock products.
Risk of other contaminants	Evidence of high levels of dioxins in organic eggs. Access to outdoors and soil may be a factor, but the current data does not confirm this.
Risk from zoonotic diseases	No data published on increased levels of zoonotic risk to consumers of organic livestock products. High carrier levels of organic broilers of *Campylobacter spp.* found in DK and the UK.

When looking at examples of the recent developments in specific organic livestock production systems in the UK and in Denmark, questions arise with regard to how these developments reflect the 'holistic' quality of the product and the process? Can we claim that organic products are more 'natural', when the flocks sizes of laying hens exceed 3,000 birds, or a dairy herd consists of high-yielding cows that are separated from their off-spring immediately after calving and experience culling rates in excess of 40%?

Table 4: Two examples of current organic production system developments from Denmark and the UK.

Example 1: Organic dairy farming systems in Denmark

- Average size of organic dairy herds bigger than conventional dairy herds
- Grazing during summer, but outdoor access not guaranteed during winter
- Limited labour input to husbandry
- Cow and calf routinely together after calving for 24 hours only
- Culling rate at 40% or more
- Specialised production (a dairy enterprise may even be split into a dairy production unit and a calf rearing unit where the heifers are reared fro multiple farms)
- Use of antibiotics varies but is often the same as on conventional farms (0.5 treatments per animal per year)

Example 2: Organic egg production in the UK

- In excess of 95% of eggs come from large-scale systems:
    - 3,000 birds in several multiple flocks under same roof
    - permanent housing
    - not a land-based systems
- More than 95% of the organic pullets come from conventional pullet rearing systems.
- More than 90% of birds in a major certification body flocks were beak trimmed in 2003.

Process and product quality in organic livestock production: challenges to farm level husbandry

The theme of the 2nd SAFO workshop is the potential and the limitations of husbandry practice in securing both process and food quality in organic livestock production. The last part of this paper will focus on farm level and will summarise some of the challenges and some potential solutions that arise from the current situation.

Species-specific feeding

The principle of ensuring naturalness leads to an emphasis on species-specific feeding. This emphasis is expected to improve animal welfare. While contradicting evidence exists, it has been suggested that a conflict between the high-yielding, high genetic-merit animals and a roughage-based feed ration may exist, as organic dairy cows appear to suffer from low energy levels in the early lactation (Gruber *et al.*, 2000). Similarly, poultry feeding without synthetic amino acids may prove to be difficult, particularly at current stocking densities and flock sizes that do not encourage full foraging and scavenging behaviour. A solution to the challenge of feeding livestock with a species-specific diet is likely to be found in a compromise between the genetic ability to produce or grow and the diet itself; i.e. the implementation of one of the other fundamental principles of the organic approach: selection of suitable breeds and strains for the system in question.

Land-based production (self-sufficiency in manure allocation and feed production)
The principle of self-sufficiency of feed production and manure management (land-based livestock production) may lead to some risks and disadvantages that may affect animal welfare and health, while not producing any concrete risk for human health. Internal parasite management has been shown to be a major challenge on organic livestock farms (Keatinge *et al.*, 2003). Local feed production and exclusive reliance on home-grown feed may lead to nutrient deficiencies in areas where the soil is deficient of certain nutrients. Again, development of husbandry measures, maintenance of appropriate stocking densities and selection of suitable breeds and stains of stock are amongst the most likely candidates for sustainable solutions to the problems caused by land-based production.

Outdoor access
Requirements for outdoor access for all animals is based on both the need to create natural systems and to improve welfare by allowing access to species-specific behaviour. With most ruminant systems, there are few problems arising directly from the outdoor access, apart from the parasite-related issues mentioned above. However, in monogastric livestock systems, outdoor access appears to cause both welfare and food safety related problems. Particularly in poultry systems, food safety issues, such as high contamination levels with campylobacter in broilers and contamination of eggs with dioxins, have been detected (Koene, 2001; Heuer *et al.*, 2001; Anon, 2004). Further research is needed to identify causes for the observed phenomena and to find sustainable and acceptable solutions.

Organic breeding goals
The requirement to use suitable breeds and strains of animals in organic livestock systems can be seen as a partial solution to all of the challenges mentioned above. However, both setting of breeding goals at farm level and working toward achieving the goals appears to be a formidable challenge for organic farmers. Selection tools do not always exist, and when they are available, they are not necessarily used or accepted by the farmers. The biggest challenges are likely to be in poultry and pig breeding, due to the wide distribution of hybrid breeding systems that are inherently difficult for niche farmers to control.

Restrictions in veterinary medical inputs
Limiting the use of antibiotics and other veterinary medicinal inputs improves the product quality by reducing the risk of residues and the development of antimicrobial resistance. However, limitations on drug and vaccine use may lead to increased risk of zoonoses (e.g leptospirosis in dairy cattle). Similarly, the process quality can be affected both negatively and positively. Withholding treatments or protection from animals that are suffering from or at risk of a disease is a threat to process quality. On the other hand, limited access to routine medication and prophylaxis may force the farmers to focus on improved husbandry, thus improving the overall quality of life for the stock. Finding an acceptable balance in limiting medicine use and in ensuring that necessary treatments are not withheld is another challenge to the organic livestock keepers and their advisers.

Challenges for the SAFO Network

One of the main challenges for the SAFO network is to link the issues of process and product quality. This can be done by widening the traditional animal husbandry discussion to comprise, not just the effect of husbandry on animal welfare, but also its effect on food quality and food safety. Can there be any possible risks, which are specifically linked to the organic production principles and standards? If this is the case, the solutions should be sought at the herd level and be included into monitored herd management strategies. An example of the complexity of issues would be the storage of crops for pig feeding on farm and the potential risk for zoonotic disease transmission thereof (e.g. toxoplasmosis). Another example of these challenges are the emerging data on potential contamination of organic eggs with heavy metals and dioxins, as a result of outdoor and soil access. Both situations create a conflict between food safety and, in the first example, land based production principle and, in the second example, animal welfare. The challenge for the SAFO Network is to openly address these conflicts and to seek solutions that find a balance between the conflicting expectations of product and process quality.

Another area of challenge for SAFO is to examine the differences between the aspirations of farmers and consumers, with regard to organic animal production. Consumers often link organic farming with small-scale production, where there is a close contact between humans and animals and a mixed farming system. This is in strong contrast with the highly specialised organic farms that are a norm in many countries in the north-west of Europe. The process quality issues are complex and of great interest to the SAFO network, particularly where animal welfare or food safety are affected.

Thirdly, the diversity of organic animal husbandry practices in Europe provides a major challenge to the Network. It is obvious that a range of solutions is needed for each question. While these solutions obviously need to respect the common reference point of organic farming and the principles and European organic standards, they also need to reflect the diversity of climatic conditions and farming traditions within the Community.

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Animal health on organic farming defined by experts- concept mapping and the interpretation of the concept of naturaless

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Introduction

Concepts like 'health', 'welfare' and 'naturalness' are examples of fuzzy and complex concepts, for which the definition depends on once paradigm. Verhoog *et al*. (2003), for example, showed that the interpretation of the concepts of 'nature' and 'naturalness' was performed in three paradigmatic directions that were complementary to each other.
The Louis Bolk Institute studies the concept of health in several parts of society: soil health, plant health, animal health, human health and health within organisations. In one of the studies, a number of experts is used to clarify the complex issue of animal health. Experiences are exchanged to look for coherence and opposite statements on this subject.

In this paper, the preliminary results with regard to the concept formation of animal health are presented. Secondly, the interpretation on naturalness is applied to this concept, and both expert interpretations are compared.

Methodology

Concept mapping
Concept mapping is a methodology that supports the discussion within an expert group and leads to the formation of expertise based concepts. In this study, experts were people who were dealing with organic farming in their profession over a period of at least 5 years, but most persons had experience in excess of 10 years. Both qualitative and quantitative techniques were used. The method is based on the following steps:

1. choice for a specific conceptual focus, i.e. animal health in organic farming;
2. brainstorm based on personal experience, i.e. by means of a questionnaire (results of the completion of the questionnaire are a list of items that are important for the topic according to the experts;
3. structuring of the findings by means of a second questionnaire, in which experts have to judge about all items on a five step scale (1 = extremely unimportant till 5 = extremely important) and cluster them into overall themes;
4. statistical Principal Component Analysis (PCA) analysis by means of Ariadne software; and
5. interpretation of the results.

Topics with an average score of importance above 3.5 were used for the interpretation of the results.

Naturalness discussion
The interpretation of nature and naturalness is based on qualitative inquiries only, followed by consensus discussion in a small team of researchers. A total of 25 people, working in the field of organic farming, trading and legislation, were interviewed. Concept results were presented in several workshops and discussed with groups of stakeholders, aiming at consensus on concepts. Three workshops were held for the final interpretations and discussions.

Results

Concept mapping
As a result of the first brainstorm, 79 different expressions (items) of animal health were described. In the second phase of prioritising and clustering, answers of 10 people were used: 4 veterinarians, 2 animal ethologists and 4 organic dairy farmers. Only 52 of the 79 items had an average value of importance above 3.5. These items were used for the further interpretation of the clusters.

Three central clusters were defined. Each cluster will be presented here in the following way:

- The table of items, their average score, the standard deviation and the number of people who scored this item.
- The overall themes described by the experts for each cluster.
- The description of the cluster in phrases put together on the items by the experts.
- An overall interpretation of the researchers about the specific content of each cluster.

Cluster 1
In Table 1, the items belonging to this cluster are detailed.

Table 1: Items belonging to cluster 1 with an average score of importance above 3.5; the average score of importance, the standard deviation and the number of experts who scored this item.

Item	Score	SD	N
Vital expression	4.70	0.41	10
Harmonious balance within the organism	4.50	0.50	8
Self-regulation: recognition of unbalance	4.38	0.49	8
Psychosomatic wholeness	4.14	0.69	7
Expression of joy of living	4.11	0.32	9
To maintain its own character and being flexible for external and internal changes	4.10	0.09	10
Clear expression	4.10	0.69	10
Fertility	3.90	1.49	10
A balanced growth suited to its age	3.90	0.89	10
Energetic	3.80	0.56	10
Unspoilt impression	3.71	0.49	7
Good mood	3.70	0.41	10
Proud posture	3.60	0.64	10
Wholeness of the habitus (body shape)	3.50	0.25	4

According to the experts, the following overall themes are described in this cluster: vitality, the nature on its own, its impression on man, self-regulation.

If this cluster is described on the basis of the items used by the experts, the following phrases can be composed:
"A vital expression is present."
"The items describe the level of the psychosomatic wholeness, the wholeness of the habitus."
"There is a harmonious balance within the organism, a proud posture, a balanced growth has been made suited to its age."
"The animal is energetic, expresses joy of living, has a cheerful mood, an unspoilt impression and a clear expression."
"The animal's fertility is good."
"There is an internal process of active self-regulation, due to recognition of unbalance, based on a maintenance of its own character and a flexible possibility to tackle internal and external changes."

Finally we interpreted this cluster as follows: the cluster expresses a basic orientation on organic animal health towards the animal's own identity: aspects of its vital expressions or psycho-somatic wholeness due to self-regulative activities.

Cluster 2
In Table 2, the items belonging to this cluster are listed.

Table 2: Items belonging to cluster 2 with an average score of importance above 3.5; their average score of importance, the standard deviation and the number of experts who scored this item.

Item	**Score**	**SD**	**N**
Normal relationship with its companions	4.60	0.44	10
Interest in the environment	4.40	0.24	10
Care for its offspring	4.30	0.81	10
'Presence' / 'being there'	4.10	1.09	10
Showing social behaviour to companions	4.10	1.09	10
Absence of the experience of pain	4.00	1.20	10
Adequate self defence	3.90	0.49	10
Absence of fear reactions	3.90	1.09	10
Taking initiatives	3.90	0.49	10
Being part of a herd	3.80	1.56	10
Investigates its environment for new aspects	3.80	0.96	10
Absence of unnatural behaviour	3.80	1.16	10
Playing	3.70	0.61	10
Absence of isolation behaviour	3.60	0.84	10

According to the experts the following overall themes are described in this cluster: normal behaviour, the behavioural aspects of health, the environment of the animal, social behaviour (open interest, being alert).

If this cluster is described with the items used by the experts the following phrases can be composed:
"The animal is 'present', takes initiatives, investigates its environment and shows interest for its environment."
"The animal shows a normal look-out for companions, and normal social behaviour as it takes part of the herd."
"There is an adequate stand up for one self."
"The animal shows playing behaviour and has care for its off spring. In reverse: isolation behaviour, fear reactions, unnatural behaviour and the experience of pain are absent."

This cluster interprets animal health in terms of animal welfare and behaviour: 'aspects of species-specific behaviour and well-being'.

Cluster 3
In Table 3 the items belonging to this cluster are detailed.

Table 3: Items belonging to cluster 3 with an average score of importance above 3.5; their average score of importance, the standard deviation and the number of experts who scored this item.

Item	Score	SD	N
Absence of clinical symptoms and diseases	4.56	0.47	9
Quick recovery after illnesses	4.50	0.45	10
Quick recovery of wound and injury	4.40	0.64	10
Resistance against prevailed diseases or infections	4.40	0.84	10
Normal physiological and locomotive functions	4.33	0.67	9
The provision of the daily needs	4.30	0.61	10
Possibilities for birth, raising and suckling	4.30	0.41	10
Healthy coat	4.20	0.56	10
Absence disease symptoms and in/external damage	4.11	1.21	9
Becoming in heat/pregnant	4.10	0.29	10
Stress resistant	4.00	0.40	10
Low percentage of mortality	4.00	0.89	9
Healthy appetite	4.00	0.60	10
Absence of lameness	3.90	0.69	10
Free respiration	3.90	0.49	10
Normal appetite	3.90	0.29	10
Supple movements	3.80	0.96	10
Absence of stiffness in the posture	3.80	0.96	10
Absence of skin abnormalities	3.80	0.36	10
Getting old without problems	3.70	2.01	10

Continued on next page

Longevity	3.70	1.81	10
Healthy faeces	3.67	0.89	9
Normal body temperature	3.60	0.64	10
Normal consistency of the faeces	3.60	0.24	10

According to the experts the following overall themes are described in this cluster:
(physical) health, robustness, lifetime, absence of disease, clinical illness, recovery, expression, and resistance

If this cluster is described with the items used by the experts the following phrases are composed:
"The animal has the ability for a quick recovery of injuries, damage and illnesses."
"There is some stress resistance."
"Symptoms of illnesses are absent due to a good resistance against diseases and infections."
"There is a long longevity and a low mortality in the herd."
"Animals will get old without a lot of problems, and physiological and locomotive functions are normal."
"Positive measurements are: normal temperature, healthy appetite, healthy faeces and free respiration."
"The animal shows a healthy coat, has a supple movement, is easily in heat and has an easy birth."
"Absent are: lameness, skin abnormalities a stiff posture and clinical disease symptoms."

This cluster describes measurable elements of animal health within the focus of organic farming in terms of: 'aspects of physical health, expressing itself in robustness and longevity'.

Naturalness in relation to animal health
Verhoog *et al.* (2002, 2003) defined three interpretations of naturalness. At first, a reductionistic and symptom oriented orientation on life, mentioned as Style 1: 'the 'no-chemical or replacement approach'. This orientation is based on the distinction between living (organic) versus dead (inorganic) nature and leads to rejection of artificial chemicals and search for 'natural' replacements, which is thought as being healthier.

In contrast and addition, two holistic orientations are described. As Style 2, the 'Agro-ecosystem approach' is defined with a background in assuming that people can learn from the wisdom in nature by imitating natural processes. The functioning of the system is central, which is thought to be based on the bio-diversity of species and leading to prevention strategies and new complex management based on context knowledge. The second holistic orientation is defined as Style 3: The 'Integrity (of life) approach'. There is a positive, imaginative attitude towards nature and an orientation on the personal role and intentions, based on a respect of the characteristic nature of the other, reflecting its entity, the value of its own. Nature is seen as a friend to live with instead of an enemy to beat out.

These three styles (or paradigms) affect the interpretation of health and welfare. Two examples are given: the interpretation of being ill and the control of hygiene in organic systems in relation to contagious diseases.

Being ill
Style 1: An illness makes no sense and the animal suffers. This leads to the insight of eradication of diseases and symptomatic control of illnesses.
Style 2: Being ill is a problem of the balance of the animal and its environment. This leads to the interpretation that illnesses can be managed within a healthy farming system.
Style 3: Being ill is a problem of the human treatment of the animal, his personal attitude. Illnesses are meaningful signals for a disturbance and unbalance of the animal and the system. This leads to the interpretation that illnesses should be managed by an improvement of self-regulation aspects of both animal and farming system.

Hygiene and infectious diseases
Style 1: The control of contagious diseases is oriented on the eradication of pathogens by hygiene measures and vaccination. A hospital-like hygiene is the standard.
Style 2: Disease control is based on a normal hygiene and the built up of the animal's and herd's natural resistance. It is important that animal can learn during their youth. The slogan 'a little dirt does no harm' fits very well in this strategy.
Style 3: Additional measures are taken like local (adapted) breeds. Self-regulation systems and personal solutions are found in this approach.

The comparison of both expert studies
All three clusters or domains of animal health, defined on the basis of the concept mapping study, are related to the paradigm of integrity described in the concepts of naturalness. The three clusters focus on the self-regulation aspects of animal health and for systemic solutions in health issues:

- Cluster 1 expresses a basic attitude towards organic animal health oriented on 'the animal's own identity: its vital expressions or psycho-somatic wholeness due to self-regulative activities';
- Cluster 2 is the translation of this identity into measurable issues of animal welfare, herd management and rearing. This cluster interprets animal health as species-specific behaviour and well-being; and
- Cluster 3 describes measurable elements of animal health in terms of physical health, expressing itself in robustness and longevity.

Conclusions

- Experts in OF use fairly high standards for the interpretation of animal health issues.
- The species specific animal needs and the possibilities for self-regulation of the animal are an important focus for further interpretation of on-farm measures.
- In terms of naturalness the integrity paradigm covers most interpretations of the health definitions.

The three clusters distinguished by experts are similar to the elements of human health in terms of the mental, social and physical health. Another element of human health is the absence of disease, which is mentioned within the third cluster. If such an expert focus would be translated

into practical research, the design of research should be interdisciplinary, systemic and focusing on the question of (id)entity of either the illness, the pathogen and the farm animal. In their focus on aspects of organic animal health, experts did not mention any attention for short term measures like alternative remedies.

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Animal welfare and health problem areas from an organic farmer's point of view

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Status quo analysis: animal health

In Germany, many status quo analyses on animal health situation on organic farms have been carried out in different animal species within the "Federal program - organic farming" (an initiative of the Ministry of Consumer Protection, Agriculture and Nutrition). All these analyses have come to one important conclusion: the main problems in animal health in organic farming are in knowledge transfer. Only a few problems result from circumstances that would require new technical research (e.g. animal nutrition with organic feed). The main problems appear to be bad hygiene standards (in all livestock species), mastitis, ketosis (metabolic diseases), lameness in dairy cows, parasites and *E. coli*-related mortality in piglets, parasites in sheep and suckler cows and fether picking, cannibalism and parasites in poultry. In general, the researchers found a high variability in disease/health levels between farms and similar levels of diseases as in conventional systems.

Why is the situation not better?

The following issues are likely to be the main reasons behind the lack of clear improvement in animal health:

- The specialisation of the farmers is often not as high as could be expected of organic farmers. As the demand on high quality products increases, specialisation is necessary.
- The advisory system in organic farming is not adequately specialised – there are too many allaround consultants. Only a few advisers are able to solve very special individual problems on a farm.
- Organic livestock farms, especially dairy and pig farms, have an enormous economic pressure due to poor prices of organic milk and pork (and sometimes eggs). Most farms do not cover their running costs and destroy the farm's capital. There is to little investment in buildings, and farmers' working hours are stressfully long. Consequently, there are some husbandry and structural problems (e.g. buildings) that are not compliant with the EC directive 2092/91 (farmers utilise the transition period until 2010).
- Finally, there are some special conditions in organic husbandry that are directly responsible for some health problems (e.g. bioaerosole and mycotoxins from straw, the restriction on preventive treatments, the contact with the environment and the soil, the deficiencies in nutrition in some situations, the ban of antiparasitic desinfection in stables).

What Bioland does to improve animal health?

- Some advisers from Bioland have specialised in nutrition and husbandry, which are the main causes of many health problems.
- There are plans to improve the advisory system with more specialisation and to offer it in all regions. However, the federal organisation of Germany causes problems to this.
- Every year, Bioland organises nationwide meetings with farmers, advisers, merchandisers, authorities, control bodies, scientists, etc. for two or three days, to provide a forum for discussing the actual situation, developments and perspectives for each species (poultry, pigs, beekeeping and ,in the future, dairy).
- In the Bioland Standard since 1994, there is a list of forbidden active substances and groups of active substances. For transposing the standards we have a booklet "Leitfaden zur Tiergesundheit" (Hrsg. Andreas Striezel with a few co-autors). For the telephone and mail consulting we have a contract with three veterinarians, who are indirectly (via the advisers) reachable for all Bioland-farmers. For the advise and inspection we have a complete list of veterinary market products (Handelspräparate) (made by the veterinarian Matthias Link). This is updated every 6 months.
- The private control organisations do not all work at the same manner, due to differences in different federal states and due to the competition between the control organisations. We try to improve the inspection on the farms, working together only with one organisation on a high level to have a good feedback between Bioland and inspection. The point is two educate the inspectors with a high specialisation degree.

Future outlook

In organic animal production, we need product quality (no residues and pollutants, no zoonotic bacteria, good sensory qualities etc.) and process quality (farm integrated production, limited emissions out of the system, high animal welfare standard, good animal health standard, high traceability and transparency) on the highest level. The main task for the farmers' organisation is to transfer the necessary special knowledge onto the farms.

The main problem for the organic animal farms currently is the poor economic returns that destroy the efforts of even the best farmers. An important task for the future is to define and to transpose the good manufacturing organic practice ("GMOP"), because most health problems can be solved with good management and nutrition.

A veterinarian's perspective of animal health problems on organic farms

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Introduction

Organic production standards encourage "positive health" and restrict or prohibit certain conventional measures of disease prevention. The author's personal approach to mastitis control and fertility problems in dairy cows and trace element problems and worm control in sheep is outlined, and it is discussed if organic standards, as a whole, promote or inhibit animal health.

Mastitis control in dairy cows

The herd and mastitis management

In a well managed organic herd, the breed was changed during organic conversion, from Holstein to crossbreeds, including Ayrshire, Swedish Red and Brown Swiss. As antibiotic use is restricted and prophylactic antibiotic dry cow treatment prohibited, those changes were necessary, especially considering that half of the cubicles were about 40 years old and too small for Holstein cows (2.10 m long against the wall).

About 100 cows are now yielding an average of 7,000 litres per annum and fed solely on grass/grass silage and cake in the parlour. The farm is a family enterprise, run by two brothers who are excellent stockmen, know their cows and detect any problems at an early stage. Basic routines in the parlour are dry wiping before milking and teat spraying after milking. After a high cell count cow or a mastitic cow, the cluster is dipped in paracetic acid, which is known to have a fast disinfectant action. The cubicles are straw-bedded, without additives like lime etc.

Cows are dried off abruptly. Problem cows with high cell counts receive antibiotic dry cow treatment, as this is the most successful period for treating existing intramammary infections. The majority of cows (88 %) are dried off with an internal teat sealant only.

Success of the programme: cell counts

Somatic cell counts were low just after conversion, which was expected, as the whole herd was in the first lactation. While everyone expected a rise in cell counts with the herd aging, this was practically not the case (Table 1)

Table 1: monthly somatic cell counts

Date	Days	Day kg	Fat %	Prot %	SCC '000
05/02/2004	183	21.20	4.04	3.13	155
08/01/2004	172	22.71	3.96	3.14	133
04/12/2003	160	23.73	3.95	3.14	89
06/11/2003	158	23.68	4.08	3.04	95
07/10/2003	150	22.28	4.16	3.18	102
05/09/2003	141	26.48	3.94	3.11	64
06/08/2003	127	29.08	3.41	3.02	78
10/07/2003	119	29.99	3.54	3.07	76
05/06/2003	139	29.57	3.44	3.26	145
07/05/2003	176	25.49	3.54	3.33	181
03/04/2003	184	22.57	3.95	3.09	105
07/03/2003	221	16.65	4.02	3.14	158
06/02/2003	221	18.00	4.00	3.22	123
08/01/2003	205	17.40	3.99	3.24	133
04/12/2002	194	18.88	3.94	3.18	124
06/11/2002	182	20.02	4.11	3.22	98
08/10/2002	159	24.19	4.09	3.25	152
05/09/2002	136	25.40	3.62	3.11	151
07/08/2002	120	26.87	3.61	3.15	94
08/07/2002	125	28.25	3.61	3.20	90
10/06/2002	120	27.48	3.67	3.10	72
08/05/2002	157	24.11	3.84	3.17	162
11/04/2002	188	22.39	4.01	3.20	68

Success of the programme: mastitis incidence

The cow incidence of mastitis was satisfactory in the first recorded year (32%), and decreased slightly to 30 % in the second year, in spite of the herd being older. These figures are below the national average in the UK, which is around 40% or higher and among the lowest in the practice.

A few cases of dry cow mastitis occurred before the internal teat sealant was available. None of these were summer mastitis, as the original calving pattern was chosen to avoid having dry cows during the main fly season. With the introduction of the internal teat sealant, dry cow mastitis has disappeared completely.

In the previous 12 months, not a single case of mastitis occurred in first lactation animals (n=11), the incidence for second lactation animals was 17% (n=46) and for third lactation animals 50% (n=46). This pattern confirms that contagious mastitis dominates the picture, which is backed up by bacteriology (*Staphylococcus aureus* isolated from samples from the majority of problem animals).

Treatments and evaluation

Attempts to treat mastitis with homeopathy were disappointing. Although some cases cleared clinically, most cases recurred later, and we hardly noticed any cell count response. For that reason, and knowing about the importance of early intervention, antibiotic treatment is first choice for clinical cases. Bulk tank and individual cell counts show a high success rate with

regard to cell count response. Four out of five *Staphylococcus aureus* cases were cured, two at drying off and two in lactation. Systemic antibiotics were only used in six cases in the last two years, so the amount of antibiotic used remained low. Most cases were treated once a day for three days with a standard intramammary tube.

The superior success rate is apparently due to

- the two year's break in milk production (=all in, all out system), with resistant bacteria having disappeared;
- the overall low use of antibiotics causing low selection pressure for resistance; and
- early detection and prompt treatment.

Conclusions

Compared with most conventional farms, the example farm showed

- low incidence of mastitis;
- low use of antibiotics;
- better response to antibiotics when used; and
- excellent milk quality status.

Further room for improvement could be identified in:

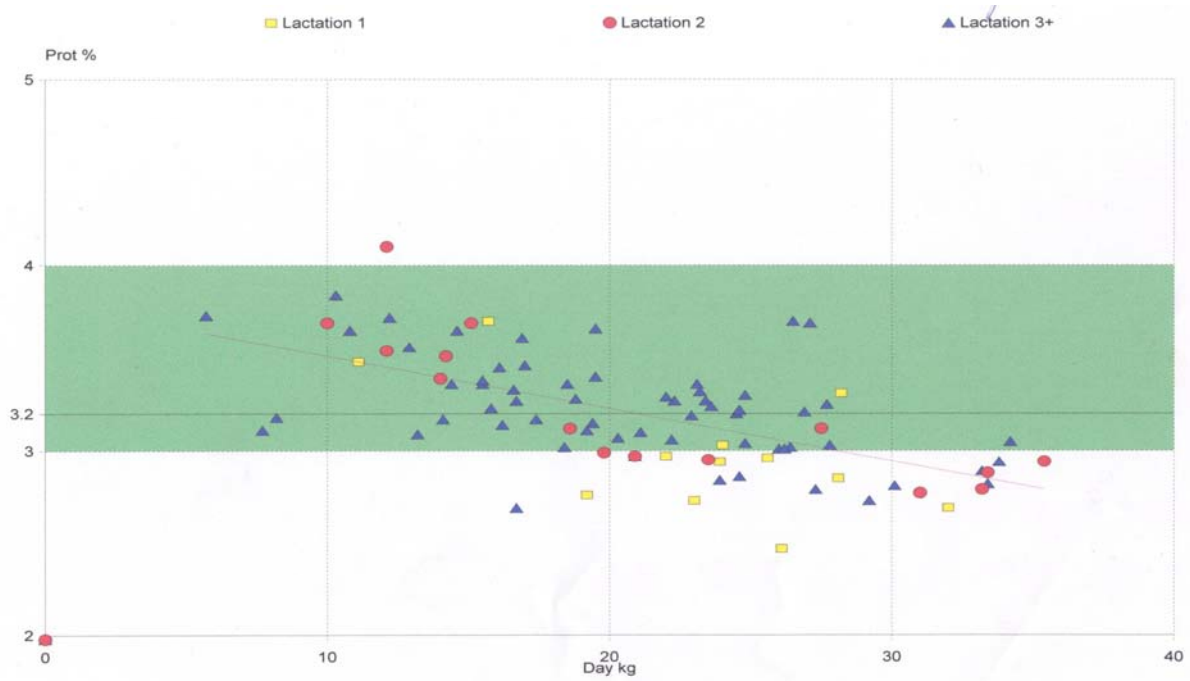
- selection of cases for therapeutic antibiotics (quick test to show if gram+ or gram-); and
- better choice of homoeopathic remedies.

Fertility in dairy cows

One constraint on organic farms is the lack of maize silage as a complementary forage to grass silage. Possible alternative is the whole crop silage, but market forces (good price for organic grain) make this rare in the UK. As a result, many grass-land based organic farms have to buy in energy feeds. A high amount of metabolisable energy in some of these cakes may come from oil, while fermentable energy (sugars and starch), necessary to utilise the protein in grass, may be lacking.

As a result of the energy problem, many animals, especially heifers, struggle to keep milk proteins up with increasing yields (Figure 1)

Figure 1: Protein against milk yield



Within these constraints, the following fertility parameters were achieved in the example herd:

- Calving interval: 390 days
- Conception rate: 50 %
- Culling for fertility: less than 50 % of overall culling
- Overall culling rate: 15 % (but young herd, most cows in third lactation)
- % positive at pregnancy diagnosis: 70%

Again, the parameters suggest that good stockmanship and heat observation can compensate for some constraints on farm. Fertility in the overall national herd is declining rapidly, with the overall conception rates below 40 %, calving interval above 400 days and overall culling rate at around 30%. Higher yielding cows with no genetic selection for fertility parameters, combined with more cows per stock person and similar labour constraints on forage harvest and conservation, all lead to this decline, which make the value of organic principles more and more obvious. Many farmers see marketing and achieving acceptable milk prices as a much bigger challenge than technical and animal health problems on farm. Solving the milk price problem will have positive health implications as the "need" to cut corners disappears and long overdue investments in buildings etc. can be made.

Fertility treatments

The vast majority of fertility treatments are carried out using homoeopathy. Fertility is a good area to start using homeopathy in, as the success or failure has limited welfare implications. To assess the success, placebo controlled studies have to be carried out, as time alone "cures" many acyclic cows when they have passed the negative energy state.

Vaccination
Bovine viral diarrhoea vaccination was introduced about 12 months ago, following some embryonic losses and high titres in bulk milk and young stock. However, this is reviewed on an annual basis, as the clinical impact has still to be proven: Calf health was good before and after the start of vaccination, and conception rates have remained stable. Leptospirosis vaccination is carried out annually, as the turnout to wet fields bears a risk of abortions. As lungworm problems have occurred in the past, oral vaccination is given to the youngstock before first turnout. During conversion, egg counts in the summer and serum pepsinogen levels at housing have been investigated. They revealed no significant worm burden, so that worming (strategic or therapeutic) was never carried out.

Trace element problems and worm control in sheep
Many organic as well as non organic sheep farmers have their animals monitored for trace elements on a regular basis. Deficiencies can cause poor growth and a higher susceptibility to infectious and parasitic diseases. Unquestioned supply of trace elements has lead to cases of toxicity, in sheep as well as in cattle. Ewes in mid pregnancy, fed entirely on grass or conserved forage are the main candidates for blood sampling, but growing lambs can be sampled as well. The value of blood copper levels is under discussion. Liver copper levels, if available, would be the diagnostic “gold standard”.

As for worm control, the approach of egg counts and worming as necessary is increasingly used in conventional farms to avoid unnecessary costs and wormer resistance. Worming in regular fixed intervals is now seen as bad practice. In organic farming, lower stocking rates, evasive grazing practices and – hopefully in the near future– genetic selection are encouraged and will reduce any worm burden. Most organic farmers still worm ewes at lambing to prevent pasture contamination. Certain endoparasites (Nematodirus, fluke) make a strict “test and worm as needed” approach difficult, as severe clinical signs can be caused by immature/larval stages. On problem farms, strategic treatments may be given, based on farm history.

Cases of resistance against all three classes of wormers have recently been reported in the UK, with the recommendation to cull the flock, plough the fields and keep them free of livestock for several years. Wormer resistance has made sheep farming impossible in some parts of the world. New UK guidelines to avoid wormer resistance are a big endorsement of organic principles. They include:

- Farm history and treatment of incoming stock if necessary;
- Minimise wormer use, do egg counts before worming;
- Test for resistance;
- Leave some animals untreated to maintain a population of susceptible worms, especially when turned to clean pasture; and
- Ewes with singles, especially when older, do not usually require routine treatment. Their contribution to pasture contamination is minimal.

Overall conclusions – does organic farming cause animal health problems?
Conventional farming faces increasing problems and adopts more principles which have been used on organic farms for decades. Selective dry cow therapy and selection for antibiotic mastitis treatment in dairy cows and a "test and treat as needed" approach for trace element supplementation and worm control are examples of this.

However, animal health problems on organic farms do occur, due to
- misinterpretation of the standards;
- general neglect and poor stockmanship; and
- bad luck (movement restrictions due to TB, FMD etc.).

The UK certification bodies are working to minimise these problems in following ways:
- the standards are revised, with the emphasis on being understandable, and training for farmers and vets is given;
- animal-based welfare assessment as part of the inspection process is currently under discussion; and
- a sympathetic approach with limited derogations is given to farmers who face exceptional problems.

I would like to conclude by saying that I have not encountered any health problems which are solely due to the organic farming system.

Part B:
Animal health and welfare: organic dairy production

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Swiss organic dairy farmer survey: Which path for the organic cow in the future?

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Introduction

Organic farming in Switzerland is very well developed but management, genetic and health problems persist among many organic dairy farms. In the summer of 2003, the Research Institut for organic agriculture (FiBL) carried out a survey of 1,000 organic dairy farmers to find out where some of the remaining problems are and to develop an idea of what the organic cow of the future should look like. The aims of the survey were:

- To produce an overview on the actual problems in organic cattle breeding;
- To establish the level knowledge of the ecological breeding index (EBI) among organic farmers and ask their opinion of the usefulness of it;
- To identify possibilities to improve the EBI; and
- To evaluate the farmers opinion regarding the general environment of breeding (organisations, standards etc) and to identify future needs in cattle breeding.

Sample size

Almost all Swiss organic farmers are members of the private organic agriculture label organisation BIO SUISSE. The BIO SUISSE member farmers were chosen for the survey. To minimise expenses of the project and the time needed for analysing the data, the sampling size for the survey was estimated in following manner (Lollier, 2003).

- Number of organic dairy farms in Switzerland in June 2003 (Bio Suisse, 2003): 3,595
- Estimated rate of response to the questionnaires: 50%
- Precision of the result aspired: at Δ = +/- 5%
- Estimated frequency of "Yes" to the principal question: 50%
- Risks standard for the analysis and confidence interval: α = 5%

Calculating the framing of the results at the risk α:

$$\left]f \pm u_\alpha \sqrt{\frac{f(1-f)}{n}}\right[\text{ or }]f \pm \Delta[\text{ with } \Delta = 5\%$$

(u_α = 1.96 with the risk of 5% in the reduced centred Gaussian distribution)

The minimal number of questionnaires to be treated:
A precision lower or equal to Δ is requested.

Thus $u_\alpha \sqrt{\frac{f(1-f)}{n}} \leq \Delta$ whereby $n \geq \left(\frac{u_\alpha}{\Delta}\right)^2 f(1-f) = \left(\frac{1{,}96}{0.05}\right)^2 (0.5) \times (1-0.5) = 384{,}16$

Therefore, at least 385 valid questionnaires were needed for analysis. With an estimated return rate of 50% at least 770 questionnaires had to be sent out. In fact, 1,000 randomized questionnaires were sent out (942 to the German speaking part of Switzerland, 46 to the French and 12 to the Italian speaking part of Switzerland).

Data analysis

In the case of two experimental qualitative variables, the test of homogeneity of chi^2 was used, which allows the comparison of several experimental distributions.

In the case of two independent samples, the test of Mann and Whitney was used, which makes it possible to carry out a nonparametric comparison of two average exits of independent samples.

In the case of K independent samples, the test of Kruskal-Wallis was used, which allows a non-parametric comparison of several experimental averages.

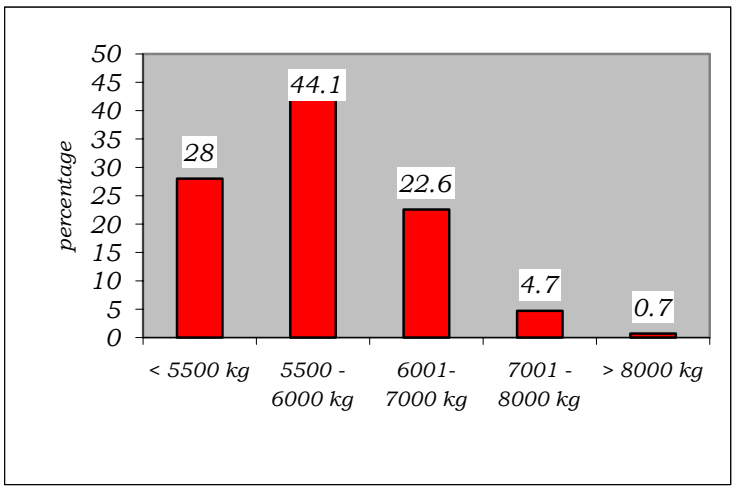
Results and discussion

608 valid questionnaires were returned. This return rate of over 60% reflects the high interest of the organic dairy cattle breeders to the survey. More than 70% of the farmers that answered were from the mountain area. The conversion from conventional to organic farming in this area is much easier, as the management in the mountain area is quite similar to that required by the organic standards.

Milk yield

The estimated milk production on the organic farms (Figure 1) was more than satisfying when compared with the national average of 5,570 kg (Schweizer Bauernverband, 2002). Production of 8,000 kg milk per lactation was reached only on very few farms. Such high milk production appears possible on farms capable of feeding the cows adequately, with accurate operating management high quality forage.

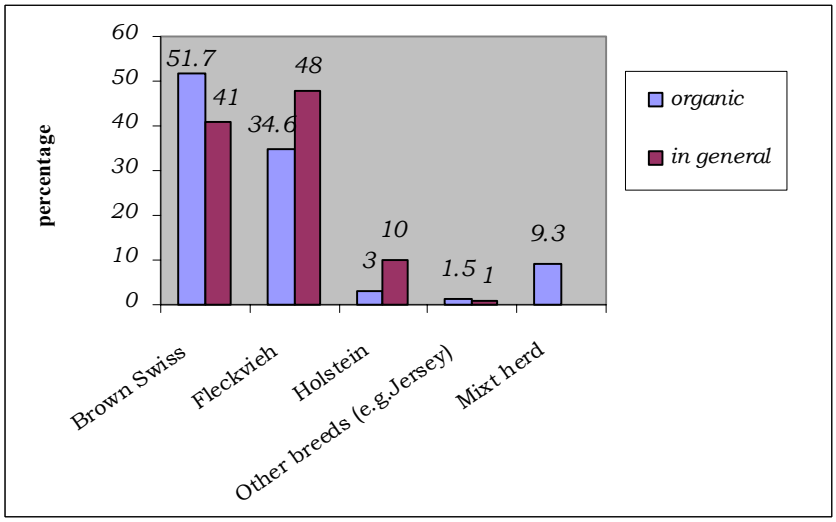
Figure 1: Distribution of the milk yield on the Swiss organic dairy farms.



Dairy breeds

The most common organic cow in Switzerland was a Brown Swiss cow (Figure 2). More than 50% of farmers work with this breed. This was followed by Fleckvieh on one third of the farms, the most numerous organic cow in the Western part of Switzerland. Holsteins were a rarity in the organic agriculture. This may be explained by the high performance of the cow that cannot always be fed correctly under organic agriculture conditions.

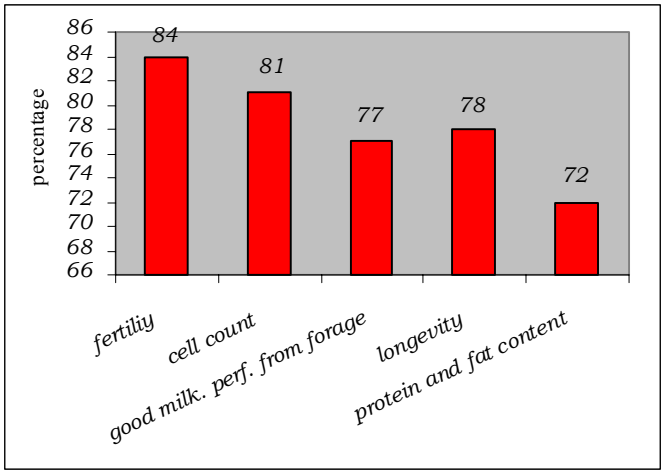
Figure 2: Breeds used by Swiss organic dairy farmers.



Selection criteria for breeding

The most important criteria for breeding selection on organic dairy farms appeared to be fertility, low cell count, good milk production from forage, longevity and milk quality, especially protein content (Figure 3). This displacement of production traits in favour of functional traits was also observed in Austria (Schwarzenbacher, 2001). On organic farms with high milk yield (> 7000 kg milk per cow and lactation), the selection was focused on protein content of the milk. Fleckvieh holders emphasized, in particular, their selection criteria of speed of milking. Milk yield was important on farms in the valleys, whereas the meat production was of great concern for Fleckvieh holders, farms with low milk performances and farms in the mountain area. Persistence of yield over lactation was very important in the French part of Switzerland and on farms with high milk yield. It is not clear why persistence is not mentioned more often by other farmers, as in general it is an important criterion for organic dairy farming.

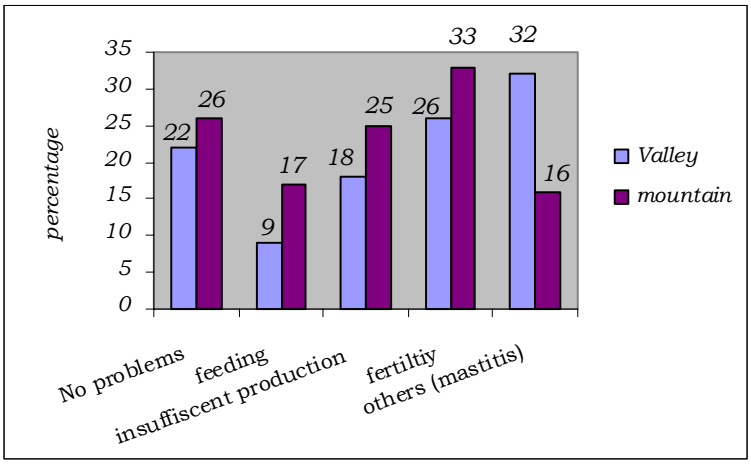
Figure 3: Importance of selection criteria in Swiss organic dairy farms.



Problem areas

Varies problems experienced by the Swiss organic dairy farmers were highlighted by the returns (Figure 4). A quarter of the respondents stated that they encountered no problems with their dairy cows. Especially farms that had a low herd replacement rate (< 15%) and farms using no or little concentrate fodder (< = 50 kg per cow and lactation) were among the "problem-free farms". One third of farmers struggled with fertility; more often on farms that had high herd replacement rates (> 26%). A total of 20% had problems with low milk production and quality, especially with the protein content of the milk. Feeding problems we mentioned more frequently in mountain areas than in valleys. This may be a result of the bad fodder conditions at higher altitudes. The largest problem in the valley areas concerned udder health, which was mentioned by one third of all valley farmers.

Figure 4: Problems stated from Swiss organic dairy farmers.

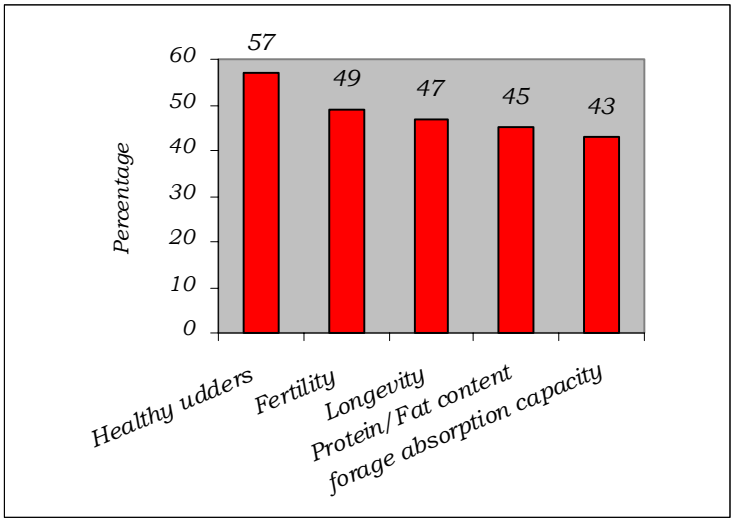


Ecological breeding index

The ecological breeding index (EBI) was introduced in Switzerland in 2000. It ranks sires based on a quality evaluation of their off-springs regarding functional and performance traits. This tool is appreciated by farms working with artificial insemination. The knowledge on the EBI among Brown Swiss and Holstein holders was very good: four out of five organic farmers were familiar with it. Among the Fleckvieh holders, the EBI was less well known. This is not surprising, as the EBI had not been introduced at the Fleckvieh Federation during the study. Farmers in the French part of Switzerland with low milk yields and farms not registered in the herd-book also showed limited knowledge of the EBI. Almost 90% of the farms felt that the index is helpful for the selection of the matching sires for their cows, but there appeared to be a difference according to milk yield. Farms with no or very low concentrate fodder use (< = 50 kg per cow and lactation) were mainly satisfied with the EBI, and farms with high milk performances (> 7000 kg) were mostly dissatisfied.

Despite the overall acceptance of the EBI, some adjustment is necessary to meet the requirements. There is a need to re-balance the weighting within the EBI (Figure 5). Healthiness of the udder, fertility, longevity, milk contents and forage absorption capacity (as soon as it can be seized in figures) should be weighted higher than before. Farmers from the French part of Switzerland, farmers using high amount of concentrate fodder and farms with average milk yield (6000 -7000 kg of milk per lactation) would like to have the trait of milk yield weighted higher in the existing EBI. A stronger weighting in favour to the milk contents is important for farms that use large quantities of concentrate fodder (> 400 kg per cow and lactation) or participate in progeny testing and for farmers who use alpine pastures for their cows during summer. The morphology is particularly under-weighted for the farms with high milk yield. The fitness to pasture is of great importance for production-weak farms and should be considered in the EBI.

Figure 5: Criteria stated to need more weight within the Ecological Breeding Index.



It is evident that the weighting within the EBI should be discussed. However it would be appropriate for these discussions to be based on research of the economic and ethical emphases of the individual traits.

General satisfaction with breeding services and requirements

Concerning satisfaction with the breeding institutions and the applied regulations, two thirds of the organic dairy farmers were content with the current situation. The others would like to see, above all, larger variety in the bulls offered. Most farmers were satisfied with the BIO SUISSE regulations. On one hand, farmers did not want a reinforcement of the regulations. Especially farms that fed no or little concentrate, farms with low milk performances and farms not registered in the herd book were satisfied. On the other hand, farms with high concentrate use (>400 kg per cow and lactation), farms with higher milk yield or farms participating in progeny testing were largely dissatisfied with the current regulations.

Conclusions

The survey showed a high interest of the Swiss organic dairy farmers in breeding, suggesting that there is potential to breed an adapted organic dairy cow. However, it is clear that it would be difficult to breed an “organic dairy cow” that would be suitable for all farms. The differences between farms, particularly between mountain areas and valley regions, were notable. As a result, each farm manager has to specify criteria and breeding goals essential for his or her farm and try to pursue and reach these goals with the available services. Existing tools, like the EBI, are widely considered as helpful, but have to be improved with new knowledge, and further possibilities should be developed.

The modern dairy cow for the organic sector must have a long productive lifespan, good milk yield and milk protein content, requiring little or no concentrate, and a low somatic cell count. In the future, FiBL will analyse anonymized herd book data of organic dairy farms. This should show whether the figures of the inquiry are confirmed or whether new perceptions become evident. FiBL also plan to discuss the results with representatives of breeding organizations and genetics associations as well as with interested organic dairy breeders, in order to evaluate the need of change and take action if necessary.

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Animal health in organic dairy farming – results from a survey in Germany

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Introduction

In organic farming, the housing, feeding and management conditions, as set by EU legislation and organic farming associations, are supposed to be welfare friendly and beneficial to health. However, there is evidence that the adaptability of farm animals is often overstressed in organic farming (Sundrum, 2001). Production diseases are generally regarded as a serious problem in dairy farming due to their welfare relevance and economic impact (Kossaibati and Esslemont, 1997). However, there is only little information available about the situation on German organic dairy farms. While studies in other European countries revealed similar incidences as in conventional farming for the most important diseases (e. g. Weller and Cooper, 1996, Vaarst *et al.*, 1998, Reksen *et al.*, 1999, Weller and Bowling, 2000), farm structures and housing systems in many countries differ from the German farming conditions. It was the aim of the present study to assess (1) the health state in German organic dairy farming with regard to mastitis, lameness and metabolic disorders, to assess (2) the use of preventive measures in order to control diseases and (3), to investigate possible relationships of the health state with the specific housing conditions and/or the application of these measures.

Materials and methods

A questionnaire on housing, herd health management and disease incidences during the previous 12 months was sent to 1,000 randomly chosen organic dairy farms with a herd size greater than 15 cows. A cross-sectional study was then carried out in a representative sample of 50 loose-housed herds. These were selected out of the farms that had responded (n=283) to the questionnaire and had agreed to be included in further studies (n=150; Table 1). The housing systems were either cubicle (n=39) or straw yard systems (n=11). Holstein-Friesian was the most prevalent breed (n=30). Other breeds were Simmental (n=11) and Brown Swiss (n=9).

On each farm, herd health records from 2001 and 2002 were copied and subsequently evaluated with regard to metabolic disorders, mastitis and lameness treatments. Data from milk performance testing were analysed as well. Furthermore, lameness prevalence was recorded using a 5-point locomotion scoring system (Winckler and Willen, 2001) during the farm visit, and leg injuries were assessed taking size and severity of the lesions into account.

Table 1: Key features of the farms included in the questionnaire study and on-farm study (mean, min/max values are given in brackets)

	No. of farms	Herd size [n]	Milk yield [kg (cow*year)$^{-1}$]	Year of conversion
Questionnaire study	235	46 (15-280)	5,956 (3,000 - 9,653)	1991 (1954 - 2000)
Cross-sectional study	50	53 (20-190)	6,277 (3,175 - 9,653)	1991 (1955 - 1999)

When compared with log-book entries, data on disease incidences provided by the questionnaires turned out to be not reliable in most cases. Therefore, the following results are based on data, which were obtained during the farm visits. However, due to the small sample size, multivariate analysis was not possible.

Results and discussion

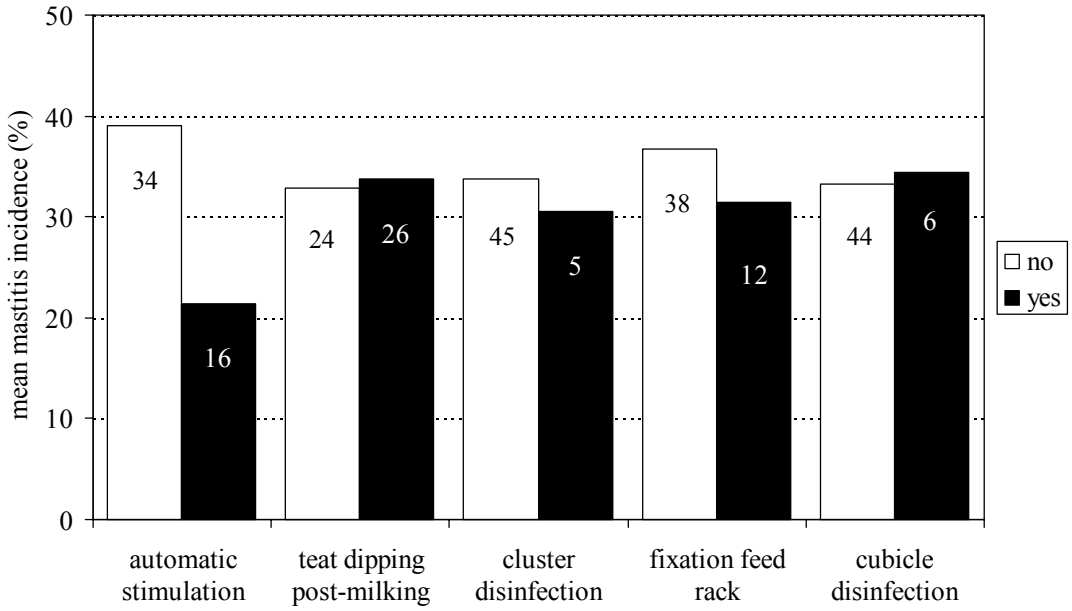
The mean incidence of clinical mastitis (i. e. incidence of treated mastitis cases) was 33.4% (Table 2). This is well in the range of earlier studies in organic as well as conventional dairy farming (Esslemont and Kossaibati, 1996, Weller and Bowling, 2000, Hovi and Roderick, 2000, Vaarst *et al*., 2001, Whitaker *et al*., 2000). Herds housed in cubicles showed, on average, a slightly lower mastitis incidence and milk somatic cell counts than herds housed in straw yard systems (Table 2). However, there was substantial variation within the housing systems, indicating that such differences are not likely to be statistically significant. These findings are in contrast to Weller and Bowling (2000) or Whitaker *et al*. (2000), who found about twice as much mastitis cases in straw yards compared to cubicle housing systems.

Table 2: Clinical mastitis incidence, mean somatic cell count and lameness prevalence in the cross-sectional study (mean, min/max values are given in brackets)

	No. of farms	Mastitis incidence [%]	Somatic cell count [x 1,000/ml]	Lameness prevalence [%]
Total	50	33.4 (1 – 101)	267 (70 - 528)	17.6 (2 – 53)
Cubicle housed herds	39	32.3 (1 – 101)	252 (69 – 528)	10.0 (2 – 19)
Straw yard housed herds	11	37.3 (7 – 77)	319 (193 – 500)	19.7 (10 – 52)

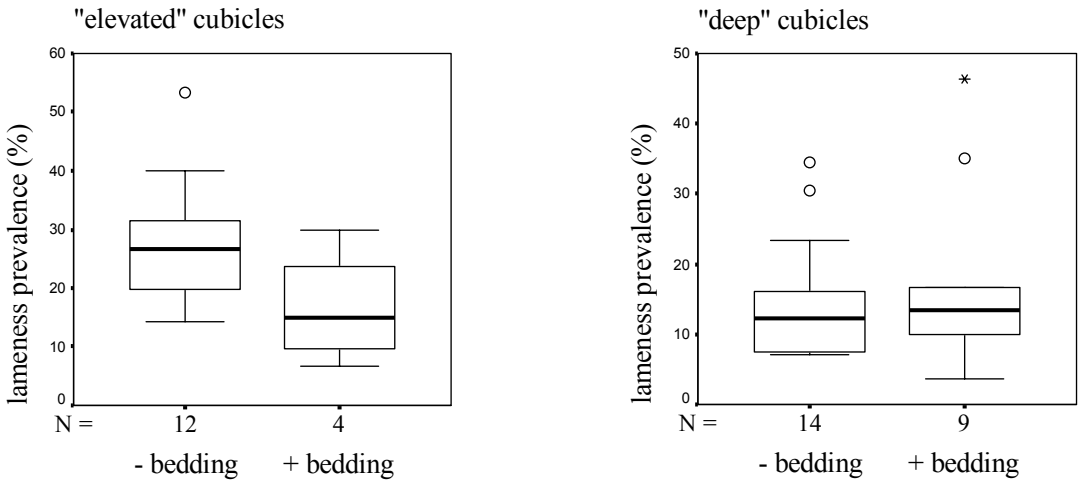
With regard to preventive strategies, most well-established preventive measures such as teat disinfection had no obvious effect on mastitis incidence. However, automatic pre-milking stimulation seemed to exert positive effects on udder health (Figure 1).

Figure 1: Comparison of clinical mastitis incidence with regard to the implementation of several preventive measures (no interactions considered)



At herd level, the average lameness prevalence was 17.6 % (Table 2) and thus much lower than that recorded in conventional dairy farming using the same gait scoring system (Winckler and Brill, 2004). Cubicle housed herds showed significantly more lameness (20 %) than herds in straw yard systems (10 %; $p<0.05$, Mann-Whitney-U, df = 1) thus supporting previous studies (Somers *et al*., 2003). However, the proportion of moderately/severely lame cows was low and did not differ between cubicle houses and straw yard systems. Differences in lameness prevalence between housing systems were accompanied by significant differences in leg injuries such as moderate/severe swellings of the carpal (17 % vs. 0 %) and tarsal joints (7 % vs. 0 %). This confirms other studies that have identified relationships between environmental criteria and pathological parameters (Busato *et al.,* 2000, Capdeville, 2001, Winckler *et al.,* 2002). Separate analysis of the cubicle housed herds revealed a significant interaction between cubicle type and softness in terms of amount of bedding provided (Figure 2). Lameness prevalence was significantly higher, when "elevated" cubicles with mostly rubber flooring were only insufficiently littered. In deep bedded cubicles with organic straw/manure stall basis however, lameness prevalence remained comparably low regardless of the amount of loose bedding.

Figure 2: Influence of cubicle type and amount of bedding on lameness prevalence



The incidence of metabolic disorders showed a high level of variation (Table 3). For example milk fever incidence ranged between 0 and 25 % (mean 5.9 %). However, almost two thirds of the farms did not apply any specific measures to prevent milk fever (e. g. anion-rich diets, oral administration of calcium). Treatments of ketosis (0–13 %), acidosis (0–9 %) and displacement of the abomasum (0–3 %) were less frequent and seemed to be of relevance only on single farms.

Table 3: Incidences of metabolic disorders in the cross-sectional study (n = 50 farms)

		mean	min	max
Milk fever	%	5.9	0	25
Clinical ketosis	%	0.9	0	12
Rumen acidosis	%	0.5	0	11
Abomasal displacements	%	0.2	0	2

Conclusions

The results of the present study demonstrate that production diseases, such as mastitis, lameness and metabolic disorders (milk fever), still play a considerable role in (German) organic dairy farming. The incidences of clinical mastitis and metabolic disorders were similar to those reported for conventional farms. Lameness seems to be less prevalent in the organic farming system. However, an average proportion of almost 20 % lame cows is unacceptable from animal welfare and economic point of view.

Potential approaches for intervention strategies may be deduced from significant effects of housing parameters on lameness prevalence in the present study. With regard to mastitis, the question remains open, whether standard disease control strategies may be effective in further reducing disease incidences. At least in this study, no obvious patterns were found on the farms that have minimal problems.

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Suckling as an alternative rearing system for replacement calves on dairy farms

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Introduction

Maternal behaviour and contact between cow and calf is limited or absent in modern dairy systems due to the wide use of bucket feeding of artificial milk. This is also the case in organic dairy systems. An increasing number of individual farmers are not satisfied with the artificial bucket feeding system. In order to improve the welfare of their dairy cattle, a number of organic farms introduced suckling systems. The aim is to develop an alternative calf rearing system for replacement calves that will improve animal welfare on dairy farms and meets the requirements of farmers in terms of practicality and cost. On the dairy farms that make use of a suckling system are calves suckled by their mother or a nurse cow, for a duration that ranges from three days up to three months. Compared to artificial calf rearing, suckling systems are beneficial to the welfare of calves. The calves will be nursed by their mother, suckled with milk, learn to eat roughage at a younger age, have social contact with other calves and cows and have space enough to exercise and play. Most of these factors are absent in artificial calf rearing systems (Krohn, 2001). In a pilot study, which started in 2002, the effect of suckling on several aspects of the farming system, including calf growth, animal health, milk production, rearing costs, animal welfare and naturalness were studied during the winterseason (september-march). In the winterseason of 2003, the focus of the research continued to be on live weight development of calves. In addition, behavioural studies of calves before and after weaning were carried out. This paper will focus on the following aspects of the project:

- Motivation of farmers to make use of suckling systems;
- Calf growth; and
- Milk consumption.

Suckling as a rearing system for dairy calves has potential benefits. However, suckling systems can also be in conflict with measures to secure food quality. For example, in the case of Johne's disease, suckling may spread the disease with an infected herd. Results of long term effects of suckling on cows and calves are still to be determined.

The suckling methods

Three farms, which introduced suckling as a calf rearing method, were studied for 18 months. The farms were selected on the basis of their willingness to co-operate and exchange information on different aspects of their farm. The farms made use of different suckling systems, in which the period of suckling by the own mother was followed by a period of suckling by a nurse cow. The duration of the different suckling methods varied between farms, and the age at weaning varied as well.

Three methods can be distinguished in the suckling systems.

1. Single suckling during the colostrum period, which covers the first days after birth when the cow produces colostrum. During the colostrum period mother and calf are housed separate from the herd for approximately three days. The cow is only milked mechanically when this is necessary for udder health the cow or to support the calf with additional feeding. After this period, there are two options.
2. Single suckling with additional milking. After the colostrum period the calf is introduced with its mother in the dairy herd. The milk consumption of the calf is *ad libitum*, the cow is milked twice a day mechanically.
3. Multiple suckling without additional milking. The calf is placed by a nurse cow with 2-4 other calves. The nurse cow is housed separate from the dairy herd. The milk consumption of the nursed calves is restricted by the number of calves under each nurse cow. The nurse cow is not milked mechanically.

In figure 1, the suckling systems with the different periods are presented. The suckling systems used are a combination of the above mentioned methods. In 2003 all farms made use of suckling with the own mother during the colostrum period. Two farms made use of a single suckling with additional milking followed by a multiple suckling. At one farm, the duration of single suckling varied from two days up to two months and multiple suckling varied from one month up to three months. All calves were weaned at three months. One farm used a single suckling for two months and there after multiple suckling for one month. All calves at this farm were weaned at three months. One farm made only use of multiple suckling after the colostrum period. Calves were weaned at varying ages of three to five months. Results on long term effects of suckling on the farms for cow and calf are still to be determined. At the end of 2004 the first suckling calves will come into the first lactation.

Figure 1: Periods in the suckling systems

Birth Weaning

1-3 days with own mother in calving stable	Calf with mother in the herd Machine milking 2 times a day Duration 1 up to 2 months	Nurse cow with 1-4 calves in separate area • No machine milking • Duration 1 up to 2 months

1-3 days with own mother in calving stable	Nurse cow with 1-4 calves in separate area No machine milking Duration 3-4 months of age

Motivation of the farmers

Motivation of farmers was bases on experiences with bucket feeding and suckling systems and the expectations farmers had with the use of a suckling system. In a problem analysis according to Udo *et al*, 2002, the cause-effect relations were established. Seven farmers and four experts were selected and asked for their experiences and expectations with suckling. The information was collected by means of semi-structured interviews with open questions.

According to some farmers, the bucket feeding system leads to poor immunisation and diarrhoea in calves, and high somatic cell counts and poor development of social behaviour (Langhout, 2003). These farmers also felt that it was hard to defend their calf rearing practices to critical consumers who support the development of sustainable farming. Another important argument mentioned in favour of the suckling system was expected increased naturalness of the farming system. Naturalness refers to the avoidance of inorganic, chemical inputs, to the application of organic, agro-ecological principles and to the respect for the 'integrity of life' (Verhoog *et* al, 2002).

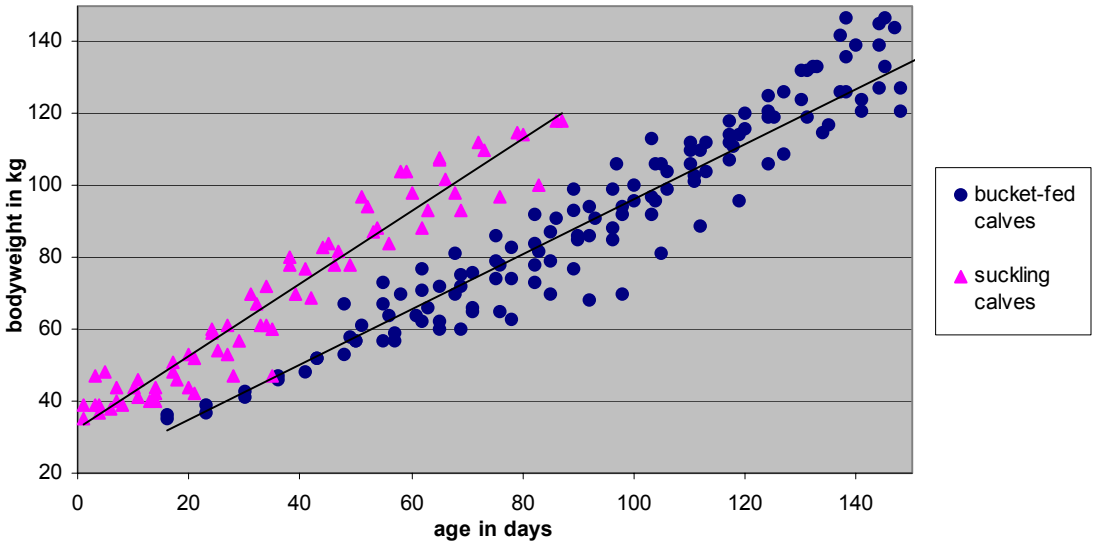
Problems resulting from the bucket feeding system were indicated as reasons for the willingness to experiment with suckling systems. The expectations of positive effects of the suckling system in the long term were high. Expectations on improved udder health, development of social behaviour and improved health of calves and cows are supported by several studies. The strong points of the system, according to farmers, were less labour, pleasure and enjoyment, and increased activity of cows. Weak points indicated by the farmers were fear for inter-suckling and decreased milk ejection.

Calf growth

The milk consumption and growth of calves was studied. At one farm 17 calves were assigned to two treatments in 2002. Calves born before the experimental period received a control treatment (bucket feeding system). Calves born during the experimental period received a suckling treatment. The treatments were conducted during pre-weaning until calves reached the body weight of 100 kg. Post weaning, all calves received the same treatment. Bucket-fed calves (n=10) were fed fresh cow milk in open buckets, six kg per day. Bucket-fed calves were housed in single pens for 14 days, thereafter in groups of two up to four calves housed in straw pens.

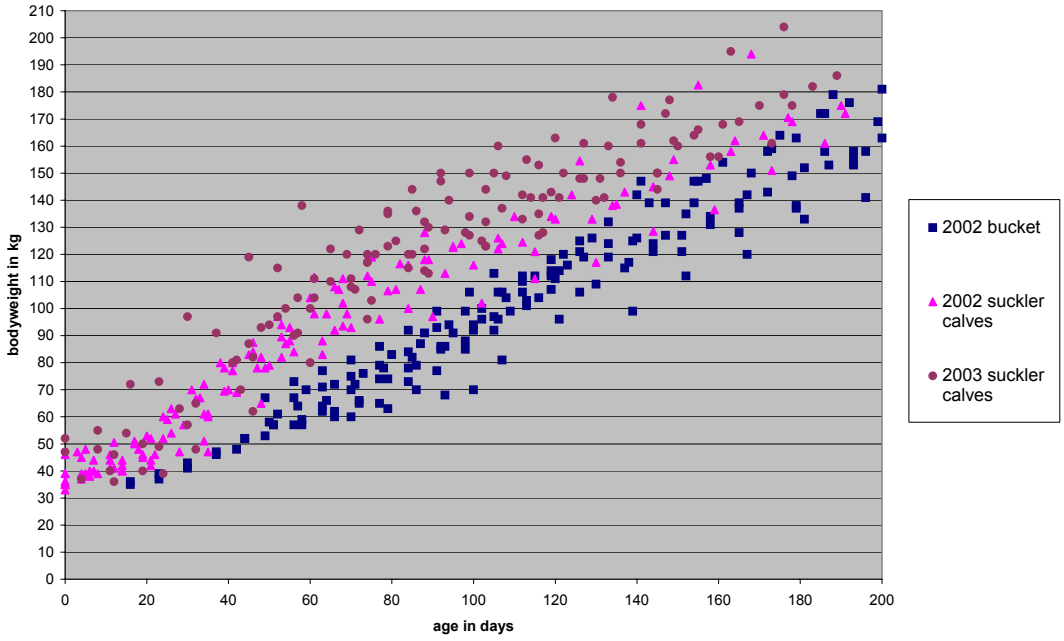
The milk consumption of suckled calves was *ad libitum* by sucking their mother. Suckled calves had free access to the cubicle stable of the dairy herd. The calves had also access to a straw pen, which was not accessible for cows. Calves and cows were kept indoors 24 hours a day. During the post weaning period, all 17 calves were housed in a cubicle stable in groups of four to six calves. Calves were fed *ad libitum* grass silage and one kg of concentrates per day. Weight gains in the pre and post weaning period of calves was measured weekly during the experimental period of five months. In figure 2, the body weights of the calves in both treatments (repeated measurements) in this experiment are presented.

Figure 2: Weight development of the calves at Farm II (Langhout, 2003).



The bucket-fed calves showed significantly lower growth in the first month pre weaning than the suckled calves (Langhout, 2003). There was a large difference in growth in the first month. The mean growth pre weaning of suckled calves was 0.97 kg/day vs. 0.59 kg/day for bucket-fed calves. The difference is 0.38 kg/day ($P< 0.1$). For the second month pre weaning a significant difference was also found. The mean growth of suckled calves was 0.50 kg higher than growth of bucket-fed calves ($P< 0.001$). Bucket fed calves were weaned at 118 days and suckled calves at 65 days. In the following year, the farmer changed his suckling system for all replacement calves into the following regimen: three day colostrum period, two month single suckling, followed by one month multiple suckling with a nurse cow (n=16). Calves were weaned at 90 days of age. In figure 3, the body weights (repeated measurements) of these calves are presented. A difference between the two suckling systems can be observed. The figure also shows a large variation in the first three months between calves in the suckling systems compared to the variation within the bucket feeding system at this farm.

Figure 3: Bodyweight development of calves in two successive years.



Milk consumption by calves

The difference in milk production of suckler cows between pre and post weaning of the calf, together with the difference between suckler and non-suckler cows in the first months of the lactation was used to estimate the milk consumption of the suckled calves (Langhout, 2003). At one farm 12 cows were assigned to the treatment of suckling their calves, 36 cows were used as controls. During the first month of the experiment, cows had access to outdoor grazing during the day. After the first month, cows were kept indoors in a deep litter stable 24 hours a day. In the stable, all cows were fed *ad libitum* grass silage and were fed concentrates corresponding with their lactation stage. All cows were milked two times a day in a milking parlour. The farmer selected the cows for the treatments. Only cows that gave birth to a female calf for replacement were assigned to the treatment of suckling. Cows that gave a bull calf or female calf not used for replacement were assigned to the group of non-suckler cows. The milk yield of all the cows was measured every four weeks during the experimental period of five months. Milk quantity was measured in kg/day. Suckler cows showed significantly less measured milk production during the pre weaning period compared to post weaning.. This difference varied from 13.3 kg ($P< 0.001$) pre weaning vs. post weaning within the suckler cow group to 15.7 kg between suckler and non-suckler cows ($P<0.001$). In the first 14 days the consumption of calves estimated was up to 10 kg of milk per day and, thereafter, up to 15 kg per day.

Conclusions

In a suckling system different methods can be distinguished, the colostrum period with the own mother, single suckling with the own mother and multiple suckling with nurse cow. In practice a

combination of 2 or 3 methods is used. Farmers expectations of long term effects of suckling systems are high. Less labour, pleasure and increased activity of cows were regarded as the strong points of suckling systems by the farmers. Suckling systems have the potential to improve calf growth with 0,5 kg per day pre weaning. In single suckling systems milk consumption of calves is up to 10 kg per day in the first 14 days and up to 15 kg there after. Single suckling can be used in combination with multiple suckling improve welfare and naturalness on dairy farms. In multiple suckling one can make use of cull cows of dairy production as nurse cows. Farmers continuously adjust the system to their specific circumstances and needs. In this way, different suckling methods are tested for their potential and limitations in practice. One should aim at the development of an animal production system in which healthy animals produce healthy products. The identification of factors that support health and the development of the immune system is important, in order to implement them in animal husbandry systems. Suckling systems can contribute to this, the long term effect and preconditions for use of these systems are, therefore, under study.

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Feeding strategies in Swiss organic farming to improve food quality and animal health

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Introduction

At the moment, Switzerland has about 6,500 organic farmers, with 11 % of the agriculture area managed organically. The main regulations in organic farming are The Schweizer Bio-Verordnung (Swiss Government Regulation for Organic farming). These regulations are increasingly adapted to the EU-Regulation for organic farming. The BIO SUISSE regulation has further requirements. Nearly all organic farmers are BIO SUISSE farmers. The symbol of BIO SUISSE is a bud.

Non-organic feeding components

The BIO SUISSE and the Swiss Government Regulation have an allowance for non-organic feeding components for ruminants of 10 % and for non-ruminants of 20 %. The BIO SUISSE goal is a 100 % organic feeding for ruminants by the end of 2006 and for non-ruminants nearly 100 % in the end of 2008. The realisation of this goal depends on the adaptation to the EU-Regulation. Since the beginning of 2004, the BIO SUISSE farmers are only allowed to feed non-BIO SUISSE certified components that are on a positive list of such allowed components. The list is constructed with experts in the feed industry. It is evaluated, which non-organic components are still necessary, based on animal needs and the availability. Currently, the list includes potato protein, corn gluten, forage, sugar molasses, brewer's yeast, linseed, dextrose for ruminants, wheat protein for calves, milk powder for piglets, dairy waste products and restaurants waste for pigs and juniper berries for rabbits. The list is updated every year.

Feeding guideline

We have also developed a feeding guideline. The feeding guideline is the basis for producing animal feed staffs. The guideline was created in cooperation with experts from the governmental research institution ALP, the feeding industry, BIO SUISSE staff (farmers) and FiBL experts for animal feeding.

The cooperation work gives the possibility to combine the needs of all interested parties. The list has the following contents:

- Basis of the possibility to use fodder for organic production;
- Permitted production processes;
- Permitted fodder components;
- Permitted additives;
- Permitted content of vitamins and trace elements; and
- Forbidden additives.

"90 % forage feeding"

The BIO SUISSE regulation "90 % Forage Feeding" demands, since the beginning of 2004, that ruminants must get 90 % of their annual dry matter intake form forage. Only feeding which is appropriate to the species, can be considered as feeding for health and welfare.

In order to enforce the regulation, the BIO SUISSE had worked out a definition of forage. Forage includes fodder from permanent grassland or ley, forage crops including whole crop silage, sugar beet nuts, fodder beet, unprocessed potatoes, waste of fruit and vegetable processing, brewer's grains and straw for feeding. The basic principle of the Swiss Government Regulation is: The fodder must be based on animals' physiological requirements at all development stages. The feeding should aim at quality production rather than maximum production.

The main reasons for the "90 % Forage Feeding" regulation are the importance of forage for ruminants in respect of the animal health, the improvement of milk and meat quality and the ethical considerations with regard to animal food not being fed in competition to human food.

Appropriate feeding

The physiological characteristics of cows and, therefore, the demand for forage, are based on the fore-stomach growth with the structure in the fodder, with a capacity of 200l. These physiology is not compatible with concentrates. The fore-stomachs are specialized in rumen, reticulum and omasum; each with different morphological and functional organization.

Rumination would be difficult useless, if the fodder had no structure, as the necessary work of the fore-stomachs is animated and controlled by masses of sensitive receptors, which react on mechanical stimulus by hard particle with adequate size. Wholemeal is not suitable to carry out this role of stimulation and animation. Furthermore, concentrates cause a fast digestion rate in rumen, with the effect of overacidification, indigestion, displacement of the abomasum and the increase of harmful substances and enzymes in the blood.

All other organs, especially the liver have their part in the digestion. Only if the digestion works properly, the liver can work correctly, which is essential for the synthesis of hormones and therefore for the fertility, and for resistance.

Fodder rations that are not appropriate to the species lead to a disorder of the cow's inner balance. This in turn causes stress and stress means fertility problems and lack of resistance.

Food quality

There are factors in the food quality that are based on the feeding components, especially the forage. The amount of CLA (conjugated linoleic acid) increases with increased forage feeding and is a positive food characteristic because of its anticarcinogenic properties. Similar increase can be seen in the amount of alpha linolenic acid, with a positive effect on the cardiovascular system, and in the proportion of n6/n3 fatty acids that have a positive effect on the central nervous system. Various papers report a positive effect of pasture production systems on food quality, for example Leiber *et al*., 2004, Institute of Animal Science, ETH Zürich and Scheeder, 2004.

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The investigations of complex management: The story of bulk milk somatic cell counts and deep litter barns

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Introduction

A review of several studies of somatic cell counts (SCC) in organic dairy production indicates that barn type affects the average level of bulk milk somatic cell counts (BMSCC). BMSCC were highest for the deep litter barns when compared with tied barns and cubicle housing (Table 1). Dutch results were similar to the German findings of Krutzinna *et al*. (1996), showing the danger of the deep litter barns. However, the variation (standard deviation, SD) was highest for the deep litter barns.

Table 1: Bulk milk somatic cell count (BMSCC x 1000 cells/ml) and housing system of the lactating cows of Dutch and German organic dairy farms.

Housing system	NL1 1989-98[1]		NL2 2000-03[2]		NL3 1998-00[3]		D 1990-92[4]
	BMSCC	SD	BMSCC	stdev	BMSCC	SD	BMSCC
Tying stall	299	66	254	96	NA[5]	NA	261
Cubicles	286	70	259	105	213	76	258
Deep litter	361	99	300	125	273	118	352

BMSSC were measured 13 times per year on a routine basis. Averages were counted per year. In NL1, total 46 farms of dairy company 'De Vereeniging, Limmen' were selected for this analysis (14 tied barns, 9 cubicles and 20 deep litter barns). In NL2, 48 farms were selected (3 tied barns, 41 cubicles and 4 deep litter barns; data ASG-WUR). In NL3, 9 farms are included (7 cubicles and 2 deep litter barns; data BIOVEEM-project). In de German study 230 farms are involved.

[1] Calculated over 1989-1998 (46 farms, Baars and Barkema, 1998).
[2] Calculated over 2001-2003 (48 farms for BMSCC, 87 farms pathogens taken from subclinical mastitis cows)
[3] Calculated over 1998-2000 (9 farms in the project BIOVEEM; Baars, 2002)
[4] Calculated over 1990-1992 (230 farms; Krutzinna et al., 1996).
[5] Data were not available.

This paper will address the question how to investigate complex and preventive management like the maintenance of udder health in a learning community of farmers, advisors and researchers. At the same time the pool of organic farmers is diverse dealing with different goals to develop their systems in future and the knowledge level among farmers is increasing.
Data were used out of different studies on SCC in organic farming. Studies all had a different methodological approach: cohort (larger data set), longitudinal (evaluation of changes over years), single case studies (pioneer farmers) or retrospective (reflective).

Results

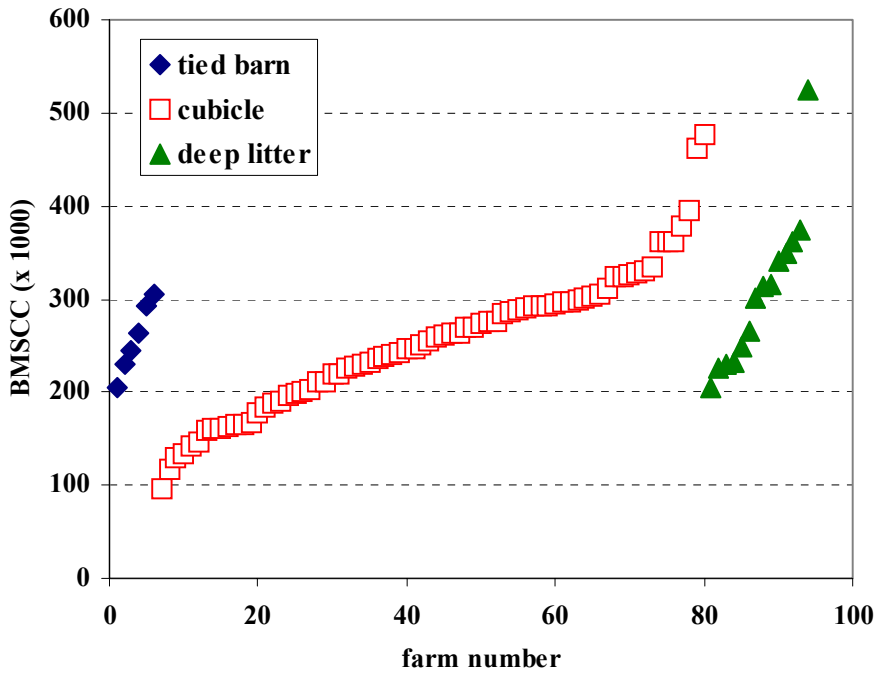
Three Dutch studies are described (NL1-NL3). First, recent data from a survey carried out in 2003 (NL2), secondly the older data based on NL1 (Baars and Barkema, 1996), and, thirdly, a case study at one of the BIOVEEM-farms (NL3).

Study NL2

This study is presented in terms of a 'traditional' epidemiological study dealing with a larger data set of farms, taken at random out of the Dutch pool of organic dairy farms in The Netherlands. Goal of this study was to identify some main factors affecting the level of clinical and subclinical mastitis in herds.

In Figure 1, the average BMSCCs of 94 organic farms are presented, ordered by the cell count by barn type. BMSCCs were calculated from the three-weekly milk recordings of individual cow SCCs.

Figure 1: Average calculated BMSCC over a three-year period (2001-2003) by farm and by type of barn on 94 organic dairy farms in the Netherlands.



Quantitative measurements were combined with qualitative data. In a questionnaire, farmers were asked about their management. During a farm visit, hygiene conditions of the milking parlour and milking equipment were assessed according a protocol. In Table 2, some of the results on factors affecting SCCs for each housing system are presented. The farms with tied barns, cubicles and deep litter barns converted to organic production at 6.5, 5 and 13 years earlier, respectively. The

data shows an increased amount of cubicles in recently converted farms. In the group of farms with cubicle housing, the ratio biodynamic (Demeter): organic (EKO) is 1.15, while in farms with deep litter and tied barn this ratio is only 0.14. Both findings show an interconnection of year and conversion, barn type and origin (blood group in terms of EKO or Demeter farm). Recently, there was mainly a conversion to organic farming (EKO) at farms with cubicle housing (see also Baars, 2002).

Table 2: Factors affecting BMSCC in relation to barn type presented as is the percentage of positive cows or positive farmers

Item (below) and barn type (right)	Tied barn	Cubicles	Deep litter
Percentage of cows			
Clinical mastitis cows (cases/100 cow-years):	25	20	24
Sub clinical mastitis cows (cases/100 cow-years):	26	24	28
Percentage of farmers			
Drinking water from tap	71	43	30
Extra bedding material [1]	0	48	0
Hygienic insufficient	14	11	20
Cows may lay down after milking	100	72	20
Separate milking mastitis cows	70	20	20
Washable towels for cleaning udder pre milking	71	43	60
Cleaning teat cubs with hot water after mastitis cow	71	57	30
No medication for dry cow therapy	29	34	50
Treatment: first mastitis with antibiotics	57	53	10
Repeated mastitis with antibiotics	86	65	50
first mastitis with mint oil massage	57	57	70
Repeated mastitis with mint oil massage	29	35	40

[1.] In addition to straw/wood shaving/sawdust, chalk and stone meal were used in the bedding material in order to improve udder health.

Both clinical and subclinical mastitis incidence appeared to be slightly lower amongst cows kept in cubicle housing than in the other housing systems. Known risk factors for udder health differed between housing systems. Amongst the farms with a deep litter barn, more farms had their own drinking water supply and on a higher number of farms had non-optimal hygiene status than among the other farms. On farms with deep litter barns and with high hygiene status for both milking parlour and milking equipment, the percentage of subclinical mastitis was 24.5% compared to 34.5% on farms with deep litter barns and insufficient hygiene at milking. Extra bedding materials, in addition to straw, were not used in deep litter barns. Farmers with deep litter barns used more washable (cotton) towels instead of disposable (paper) towels for pre milking udder cleaning than farmers with cubicles, and teat cups were not cleaned with hot water after milking a cow with (sub) clinical mastitis on farms with deep litter barns. On farms with deep litter barns and washable towels, up to eight cows were cleaned per towel, whereas a maximum of five cows were cleaned per disposable towel. On 50% of the of the farms with deep litter barns, farmers did not use any medication at drying off (90% of the cows or more were not treated).

Another difference in management between housing systems was the treatment of clinical mastitis. A division was made between the treatment of the first case of mastitis in a cow and the repeat cases. The use of antibiotics in deep litter barns was lowest for both types of mastitis. On farms with deep litter barns, farmers used more mint oil, especially for first cases, instead of antibiotics when compared with the other farm types. With regard to subclinical mastitis, 70% of the farmers with deep litter barns did not act at all when a case was identified, while approximately 40% of the farmers with cubicles acted by frequent milking, massage with mint oil or use of homeopathy.

Bacteriological status of cows with a high individual cow somatic cell count (ISCC), which was defined as sub clinical mastitis (heifers > 150.000 cells/ml milk, older cows >250.000 cells/ml milk) showed that the highest amount of quarters without any pathogens (defined as healthy) was in the deep litter barns (Table 3). Only *Bacillus cereus*, an environmental pathogen, was found at higher frequency in deep litter barns than in the other barn types. *Staphylococcus aureus* (cow-transmitted pathogen) was found more often in cubicles and *Streptococcus uberis* was found more often in tied barns than in the other barn types. Other *Streptococci* not *uberis* (STC) were found as the main pathogen in subclinical cows for both cubicles and deep litter barns. None of the percentages of pathogens between barn types were statistically different.

Table 3: Bacteriological results from quarters with subclinical mastitis on 94 organic dairy farms in the Netherlands.[1]

Barn type	N farms	N quarters	% free of pathogens	% of samples with pathogens				
				BAC	SDY	SAU	STC	SUB
Tied barn	6	220	56.4	9.4	8.3	12.5	37.5	27.1
Cubicles	69	3414	57.5	6.6	8.1	16.6	45.4	19.0
Deep litter barn	12	539	60.7	10.4	6.1	14.2	46.2	20.8

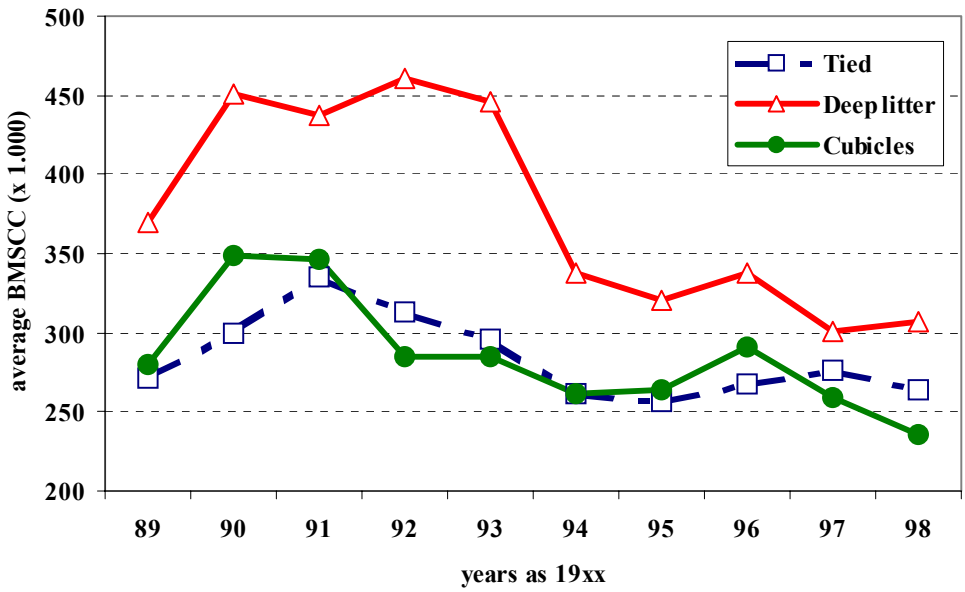
[1]. On each farm 8-18 subclinical cows were sampled. BAC = *Bacillus cereus*; SDY = *Streptococcus dysgalactiae*; SAU = *Staphylococcus aureus*; STC = *Streptococcus* not *uberis*; SUB = *Streptococcus uberis*.

Information out of such epidemiological studies will receive more sense if we integrate them with longitudinal studies, like NL1.

Study NL1

Data were used from the milking factory 'De Vereeniging' (see also Baars and Barkema, 1996). Biodynamic milk was processed since 1980 and the number of farmers were increasing till over 40 at the end of the 1990s (tied: 14; cubicle: 9 and deep litter: 20). Milk records were used from routine samples for SCC in bulk milk (13 times per year). The highest arithmetic average BMSCCs, calculated for all suppliers, were recorded in 1991 (378,000 cells/ml). After 1991, BMSCCs showed a steady decline towards its lowest level of 175,000 cells/ml in 1998. However, there were large differences between barn types (Figure 2).

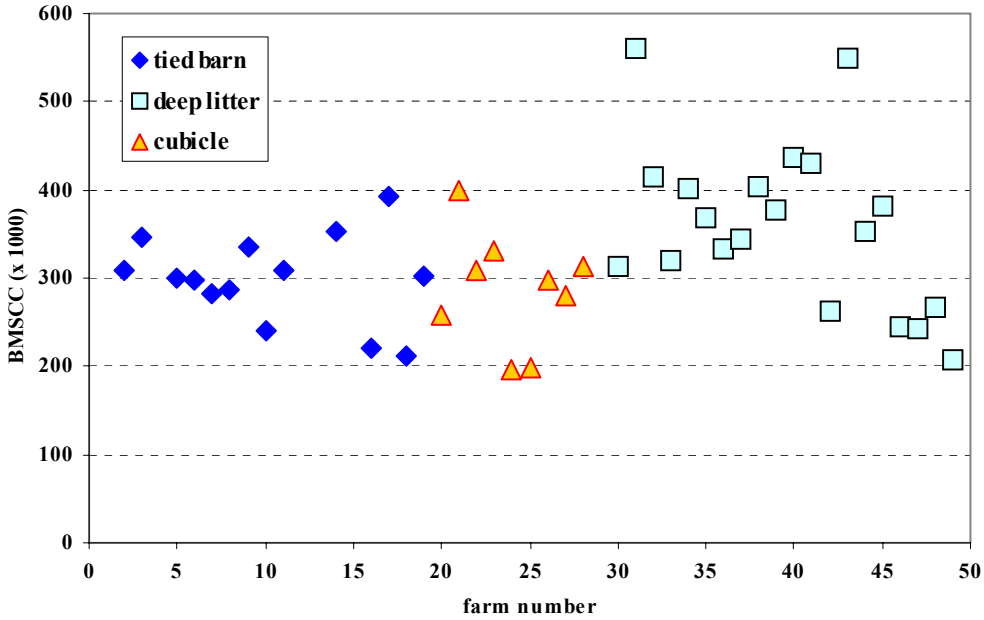
Figure 2: Development of the average BMSCC in different barn types per year (1989-1998)



The largest decline in BMSCCs was found in 1994, at the farms with a deep litter barn. At that time, farmers reacted on changes in the new penalty level for BMSCC, which was defined at a level 400.000 cells/ml. Nevertheless, since 1994, BMSCC remained higher on the deep litter farms than on the farms with other barn types.

A more detailed look at the figures at individual farm level over the same 10-year period shows that the differences in BMSCC levels between different farms in both the tied barns and the cubicle housing is small and the range of levels fall within similar boundaries, whereas there is a much wider range of BMSCC levels on the deep litter farms (Figure 3). This suggests that management factors/differences within the farms using a deep litter barns were more important on these farms than on the other two barn types. Some cases will be outlined here.

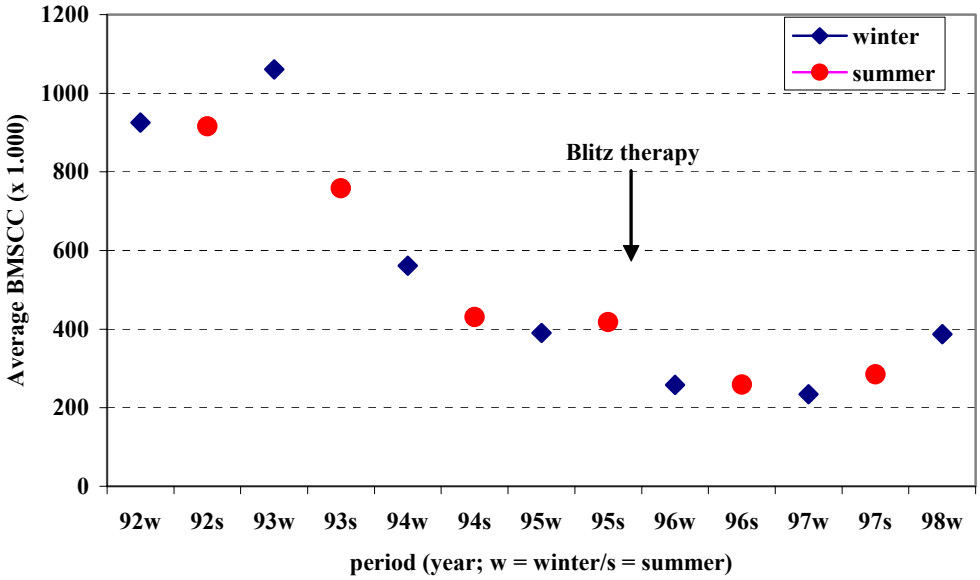
Figure 3: Average BMSCC over a ten year period (1989-1998) by farm and by type of barn



Such a longitudinal study showed that there was a large variation over time and in between farms. Even individual farms showed an enormous fluctuation in between years. Therefor it is interesting to evaluate case histories (see also Baars and Barkema, 1996), and two examples are presented here. Integrated studies of systems are classified as 'case studies ' or 'case histories', and in science the lowest category of studies in terms of scientific rigour and predictive power (Vandenbroucke, 1999).

In the deep litter barn with the highest BMSCC averages (farm 31: 561,000 cells/ml) almost all udders were infected with *Streptococcus agalactiae.* After several years of struggle, BMSCCs remained at a level of 400,000 cells/ml. All infected animals received an intramammary antibiotic therapy (so-called Blitz therapy) (Loeffler *et al*., 1995) and the pathogen was eradicated from the farm. Subsequently, the BMSCC levels declined dramatically (Figure 4). After 1997, the BMSCCs increased again. It was assumed that this was caused by an increased level of subclinical mastitis caused by *Staphylococcus aureus*. This example shows that average or long-term data have to be interpreted critically. Farm 31 had the highest average BMSCCs for the period of 1989-1998, as displayed in Figure 3. However, the averages in 1996 and 1997 (Figure 4) were at the lowest level of averages recorded in the whole study.

Figure 4: Deep litter barn on Farm 31: development of the average BMSCC by season and by year and the effect of *Streptococcus agalactiae* eradication after August 1995 and the recolonisation by *Staphylococcus aureus* since October 1997.

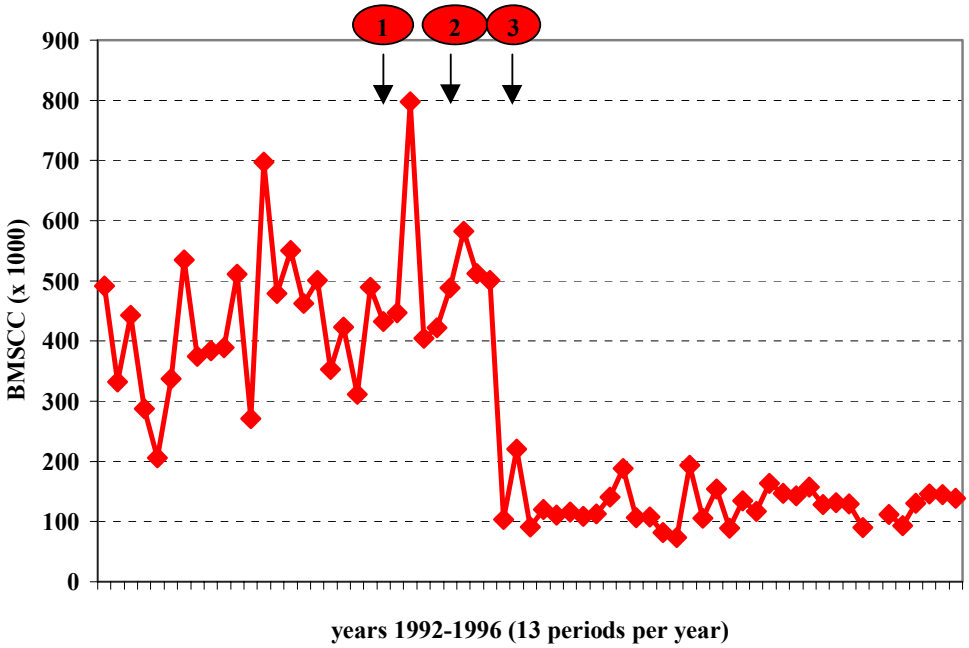


Another case history focuses on a farm that changed its udder health management during milking, changed its barn type from tied to deep litter, and the complete milking machine (Figure 5). Only after this last change BMSCCs decreased dramatically.

The study NL1 included 40 organic dairy farms where additional eight 'successful' BMSCC outcomes were described (Baars and Barkema, 1996). 'Successful' was defined as a situation where long period of a steady but high average level of BMSCCs is followed by a sudden fall of BMSCCs in connection with a management change, as described in Figure 5.

The evaluation of causality in case studies, within casuistic outcome research, is based on 'pattern recognition'. In the example of figure 5, the pattern is described as a process in time, and it was characterised as the combination of 'long before and short after', which means a long and steady clinical history which is immediately changed after a well described intervention (Kiene, 1998 and 2001; Baars, 2002). Due to on-farm actions, there is a causal relationship between such a specific action (i.e. change in milking equipment) and the result (i.e. decline in BMSCCs).

Figure 5: Change of barn type (arrow 1: tied > deep litter), milking management (2) and milking equipment (3): development of BMSCC by period in 1992-1996.



Based on the retrospective analysis of data and farm management in relation to the timing of SCC reduction, it became clear that at eight out of nine organic farms the control and improvement of the milking machine played an important role in the reduction of BMSCCs. This means that the described pattern in time was repeated in other cases, which makes the result more important. If problems with (sub)clinical mastitis were present, irregularities of the milk vacuum were found by a dynamic measurement of the equipment. It was found that it was paramount to vacuum capacity of the pump, milk removal from the udder, size of the claws, and vacuum regulation and stability (size of pipes). Post-milking teat disinfection was another important factor in preventing infection of the udder on four of the nine organic dairy farms (Baars and Barkema, 1996).

An evaluation of causality in single case studies is often very difficult if one deals with problem farms, where farmers are advised to develop 'good organic practice'. In the project Bioveem (Baars, 2002) farmers are accompanied by a circle of researchers and advisors to develop both new knowledge and to put existing knowledge into farm practice. In the NL3 study the difficulty for evaluation is shown.

Study NL3

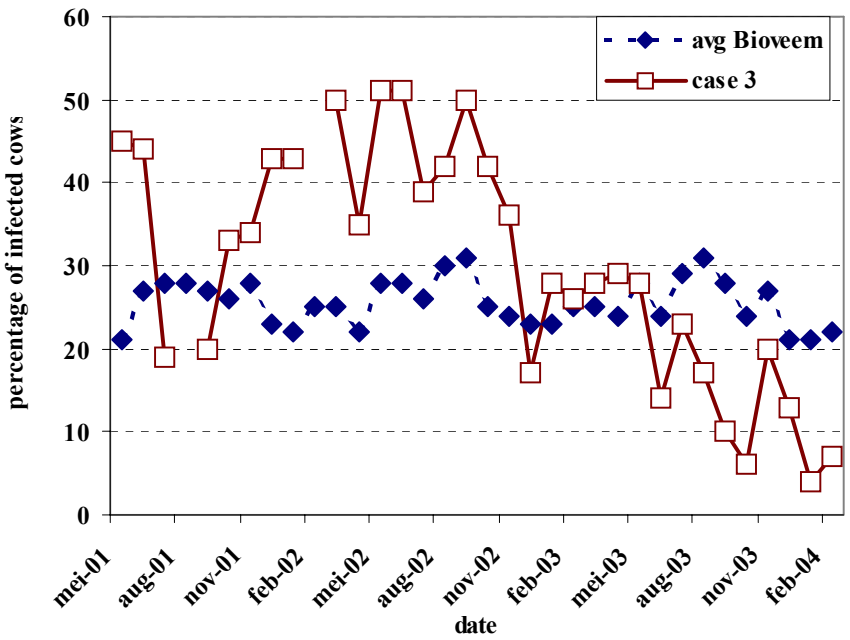
Mid 2002, a farm with a deep litter barn from the Bioveem-project (Baars, 2002) had serious problems with high BMSCCs. After testing the milking equipment and balancing the ration, a number of preventive and curative measures were taken to improve udder health. Measures were

undertaken at once, and, therefore, an evaluation of specific measures was not possible. The following measures were implemented:

- Using more straw in order to improve housing hygiene;
- Recording of all diseases and abnormality's;
- Sampling subclinical and clinical mastitis cows for SCC and pathogens;
- Separation of subclinical mastitis cows from the rest of the herd, both in housing and in grazing;
- Separate milking of subclinical mastitis cows;
- Pre-dipping with iodine;
- Rinsing the teat cups with hot water after each subclinical mastitis cow;
- Culling of chronically infected subclinical mastitis cows;
- Initiating dry cow therapy with limited use of antibiotics, based on cell count and pathogens; and
- Housing dry cows in two groups in order to achieve an improved balance between feed supply and demand.

The overall result of these efforts are presented in Figure 6. There was a dramatic decrease in the number of cows with subclinical mastitis from September 2002 onwards. As a reference figure, the average percentage of subclinical mastitis cows at the 17 farms in the Bioveem project is also presented.

Figure 6: A case study of an organic dairy herd in a deep litter barn: percentage of cows with subclinical mastitis (2001-2003) after a total change of management since summer 2002.



Discussion on factors for high SCC

Data from the different projects demonstrates that, although a deep litter barn could be a risk factor for high BMSCCs and for an increased level of subclinical mastitis, on-farm milking management, equipment and human factors can have a major impact on the final level of BMSCC on a farm. In the Netherlands, the deep litter barn is much more common in biodynamic farming and on farms that converted to organic production early (the early converters). Recently converted farms keep cows in cubicles and are more willing to use antibiotics both for drying off and for clinical mastitis therapy than biodynamic farmers and the early converters.

Other factors that may affect the hygiene status in a deep litter barn, apart from the farmer's experience, is the depth of litter bed. The hygiene and the temperature of the bedding is affected by the amount of straw per cow used and the number of months after which the bedding is removed, insight out of farmer's experience. This is done more frequently in shallow barns, which affects the temperature of the bedding, especially in the early spring (Feb-April). Other farm-specific factors may be the shortage of trace elements (mainly selenium), which affects the level of SSCs (Baars and Opdam, 1996; Van der Brug, 1996). In a controlled trial, their mean ISCCs of heifers housed in a deep litter barn were significantly reduced after supplementing trace elements (196,000 vs. 105,000) (Baars and Opdam, 1998).

In future research, attention should be paid to factors affecting the level of ISCC under an organic management *without* any use of antibiotics, both for cubicle housing as for deep litter barns. Lessons learned from case studies based on the reflection made in on-farm experiences should be integrated into future research. Attention should be paid to preventive strategies, which include strengthening of the animal's resistance, feeding strategy, including liver function and trace element availability.

Conclusive methodological remarks

Although herds housed in deep litter barns appear to have higher BMSCCs than herds housed in other barn types, several case studies show that there are farm specific circumstances that contribute to this. Case studies allow the researcher to focus on a specific farm and a specific farmer rather than *the* deep litter barn. Instead of an individual risk factor, one deals with a specific set of circumstances. Case studies should be combined with the evaluation of successful farmers, who had overcome their problems by on-farm testing and experimenting. Successful farmers are dealing with challenges in stead of problems, and their focus is much more interdisciplinary oriented.

Case studies have a considerable potential to stimulate new learning and formulate new ideas. Case studies can be exploratory, descriptive or explanatory and can be combined with multivariate statistics. Case studies are highly sensitive to novelties that are identified in a qualitative way. According to Vandenbroucke (1999) case studies are important because a case-report can tell us what is 'unknown' or 'unrecognised'. It can present a general truth that can be stated in abstract scientific terms even though it was based on a single observation. Yin (1993) defined the case study method as a form of empirical inquiry that investigates a contemporary phenomenon within its real-life context, addresses a situation in which the boundaries between

phenomenon and context are not clearly evident, and uses multiple sources of evidence. In contrast with a Randomised Clinical Trial, in single case studies the causality is based on the recognition of patterns (Kiene, 1998 and 2001), based on farmer's action and result plus the knowledge of the natural course (so-called patterns) as an important element of expert knowledge.

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Udder health concepts that comply with organic principles – how to reduce therapies?

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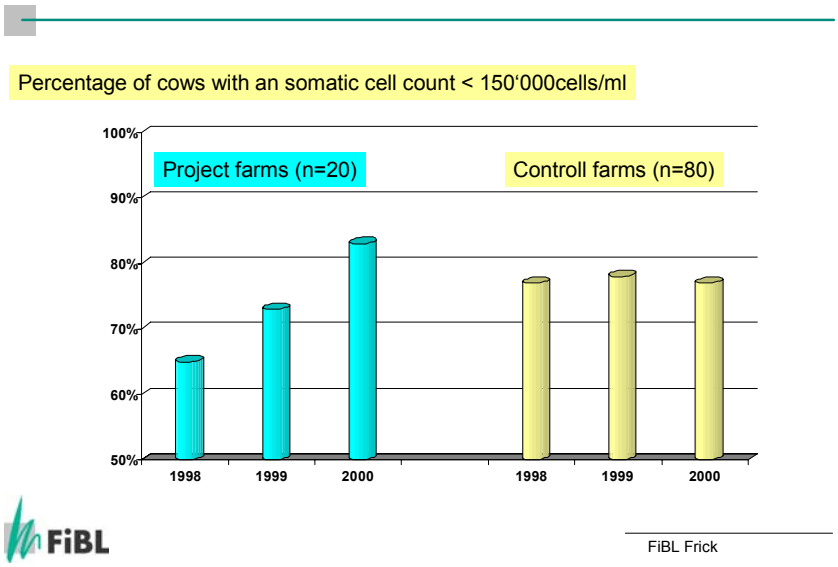
Introduction

Both the consumers and the legislators expect products from healthy organic livestock. Consequently, keeping farm animals healthy has the highest priority in veterinary work on organic farms. Different Swiss FiBL projects on bovine mastitis in recent years were aimed at health concepts that comply with organic livestock production principles. This paper summarises some of the work carried out.

Somatic cell counts and clinical mastitis

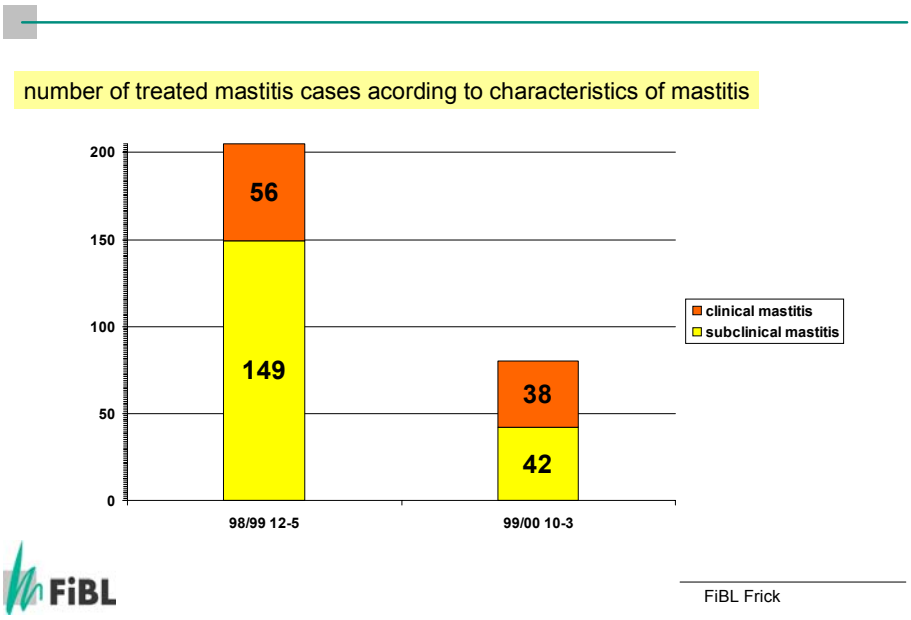
One project included 20 farms (with an average of 15 cows per farm) of a high mountain Swiss region and placed emphasis on milking hygiene, milking technology, mastitis treatment during lactation (homeopathy versus antibiotics) and dry-off treatment (homeopathy versus placebo and partially additional antibiotic). The overall result was a reduction of cows with a somatic cell count higher than 150,000/ml based on milk recording dates between January and May from 35% in 1998 to 17% in 2000 (Figure 1).

Figure 1: Percentage of cows with a somatic cell count <150,000, as observed in an udder health project (Walkenhorst *et al.*, 2001).



During the project the average number of treated mastitis cases per farm decreased from 10 to 4 (Figure 2).

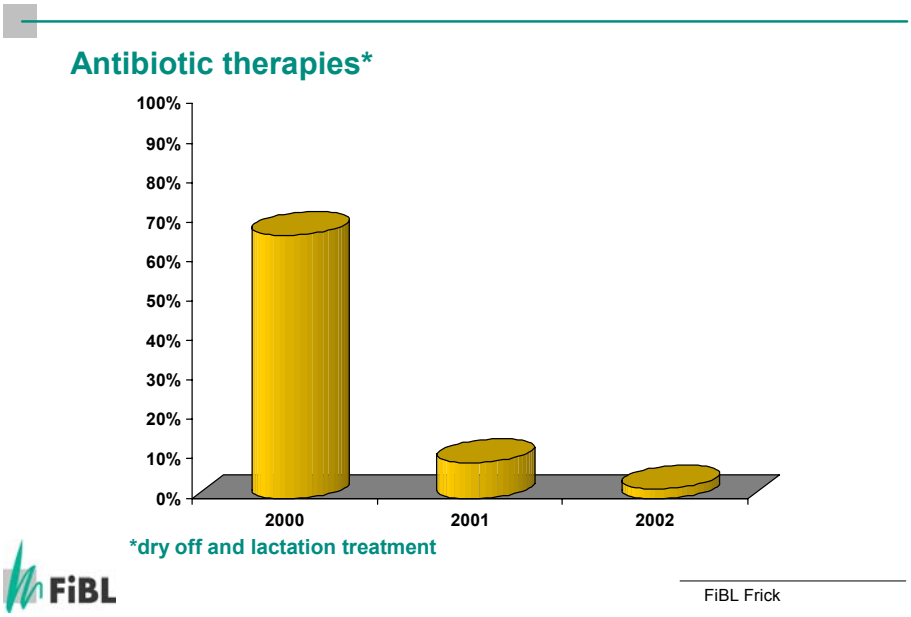
Figure 2: Number of treated mastitis cases according to characteristics of mastitis in an udder health project (Walkenhorst *et al.,* 2001).



Reduction of antibiotic use

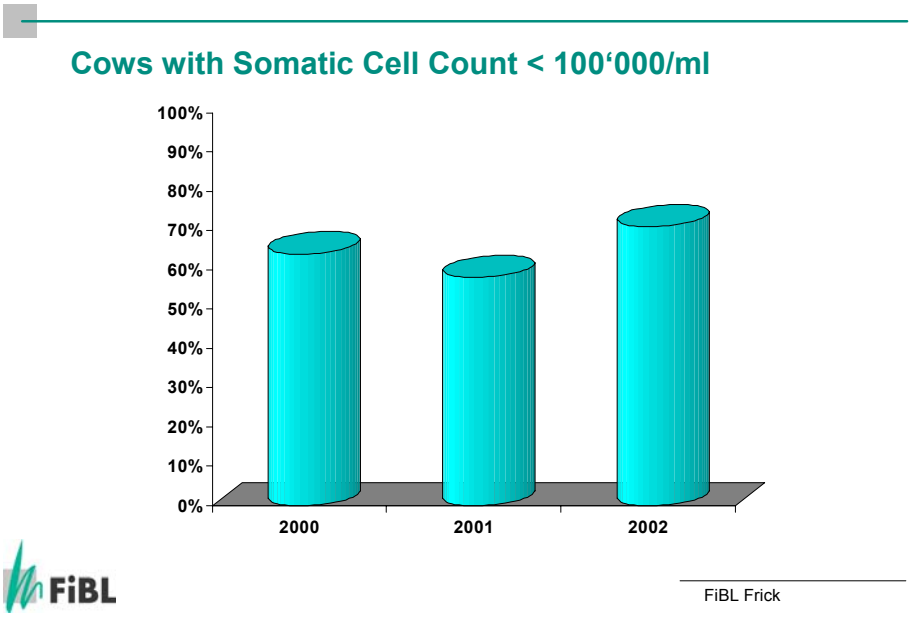
A second project, considering farms in the north west of Switzerland, was aimed at the implementation of an organic principles compliant udder health concept, placing emphasis on reduction of the use of antibiotics. In order to achieve this, it was envisaged that factors contributing to mastitis will consistently be eliminated or at least reduced by implementation of herd health management and, in addition, by the establishment of complementary therapy and prophylaxis in udder health. The project placed emphasis on a better co-operation between practical veterinarian and the farmer in the issue of preventive herd health management. On the three pilot farms, a reduction in the use of antibiotics from 70 treatments per 100 cow and year in 2000 (previous the start of the project) to two treatments per 100 cow and year in 2002 (second project year) could be shown (Figure 3).

Figure 3: Minimisation of antibiotic treatments for mastitis in an udder health project (Notz *et al,*, 2001).



Thereby, the udder health status of the herds remained stable with round about 65% of cows with a somatic cell count lower than 100’000/ml (Figure 4).

Figure 4: Udder health status according to the proportion of cows with somatic cell counts < 100,000 cells/ml in an udder health project that showed significant reduction in antibiotic use (see Figure 3) (Notz *et al.*, 2001).



Udder health concepts into practice

The objective of the current project is the enlargement and implementation of the previous concept into practice. A project team of veterinarians and agronomists will collect data of mastitis causing factors on 100 new farms per year in Switzerland: housing, feeding, human-cow-interaction, milking technology, milking hygiene. These data will be connected to the mastitis status of the herd based on quarter milk samples and milk recording dates. During a period of at least 2 years these farms will be intensively advised by the project team and the practical veterinarian. Therapies will primarily be based on homeopathic remedies. The development of mastitis causing factors and the mastitis status of the farms is followed up at regular intervals to show possible correlations between (changing) factors and mastitis status. The monitoring system of the project is presented in Table 1.

In addition, an Internet based network of health data should be implemented for providing information for farmers and veterinarians in preventive herd health management. The aims of the project are reduction in the use of antibiotics in udder treatment, improvement of the udder health state of the herds and, as a consequence, improvement of milk quality.

Table 1: Analysis of mastitis situation within the project.

	Clinical examination	Quarter based bacteriology	Quarter based SCC	Milk recording data
Start	X	X	X	
After 1st project year	X	X	X	
Monthly				X
Dry off (if SCC>100 or CMT pos.)	X	X	X	
Calving (if SCC>100 or CMT pos.)	X	X	X	
Mastitis	X	X	X	
Mastitis + 30d	X	X	X	

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The relationship between worm burden and milk quality in goats

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Introduction

Livestock production from small ruminants, like all livestock production, must be considered as a business enterprise where profits need to be made. In fact, in small ruminant production, the gain per animal is minimal compared with the gains achieved in cattle production, suggesting that any irregularities will cause serious economic losses.

The business volume of antiparasitic drugs in Germany is about €92 million per year, suggesting that the economic importance of antiparasitic treatments is great even at farm level (Bundesverband für Tiergesundheit, 2002). While this figure includes the ectoparasitics and anthelmintic drugs for pets, the application of anthelmintics to farm animals still remains an economical and an environmental problem.

Anthelmintic resistance is an added problem and cost in relation to antiparasiticide use. As a result of the use of the same three types of anthelmintics for decades, the occurrence of resistant parasites increases rapidly. As sheep and goats are considered as "minor species" in the European drug legislation, only a few numbers of compounds are licensed for use in these species. This situation aggravates the problem of anthelmintic resistance. The prevalence of benzimidazole resistance is particularly high in goats, especially in dairy goats (Hoste *et al.*, 2002). Many farmers respond to poor treatment results by an increased treatment rate - or by preventing access to grazing. It appears that the situation on organic farms in Germany is no difference from that found in the conventional husbandry systems. This was epitomized by the situation at The Institute of Organic Farming in Trenthorst, when the institute bought small ruminants from seven organic farms. All flocks brought the resistance against benzimidazole with them (Koopmann and Epe, 2002).

In order to reduce anthelmintic use and to find out alternative, economic and sustainable solutions, it is necessary to understand better the connection between parasites and individual immunity. The evaluation of productivity parameters, like milk yield and milk quality, could help to estimate the effect of subclinical parasitism and the ability of the animal to tackle the problem. A relationship has been demonstrated between the level of milk production and the susceptibility to gastrointestinal nematode infection (Chartier *et al.*, 2000; Hoste *et al.*, 1999; Hoste and Chartier, 1993). The adverse effects of subclinical parasitism in dairy cows has been described and discussed previously (Kloosterman *et al.*, 1996; Nodtvedt *et al.*, 2002; Ploeger *et al.*, 1990a). In all, 80 % of reviewed studies reported an increase of milk yield after deworming (Gross *et al.*, 1999).

For small ruminants, only limited data are available. Goats are less resistant to nematode infection than other ruminants (Etter *et al.*, 2000), and an experimentally induced subclinical

parasitism in a goat herd led to a persistent decrease in milk yield (2,5–10 %). No changes in fat and protein content could be detected. Higher yielding goats showed a more severe reduction in milk yield (13,0–25,1 %) and a decrease in fat content (Hoste and Chartier, 1993) than lower yielding animals.

Two main topics of the Trenthorst Institute's research focus on milking and milk quality of small ruminants and strategies to reduce anthelmintic treatments. The described study connected the data gained from these topics areas.

Materials and methods

In 2003, the herd of the experimental farm consisted of 45 goats (breed: "Bunte Deutsche Edelziege") and 19 ewes (breed: "Ostfriesisches Milchschaf", variation: schwarz). The observed animals were older than two years and at least in their third grazing season. Lambing season started in January and lasted until March. Milking started in March in a side by side milking parlour with 10 places and 5 milking units for sheep and goats, respectively. The milking intervals were 11 to 13 hours.

Turnout to pasture began at the end of April and lasted until October. Lambs were separated. The goats had continuous grazing on permanent pastures with a stocking rate of about 1,000 kg bodyweight per ha. The pastures were dominated by grass with a very low fraction of clover and herbs. During milking, each animal received about 1 kg of cereal supplement. Minerals were freely accessible. As the summer of 2003 was extremely dry, hay and grass-silage was fed in addition to grazing and cereals.

At the end of the summer, the goats developed high worm burdens and showed clinical symptoms of endoparasitic infestation. In September, the goats were dewormed. Faeces samples were taken from every animal, and these were assayed for the excretion of gastro-intestinal-nematode (GIN) eggs (faecal egg counting – FEC - method after McMaster, 3 chambers, one counted egg correspond to 33 eggs per gram – epg - fresh faeces).

To monitor udder health, half udder-samples for cyto-bacteriological analyses were gathered every 14 days. The production data, like milk yield and milk composition, were obtained from the monthly milk recording data.

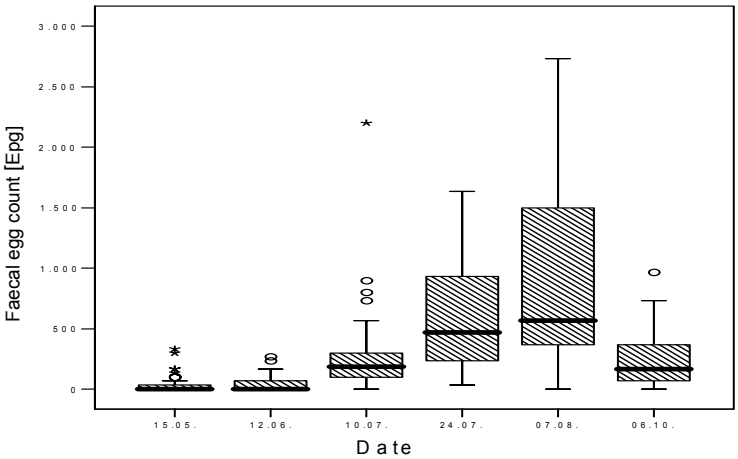
The statistical analysis was carried out using the software package SPSS (12.0).

Results

First results showed that the ewes developed neither a remarkable parasitic infestation (average FEC was 12 epg) nor abnormal values in milk. Therefore, this group was excluded from the trial.

The goats' excretion of GIN eggs increased after turnout and reached a median of FEC over 500 epg (Figure 1) in the middle of the summer.

Figure 1: Faecal egg count of gastro intestinal nematodes in lactating goats (Boxplot)



The large range observed is not unusual for worm egg data. Due to some extremely high values, not marked in the graph, the arithmetic mean of FEC in August was about 1,000 epg. A first evaluation showed no significant relationship between the worm burden, estimated by the FECs, and any of the milk parameters.

Ranking the goats into three classes according to the level of their egg excretion, allowed the following allocation of the animals into subgroups based on FEC: from 0-100 epg described a goat with a low level infestation, 101-300 epg a medium level infestation. Above 301 epg the goat was considered to have a high level of infestation. The animals were then grouped according to their level of parasitic infection. One group of 17 animals, two of them in their first lactation, started slowly with the egg output and the FEC stayed at a low level until just before the end of the investigation period in August. This group was defined as having a “mild” course of parasitic infestation (Table 1).

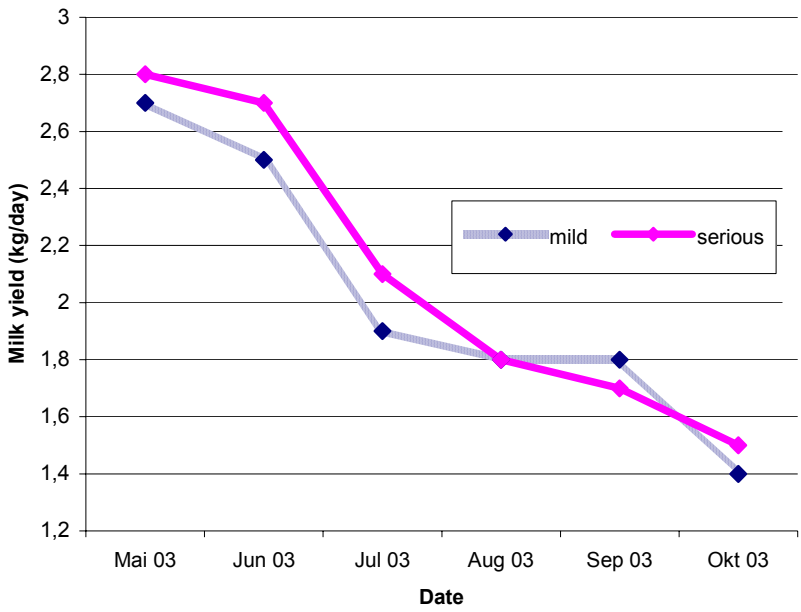
Table 1: The level of egg output in the goats with “mild” infestation.

May	June	July	July	August
Low	low	low	low	Low
Low	low	low	medium	medium
Low	low	medium	medium	medium
Low	low	low	medium	high

The other group of goats (n = 28), with 13 in their first lactation, started with an abrupt increase of the egg-output, and the FEC stayed on a medium or high level until the end of investigation. This group was defined as having a "serious" course of parasitic infestation.

The comparison of the daily milk yield of the animals from group "serious", showed during the months with the very heavy worm burdens, middle of July to middle of September, a steeper decrease of milk yield than the lactation curve of the "mild" group did. In fact, the "mildly" affected goats nearly kept their performance (Figure 2).

Figure 2: Mean milk yield per animal and day in goats with different parasitic infestation status.



The average milk yield was 419 kg/year (240 days corrected). The breed average is about 667 kg. Referred to the lower bodyweight, the production was about 20 % under the normal yield. One reason, apart from the worm burden, may be the late start of milking of some of the goats, due to technical delay. The extensive raising and feeding and the level of the genetically value one year after building-up the herd, has to be considered as well.

Although no significant direct correlations between egg-output and parameters of the milk quality have been found, comparing the two groups of infection brings up a slight but mainly not significant difference of the means (t-test, $p<0,05$; Table 2).

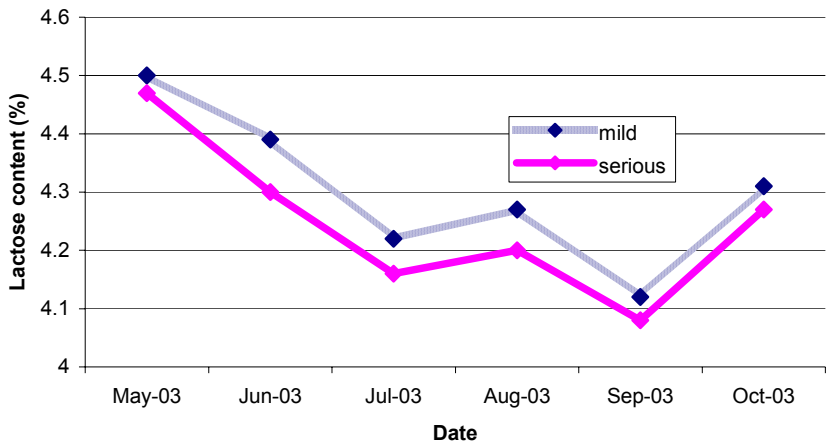
Table 2: Mean and standard deviation of parameters of milk composition and somatic cell count at the day of the milk recording, displayed in the groups ("mild" course of infestation: n = 17; "serious" course of infestation: n = 28)

Parameter	**Course of infestation**	**Month of the milk recording**					
		May	**June**	**July**	**August**	**September**	**October**
Fat [%]	mild	2,94 ± 0,37	3,03 ± 0,41	2,73 ± 0,40	3,11[a] ± 0,36	2,58 ± 0,41	3,24 ± 0,43
	serious	2,98 ± 0,35	2,85 ± 0,27	2,69 ± 0,30	2,84[b] ± 0,39	2,63 ± 0,30	3,17 ± 0,38
Protein [%]	mild	2,99 ± 0,19	2,91 ± 0,20	2,73 ± 0,21	2,75 ± 0,21	2,81 ± 0,22	3,12 ± 0,20
	serious	2,96 ± 0,22	2,84 ± 0,17	2,66 ± 0,14	2,64 ± 0,20	2,79 ± 0,17	3,15 ± 0,23
Lactose [%]	mild	4,50 ± 0,13	4,39 ± 0,11	4,21 ± 0,13	4,27 ± 0,11	4,12 ± 0,15	4,31 ± 0,20
	serious	4,47 ± 0,22	4,30 ± 0,20	4,16 ± 0,30	4,21 ± 0,18	4,08 ± 0,20	4,27 ± 0,24
Cell count lg	mild	2,40 ± 0,32	2,50 ± 0,30	2,79 ± 0,30	2,56 ± 0,38	2,55 ± 0,30	2,93 ± 0,47
	serious	2,37 ± 0,37	2,49 ± 0,35	2,66 ± 0,39	2,56 ± 0,37	2,49 ± 0,30	2,71 ± 0,37

[a,b] $p < 0,05$

With regard to the lactose content, a collateral difference between the groups of either "mild" or "seriously" infested goats was observed (Figure 3). The difference was small and not significant, but remarkable, as lactose content is normally a very steady value.

Figure 3: Lactose percentages: Comparison between "mild" (n = 17) and "serious" (n = 28) affected goats



The protein (Figure 4) and fat-contents (Figure 5) differed also.

Figure 4: Protein percentages: comparison between "mild" (n = 17) and "serious" (n = 28) affected goats

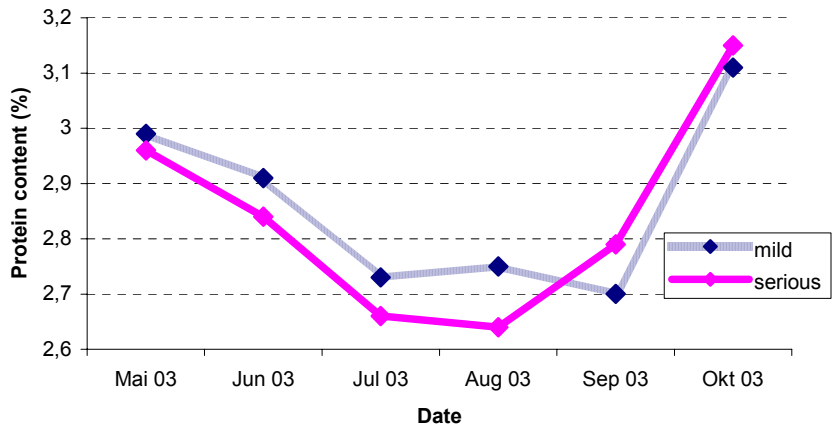
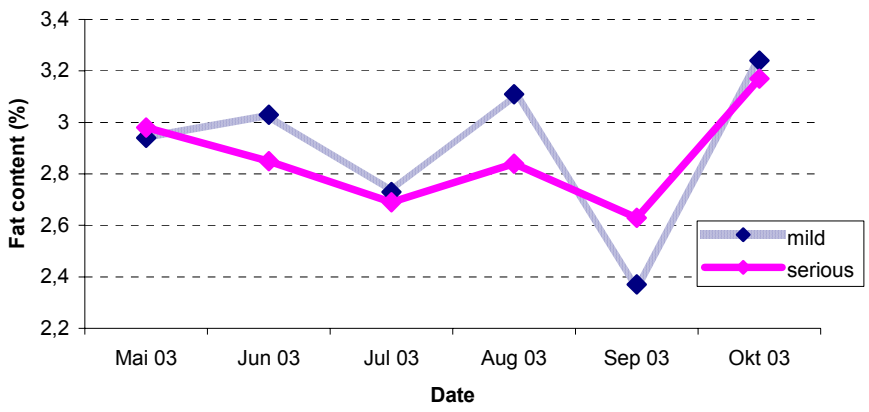


Figure 5: Fat percentages: comparison between "mild" (n = 17) and "serious" (n = 28) affected goats



The differences between the "mild" and "serious" groups were visible but not significant. No differences between the groups could be demonstrated with regard to the number of animals with infection of udder and the number of infected udder-halves (Table 3).

Table 3: Frequency of animals dependant to the course of infestation and the number of bacteriological infected halves of udder.

	Course of parasitical infestation:				
	mild		serious		Σ
infected halfs	abs.	%	abs.	%	abs.
0	8	47,1	10	35,7	18
1	6	35,3	14	50,0	20
2	3	17,6	4	14,3	7
Σ	17	100	28	100	45

Discussion

In contrast to the other diseases, parasite-related diseases affect the health of livestock in organic farming more than in conventional farming (Lund and Algers, 2003). One reason to this appears to be the condition of outdoor management in ecological farming. It increases the animal well being, but also the risk of vector or intermediate host-transmitted parasite infections (Schnieder, 2003). The infestations with gastrointestinal nematodes are an important cause of reduced production of meat, milk and wool in domestic livestock (Kloosterman et al., 1992).

While deworming may have adverse effects (Tharaldsen and Helle, 1989) or no effect at all (Prosl et al., 1983), the detrimental effect of nematode infections on milk performance has been demonstrated when heifers were treated after housing. They developed in the following lactation 195 kg milk yield gain (Ploeger et al., 1990b). Adult dairy cattle in a similar study gained 133 kg milk per lactation (Ploeger et al., 1990a). Even low infected cows, with an average of 10 epg, produced an additional 0,94 kg of milk per day after treatment with a modern anthelmintic drug (eprinomectin) at calving. Eliminating the present subclinical parasite burdens produced a consistent increase in milk production (Nodtvedt et al., 2002). A survey from 1999 mentions, that 80 % of 87 reviewed studies show a significant increase of milk yield (average 0,63 kg/day) after deworming (Gross et al., 1999).

The influence of parasitism on the milk composition is rarely investigated. No effect of deworming (eprinomectin at calving) of low infected cows was seen on milk composition and somatic cell count. But in a review, the yield of milk fat after deworming was higher in 26 of 35 experiments (Gross et al., 1999; Nodtvedt et al., 2002). On small ruminants, only few data are available. Hoste and Chartier showed that subclinical parasitism in goats led to a persistent decrease in milk yield (Hoste and Chartier, 1993). The level of performance has to be considered as well. Even on a low level of nematode infection, the high-producing goats showed a 4 – 8 % increase in milk production, when febantel-treated monthly (Chartier and Hoste, 1994). An experimentally induced subclinical parasitism in a goat herd led to persistent decrease in milk yield (2,5 – 10 %). No changes in fat and protein contents were detected. High producing goats showed a more severe reduction in milk yield (13,0 – 25,1 %) (Hoste and Chartier, 1993).

The results of our study suggest that there appears to be a different kind of reaction in goats to tackle the parasite challenge. The goats showed either a “mild” or a “serious” course of infestation, estimated by the individual FECs. The higher milk yield at the beginning of the investigation of the goats with a “serious” course of infection agrees with earlier findings on the greater susceptibility of high yielding goats to parasitic infection (Chartier and Hoste, 1994). Despite the fact that there was no significance, goats from the “serious” group developed a steeper decrease of the milk yield in the middle of the summer, while the “mild” group nearly kept their production level.

Goats with “mild” course showed a steady tendency of higher amounts of the milk quality values, mainly in lactose content, but also in protein and in fat. The difference in lactose content, while not statistically significant, is remarkable. The lactose value is connected with the maintenance of the osmotic pressure and determines the milk yield. The variability is strongly restricted. The observation needs to be confirmed by repeated investigations.

Adult goats are known for their insufficient development of immunity against endoparasites (Hoste and Chartier, 1998). Our investigation reveals, that even third-year-grazing, low-producing goats develop high worm burdens on pasture.

Conclusions

No assured relationships between absolute numbers of excreted eggs of gastro intestinal nematodes and parameters of milk quality of goats could be demonstrated. Irregularities in udder health are not necessarily promoted by subclinical parasitism. The course of the parasitic infestation in goats should be investigated further, particularly to establish if the infestation level is an expression of individual resistance or immunity and how it may be related to parameters of milk production and milk composition.

Acknowledgements

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Part C:
Animal health and welfare: beef and sheep production

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Problem areas in animal health and welfare on organic farms - Effects of pasture on animal health, welfare and performances of organic beef reared in Tuscany

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Introduction

In Tuscany, as in the whole Mediterranean area, pastures produce grass only in limited periods (spring and autumn), and beef cattle from the age of 6-8 to 18-20 months are traditionally reared in boxes within stables.

The majority of the farmers, who plan to convert to organic production are limited by climatic, but also cultural, problems. Until 40 years ago in Italy, many farmers still kept cattle indoors, and it was not so easy to convince them that it was possible and profitable to rear animals in boxes in the stable. Furthermore, before the introduction of EU Regulation No 1804/1999, the Italian regional and private Regulations stated that the organic animals must have spaces indoors and outdoors, but the pasture was not compulsory (Martini et al., 2001).

These facts are an obstacle to the complete application of the current EC Regulation that requires that herbivores must have access to pasturage whenever conditions allow it (Paragraph 8.3.1.). By way of derogation from paragraph (8.3.1.), the final fattening phase of cattle, pigs and sheep for meat production may take place indoors, provided that this indoors period does not exceed one fifth of their lifetime and, in any case, for a maximum period of three months (8.3.4.). Thus, the majority of organic farms are in derogation (as stated at the point 8.5.1.), and farmers have to present plans to their control bodies, which ensure compliance with the provisions of the above mentioned Regulation (8.5.2.) by December 2010. The challenge is to change farmers' mentality and to show that fattening organic beef cattle at the pasture is possible and profitable, also in these climatic conditions.

Materials and methods

The research was carried out in the farm of Valdastra, in the Commune of Borgo San Lorenzo, in the Mugello area in Italy. The aim of this research was to compare welfare, health and performances of 16 Limousines male cattle, fattened after weaning: half at the pasture from 9 to 3 months before slaughtering and half in boxes in a stable from 9 months to slaughter (Table 1).

Table 1: Rearing scheme

From birth to 8 months at the pasture with mothers From 8 to 9 months in the stable (boxes of 35 m^2 indoor and 35 m^2 outdoor) At 9 months the animals were divided into the following groups:	
STABLE	PASTURE
8 animals in the stable; in a box of 35 m^2 indoor and 35 m^2 outdoor, from 9 months to slaughtering	8 animals at the pasture from 9 months to 3 months before slaughtering. The access to the pasture was trough a pen 2000 m^2 large.
	For the last 3 months in the stable; in a box of 35 m^2 indoor and 35 m^2 outdoor

During the observation period, November 2002 to November 2003, temperature and rainfall were registered. The correspondence of the feed ration with the EU Regulation was checked throughout the study. The welfare of the two experimental groups was investigated using the avoidance distance (AD) method (Waiblinger and Menke, 2003; Mülleder *et al*., 2003). Trough all the experimental period, the health status of the two groups was monitored, and homeopathic treatments were recorded. Each month, in order to evaluate the body development, all animals were weighted and the following parameters were recorded: wither height, pelvis height, chest height, chest girth, body length, rump length, hips width and thurls width.

At slaughter, all carcasses were photographed, evaluated (EUROP method), weighed and measured, registering: dressing percentage, carcass length, leg length, maximum leg width, minimum leg width, cervical vertebrae length, dorsal vertebrae length, dorsal vertebrae 1–6 length, dorsal vertebrae 7-13 length, lumbar vertebrae length, sacral vertebrae length and chest depth. A meat sample (steak between the 5th and 6th rib) from each animal was submitted to physical analysis (double boiler cooking loss, roast cooking loss, double boiler cooked meat shear force, roast cooked meat shear force, L lightness, A redness, B yellowness, Metric Hue Angle and Chroma).

Finally, the optimal organic beef housing in Tuscany was described, and economic cost was evaluated.

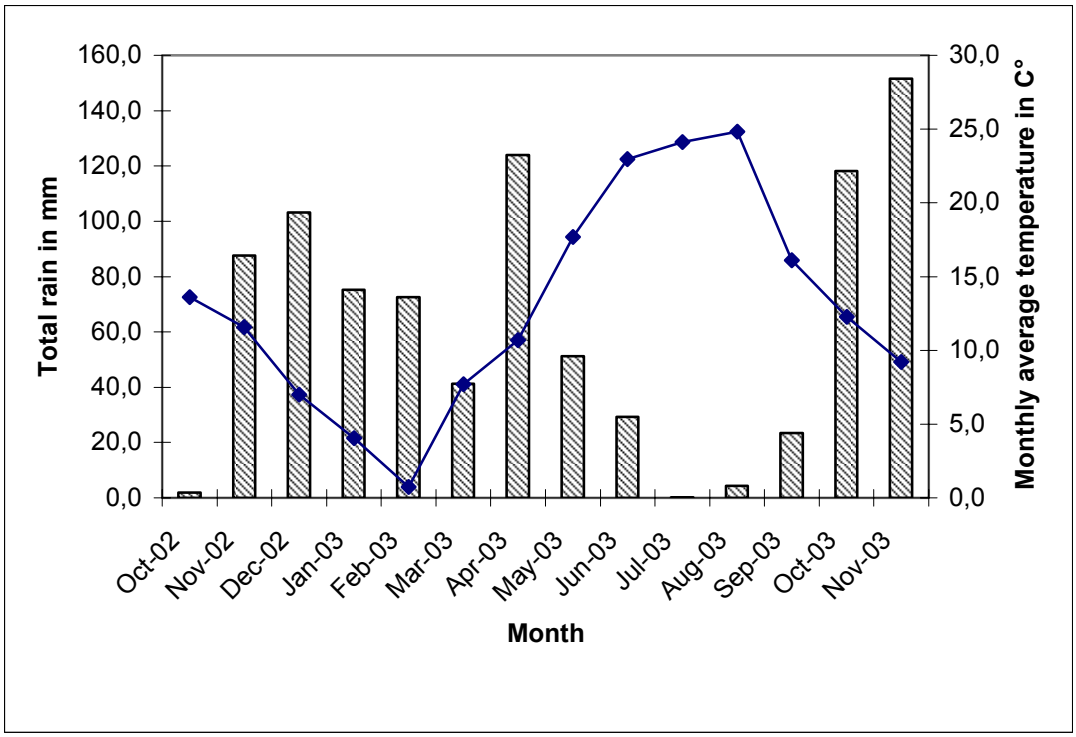
Live, slaughter and physical meat analysis data were analysed by ANOVA. For live data, the following factors were considered: the type of housing (stable or pasture), the time and the interaction between housing and time. For slaughtering and meat analysis data, only the type of housing was considered as a factor.

Results

Rearing and slaughter data

In Figure 1, the climatic data, registered through the experimental period, is presented. The Mugello area usually benefits from adequate rain, but in 2003, the summer was particularly warm and dry, with temperatures above the level of the thermo-neutral zone. For the European cattle types, the level of thermo-neutral zone has been indicated between 4,4°C-21,1°C (Brody *et al*., 1955), between 0°C and the 16°C by Findley (1958), and in 10°C by (Smith, 1959).

Figure 1: Climatic conditions 2002/2003 in Borgo S. Lorenzo (FI).



All components of the ration were organic, and the organic forage/concentrate ratio (60/40) was adhered to. The supplemented commercial feed, Bioforce 19, contained in the ration, was produced by a specialized Italian company, and was 100% organic. It was not possible to register the feed consumption, so it is not known if there was a difference between animals housed in the stable and those at the pasture. Nevertheless, in Italy, and in all Mediterranean area, it is customary to integrate the ration in summer and in winter, and consequently it is difficult to estimate how much pasture the animals consume. However both the group in the stable and that at the pasture received every day the same amount of feed (Table 2).

Table 2: Feeding/day in fresh matter and dry matter for both groups

	11/02-12/02	**01/03-4/03**	**05/03-07/03**	**08/03-11/03**
Live weight kg	250 - 300	300 - 450	450 - 550	550 – 650
Hay kg	2,0	-	2,0	2,5
Alfa alfa hay kg	-	2,5	2,0	-
Straw kg	-		0,5	
Grass silage kg	-	2,0		16,0
Maize silage kg	6,0	7,0	10,0	-
Ground ear corn kg	-	1,5	1,0	-
Barley meal kg	0,8	-	1,0	4,0
Bioforce 19[1] kg	2,0	2,5	2,8	3,0
Total feed kg	10,80	15,50	19,30	25,50
Total DM kg	6,20	8,47	11,17	15,56
Total DM of forage kg	3,74	5,24	7,16	9,40
Ratio F/C %	60,32/39,68	61,86/38,14	64,09/35,91	60,4/39,6

[1] Crude Protein 19%, Ether Extract 4,5%, Crude Fibre 7,0%, Ash 6,8%, Moisture 13%

Measures of avoidance distance (AD) didn't prove to be helpful to assess animal's welfare, probably because animals housed in the stable were more accustomed to being handled than those at the pasture. Consequently, no difference between the two groups was found. According to Boivin *et al.* (1998), cattle appear able to recognise the familiar caretaker wearing unusual clothes and to discriminate people wearing the same clothes (Taylor and Davis, 1998). Some result, with the approaching test to the feeder, were obtained, and it was considered that this test could be useful to measure the effective welfare of beef cattle of same sex and of same age housed in the same farm, either in the stable or at the pasture. However, in situations like this, it would probably be better to evaluate behaviour, such as the proportion of abnormal lying down and getting up movement. Several authors (Wierenga, 1987; Lidfords, 1992) have reported many difficulties in these movements in animal kept on slatted floors. From a behavioural point of view, stocking density and the floor type might interfere with the expression of many behavioural patterns, such as exploration, social interaction and aggressiveness, that may be evaluated as welfare indicators. Moreover, pathologies could be a good welfare index in systems like this, as animals kept on straw bedded areas have been shown to have a higher incidence of lameness and animals kept on slatted floors more tail tip necrosis (Scahaw, 2001).

It was possible to administer regular treatments with homeopathic and phytoterapeutic remedies only to the animals housed in the stable (Table 3). A homeopathic complex, *Tricalcarea* and *Calcarea carbonica* were used.

Table 3: Homeopathic treatments

Stable	Pasture
Tricalcarea (*C. carbonica, C. phosphorica, C. fluorica*) 200 CH *Calcarea carbonica* 200 CH BIOFOOD PL by APA CT (Phitotherapic)[1] Every 15 days	Nothing

[1]Hydroalcoholic extracts of Propolis, *Rosa canina L.*, Echinacea, Liquorice and Fennel. Essential oils of Lemon, Cajuput, Eucalyptus, *Satureja montana* and Cinnamon.

However, troughout the experimental period, no health problems were registered in either group. However, in May 2002, when the experimental animals were 2-3 months old, the Mugello area was affected by a generic animal influenza, and all the herds, Valdastra animals included, were vaccinated. During the research period, one animal at the pasture had a broken leg and was slaughtered. This animal was not considered in the data analysis.

Table 4 shows the results of the ANOVA. All animals showed an optimal beef growth, in conformity with the best Limousine standards. Withers height, pelvis height, body length, rump length (pasture>stable) and hips width (pasture<stable) were influenced by the housing, and only rump length by the housing x time.

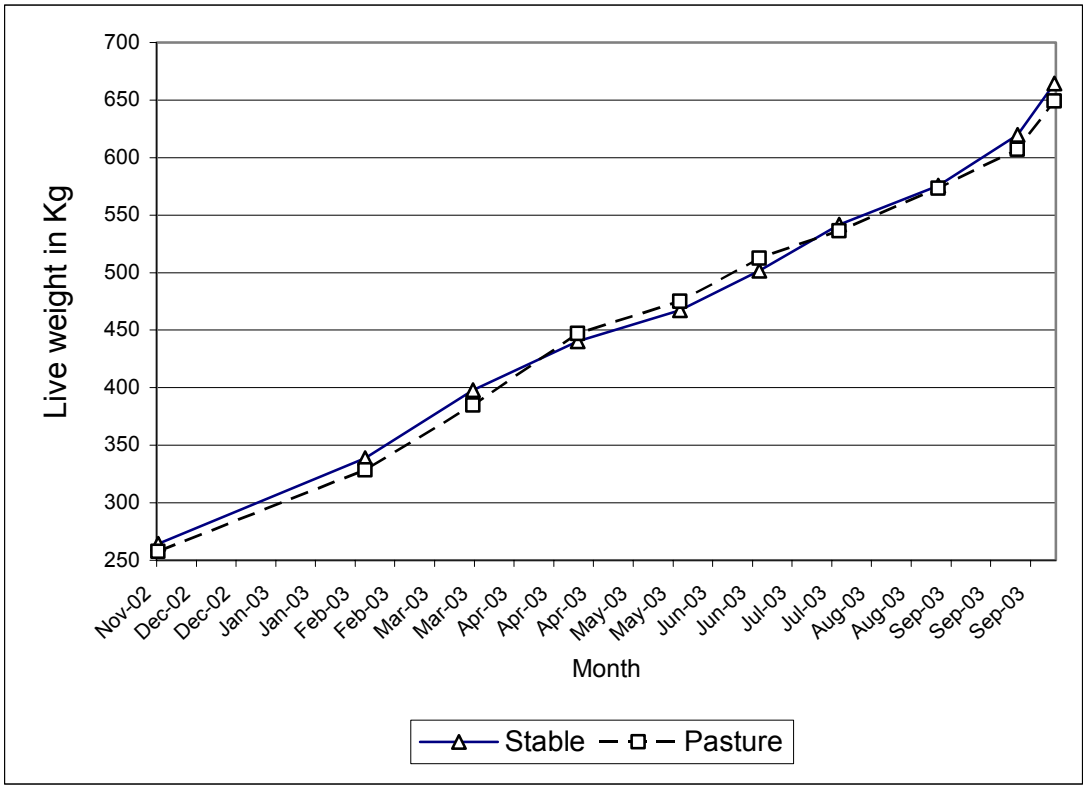
Table 4: ANOVA analysis results for the live animal data.

	Housing			**Time**	**Housing x Time**	**DSE**	**DF**
	stable	pasture	sign	sign	sign		
Live weight kg	460,8	458,0	ns	**	ns	26,0	122,0
Withers height cm	118,3	120,0	**	**	ns	2,9	120,0
Pelvis height cm	127,5	128,8	*	**	ns	2,2	120,0
Chest height cm	60,7	61,1	ns	**	ns	1,8	121,0
Chest girth cm	181,3	180,3	ns	**	ns	4,7	121,0
Body length cm	145,6	148,5	**	**	ns	5,8	121,0
Rump length cm	53,3	54,0	**	**	**	1,8	121,0
Hips width cm	50,4	49,6	**	**	ns	1,8	121,0
Thurls width cm	53,5	53,8	ns	**	ns	1,9	121,0

*P ≤ 0,05, ** P ≤ 0,01

In Figure 2, the average weights of the two groups are presented. During the summer, the growth in both groups slowed down, but, in spite of the excessively warm summer of 2003, this had no detrimental effect on the end results.

Figure 2: Live weight development in both animal groups.



In Figures 3 and 4, the increase of withers height and rump length of the two groups is shown. The animals kept on pasture showed a better somatic development.

Figure 3: Withers height development in the two groups.

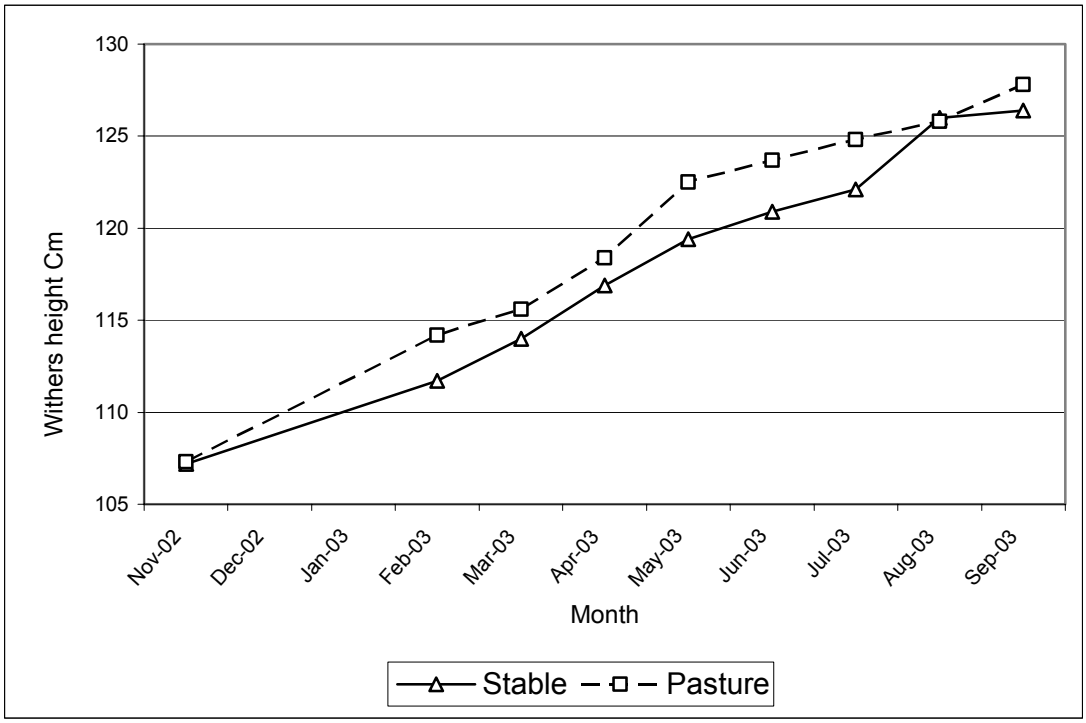
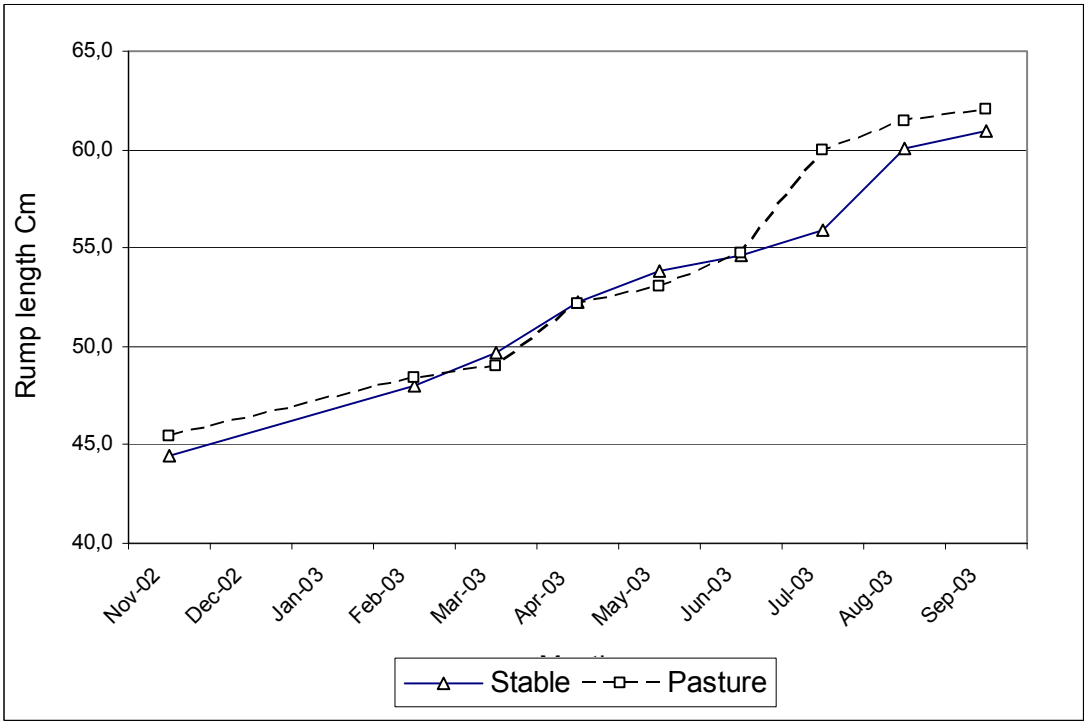


Figure 4: Rump length development in the two groups.



Data regarding the carcass characteristics are reported in Table 5. The different housing (pasture<stable) influenced only the fatness, so the carcasses of the animals kept on pasture resulted leaner. All the carcasses and meat samples of both groups showed very good quality parameters (Giorgetti *et al.,* 1991). Even if not statistically significant, the conformation of the carcasses of the animals kept on pasture resulted a little better than those of the other group, confirming what emerged from the live data analysis.

Table 5: Carcass characteristics

	Stable	**Pasture**	**Sign**	**DSE**	**DF**
Slaughtering weight kg	651,88	648,29	ns	18,66	13,00
Slaughtering age days	581,75	572,57	ns	15,22	13,00
Warm carcass weight kg	390,25	400,93	ns	16,01	13,00
Dressing Percentage %	59,86	61,86	ns	1,91	13,00
Carcass length cm	132,31	132,21	ns	2,99	13,00
Leg length cm	76,44	77,57	ns	4,36	13,00
Max leg width cm	32,63	37,50	ns	4,28	13,00
Min leg width cm	30,88	31,21	ns	2,94	13,00
Cervical vertebrae length cm	42,13	42,14	ns	1,39	13,00
Dorsal vertebrae length cm	74,56	74,79	ns	1,95	13,00
Dorsal vertebrae 1 - 6 length cm	33,25	33,14	ns	0,97	13,00
Dorsal vertebrae 7-13 length cm	41,69	42,21	ns	1,22	13,00
Lumbar vertebrae length cm	38,63	38,07	ns	3,39	13,00
Sacral vertebrae length cm	26,56	27,29	ns	1,20	13,00
Chest depth cm	41,50	41,64	ns	1,28	13,00
Conformation score (SEUROP)	13,13 (E)	13,43 (E+)	ns	0,98	13,00
Fatness score	3,50 (3+)	2,43 (2+)	**	0,86	13,00

** $P \leq 0,01$

In Table 6, the data obtained from the meat analysis are presented. Even if these results did not show any difference between the two groups, they demonstrated the optimal quality of the reared animals (Giorgetti *et al*. 1994, Poli *et al.* 1994). Although, one of the Italian beef producers' main fears is that the meat looks too dark, as dark meat does not appeal to the consumer, the meat of the animals kept on pasture did not result significantly darker than that of the animals kept in the stable.

Table 6: Physical meat characteristics and data analysis

	Stable	Pasture	Sign	DSE	DF
Double boiler cooking loss %	20,02	25,38	ns	7,61	9,00
Roast cooking loss %	29,17	37,38	ns	10,00	9,00
Double boiler cooked meat shear force kg[1]	8,49	10,37	ns	1,44	9,00
Roast cooked meat shear force kg[1]	10,16	10,18	ns	2,53	9,00
L lightness	41,64	44,76	ns	3,09	9,00
A redness	20,30	21,54	ns	1,89	9,00
B yellowness	8,06	8,25	ns	1,19	9,00
Metric Hue Angle	0,38	0,37	ns	0,07	9,00
Chroma	21,89	23,10	ns	1,65	9,00

[1]Instron method

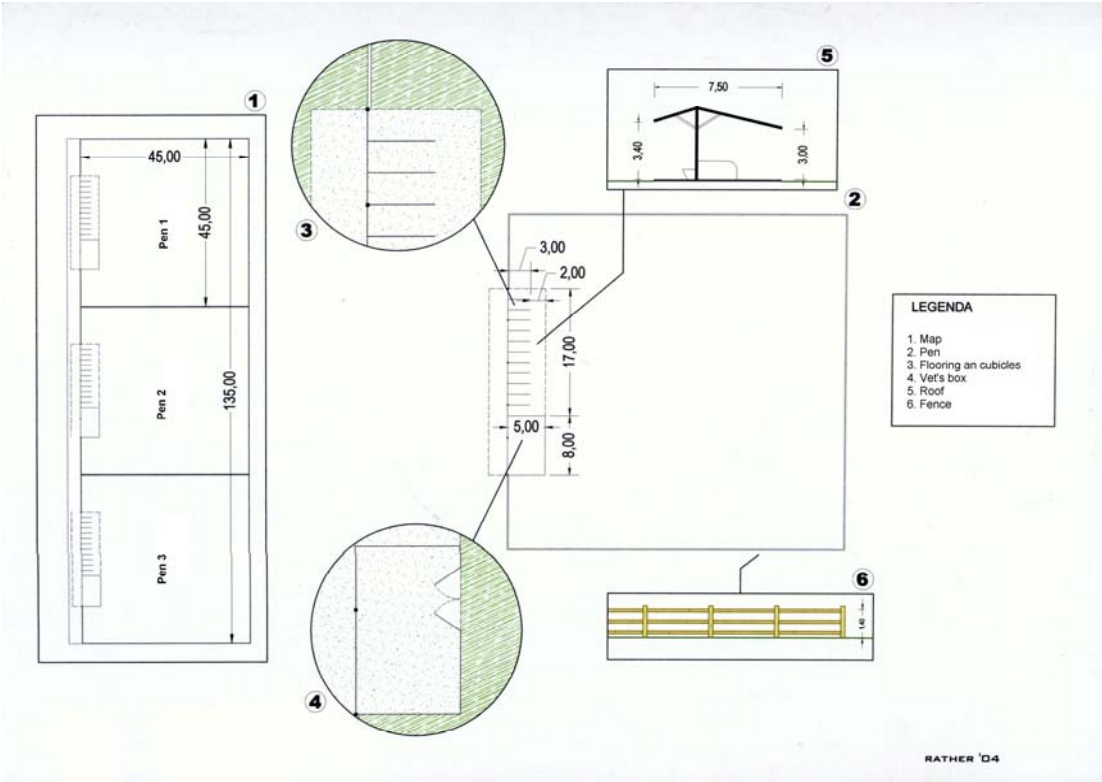
Stress problems for the animals can arise when they are moved in the stable in the last 3 months before slaughter, as allowed by the EC Regulation No 1804/1999 (paragraph 8.3.4). In order to reduce this stress, we suggest a new rearing modular structure that allows the farmer to reduce the space given to the animals, without changing both the social group and the environment in the last period before slaughter.

Cost analysis of a structure that respects animal's welfare

A covered structure, opened on four sides, which includes the feeding and the rest area, together with boxes for sick animals and for the isolation of the animals was designed. Large cubicles (1.40 x 3.00 m) for the access of the animals to the feeder were planned, taking into consideration animal's welfare and the prevention of competition phenomena. The structure has a pen, with a passage to the pasture. The presence of the pen allows the farmer to reduce the space given to the animals during the last months before slaughter, without changing the social group and the environment. The structure is made of prefabricated, zinc-coated iron. The cubicles are separated by zinc-coated iron mobile partition. Every cubicle has access to small, cup-shaped cast-iron troughs and to a zinc-coated iron manger. The sick box is fenced with chestnut poles. The flooring (including the box) is concrete, covered with litter. The feeding passage is concrete. The roof is made of double-layered sheet metal that assures good thermal insulation. The pen, fenced with chestnut poles, is floored in beaten earth. The pasture is fenced in with zinc and plastic-coated barbed wire held up every 2 meters with chestnut poles.

The structure is modular; each part hosting 12 cattle. We scaled the plan to 36 fattening beef calves (from 8 to 20 month), which is considered a representative size for cattle husbandry in the Mugello area. The project was planned taking into consideration both the requirements of the EU Regulation (in terms of indoor and outdoor area per head) and the natural environment of this area (Figure 5).

Figure 5: Plan of cattle housing compliant with the EU Regulation 1804/99 on pasture.



The structure's investment costs were evaluated according to current prices, taking into consideration material, equipment and labour needed to implement the whole plan (pen and pasture included). The annual cost was calculated as a sum of the amount of depreciation, the amount of interest on the capital, the variable costs and the annual amount of maintenance. Potential subsidies were not taken into consideration. The total cost of the structure for 36 fattening calves, including the paddock and the pasture was €202,138, while the annual cost was €39,252 (Tables 7 and 8). The investment cost per head was €5,614 and the annual cost per head was €1,090 (Table 9).

Table 7: Composition of the investment cost for cattle housing in the Mugello area, compliant with the EU Regulation 1804/99 on pasture.

Structure (including the rest and the feeding area, together with the vet's box)	152,239.68	€
Pen (including the fence)	22,755.00	€
Pasture (including the fence and the sowing cost)	27,144.03	€
Total cost	202,138.71	€

Table 8: Composition of the annual cost for cattle housing in the Mugello area, compliant with the EU Regulation 1804/99 on pasture.

Annual amount of maintenance	6,210.01	€
Variable costs	11,200.00	€
Amount of interest on the capital	8,260.84	€
Amount of depreciation	13,581.34	€
Total annual cost	39,252.19	€

Table 9: Investment cost and annual cost per head for cattle housing in the Mugello area, compliant with the EU Regulation 1804/99 on pasture.

Investment cost per head	5,614.96	€
Annual cost per head	1,090.34	€

Conclusions

The results showed that fattening of beef cattle on pasture in accordance with the EU Regulation is feasible also in the Mediterranean area. Animals on pasture resulted well conformed, preferred by the farmer and the butcher. Indeed, after this investigation, the farmer is continuing to hold the fattening beef cattle on pasture and he is also building new pens and fencing new pastures. Moreover, he has managed to sell some of the pasture-reared bull for breeding. The good somatic development of the stock kept on pasture demonstrated that this type of housing could improve animal welfare without increasing farmers' costs.

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Proposed husbandry practices to ensure animal health and product quality in organic sheep and goat production systems

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Introduction

It has been suggested that, although organic production is now a mature idea in other European countries, in Greece it is a rather new trend in livestock production Arsenos *et al.* 2003). It is also clear that the plurality of systems, in terms of geographical distribution across Europe, present considerable difficulties for those researching animal health and welfare in organic farming (Lund and Algers, 2003; Hovi *et al*. 2003).

Sheep and goat production systems, with emphasis on milk yield, are of major importance to southern European countries. The concept is that organic production will bring greater efficiency to small livestock enterprises and will have a positive impact on rural communities in mountain and sub-mountainous regions of the Mediterranean (Arsenos *et al.* 2003, Ronchi and Nardone, 2003). Greece has about 9.3 million sheep and 5.3 million goats, but the number of organic flocks accounts only for 2% of the national flock (Arsenos *et al.* 2003). The question is how could a breakthrough happen and organic systems become more widespread and profitable? Options for conversion are constrained by existing management practices, farmer attitudes and shortcomings in processing, marketing and pricing of organic products (Arsenos *et al.* 2003). However, we believe that organic systems have the potential to dominate the small ruminant sector, because the principles of organic farming are already present in the semi-extensive systems that prevail sheep and goat production in Greece.

The view is that a comprehensive understanding of the particularities of different sheep and goat systems across Europe is a prerequisite for integrating the knowledge and skills required to provide a high quality health management under organic standards (Surdrum, 2001; Gray and Hovi, 2001; Hermansen, 2003). Therefore, evaluating the importance of local breeds, breeding for disease resistance, applying preventive veterinary medicine with early disease diagnosis and using alternative medical treatments becomes a challenging task, since all these features must be effectively combined. In this paper, we put forward proposals of sound husbandry practices, which can improve the efficiency of organic dairy sheep and goats by using knowledge of nutrition, reproduction and genetics, while considering the animal health and welfare needs and ensuring high product quality at farm level.

The people involved

A range of people from different backgrounds are involved in organic systems. Within the overall aim of safeguarding health and welfare of livestock, as well as ensuring the quality and safety of

organic products on farm, the need for skilful farmers is probably higher in organic systems. We are concerned that the regulations (EC 1804/99) affect to a wide variety of people, including producers, veterinarians, members of inspection and certification organisations and various others involved in the management of organic livestock. For example, the current suggestion in the EC 1804/99 regulation that 'systematic operations which lead to stress, harm, disease or the suffering of animals during the production, handling, transport or slaughtering stages should be reduced to the minimum' is very general. Such generalisation leaves space for subjective interpretation. Specific guidance should be given to those rearing animals and it is important here to emphasise its relevance to animal welfare because a bad shepherd, for example, can be a source of poor welfare (Seamer, 1998; De Jong, 2000). Therefore, appropriate personnel, equipment, and facilities are essential to attain the highest standards of animal welfare in any organic system. We believe that farmers that seem prone to adopt an "easy care" system, characterised by low inputs of time and effort, should be excluded from organic production. Here, the role of certification organisations is fundamental. Organic certification organisations are responsible for the proper inspection of organic farms to ensure that standards are not compromised. It is generally accepted that the safeguarding of organic standards on farm is essential to retain consumer confidence in organic products (Padel, 1997; Kouba 2003; Hermansen, 2003).

In practice, there is a commonly held misconception amongst some organic farmers that there is no need for veterinary involvement because traditional medicines are not required. Farmers are in favour of homoeopathic or plant remedies without consulting their veterinarian, and in some cases veterinary advice has been delayed resulting in animal welfare being severely compromised (Loscher, 1993; Wynn, 1998; Athanasiadou *et al.* 2001).

The role of veterinarians on disease control is probably even more important in organic systems than in conventional systems where there is sometimes over-reliance on preventive medication (Slenning, 2001). Veterinary involvement in disease diagnosis and treatment prescriptions are nevertheless vital both to the well being of the particular animals concerned and for the effective surveillance of diseases and organisms which are economically important (such as mastitis) or may be transmitted to people (such as BSE). Veterinarians, even those with little experience of organic systems of animal production, have valuable expertise to offer to organic certification bodies and organic producers in terms of skills in preventive veterinary medicine and knowledge of disease control. The danger of disease is indeed very real and we would like to emphasise here that the role of veterinarians in organic systems of animal production should be subject to a major review of current organic standards.

Appropriate livestock

The various breeds and types of sheep and goats reared in Greece, their characteristics and the factors that make them more suitable for organic systems as well as issues of conflict i.e., 'indigenous versus high productive breeds', 'highly productive or high producing animals' have been discussed elsewhere (Arsenos *et al.* 2003). In the Mediterranean countries, mixed flocks of sheep and goats are common practice. The breeds of sheep and goats used are adapted to the prevailing climate and food supply but differ mostly in size, with most genotypes being small. Production objectives vary between farms within and between different areas, but the main objective is milk production, with meat production being of less importance (Zygoyiannis *et al.*

1997, 1999). Cross breeding, using larger indigenous breeds from lowland areas, has been employed to increase milk yield of ewes and growth potential of lambs of unimproved genotypes.

Organic standards recommend a closed herd policy as the ideal practice and the selection of animals characterised by vitality and long productive life. Breeding for disease resistant and longevity becomes a key issue, in this respect (Conington *et al*. 2001). Furthermore, since organic farms are allowed (EC 1804/99) to bring in replacement animals, specific measures should be taken to prevent the introduction of disease through these animals. Emphasis should be made on the quarantine of all imported animals for at least three weeks. It is important that during the quarantine period, a qualified veterinarian should examine all animals regularly for signs of diseases. In terms of animal welfare, the flexibility in the regulations for continuous importation of new animals to organic enterprises is not recommended.

The animals will have to adapt and cope with the stress of encountering unrecognised members and also new management practices. Hence, when purchasing replacement animals, younger ones should be preferred because they have a better chance of adapting. This is particularly important if climatic conditions in the new farm differ largely from those in the farm of origin. Moreover, new animals can generate problems, such as increased aggression, until a hierarchy status is set.

Lastly, the total number of sheep and goats needs to be considered, and the maximum size of a viable flock should be clarified. We believe that estimates of a viable flock size will increase, but at present around 300 dairy ewes or does appears to be a reasonable number for effective management, at least under existing conditions in Greece.

Animal identification

Accurate identification is needed for effective husbandry practices, including feeding, breeding and health management. In practice, paint marking may assist in temporary identification but cannot assist ongoing management. A permanent identification method that is easy to read either indoors, in the shed, or outdoors, in the yards, is recommended. Amongst the various types used, i.e. ear tags, tags on neck collars, electronic implants, the most common method is the use of ear tags. In our view, the tags must be small and round in shape and should not hang down below the ear. The latter is particularly important for sheep and goats browsing in mountainous areas because large ear tags could lead to ear rupture. Moreover, the obligatory use of common identification methods amongst EU countries will allow for an effective traceability of organic products (Anonymous 1998).

Appropriate facilities

All buildings and rest areas should satisfy the needs of animals concerned as regards ventilation, space, and comfort, allowing freedom of movement to develop natural behaviour (EC 1804/99; Bartussek, 1999). Particular care should be taken to provide clean and dry bedding and walkways, especially in dairy sheep farms where mastitis and footrot have been identified as major problems. Light constructions are widely used for housing of semi-extensively reared sheep and goat. There are also well-designed sheds offering more control over seasonal

conditions during winter and summer months. The shed should be clean, weatherproof with good ventilation, without draughts and comfortable. Cleanliness implies that bedding material is regularly added and changed at least twice a year. Dry bedding will facilitate disease control. At farm level a mud free environment for the animals should be provided. That will keep the udder clean and dry and the possibility of contamination to a minimum (Scott, 2001).

Appropriate facilities should also ensure a safe environment because predators (e.g. wolves) are a serious problem in semi-extensively sheep and goat systems in Greece. Before or after conversion, a whole farm plan should be developed. In particular, attention should be paid to: (i) easiness of running the farm - including approach, handling and feeding of animals, access of machinery and people to all required areas, (ii) health management, i.e, provision of footbaths and quarantine areas, (iii) future development: most farmers will not be able to implement all their aims at once, therefore flexibility in the design of the farm is important.

Transport

The philosophy of organic production is that suffering of the animals during the production, transport, handling, or slaughtering stages should be reduced to a minimum. Issues such as time spent in transport, animal handling facilities and methods (including loading and unloading), design and construction of slaughterhouses, and slaughtering procedures should be considered (Gade, 2002). For example, loading facilities should be designed to ensure safe and comfortable movement of animals and organically reared animals should be slaughtered as close to the point of production as possible.

A closing down and centralisation policy of slaughter-houses throughout European countries is going on right now. Animals from organic farms have to be transported for longer and longer distances. The latter is likely to have serious effects on organic meat production. Research efforts and on-farm resources should be directed to short duration stressors such as transportation and slaughtering. Transported sheep and goats should have enough space to enable them to stand up if they fall. They must be healthy, well fed and watered and encounter minor physiological changes of relatively short duration.

Husbandry practices and animal health

Animal health and welfare are subjects closely related to each other, multidisciplinary (e.g. biological, philosophical, social etc.) and not easily quantifiable (Athanasiadou et al. 2001). We have chosen to deal with them separately; animal health is considered as a state implying the absence of disease. On the other hand, animal welfare is a controversial subject and there is no consensus on its definition (Wemelsfelder, 1997; Webster, 2001), especially under organic systems of production (Aloe *et al*. 2001; Gray and Hovi, 2001). In principle, organic systems, basically free-range systems, have developed with high priority to animal health and welfare considering aspects from proper housing and nutrition to preventive care and treatment of disease (Winter et al. 1998; Bartussek, 1999; Browne et al 2000; Gray and Hovi, 2001).

The farmer should have a health management program that addresses both infectious and non-infectious diseases. The health management program should be based on sound information and a thorough understanding of animal requirements and the restrictions imposed by the certification body. For example, the number of animals reared in the farm is very important to production goals and the well being of each individual. The schedule of major husbandry and management practices on farm is important information for those interested in developing a health plan. Firstly, the timing of events may be an important predisposing factor to the outbreak of a disease. For example, the relationship between the time of lambing and the incidence of perinatal mortality; late born lambs have higher mortality rates due to the built-up of bacteria in the area of lambing. Hence, changing the length of time and the area of lambing between early and late lambing will result in reduced mortality of newborn lambs and kids. Secondly, preventive measures like vaccinations or foot paring and bathing should be integrated with other management practices to reduce animal stress and save time for the farmer. Management practices depend on the production objective, that is, whether the farm is focused on milk or meat production. For example, appropriate management is identified as the most effective measure against the incidence of internal and external parasitism and mortality of newborn lambs and kids (Scott, 2001).

Although health care and husbandry practices in conventional systems and those of organic systems have similar objectives to achieve, there is one important difference which revolves around two generalised areas: vaccination schemes and the prophylactic use of veterinary drugs. The latter have been developed in conventional systems of production to provide means of ensuring that animals enjoy high health and welfare status. In our view, there is some controversy as to whether organic sheep and goats flocks should follow a scheduled vaccination program. There are suggestions such as ‘vaccination should be restricted to cases where is a known diseases risk on farm or neighbouring farms’ (EC 1804/99), but, in our view, such statements represent a threat to animal health. We believe that farmers should be advised to vaccinate animals at least against clostridial disease and enzootic abortion, which are the most common health problems in Greece. It is important to emphasise to farmers that, when vaccinated, all animals should be dry because, when the fleeces are wet, subcutaneous injections can result in abscess formation. Attention should also be paid to the use of clean needles that are regularly changed during vaccination of large number of animals. Moreover, the handling of animals should be careful and gentle, speed should not be the issue. It should be noted that different sheep and goat breeds react differently to handling by people.

Assuming that stocking rate is according to recommendations, the next important consideration is animal interactions. Ruminants are characteristically tolerant of the presence of other animals of their own species. This is important in terms of de-horning the animals, which surprisingly is allowed by organic standards despite being an issue of animal integrity. In Greece, as well as in other Mediterranean countries, the de-horning of sheep and goats is not a common practice. However, tail docking should be considered when fat-tail animals (e.g. sheep of Chios breed) are reared.

Additional husbandry practices relate to the reproductive cycle and management of pregnant and lactating animals. Oestrus manipulation using non-chemical methods is best achieved through nutritional management and application of the ‘ram effect’. Breeds of sheep and goats in Greece are "seasonal breeders. It has been shown that such ewes that do not ovulate normally, if kept

isolated from rams, for a period of at least two months, will then be stimulated to ovulate by re-exposure to rams. All rams used should be well fed to maintain good condition score. Another suitable practice of reproductive management would be to capitalise on the inherent (genetic) capacity of certain ewes or does to ovulate spontaneously and exhibit oestrus out of the 'normal' breeding season (Avdi *et al.* 2003).

In addition, it is important to understand that managing disease prevention in sheep and goat flocks requires an epidemiological approach. A health plan should consider both the consequences of the steps required to reduce the prevalence of a disease and the consequences of any changes to the farm as a whole. Hence, the development of any health plan requires veterinarians with comprehensive knowledge of organic systems as well as positive input and advisors from certification organisations with on-farm experience.

Currently there are no national control measures operating in Greece specifically for organic sheep and goat farms. There are few, if any, structured flock heath plans operating on organic farms at present. Hence, the danger of important contagious disease that can be introduced through purchased flock replacements is indeed a real one. Recent data from a survey (Arsenos *et al.* 2003) revealed that veterinary involvement in flock health plans and management of organic livestock was scarce. For example, none of the participating farmers employed a veterinarian to collect blood samples periodically in order to determine the nutritional status and mineral/trace element status of animals in the flock, a practice that is fundamental to good animal husbandry in order to implement any dietary or management changes.

Internal and external parasitism

The level of internal and external parasitism depends on the age of the animal, the breed, the parasitic species involved and the intensity of parasitism in the host. Gastrointestinal (GI) parasitism is a crucial issue in sheep and goat production systems because it is related with reduced animal productivity (reduced nutrient utilisation, growth rate, milk and wool production) and high animal mortality due to severe infestation levels (Hoste *et al*. 2001; Papadopoulos *et al*. 2003).

It has been suggested that indigenous goat strains and breeds are most likely have relatively high tolerance of, or resistance to, parasitic diseases under harsh environmental conditions (Papadopoulos *et al.* 2001). Around 75% of the goat population in Greece belong to the indigenous breed *Capra prisca*. They are reared mainly as dairy animals under extensive or semi-extensive husbandry systems. The common practice is that animals depend mostly on grazing natural pastures with additional feeding of concentrates taking place only during winter months. Hence, the performance of goats is greatly influenced by both natural pasture availability throughout the year and the environmental conditions (Zygoyiannis, 1988). The idea is that the development of grazing management systems which reduce parasitic nematode infection, requires detailed knowledge of the population dynamics the seasonal availability of infective larvae on pasture and larvae ecology (Niezen et al., 1998; Barger, 1999; Thamsborg et al. 1999).

It has been shown (Papadopoulos *et al.* 2003) that the epidemiology of GI parasites in Greece depends on the relationship between pasture contamination and the seasonal availability of

infective larvae on pasture, and the build up of infection in sheep. Under the Mediterranean climatic conditions the contamination of pasture with larvae during summer months decreases to zero levels. Obviously, this results in anthelmintic treatments of small ruminants in Greece usually being carried out once or, maximum, twice per year. Papadopoulos *et al.* (2003) stated that the most appropriate time for treatment is the end of winter - beginning of spring, before the peak of FEC occurs. If a second treatment is needed, then treating animals during the summer, when due to the drought the only surviving worms are the ones in the host, might offer a good chance to kill these worms. Furthermore, this would allow minimum contamination of the pasture and prevent the build up of worm burdens in the hosts. Nevertheless, in the latter case, it is important to note that care should be taken since the selection pressure for anthelmintic resistance is higher and any treatment should be applied with caution.

Regarding goats it was revealed that they do not have high FEC and therefore, do not seem to urgently need any anthelmintic treatment at all. When anthelmintic drenching is required, the dose should be estimated based on the body weight of the heaviest animal in the flock. Such a practice will counter for poor drenching techniques and errors in calculating the appropriate dose volume for different animals whereas it will minimise the development of anthelmintic resistance. These practices could be used as a basis of epidemiological knowledge of both the time of built up at harmful levels and the survival of nematode parasite populations in flocks of dairy goats reared under traditional husbandry conditions in Greece as well as other Mediterranean areas with similar (e.g. Papadopoulos *et al.* 2001).

Analogous approaches should be taken for the control of ectoparasites that cause skin diseases and are common in practice of sheep and goat flocks. Apart from raising animal welfare concerns, ectoparasites affect the quality of organic meat produced due to losses in body condition of infected animals and the condemnation of their carcasses at slaughterhouses.

Footrot and lameness

In general, the causes of lameness on organic dairy farms are not widely different to those on conventional farms (Roderick and Hovi, 1999). This emphasises the need for maintaining closed flocks, while attention should be taken to avoid problems of inbreeding (Rauw *et al.* 1998). Differences between farms in the incidence of lameness may not only reflect the application of organic standards, i.e. regarding housing facilities, and grazing fields, but also the type of diet fed. It is important to quantify the relative incidence of the various forms of lameness in dairy sheep on organic farms.

Control measures should be focused on identifying possible causes, such as susceptible animals and factors associated with feeding and housing conditions. Husbandry practices to eradicate the problem of foot rot in organic farms should include the assessment of the relative incidence of the various forms of lameness, the identification of predisposing factors and the regular examination and paring of feet (usually lame animals are spotted at the times of milking), foot bathing, isolation of infected animals and possibly culling of animal that are prone and persistently affected. For example, the selected males and other replacement animals in the flock should have sound feet. Their hooves should be hard and compact. In practice the traditional approach to the

control of footrot is to carefully trim the hooves of affected animals before they walk through a footbath containing 5% formalin and 10% zinc sulphate solution.

Mastitis

It is important to establish within each organic dairy enterprise a basic approach to mastitis since there are various organisms, such as bacteria, fungi, mycoplasmas and algae that appear to dominate in particular cases. Indeed, mastitis is a herd problem and must be addressed as such. Reports from organic dairy farms around Europe indicate that mastitis is one of the most predominant problems in organic dairy herds (Vaarst and Enevoldsen, 1997; Busato *et al.* 2000; Vaarst *et al.,* 2003). The withdrawal of long-acting antibiotics during the dry period, in combination with alternative treatments of questionable efficiency during the lactation period in animals that require treatment, result in the high incidents of mastitis in organic livestock (Weller and Bavies, 1998; Weller and Bowling, 2000). The use of antibiotics during the dry period is a standard prevention approach for conventional farmers, but organic farmers can only use antibiotics to treat clinical mastitis, following the advice of a veterinary surgeon. In order for organic farmers to prevent incidents of mastitis, they should attempt to keep high hygiene standards in their establishment, keep monitoring the condition of the animal, keep the sick animals separate and treat them accordingly (Vaarst and Enevoldsen, 1994).

Close monitoring of the animals requires a lot of effort and time, which farmers often cannot spare. Therefore, prevention management without the use of antibiotics is often not effective under the organic standards. In our view emphasis should be placed in keeping the udder healthy and as clean as possible with well-designed housing and good management i.e. providing the appropriate bedding material and a well designed and well maintained milking machine. Selection, design and correct installation of machines is important so that milking can be completed in about 1½ hours, irrespective of the number of sheep or goats being milked. For example, a false vacuum pump or a worn-out teat cup liner can be the cause of mastitis. Here it is also important to note that footbaths should exist at the exit of the parlour. Equipment with milk contact surfaces should be cleaned after each milking. Components that are difficult to clean should be inspected daily to ensure that their surfaces are clean.

Perinatal mortality

The average perinatal mortality rate in sheep and goat flocks in Greece exceeds 10% and may be as high as 25-30%. It is estimated that the same rates also apply to organic flocks (Arsenos *et al.* 2003). Such levels are unacceptably high and also present serious concerns for animal welfare while at the same time constrain the maintenance of closed flocks due to the need for purchasing replacement animals.

Optimisation of the lambing percentage can be influenced by management intervention. Ensuring a good start for lambs through accumulation of colostrums during the critical first 2 hours of life is a fundamental husbandry practice. The latter will guarantee the plentiful accumulation of protective antibodies, whose passive transfer declines with time for the following 36 hours. On the other hand, maintaining ewe's body condition score at 3 at lambing ensures the appropriate

lamb birth weight. Accurate measurement of body condition is an important management tool. Hence, a monitoring programme including recording the ewe's condition score at mating and lamb weight at birth is essential to determine whether feeding was successful. Above all, the collection of dead lambs for post-mortem examination can provide a pathological diagnosis. The farmer should be given constructive advice, depending on the type of farm, to correct nutrition or to increase supervision of the flock during lambing periods. Management practices to minimize perinatal mortality should ensure selection of replacement animals from ewes with good mothering abilities, particularly the primiparous animals, balanced nutrition during pregnancy, good supervision of lambing ewes to avoid dystocia and feeding of lambs with colostrums as soon as they are born.

Nutrient deficiencies and metabolic diseases

Specific problems, relevant to health and welfare, may emerge as a result of nutritional deficiencies when animals graze or fed home-grown feeds exclusively, particularly in areas where soil deficiencies are known to be prevalent (Roderick and Hovi, 1999). The effects of feeding strategies and nutrient supplements on specific issues of animal health (i.e., immune response) have been clearly demonstrated (Houdijk *et al*. 2001a,b). There is a need to ensure that rations based on organically produced feeds are not insufficient in any nutrient and hence are able to keep the animals in full health and vigour at all stages of their productive life.

Mineral supplementation is allowed by the standards only when the requirements of the animals cannot be met by the practices of organic husbandry, such as grazing of pastures with mineral availability. With respect to trace element deficiency, in Greece, selenium deficiency (white muscle disease) has been associated with high mortality rates of newborn lambs especially in farms with sheep of Chios breed and its crosses, which are predisposed to that disease. The approach to the problem should be quick and practical after the interpretation of post mortem finding with respect to a detailed flock history.

Grazing management

In organic sheep and goat systems, it is important to maximise the quantity of fresh pasture in the diet throughout the year. This achieves the aim of minimum cost feeding, with feed of maximum nutritive value. However, in Greece, supplementary feeding of lucerne hay, silage and concentrates is needed, particularly during winter months when there is nothing to graze. Maximisation of pasture feed supply could be achieved through irrigated sown pastures using a combination of vigorous pasture grass and clover species. The provision of sown pasture for grazing is rare in Greece. In view of the climatic conditions during summer (mean maximum and minimum day temperature around 34°C and 17°C, respectively, and mean precipitation 0.6 mm) it is obvious that irrigation would be necessary. Zygoyiannis *et al* (1999) stated that the provision of sown pasture in fattening lambs could be used to produce consumer acceptable carcasses at much heavier weights than those, which are traditional in Greece.

Homeopathy and the use of alternative medicine

The current standards for organic livestock recommend that phytotherapeutic or homoeopathic products should be used in preference to allopathic medicines or antibiotics, provided that their therapeutic effect is proven for the species of animal, and for the condition for which the treatment is intended. But the use of unlicensed and untested herbal and homeopathic remedies in organic livestock is questionable, as such medicines are not formally approved under veterinary arrangements and there is relatively little verified evidence about their therapeutic potencies and effectiveness. At the moment, homeopathic treatment schemes are designed and implemented by people unqualified to deal with animal diseases. They are presented as rather voluntary schemes, and farmers, therefore, make their own decisions about whether or not to use such remedies.

Although there is evidence that farmers using such remedies report beneficial effects (Roderick and Hovi, 1999), we suggest that homeopathic remedies should be used in a manner that complies with all legally approved codes. Their effectiveness and safe use should be approved by wide representative groups of those involved in animal production. Therefore, we welcome any discussion regarding this issue and give our full support for further research to demonstrate the effectiveness and the benefits of alternative treatments. In the meantime, the use of alternative therapies should be guided by caution, considering what is the best treatment in order to avoid unnecessary suffering of the animal.

Conclusions

The adoption of organic systems in animal production in Greece is gaining popularity. However, more research is still needed to deal with the wide range of such systems across Europe. There is no quick, simple answer to what are the best husbandry practices to ensure animal health and product quality in organic sheep and goat production systems. The ability of an organic dairy sheep or goat flock to achieve optimum productivity will depend on the interaction between the genetic potential of animals, the availability of feeds and balanced feeding, management, environment and health. In this paper, we propose specific husbandry practices to deal with parasitic diseases, footrot and lameness, mastitis, perinatal mortality and metabolic diseases related to nutrient deficiencies. Issues related to the use of alternative medicine and animal welfare are also raised. The questions on sheep and goat welfare in organic systems will be highlighted in the future, unless higher standards of husbandry are imposed and effectively enforced. Hence, appropriate husbandry practices should be an integral component within the organic systems.

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Production effects of different systems of environmentally friendly grazing of fat heifers in the Carpathians

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Introduction

In Poland, upland areas occupy mainly the southern and southwestern regions of the country. They include two mountain ranges, The Carpathians and The Sudetes. Compared with the remaining lowland part of Poland, these areas are characterized by distinct environmental conditions; in particular, orographic, edaphic and climatic ones. Similarly, the pattern of land use with prevailing forests and grasslands is different here. As a rule, grassy vegetation and woodlands occupy over 70% of the landscape. Only in the periphery of a highland, particularly in the Carpathians, as well as in its lower parts and mountain valleys, there are major complexes of arable land with better soil and climate.

Over the band of arable land rise the grasslands, frequently intersecting the forest above. At lower altitudes they form meadows for hay, used less intensively with the rise of elevation (cut 3, 2 or 1 time per year). At higher altitudes there are pastures grazed by sheep flocks and herds of young cattle, normally slaughtered in the late autumn. Pastures in the Carpathians are met on mountainsides, slopes and ridges. At present they are utilized in extensive grazing systems. In addition to their production, they also have a protective role to the soil, water environment and organisms existing in turf and soil. In this mountainous region farming is environmentally friendly, partially due to the fact that more intensive land use would be non-profitable, considering net gain per hectare.

Environmentally friendly pasture management in the Carpathians implies not only a limited use of minerals and herbicides, but also giving attention to pasture-yield affecting potential of fresh manure in form of droppings left by grazing animals. This also involves elimination of some grassland husbandry practices which would destroy the natural balance in turfs or grow the risk of erosion as well as limiting intense exploitation of pasture sward due to excessive stocking. The main advantage of these systems is obtaining nourishing and tasty beef from young cattle fed on organic greens from a permanent pasture, distinctive for biodiversity of turf species. The main weakness of such grazing; however, is relatively small production effect in terms of animal weight gains per unit of the surface.

This paper explores the potential of these systems to produce organic beef profitably and explores potential improvements to the systems in the light of data from a project that looked at the productivity of highland pastures, with young cattle grazed according to different systems and different management practices.

Location and environment

The study was conducted in 1986-1998 on a permanent mountain pasture managed by Institute for Land Reclamation and Grassland Farming, the Reasearch Station at Jaworki (the Male Pieniny range). An experiment was set up over a north-eastern mountainside between 800 and 850 meters above sea level (Figure 1).

Figure 1: Grasslands at Jaworki Research Station, in the West Carpathians.

Local soil by its type falls into a brown sour class (according to Komornicki, 1958). It has poor fertility, being deficient in almost all main nutrients (Twardy and Bobak, 1995). Its physical and chemical characteristics are representative of typical soil from the Carpathian permanent pastures (Kostuch, 1976).

The plant community of the pasture was classified as the *Lolio-Cynosuretum* association (Twardy, 1991, 1996). Grasses were a predominant group and their share constituted at least 80% of the plants. Legumes, mainly white clover (*Trifolium repens,L.*), reached 8-10 %, while herbs and weeds contributed 10-12% to the total vegetation cover.

The climate of Jaworki favours grassland farming as the main form of land use. Average annual precipitation amounts to nearly 900 mm and a mean yearly temperature is 6ºC. In the grazing season, which lasts typically from May to September, there is a 550 mm precipitation on average and the mean temperature is about 13ºC.

Material and methods

The research was accomplished in field circumstances using four adjacent pasture objects, 2.0 ha each. Two of them (No 1 and 2) were grazed in rotations, whereas the other two (No 3 and 4)

were used by means of uncontrolled grazing. The husbandry procedure of pasture topping at 6-8 cm of height was employed for objects No 2 and 4. Here the rotational object was topped 3-4 times in a season and freshly cut green matter left on its surface, while the freely grazed one was topped only twice per season.

The first pasture topping took place after the second rotation and was carried out at the same time on the object grazed according to an uncontrolled system. In the latter case, the next and final procedure of topping was due to the regrowth of weeds, especially of creeping thistle (*Cirsium arvense L.*).

Before the onset of experiment all the objects were single fed with phosphorus (60 $kg \cdot ha^{-1}$ P_2O_5), and afterwards no minerals were used.

Animals consisted of Red Polish heifers at initial weight of 190-230 kg. They were in good health condition and adapted to grazing. At the beginning of the trial, the rate of stocking was not high, at about 1.5 $LU \cdot ha^{-1}$, where a large unit was 500 kg of liveweight. Grazing the experimental pasture started simultaneously on each individual object with the use the 'non-stop' system (animals kept day and night on the pasture). The heifers fed on pasture green only having fresh water and minerals at their disposal.
In this study, animal production and pasture yield data were collected. Grassland production of fresh green [$Mg \cdot ha^{-1}$] was estimated by means of control plots secured with portable cages. This involved four replications for each paddock, or a portion of similar surface in case of uncontrolled grazing. After the period of each rotation cycle mean values were calculated to compute total yielding per year.

In order to obtain dry matter coefficients, a series of four samples of 50 g of plant material was taken and dried to constant mass at 105ºC. The average coefficients and yielding of fresh green were used to calculate dry matter production.

The heifers were weighed at the beginning and the end of grazing season as well as after each pasture rotation to assess their weight gains. This procedure took place simultaneously over all the objects, and the results were presented as average gains both per head and per hectare.

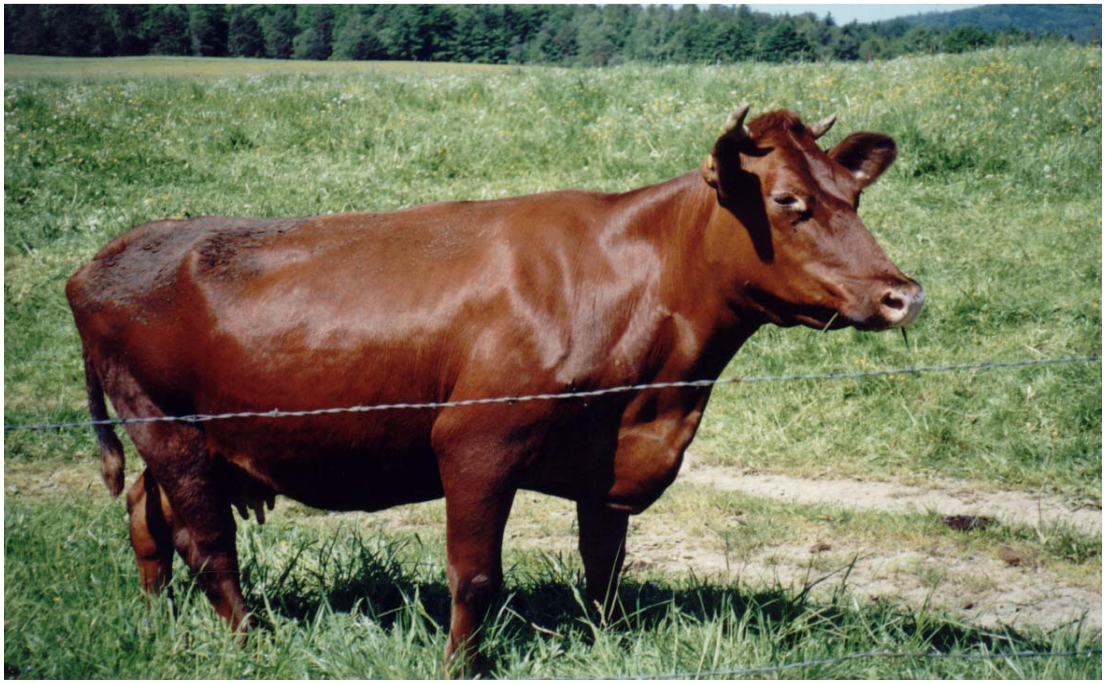
Pasture productivity from each object was estimated by means of an animal method. It was assumed that daily maintenance requirements of the heifers were 8.87 MJ $NEL \cdot 100\ kg^{-1}$ of liveweight, while the production requirement was 29.55 MJ NEL per 1kg of weight gain (Twardy, 1996).

Meteorological data were registered continuously at the climatic station of Jaworki at the same altitude. This paper includes average precipitations for individual months, grazing seasons (May to September) and years as well as mean yearly air temperatures in the whole experiment.

Characteristics of the experimental breed
Animal material in the experiment consisted of Red Polish heifers (RP). This is an indigenous breed, still met in the southern mountainous region, which was, in the past, officially allocated as the RP breeding area. Currently, the population of purebred stock is diminished and became the subject of a national project for protection of animal genetic resources (Krupiński *et al.*, 2003).

The breed is well adapted to the Carpathian natural environment, most of all to its severe climate. It is accustomed to rainfalls, drops in temperature, high daily amplitudes and cutting winds, which are not uncommon at higher altitudes. This cattle is famous for its longevity, good fertility and excellent health. Their natural immunity to disease developed owing to traditional custom of keeping young animals on a pasture. Late-maturing cows attain full growth at 420-460 (500) kg and 5 years of age. Their milk performance is relatively small averaging 3,000 kg per lactation. The milk is remarkable for a high content of dry matter, being not only rich in fat and protein, but also in minerals such as calcium and phosphorus. The bulls are about 150-200 heavier than cows and attain maturity at 2 years of age (Twardy, 2001). The calves are rather small at birth, especially in comparison to these of beef cattle, so the cows have easy calvings. Average weight of newborn varies between 30-35 kg for baby heifers and 35-40 kg for baby bulls.

Figure 2: Red Polish heifer



Beef performance of RP breed is not high, although the meat is valuable and tasty, particularly from young animals. Nutritional quality of the meat gradually diminishes with the age of the growing cattle. Bull and heifer calves at 3-4 months and 80-120 kg undergo selection for keeping or slaughter. If grazing season with its cheap green fodder starts, the slaughter is put off about 4-5 months, till the autumn. Such young fat heifers were the experimental material for this trial.

Results

The experimental results are shown in Table 1 and 2, comprising average values for the whole thirteen-year period. The mean production of controlled-grazing objects varied from 30.4 to 37.8 $Mg \cdot ha^{-1}$ of fresh material or 4.9 to 6.2 $Mg \cdot ha^{-1}$ DM. The highest values, 6 $Mg \cdot ha^{-1}$ DM on the average, were noted regularly in the rotational object, where topping was neglected. They were

1.25 Mg·ha^{-1} higher than in case of the rotational object, where a topping procedure was carried out systematically. Similar regularity was observed in freely grazed objects. Here the average production from the one without topping was about 0.85 Mg·ha^{-1} DM higher than of its regularly cut counterpart, reaching 5.05 Mg·ha^{-1} DM.

The most marked difference was noted between the rotational object without topping (See Table 1, object No 1) and the uncontrolled one topped twice in a season (object No 4). It amounted to 1.95 Mg·ha^{-1} DM or nearly 30% in favour of the former. Crop yield of the objects estimated by means of animal method varied from 15,390 to 18,735 MJ NEL per hectare (Table 1 and Table 2).

As it is shown in Table 2, the longest grazing period (132 days) was recorded for the rotational object without topping, while the shortest (116 days) for the free grazed one, where topping was applied. In the other objects, the respective values were 118 days (object No 2) and 120 days (object No 3).

Table 1: Pasture production (mean values for 1986-1998)

No of pasture object	System of grazing	Yield of pasture green, [Mg·ha^{-1}] fresh material	dry matter	Productivity [MJ NEL ·ha^{-1}]
1	Rotational (without topping)	37.80	6.15	18,735
2	Rotational (topped 3-4 times in a season)	30.40	4.90	16,205
3	Uncontrolled/free (without topping)	30.55	5.05	15,390
4	Uncontrolled/free (topped 2 times in a season)	25.75	4.20	15,721

Average gains per head varied between 64.8 and 77.9 kg for a whole season, or between 0.54 and 0.59 kg per day (Table 2). Production of animal liveweight per hectare ranged from 238.5 to 323.3 kg·ha^{-1} and was regularly higher in case of rotational grazing. Here, the difference in total productivity in favour of the non-topped object exceeded 56 kg·ha^{-1}. For the freely grazed object, the respective difference was not so distinct, reaching only about 16 kg·ha^{-1}. The most remarkable difference occurred between both objects where procedure of topping was absent, and it was 68.5 kg·ha^{-1} in favour of the rotational one. These differences were obtained in circumstances of nearly the same initial stocking rate of the objects averaging 1.5 LU·ha^{-1}. Final stocking rate was also similar among these objects and ranged from 2.0 to 2.2 LU·ha^{-1}.

Table 2: Animal production (mean values for 1986-1998)

No of pasture object	Animal liveweight		Longevity of grazing	Animal liveweight gains		
	Initial	Final		Per head		Total for season
				Daily	Per season	
	[kg·ha^{-1}]	[kg·ha^{-1}]	[days]	[kg]	[kg]	[kg/ha^{-1}]
1	784.8	1108.1	132	0.59	77.9	323.3
2	796.4	1063.1	118	0.56	66.1	266.7
3	784.6	1023.1	120	0.54	64.8	238.5
4	796.8	1051.6	116	0.58	67.3	254.8
Mean	790.7	1061.5	121	0.57	69.0	270.8

According to Table 3, the values of precipitation as well as air temperatures in summer season provide for plant growth and keeping animals day and night on pastures. For the whole experimental period (1986-1998), monthly distribution of rainfalls was uniform, ranging between 90.6 mm in September and 115.2 in July. Total precipitation for summer months (from May to September) was 544.3 mm, while annual precipitation achieved 884.0 mm. Mean air temperatures varied monthly from 11.1ºC (May) to 16.1ºC (July), while for a grazing season (May to September) the average temperature was 13.6ºC, and the yearly mean for whole experiment 6.2ºC. These results were not different from long-term values counted monthly, seasonally and yearly at the climatic station.

Table 3: Average monthly values of precipitation and air temperatures

Years	Months May	June	July	Aug	Sept	Seasons May to Sept	Jan to Dec
PRECIPITATION [mm]							
From 1986 to1998	114.6	110.5	115.2	113.4	90.6	544.3	884.0
From 1956 to 2003	94.9	131.2	133.7	110.0	72.8	542.6	889.0
MEAN AIR TEMPERATURE [ºC]							
From 1986 to 1998	11.1	14.3	16.1	15.5	11.2	13.6	6.2
From 1956 to 2003	11.2	14.2	15.7	15.3	11.5	13.6	6.1

Summary and conclusions

Our experimental proposals included low stocking rate, non-stop grazing of the pasture, feeding on greens only and avoiding any mineral fertilization. In the 1980's, it had already been noted that it was necessary to develop environmentally friendly systems of land use. This has since been carried out by scientific experts in Poland, formulating principles known as 'Code for good farming practice' (2002), published by the Ministry of Agriculture and Rural Development, and putting together practical guidelines of water, air, soil and landscape protection in agriculture.

It needs to be emphasized that the West Carpathians in their main portion comprise natural parks and protected areas with their surroundings, where environmental effects of farming and cultivation are under strict control. In this experiment, the pasture yield was influenced by some climatic factors as well as systems of grazing and some grassland husbandry practices. Our results pointed out that a rotational system is more favorable as far as plant production is concerned. However, the use of some pratotechnic procedures, particularly a pasture topping at different heights and frequencies, is also an influential factor (Caputa *et al.*, 1975; Pajdzik and Twardy, 1984). As a consequence of regular topping, the mean yield loss was assessed at the level of 7.4 Mg green material or 1.25 $Mg \cdot ha^{-1}$ DM (Table 1). Taking into account that this procedure was done 3-4 times per season, average green production diminished to the level of the not-topped, freely grazed object. The average yielding of the latter was only 0.85 $Mg \cdot ha^{-1}$ DM superior to its twice-topped counterpart. These relationships among systems of grazing, grassland husbandry procedures and pasture yield were observed for each individual year (Twardy and Bobak, 1995; Twardy, 1996).

The highest level of animal production was recorded in case of highest yielding of a pasture. This relation occurred for all traits involved: average daily gains per head (0.59 kg), gains per head and season (77.9 kg) and total gains per season (323.3 $kg \cdot ha^{-1}$). In this case, also the period of grazing was the longest, reaching 132 days. On the other hand, the lowest productivity characterized free grazing system without topping. In a 120-day-long grazing season, daily gains per head were 0.54 kg, these per head and season 64.8 kg and total gains per season 238.5 $kg \cdot ha^{-1}$.

Feed conversion for maintenance and production was high and ranged from 18.0 to 21.1 kg DM for weight gain of 1 kg. It would be accounted for abundance of fodder at disposal in concert with extensive energy requirements of the heifers 'non-stop' grazed in the mountains. This evaluation takes into account also fodder losses due to contamination and treating pasture sward by animals.

The main conclusions are:
Yielding of a pasture, animal production and the length of grazing period are differentiated with the system of grazing.
Environmentally friendly grazing without any minerals appeared to be possible. In the circumstances, the pasture yield of 4.2 to 6.2 $Mg \cdot ha^{-1}$ DM and animal liveweight gains of about 238 to 323 $kg \cdot ha^{-1}$ in young cattle were obtained.
The time of a pasture topping should be based on an evaluation of growth phases of dominant weeds.

In case of freely grazed grassland, topping of a pasture diminishes its yield (about 15%), but at the same time causes a rise in animal production (about 15%), which would be related to more desirable botanical composition of the sward.
According to our results Red Polish heifers have low but steady daily gains (0.54-0.59 kg), so the length of grazing period is decisive for total production effect.

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Nutritional aspects of bioactive forages for worm control in organic sheep and goats

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Introduction

In recent years, there has been a growing interest to seek alternative, sustainable methods to control gastrointestinal trichostrongyles in domestic ruminants (Waller *et al* , 1999). This is due to the constant development of resistant strains of gastrointestinal nematodes to broad spectrum anthelmintics (Jackson and Coop, 2000) and also, in order to respond to the increasing demand of consumers for reducing the use of chemicals in farming industry and the related products. Therefore, these alternative solutions also present major interest in organic farming (OF) systems, where the administration of chemical drugs is strongly regulated and should be restricted to curative purpose. Among the currently investigated options, there is a growing body of evidence to suggest that the consumption of some bioactive plants can, in certain circumstances, be associated with negative effects on the nematode populations of the gastrointestinal tract in small ruminants. These plants, therefore, seem to represent an attractive solution against the parasitic nematodes, and their use is compatible with the principles of organic farming.

Bioactive plants in nematode control

The first evidence on the anthelmintic properties of bioactive plants has been acquired on infected sheep in grazing conditions (Niezen *et al*, 1995; 1998a). They indicated that sheep grazing some legume forages, like sulla (*Hedysarium coronarium*) sainfoin, (*Onobrychis viciifolia),* birdsfoot trefoil (*L. corniculatus)* or maku *(Lotus pedunculatus)* presented less severe parasitic infections, as measured by reductions in nematode egg excretion and decreases in worm populations, compared to sheep grazing pastures seeded with control, tannin-free plants, such as plantain, lucerne or ryegrass (Niezen *et al*, 1998a, Marley *et al*, 2003). In most cases, these negative consequences on nematode populations have been associated with improved production performances of the parasitised hosts (Niezen *et al*, 1998a; 1998b, Marley *et al*, 2003). One common characteristic of those legume forages associated with reduced levels of parasitism was the presence of moderate to high concentrations of condensed tannins (Kahn and Diaz, 2000). Similar results were obtained in goats grazing *Lespedeza serecea,* another tanniferous plant, when compared to the control group grazing on tall festuque, a non tanniferous forages (Min and Hart, 2002; Min *et al*,2003).

The role of tannins

These anthelmintic properties of tannins were further explored in indoor conditions in experimentally infected sheep and goats. The parasite species used for the experimental infections corresponded to the most frequent and pathogenic ones occurring in these two small ruminant species. Quebracho, i.e. extracts of the bark from South American trees, *Schinopsis spp* was used as a rich source of tannins, since these polyphenolic compounds represented 50 to 70 % of the DM. By comparison to control animals, the administration of quebracho drenches have been associated in both host species either with reductions in nematode larval establishment, in the fertility of female worms or in the number of adult worms (Athanasiadou *et al*, 2000a and b; Athanasiadou *et al*, 2001; Paolini *et al*, 2003a and 2003b).

On the other hand, these various studies have also underlined that several factors contribute to modulate the *in vivo* effects of tannins on worm biology. The response to quebracho differed between the abomasal and the intestinal nematode species (Athanasiadou *et al*, 2001). Moreover, the efficiency against the worm populations seems to depend on the tannin concentrations (Athanasiadou *et al*, 2001). Last, in goats, variations in effects were observed depending on the parasitic stage submitted to the action of tannins (Paolini *et al*, 2003b). Moreover, differences are also suspected to exist between sheep and goats.

In vitro studies have also been performed which aimed at measuring the effects of various plant extracts on different parasitic stages (eggs, larvae or adult worms) and/or nematode species in order to confirm the *in vivo* results. Such *in vitro* studies enabled to screen the anthelmintic properties associated with extracts from a large range of tanniferous plants, either legume forages, aromatic or woody plants which are naturally consumed by small ruminants in grazing or browsing conditions (Molan *et al*, 2000a and b ; Athanasiadou *et al*, 2001; Paolini *et al* 2004). In some cases, these *in vitro* results also provided indications on the possible mechanisms explaining the anthelmintic properties associated with the plant extracts. In particular, the use of some specific inhibitors of tannins, like polyethylene glycol (PEG), helps to confirm the role of these polyphenolic compounds in the detrimental effects on the parasitic stages. A bulk of evidence acquired from different in vitro studies supports the view that condensed tannins are involved in the anthelmintic properties of the tested bioactive plants (Molan *et al*, 2000a and 2000b ; Molan *et al*., 2003, Paolini *et al*, 2004). However, some studies also indicated that the potential implication of other plant secondary metabolites should not be rejected (Molan *et al,* 2003b; Paolini *et al*, 2004).

Two main mechanisms have been proposed to explain the effects of tannins on gastrointestinal nematodes. The first hypothesis supports the view that some plant secondary metabolites, and particularly tannins, may have direct anthelmintic properties. This is mainly supported by the results of *in vitro* assays where any host influence is absent (Molan *et al*, 2000a and 2000b ; Molan *et al*., 2003, Paolini *et al*, 2004) and also by the results of short term *in vivo* studies (Athanasiadou *et al*, 2000a). On the other hand, it has been proposed that the benefits of tanniferous plant consumption could also be related to indirect effects of tannins, through a reduction of ruminal degradation of the diet proteins and subsequently, an increase in the flow of digestible proteins in the small intestine of the parasitised host (Mangan *et al*, 1988) Since protein supplementations have been regularly associated with an improvement of the host resilience and

resistance, it is postulated that such nutritional impact of tannins could partly explain their antiparasitic properties (Coop and Kyriazakis , 2001).

Although the mechanisms explaining the observed effects of tanniferous plants remain unidentified, some studies have yet explored what could be the possible modes of application of these bioactive plants in farm conditions. The advantages associated with the incorporation of "anthelmintic pastures" in the grazing systems have received much attention (Niezen et al, 1995, 1998; Marley *et al*, 2003; Thamsborg *et al*, 2003). However, some studies have also illustrated the consequences on parasite biology due to the regular, repeated administration of hay from a legume forage, the sainfoin (Paolini *et al*, 2003 c). Last, because woody plants and bushes are tannin-rich plants, the possible benefits related to the exploitation of rangelands should also receive more attention, in order to assess to what extent the content of woody plants in secondary metabolites can explain the lower levels of nematode infections usually associated with the exploitation of rangelands (Hoste *et al*, 2001, Kabasa *et al*, 2000, Kahiya *et al* 2003).

Limitations to bioactive plants in helminth control

Some current limits in the use of bioactive plants have been identified. Agronomical considerations oblige to choose the species or varieties of plants that are well-adapted to the various local environmental conditions encountered in the different climatic areas. On the other hand, since a majority of the plant secondary metabolites are also known to have some anti-nutritional properties when consumed in excessive amounts (Mangan, 1988; Jean Blain 1998), the balance between the positive effects of plant secondary metabolite in infected animals and their potential negative consequences on host physiology needs to be clearly assessed. Lastly, there is a need to identify precisely the mechanisms of action of these compounds towards nematodes. Knowing these mechanisms will help to understand the origins of the variability observed in the results and to correct them.

Overall, the results accumulated since a decade on these interactions between bioactive plants and infected small ruminants represent one of the most promising option to reduce the reliance on chemotherapy and to achieve a sustainable control of gastrointestinal nematodes both in conventional and organic farming systems. Further basic studies are necessary to favour the implementation in the farms.

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Control of gastrointestinal nematodes in organic beef cattle through grazing management

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Introduction

Gastrointestinal nematodes (GIN) are a major health and economic risk factor in ruminant production in organic and conventional farms (Thamsborg *et al.,* 1999). Fattening of organic beef cattle (OBC) on pasture is an emerging area for organic farmers in Switzerland, which partly compensates the declining development in dairy production. So far, there are no data available about the parasitic status of beef cattle kept in organic farms between weaning (4-6 month) and slaughter (24-26 month).

The aim of the present study was to assess the parasitological status of organic beef cattle in the pre-alpine and alpine region of Switzerland and to analyse the benefits of different grazing strategies for GIN control.

Materials and methods

At the end of 2001, a questionnaire was sent to 148 OBC producers who kept more that 10 animals annually. In addition to basic farm data, the questionnaire included detailed information on pasture management and on previous parasitic problems.

Regarding their possible risk of infections with GIN, the farms were classified in five categories (A-E). The classification was based on relevant epidemiological factors, such as stocking rate, separate grazing of first and second season cattle, altitude of pastures, overnight housing and others.

After specific instruction, the farmers were advised to send two pooled faecal samples (early summer, autumn), separated by age group, (i.e. animals older and younger than 12 month). The samples were examined qualitatively and quantitatively for helminth eggs and larvae (Schmidt, 1971).

Farms belonging to the higher risk categories and/or that were facing problems with GIN in 2002 were offered advise on implementation of protective grazing strategies in spring 2003. Strategies that had proved successful in the other farms were used. These included alternate grazing of older and young cattle and/or inclusion of cow pastures, mixed herds with first and second season cattle and to a lesser extent, alternate grazing with other animal species. The consequences of the proposed grazing management on the GIN infection level in the first season grazing cattle of these farms were assessed by three series of pooled faecal samples, that were investigated

quantitatively at the end of May, first half of August, and second half of September 2003 (Schmidt, 1971).

Results

Questionnaire

Thirty-nine percent of the farmers returned the questionnaire and showed interest in participating in the study. Thirty-six questionnaires could be used for the analysis. Two thirds of the farms were situated between 500 and 1,000 m above sea level. The majority of the farms had been producing for more than five years according to the BIO SUISSE organic guidelines.

The grazing season lasted 23 to 35 weeks (mean: 28 weeks) for the participating farms. On 16 farms (44%), some or all cattle were kept on alpine pastures during the summer. The season on these pastures varied between 75 and 150 days (mean: 112 days). In almost all cases, the cattle on alpine pastures were grazed together with animals from other farms. Most farmers (28) separated their OBC herds on the pasture in age groups. In approximately half of those farms, the first and second season cattle were grazed alternately on the same pastures. In the other farms, the younger cattle were grazed almost exclusively on their own pastures. Most of the farms practised a rotational grazing system, whereas, on 6 farms, the animals were set-stocked. On 14 farms, the animals had free access to the stables. On 23 farms, the animals were housed during the day or the night.

Anthelmintic treatments prior to the study were normally performed without a faecal examination (as should be required by the organic guidelines). In total, less than 30% of the anthelmintic applications were based on coprological results. Only 13% of the farmers mentioned clinical disease in the questionnaire caused by gastrointestinal worms or lungworms prior to the study. In most of the cases where newly purchased calves were affected, the cause of the problem was not identified on the investigated farms.

The overall mean daily weight gain was reported by the farmers to be 771 gram during the whole fattening period.

Parasitic infections

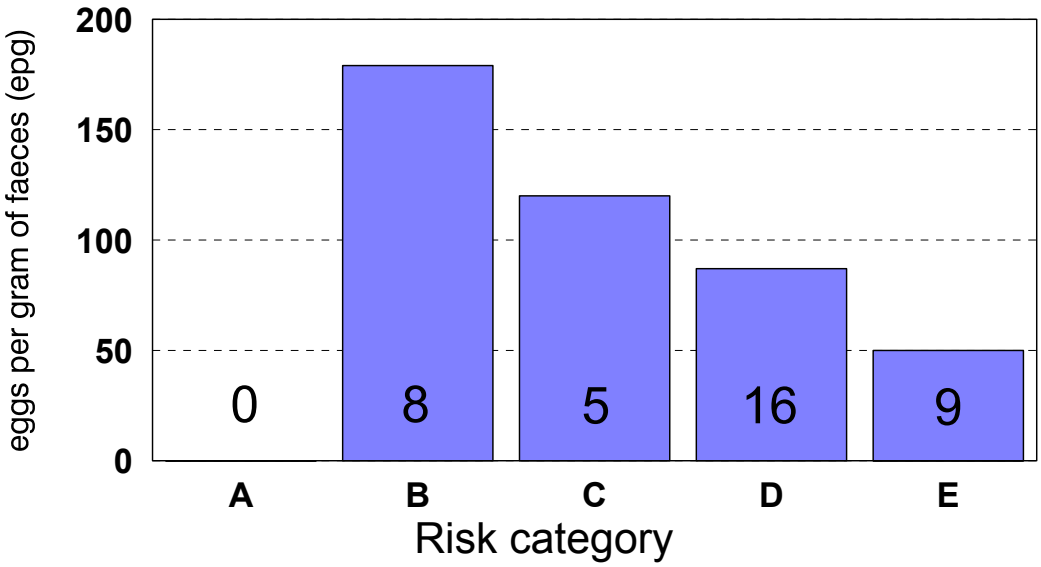
During the first year of the experiment, 165 faecal samples from 36 farms and from animals of different age groups were analysed coprologically for parasite stages. As expected, gastrointestinal strongyles were the most frequent helminths (Table 1).

Table 1: Frequency of important parasites on examined beef cattle farms

	Positive farms (%)
Gastrointestinal strongyles	97
Dictyocaulus viviparus	39
Trichuris sp.	8
Moniezia sp.	8
Fasciola hepatica	19
Dicrocoelium dendriticum	61
Eimeria sp.	100

The use of a risk profile for GIN-infections, based on the epidemiological data, revealed that two thirds of the farms were categorized into the low risk classes D and E. The classification based on the questionnaires was supported by quantitative analysis of the faecal samples in late summer, i.e. farms with the highest risk potential showed the highest parasite egg excretion in the susceptible young stock (Figure 1). *Cooperia* and *Ostertagia* were the dominant genera among the cultivated trichostrongyle larvae. Only on 7 farms, a GIN-infection above tolerable level was diagnosed. This was associated with bad general condition of some of the animals. In those cases, an anthelmintic treatment was proposed to the responsible veterinarian. The majority of those farms used herd management based on the separation of age groups with exclusive pastures for the susceptible cattle. GIN egg counts in the older animals (> 12 months) ranged around 50 e.p.g. during the entire observation period in all farms.

Figure 1: Mean excretion of GIN-eggs in susceptible beef cattle (up to 12 month age) in relation to the determined risk group of the farms (calculated on the base of epidemiological data). Numbers in the columns represent the amount of classified farms.



About half of the farmers mentioned problems with lungworms *(Dictyocaulus viviparous)* in their animals in previous years. Based on the faecal samples lungworms were found in 39% of the farms (Table 1). There was one farm with a fatal *Dictyocaulus*-infection shortly before the second routine examination in August. In this case, the infection had been misdiagnosed by the responsible veterinarian.

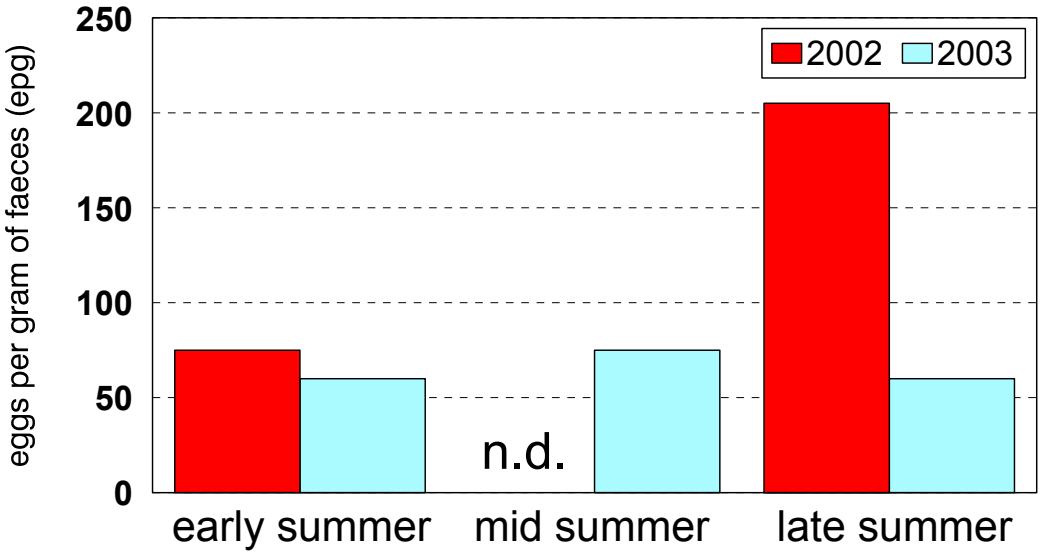
Of the 12 farms which belonged to a higher risk category and/or showed excessive shedding of GIN-eggs, 10 were interested in a continuation of the study in 2003. Eight of these farms could realise the recommended control strategies based on grazing management. Two farms could only follow the recommendations to a limited extent. In one case, this was caused by temporarily dry pasture conditions that forced the farmer to stable the older stock for several weeks. In another case, steep pastures that could only be grazed by younger cattle had to be used too intensively.

Oral vaccination, to prevent lungworm infection, was carried out by all concerned farms. Juveniles born in winter obtained the vaccination in spring before the first turnout, while newly purchased calves were vaccinated before they were integrated into the herd.

Coprological results in risk farms after implementation of control strategies

The mean excretion of GIN-eggs remained below 150 e.p.g (Figure 2) during the entire grazing season in the 8 farms that were able to adequately adopt the proposed grazing management. In the second half of the season, some animals on the two farms with restricted implementation of the measures showed an unsatisfying development and diarrhoea. The mean faecal egg excretion was about 300 e.p.g on both farms. In these cases, the use of anthelminthics (albendazole) was necessary and led to clear improvement of the animal's condition on both farms. The treatments were still reflected by the mean e.p.g. values of these farms measured in late summer. Figure 2 compares the mean egg excretion of the young cattle in the two years of the study.

Figure 2: Mean excretion of GIN-eggs in susceptible beef cattle (up to 12 month) from 10 farms before (2002) and after implementation of control strategies based on grazing management



During the last examination in late summer *Dictyocaulus*-larvae were found in small numbers in faecal samples of vaccinated animals of 3 farms. No clinical symptoms were present in these animals.

Discussion

On only one third of the examined farms, the risk analysis and/or faecal results revealed a higher risk potential for substantial infections with GIN. The main reason for the low infection level on the majority of the farms is most likely based on the grazing management practised on the farms. Thus, the general high risk for severe infections with GIN in the Swiss midland region (Hertzberg et al., 1996) is clearly reduced by these measures. The underlying effect is a substantial reduction of the stocking rate of the susceptible calves, resulting in a dilution of the pasture contamination with infective larvae. The stocking rate is regarded as one of the major factors influencing the magnitude of GIN infections in young calves (Nansen *et al.,* 1988; Eckert and Hertzberg, 1994; Hertzberg and Eckert, 1996). The faecal examinations confirmed that the older animals, that had already been in contact with pasture for at least one season, had developed a protective immunity and thus were excreting only very few GIN eggs. This did not result in harmful herbage infectivity for the younger animals.

A number of farms already practised a beneficial grazing management before entering the study, but the farmers were not aware about the parasitological background. Out of the two most effective and practical grazing strategies, especially the alternate or mixed grazing of different age groups was used, whereas the integration of other animal species was not possible in the majority of the farms, as these animals (i.e. sheep) were not available in sufficient numbers.

In addition to the prophylactic measures performed on the OBC-farms, the infection level of the newly purchased calves, deriving from dairy or cow-calf farms at the age of 4 to 6 month, plays an important role. In contrast to what could be expected, the vast majority of the animals examined on 15 farms in summer 2002 only showed a low level of GIN egg excretion (data not shown). The fact that the calf pastures were rarely exclusively used for these age groups is a probable explanation for this observation.

The implementation of the suggested grazing management on the farms, with a higher level of GIN infections in the second year of the experiment, resulted in a substantial decrease of the mean faecal egg counts. Eight of 10 farmers were able to adopt the proposed measures without reporting difficulties with this system. On those farms, the excretion of GIN eggs in summer averaged only about one third of the values of the previous year and remained clearly below the achieved threshold level of 150 e.p.g. Clinical parasitic gastroenteritis was absent on these farms. The use of anthelmintics was restricted to the animals of the two farms that were not able to establish the proposed grazing management. First season grazing cattle in these farms developed higher infections than on the remaining farms, indicating that relevant GIN infections could successfully establish under the temporary dry conditions of the season 2003. The absence of such infections on the other farms supports the view that the observed effects were mainly related to the grazing management.

The results of this study confirm the efficiency of grazing strategies for the prophylaxis of GIN infections in susceptible calves leading to a significant reduction of anthelmintic usage in these animals. This option is especially attractive for organic farmers, but is also relevant for conventional farms with respect to minimizing the use of anthelmintic drugs and thus delaying the development of anthelmintic resistance. So far the potential of GIN control by grazing managment has been highly underestimated.

As a two-year-study only allows a limited view on the problem, it is necessary to continue the observations over a prolonged period to ensure that all relevant factors with possible influence on the observed system will be covered.

Acknowledgements

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Part D:
Animal health and welfare: organic polutry production

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Organic broilers in the Netherlands

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Introduction

Organic broiler husbandry is developing in the Netherlands. At the moment, two integrations of about seven farmers each are active. In 2002, some 400,000 birds were reared, a market-share of about 1% of the total consumption in the Netherlands. In most Western European countries, the market for alternative poultry meat (corn-fed, free range and organic) is stable. In the United Kingdom, the market is still growing. There, about 3% of all poultry meat is from an alternative origin, some 500,000 birds per week. At the moment, mainly the market for free range products if growing: production of organic poultry is stable.

The aim of this study was to gather all available knowledge on organic broiler husbandry and to identify problems and possible solutions, together with organic poultry farmers. To meet this aim, the following questions needed to be answered:

1. What is the ideal management on health, food safety (Salmonella and Campylobacter) and nutritional aspects of organically managed broilers?
2. What is the ideal design of the house and the outdoor run: which elements are important, what is the best design for the outdoor run, how do the birds use the available space (surface required)?
3. What is the best type of bird: slow growing, adapted to the organic environment, product quality?

To answer these questions, on-farm research was initiated on food safety aspects, and knowledge on organic broiler husbandry was gathered through an inquiry, a desk study and a visit to organic broiler farms in the United Kingdom.

Materials and methods

Food safety

The food safety aspects were studied by means of sampling for Salmonella and Campylobacter in combination with an inquiry on organic farms. The incidence of Salmonella was measured in the clean stable (before the birds were introduced), at five weeks of age (before the birds gained access to the outdoor run), and at 10 weeks of age. At slaughter, the caecal content of 30 birds, one breastskin and 25 g of endproduct were gathered from each flock for analysis. To assess the incidence of Campylobacter, ten samples were taken from the manure originating from the caeca (dark colour) at two, five and 10 weeks of age. Due to an outbreak of avian influenza in the Netherlands, the research was paused, but in September 2003 it was resumed.

Animal husbandry
By means of the inquiry, a desk study and a visit to the United Kingdom, information was gathered on animal husbandry aspects of organic broiler production, helping us to identify possible problems and to indicate possible ways to solve these problems. The information from these three sources was organised into five topics:

1) Food safety and prevention of coccidiosis;
2) 100% organic diet;
3) Mobile housing;
4) Design of the outdoor run; and
5) Comparison of slow growing breeds.

Results

Food safety
Due to an outbreak of avian influenza in the Netherlands, the results of many flocks were incomplete and the number of flocks was limited. In total, 31 flocks were sampled. Four out of 31 flocks were positive for Salmonella (13%). Eleven out of 31 flocks were positive for Campylobacter (35%). In two of these eleven flocks, no Campylobacter was found in the samples at 10 weeks of age.

From the Campylobacter strains found in organic broilers that have been typed with the multiplex PCR technique, 27% was *Campylobacter jejuni* and 73% *Campylobacter coli*. On conventional farms, the proportions of the two strains are: 70% *Campylobacter jejuni* and 30% *Campylobacter coli*.

Animal husbandry
For the animal husbandry aspects, several problems and possible ways to solve these problems were identified:

Food safety and prevention of coccidiosis
The use of preventive medicine is prohibited in organic animal husbandry. For organic broilers, one veterinary treatment per cycle of 12 weeks is allowed. Apart from the fact that the number of treatments is restricted, organic broilers may run a larger risk of infection due to possible contacts with other species or their faeces in the outdoor run. On the other hand, the absence of preventive medication and the higher infection pressure can lead to a higher disease resistance. One of the main problems in organic broilers is coccidiosis, because it is prohibited to add coccidiostatics to the feed (Lampkin, 1997). Proper hygiene in the poultry house and treatment with medication, if problems occur, help to control the problem. Kijlstra *et al.* (2003) recently analysed the available knowledge on animal health and food safety in organic production. They found several studies that indicated that flocks of organic broilers tested positive for Campylobacter more often than conventional broilers. In a recent study by the Dutch consumers association, no difference was found in the incidence of campylobacter between organic and conventional broiler meat (Kramer, 2003). Organic poultry meat did have a lower incidence of salmonella than conventional poultry

meat. It would be interesting to study improved prevention of coccidiosis and to reduce the risk of infection with Salmonella and Campylobacter by changes in management.

100% organic diet

According to the regulations, organic broilers have to be fed a 100% organic diet. At the moment, up to 20% of the feed can still be from conventional origin, because a 100% organic diet is not feasible. From August 2005, however, 100% of the diet will have to be organic. The number of feed additives that are allowed is limited and the feed can not be produced using genetically modified organisms or related products. For broiler feed, finding a suitable protein source is the primary concern. Gordon and Charles (2002) studied alternative protein sources and found that peas are the most promising source (inclusion in the diet: 250 to 300 g/kg). Also lupins, rape-seed or oat have potential, although lower amounts can be included in the diet compared with peas. To come to an appropriate 100% organic diet for broilers, it is important to study the effect of alternative protein sources on broiler meat production. There is a risk that the methionine-level becomes too low in a 100% organic diet. Furthermore, feed costs have to be kept as low as possible, as these are one of the main reasons for the high production costs of organic poultry meat. The most interesting research questions are: Is it possible to create a low cost 100% organic diet? Can the birds compensate for changes in the diet by grass consumption in the outdoor run? Is a 95% organic diet an option (standard for organic food for human consumption)?

Mobile housing

In the Netherlands, organic and free-range broilers are mainly housed in non-mobile houses. In the USA, Canada, New Zealand and the United Kingdom mobile housing is frequently used for these systems. The use of mobile houses can be attractive, because 16 birds/m^2 can be kept, instead of 10. The house can be moved to a clean site after each cycle. Disadvantage is that the labour intensity increases, because of the transport of feed, litter and water and because of the moving of the houses. Furthermore, the climate is more difficult to control and problems can occur with frozen water systems. Also, more birds may be victimised by predators, as birds in mobile houses should have permanent access to the outdoor run. In non-mobile houses, the main advantage is that the system can be automated easily. Disadvantage is the more difficult management of the outdoor run: to avoid problems with diseases and to keep the outdoor run covered with grass, it is necessary to move the birds to a different outdoor run from time to time, or to ensure that the outdoor run stays empty for a period of time between cycles (Lampkin, 1997). Questions regarding mobile housing are: what are the possibilities of mobile housing in the Netherlands? Is it financially attractive? Is it feasible within the current legislation? Are there problems with existing designs?

Design of the outdoor run

The presence of an outdoor run is no guarantee that it is used. Recent research on seven organic broiler farms in the United Kingdom showed that a maximum of 15% of all birds used the outdoor run simultaneously (Dawkins *et al*., 2003). The research also showed that the presence of trees, a high outside temperature and the absence of bright sunlight (for instance during dusk and dawn) are factors that stimulate the use of the outdoor run.

During the visit to the United Kingdom, the present research of the same Marian Dawkins, professor in animal welfare at Oxford University, was visited. In this experiment, free-range broilers were kept in two different densities in mobile houses with outdoor runs with and without trees. Again, birds preferred the outdoor runs with trees. The planting of trees can also be viewed as a long-term investment for the farmer: now the trees offer shade to the birds, when the trees grow tall the wood can be sold (agroforestry). In France, similar results were found with 'Label Rouge' chickens (Lubac and Mirabito, 2001). Trees were shown to be attractive for the birds, because they offer a place for resting and shelter. Both studies deemed it difficult to draw the birds further away from the house. On Dutch organic broiler farms, the outdoor run consists of grass, in some cases with trees or other means of cover. Main questions on design of the outdoor run are: how does the optimal outdoor run look? Is the design of the outdoor run in line with maintenance and hygiene requirements? How should the layout of planting in the outdoor run look?

Comparison of slow growing breeds

In organic broiler husbandry, slow growing broiler breeds are used. Conventional, fast growing breeds are less suited for a growing period of 12 weeks. Bokkers and Koene (2003) compared the behaviour of fast and slow growing broilers. They found that slow growing broilers spent more time foraging, walking and perching than fast growing broilers, whereas fast growing broilers spent more time sitting, drinking and eating. Another advantage of the use of slow growing broilers is that the broiler breeders do not have to be fed restrictedly during rearing. Restricted feeding in broiler breeders is a major welfare problem. Currently, different breeds of slow growing broilers are available, differing mainly on production characteristics, such as the percentage of breast meat or feather/skin colour. In the United Kingdom, for instance, people associate brown feathered birds with alternative production and in Asia, the skin colour of the birds is very important. For the organic broiler production in the Netherlands, it would be interesting to make a comparison of the different slow growing breeds: which breed would function best on organic broiler farms in the Netherlands (robustness, activity and use of the outdoor run).

Discussion

The preliminary results showed that the incidence of Salmonella was low on organic broiler farms, whereas the incidence of Campylobacter was higher, in line with previous studies (Kijlstra *et al*., 2003). The number of infected flocks was comparable with conventional farms, but that may be caused by the fact that we had no samples from the summer period due to an Avian Influenza oubreak. In summer, the incidence of Salmonella and Campylobacter is highest. Furthermore, on organic farms the predominant type of Campylobacter is *Campylobacter coli*, whereas on conventional farms this is *Campylobacter jejuni*. This difference may be caused by the higher slaughter age of the birds or by the use of different breeds.

The study on animal husbandry aspects produced sufficient information for the identification of further research needs:

- Management of health and nutrition
  - Food safety and prevention of coccidiosis: can we improve prevention of coccidiosis and reduce the risk of infection with salmonella and campylobacter by changes in management?
  - Nutrition: 100% organic diet. Is it feasible to purchase all the ingredients from organic producers? What are the best alternative protein sources?
- Housing and design
  - Mobile housing: what are the possibilities of mobile housing in the Netherlands? Is it financially attractive? Is it feasible within the current legislation? Are there problems with existing designs?
  - Design of the outdoor run: how does the optimal outdoor run look? Is the design of the outdoor run in line with maintenance and hygiene requirements? How should the layout of planting in the outdoor run look?
- Type of bird
  - Comparison of different slow growing breeds: which breed would function the best on organic broiler farms in the Netherlands (robustness, activity, and use of the outdoor run).

The Dutch farmers have selected food safety and the feasibility of a completely organic diet as main research topics. There is a lack of knowledge on food safety of organic poultry meat. If we can identify the risk factors related with Campylobacter infection, this could help to improve farm management. Research on the feasability of a 100% organic diet is relevant, as the diet has to be 100% organic from August 2005 and little is known about the effects on production, feed costs, and welfare. Mobile housing is not used by the existing Dutch organic farmers. There is a new initiative, however, where free range broilers are kept in mobile houses. On the design of the outdoor run, the farmers mentioned that they try to keep the run easy to manage and at low cost. There is some interest, however, in predator control. On the comparison of slow growing breeds, it was mentioned that two slow growing breeds are used in the Netherlands and that both are functioning well. At the moment, there is research going on where fast- and slow growing broilers are compared (alternative broiler grown to 56 days).

Hence, we will continue our food safety research on organic farms, focusing on the role of management factors in the incidence of Campylobacter. Furthermore, on-farm research on the feasibility of a completely organic diet will be initiated, comparing 80%, 95%, and 100% organic diets.

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Health in organic laying hens – facts and fairy tales

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Introduction

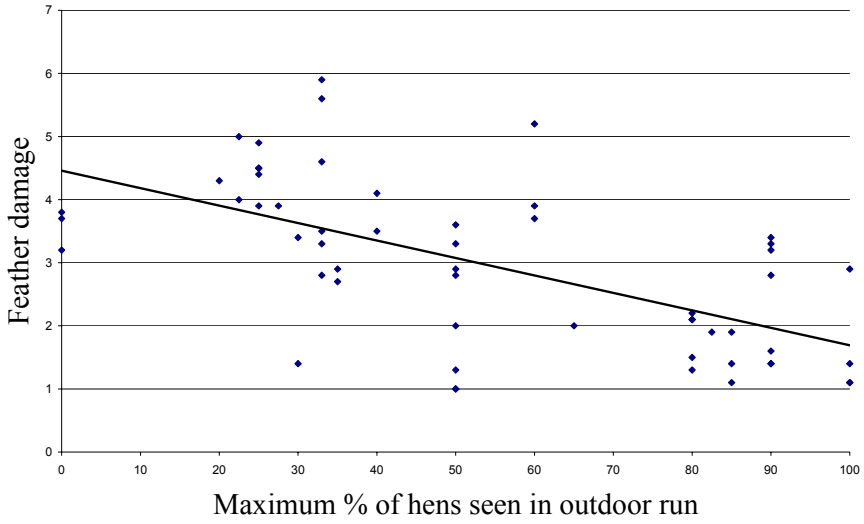
The outbreak of Avian Influenza in the Netherlands in March–August 2003 led to a strong need for information about the importance and risks of a free-range area for poultry and how these risks could be kept to a minimum. Therefore, a literature study was carried out with additional interviews, in order to inform farmers, researchers and policymakers on how to make organic and free-range farming practices as healthy (for chickens) and safe (for humans) as possible. Apart from informing these stakeholders, another aim was to define possible directions for our own future on-farm research. The original report will be published shortly. This article will present the most relevant parts of the report.

Why should we give poultry an outdoor run?

Animal welfare is difficult to measure, but one clear indicator for welfare in laying hens, especially in large groups, is the degree of feather pecking. Feather pecking is an abnormal behaviour which appears after the animals are subject to stress due to failures in the rearing period, feeding or housing. Feather pecking is an indicator of reduced welfare in both actors (El-Lethey *et al*., 2000) and victims (McAdie and Keeling, 2000). Several epidemic studies have been carried out, in which several tens to hundreds of alternative poultry farms have been compared to each other with respect to factors relating to feather pecking. From those studies, it appears that there is less feather pecking on farms where more hens are seen outside simultanously (Green *et al*., 2001; Bestman and Wagenaar, 2003; Nicol *et al*., 2003). According to Green *et al*. (2001) at least 50% of the hens should use the outdoor area, according to Bestman and Wagenaar (2003) this should be 67% (Figure 1) and according to Nicol *et al*. (2003) the risk for feather pecking was already 9 times smaller if at least 20% of the hens went out simultanously.

Another study (Häne *et al*., 2000), in which farms with and without an outdoor run were compared to each other, no difference was found. However, in this last study there was an essential difference in that the availability of the outdoor run as such was regarded and not the use of it. Some authors mention that, especially in groups larger than 500 animals, only a minority of the hens from a free-range flock come outside (Keeling *et al*., 1988; Appleby and Hughes, 1991; Bubier and Bradshaw, 1998; Bestman and Wagenaar, 2003; Zeltner and Hirt, 2003). The mechanism of the relation between the use of the outdoor run and feather pecking probably is 'environmental enrichment', but also lower chicken density and better air quality. The good effect on psychological well-being is also mentioned by the Dutch veterinarian Voeten (2000) who wrote in his book about poultry health that the only thing that immediately works against hysteria in chickens, is placing them outside.

Figure 1 Relation between the use of the outdoor run and degree of feather pecking damage (Bestman and Wagenaar,2003).



Degree of feather pecking: <1: Little/ no feather pecking; 2-3: moderate feather pecking; >3 severe feather pecking

Health in poultry kept outdoors

A study in the Netherlands (Fiks-van Niekerk *et al*., 2003) showed that, compared to battery hens, endoparasites are seen more frequently in organic layers (*Ascaridia spp, Capillaria spp, Eimeria spp, Brachyspira spp*). However, there were no data on the significance of this finding wiht regard to the welfare and the production of the animals or the economics of production in the units studied. A summary of literature findings on poultry health in outdoor systems is presented in Table 1. Compared to battery hens, higher mortality, more endoparasites and more zoonoses (salmonella) are seen in 'large' flocks (>2000) of free range laying hens. Mortality of 11% (Fiks-van Niekerk *et al.,* 2003) and 18 % (Kreienbock *et al*., 2003) are mentioned. However, in smaller flocks (<2000) mortality is lower: 7% (Lampkin, 1997; Sommer, 2001) to 9% (Berg, 2001).

It is noted that, if the mortality on organic or free-range farms is above 20%, this is often caused by cannibalism. Health problems are mentioned in literature, especially when they cause mortality, decrease production or cause problems in consumers. There are also less remarkable problems that, nevertheless, cause inconvenience or suffering for the animals. Only one of the studies (Keutgen *et al*., 1999) looked at anatomical disorders in individual chickens from different housing systems. Their findings are summarised in Table 2.

Table 1: Health and mortality in hens kept outdoors

Reference	Lampkin, 1997	Keutgen et al., 1999	Berg, 2001	Sommer, 2001	Emous, 2003	Fiks et al., 2003	Kreienbock et al., 2003
Country System Method	UK organic estimated	Germany free range animals from slaughter-house	Sweden organic question-naire	Austria free range questionnaire + samples	Netherlands free range question-naire	Netherlands organic questionnaire + samples	Germany free range question-naire
Flock size	600-1000	?	12-1700	500-700	16.000	1840 (80-5400)	20.000 (1300-75.000)
Mortality %	7	?	9 (1-60)	7.2 (0-32)	14.3 (8-28.5)	11.4 (0-21)	19
Health problems	Canniba-lism coccidio-sis	pododer-matitis, deformati-on of keel bone, parasitic worms, fatty liver	cannibalism endopara-sites, lice, leg para-sites	endoparasites Infectious Bronchitis, salmonella, cannibalism	Coli, Amy-loidosis, crowding, Coccidiosis, Infectious Bronchitis, endopara-sites, 'burn outs'	predators, crowding, coli, endo-parasites, Infectious Bronchitis, Brachyspira	heat stress, untreatable diseases

Table 2: Pathologic and histologic changes in different housing systems

	Free range 30 animals from 3 flocks	**Deep litter 270 animals from 27 flocks**	**Battery 700 animals from 70 flocks**	**Remarks**
* Pododermatitis	47	48	33	Caused by moist litter or bars
* Deformation of keel bone	73	61	36	Osteoporosis, wrong perches
Endoparasites	23	37	0	Contact with manure
* Claw injuries	0	2	13	Nails don't shorten in cages, break and get inflammated
* Inflammation of feather follikels	3	2	9	Seen on head and neck regions, caused by bars
* Peck wounds	3	7	1	Unstable social structure, not enough flight possibilities
Fatty liver syndrome	40	37	69	Caused by genetics, high production and not enough exercise
* Injuries and fractures due to handling and transport	7	5	25	Caused by weak bones, which are caused by not enough exercise

* Painful and leading to permanent alterations

It is sometimes suggested that battery hens are in better health than hens kept outdoors. It is, however, questionable whether these battery hens with weak bones, severe fatty liver syndromes, claw injuries, inflammation of feather follikels (Keutgen *et al.*, 1999) and bad welfare, but with lower mortality and higher production, really are in better health. However, a mean of 15% mortality in free-range systems clearly is not a sign of good health either. There appears to be a relation with the number of hens kept in one flock or on the farm as a whole, with better health emerging in systems with fewer hens. The author suggests that a roughly defined limit to flock size could be 1,700 hens (Table 2). The suggestion that hens kept outside in general are healthier than hens kept indoors is not confirmed in the literature. However, there are examples of organic farms performing well, suggesting that it is not the system as such that causes problems.

Food safety

Subjects that are less concernd with animal health, but closly related to food safety, are salmonella and dioxine contamination of eggs. In hens kept outdoors, more salmonella is seen than in hens kept indoors (Fiks *et al*., 2003), and there is a tendency to vaccinate against it (van Emous, 2003; Fiks *et al*., 2003). However, it has not been highlighted as a major problem in orgnanic systems (Lampkin, 1997; Berg, 2001; Sommer, 2001). Rather unknown is the risk of increased levels of dioxine in eggs from free-range hens. There has not been much research on this subject, but the scarce studies that have been carried out, suggest that eggs from hens kept outdoors contain more dioxine than from hens kept indoors (Kijlstra *et al*., 2004 in preparation). In some cases, the levels detected are above the levels allowed by the European food hygiene regulations.

Disease resistance through breeding, housing and management

Breeding for immune responsiveness is possible (van der Zijpp, 1986; Lamont, 1994; Bumsdtead, 1998; Pinard-van der Laan *et al.,* 1998; van Loon *et al.,* 2004), but has not been practiced because, during the last decades, hens have been kept indoors and vaccinations have been available (van der Zijpp, 1986). Selection for a higher immune response in laying hens goes together with less bodyweight and lower production (van Loon *et al*., 2004). Moreover, it may be possible that selection for high production under very specific and well-controlled conditions has led to the loss of genotypes that might be able to cope with a challenging environment (Savelkoul, 2003 personal communication). This could decrease the ability of production animals to adapt themselves to new husbandry systems with a great variety of environmental conditions, such as free range and organic systems.

Apart from breeding and selection, the review concluded that we should look for possibilities in the field of developing the general immune system by making use of some of the findings of modern immunology, such as the 'hygiene hypothesis' that states that the immune system needs challenges to develop itself properly (Elliott *et al*., 2002; Yazdanbakhsh, 2002; Eek and Savelkoul, 2003). These challenges may be bacterial or parasitic. The hygiene hypothesis has become famous because it appears to explain why, in the last decades, there has been an increase in immunological diseases in humans in industrialised countries, such as allergies, asthma, Crohn's disease, diabetis, multiple sclerose and rheumatism (Elliott *et al*., 2000). Although the hygiene hypothesis is founded on humans, in other species, such as pigs, calves, dogs and horses,

an increase of allergies has been observed (Savelkoul, 2003). According to the hygiene hypothesis, medical strategies have been developed in which well controlled contact between allergic patients and more or less pathogenic micro organisms is organised in order to stimulate the immune system. For example, allergic patients have been given eggs of parasitic worms (*Ascaris spp*) or so-called 'probiotics' after which their allergic symptoms have diminished (Turton, 1976 c.f. Yazdanbakhsh, 2002; Pessi *et al*., 2000).

What does this all have to do with modern poultry husbandry? Allergies have not been reported for poultry, but remedies such as administering of 'Normal Gut Flora', lactic acid bacteria or yeasts (probiotics) have proven to decrease infections with Salmonella and other bacteria in both meat type chickens (Methner, 2000) and laying hens (Corrier *et al*., 1990; Han *et al*., 1999; Davies and Breslin, 2003). It is suggested that further study in this area in connection with outdoor poultry would have potential, as outdoor hens are exposed to more pathogens than the chickens in the studies done so far.

Other nutritional effects of probiotics are: better digestability of proteins, a better availability of calcium, zinc, ferro, magnesium, copper and phosphorrus and a better synthesis of vitamins (Prasad, 1999 c.f. Pattijn). Fermented fodders (partly digested by lactic acid bacteria), such as silage, result in better growth, feed conversion and health (McDonough *et al*., 1982 c.f. Pattijn; Steenfeldt *et al*., 2001). In fermented wheat, the probiotics in question produce the essential amino acids lysine, tryptophan and methionine, while, in fermented maize, also riboflavine and niacine are produced (Lay and Fields, 1981 c.f. Pattijn). Methionine is known as a limiting factor in organic poultry feed, especially now that synthetic amino acids in feeds are not allowed. Higher percentage of tryptophan in poultry feed appared to decrease feather pecking (van Hierden, 2003). Administration of probiotics also appear to have the best effects when combined with good nutrition (containing indigestable fibres), in order to establish an environment in which the bacteria can maintain and reproduce themselves (Montagne *et al*., 2003). There are several probiotics available on the market, varying from 'normal gut flora', available from the pharmaceutical industry, to compost tea from smaller companies and the yoghurt type foods for humane use.

The degree of hygiene is dependent on the whole poultry production chain. Parent animals and laying hen chicks are kept in cleaner environments than adult laying hens in alternative systems, where they have contact with manure from other chickens or from wild animals (rodents, birds). Especially in the first weeks of age, when the chicks are kept in very hygienic conditions, the immune system developes rapidly. Under natural circumstances, the chicks would be in contact with the micro organisms from older conspecifics and the environment. In modern poultry husbandry, there is no contact between mother and the young. Newly hatched chicks are kept in desinfected stables, and there is very limited contact with environmental micro organisms. Moreover, it is not unusual that in the first 20 weeks of age, laying hens receive some 20 vaccinations. It is known that vaccines (especially the live ones) can elicit strong vaccine reactions that lead to general immune system depression. Therefore, several authors suggest an evaluation of the modern vaccination schemes (Laing, 1988; Davison, 2003). Some experienced organic poultry farmers have their own methods to enhance the health of their laying hen pullets, such as compost in the litter area (Fölsch and Hoffmann, 1999), healthy laying hens amongst the six week-old hens (Zents, pers. comm.) or feeding CCM (fermented maize cobs; Borren, pers.comm.; Donkers, pers. comm.). These measures fit well with the hygiene theory.

Conclusions

- More research should be carried out on the effect of probiotics on the health of outdoor poultry. A suggested comparable (more natural) measure could be a system of keeping healthy older hens amongst the young chicks (Zents, pers. comm.) as well as providing them with compost (Fölsch and Hoffmann, 1999) or fermented feeds such as silage or CCM (Steenfeldt et al., 2001; Borren, pers. comm.; Donkers, pers. comm.).
- It appears that the hens should have access to outdoors at a young age, in order to bring them into contact with environmental micro organisms that help their immune system develop.
- Vaccination schemes should be evaluated, in order to avoid side effects as well as combinations that depress the immune system and to replace them by other measures, such as probiotics.
- Research should be carried out on the immune response in commercial flocks of hens kept outdoors, in order to see which factors might be responsible for posistive responses.

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Protein supply for organic poultry: options and shortcomings

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Introduction

In accordance with the principles of organic farming, poultry is unlikely to play a role similar to its role in conventional farming. Nevertheless, a considerable number of organic farmers specialized on the production of organic poultry products in the last decade. For most of them, supplying their poultry flocks with sufficient amounts of high quality-protein presents a challenging task. In order to fulfil this, several factors have to be taken into account (Zollitsch *et al*., 2004).

Feed protein is broken down to amino acids (AA) and peptides, which form the precursors for tissue and egg formation. The genetic potential of animals for primary performance criteria have traditionally been seen as key targets when estimating nutrient requirements of farm livestock. More recently, nutritionists have started to pay more attention to the formation of antibodies and the amount of AA required for this process (Kidd, 2000; Konashi *et al*., 2000; Chen *et al*., 2003).

For feeding management purposes, suggested nutrient contents per kg of diet, rather than required daily nutrient intakes, will be used in this paper.

Laying hens: performance and dietary nutrient density

Frequently used laying hen hybrids have the potential to annually produce more than 18 kg of egg mass per hen (300 eggs with an average egg weight of 61.5 to 64.5 g). According to breeders' management guides, the rations for these hens should contain 163 g/kg crude protein, 3.6 g/kg methionine and 7.3 g/kg lysine from week 29 onwards. These suggestions are based on a daily feed intake of 120 g. Following a phase feeding concept, nutrient density should be increased in the layer starter feed (until week 28) and can be lower after week 45 (Lohmann, 2004).

Diet formulations that are frequently used in organic farming rely on conventional protein supplements, e.g. maize gluten, to achive the values given above (Table 1). Grain legumes and oilseed expellers will be the predominant organic protein sources.

Table 1: Rations for laying hens (Zollitsch *et al.* 2003, Joost Meyer, 2004)

Component, %	+ conventional components	100 % organic components
Triticale, wheat, maize	48.0	50.0
Peas, faba beans, lupins	25.0	--
Maize gluten (conventional)	10.0	--
Expeller (sunflower, soybean)	--	35.0
Alfalfa meal, dehydrated	5.0	5.0
Fat	2.0	--
Minerals + premix	10.0	10.0
ME, MJ/kg	11.2	10.1
CP, g/kg	187	160
Met, g/kg	3.4	2.8
Lys, g/kg	7.0	6.8

Very little field data are available on the actual AA supply from organic laying hen diets. Preliminary results from a recent field study in Austria are given in Table 2 (Velik, 2004). Samples were taken from mixed diets which were manufactured by the dominant regional feedmills. As expected, AA contents are significantly lower in organic as compared to conventional complete diets. First estimates from statistical analysis point to the severity of feather pecking being higher with decreasing Met and Met/ME.

Table 2: Amino acid and energy content in diets of free range laying hens (Velik, 2004)

Trait	Conventional diets n = 9			Organic diets n = 13		
	$\bar{x}$	min.	max.	$\bar{x}$	min.	max.
CP, g/kg	185	175	198	181	167	198
Met, g/kg	4.6	4.1	5.0	3.4	3.1	3.9
Met+Cys, g/kg	7.8	7.1	8.4	6.9	6.1	7.4
Lys, g/kg	8.4	7.9	9.5	6.7	5.8	7.6
ME[1)], MJ/kg	11.5	10.9	12.3	11.8	11.2	12.2
Met/ME, g/MJ	0.40	0.36	0.43	0.28	0.25	0.33

[1)] estimates based on proximate nutrient analysis:
ME (kJ)=15.51*CP+34.31*EE+16.69*St+13.01*Su;
EE=ether extracts, St = starch, Su = total sugar

Growing poultry

The situation for broilers is somewhat different to that for laying hens: broiler genotypes that are used in organic farming as well as in conventional free range-label programs show a growth pattern which is significantly different from that of conventional broilers. Therefore, their AA requirements will be covered by dietary protein contents that are lower than those from

conventional diets (Peter *et al.,* 1997a): a CP content of 200 g/kg (4.3 g/kg methionine) and a ME density of 10.9 MJ/kg will probably lead to maximum growth rates in these hybrids (Table 3). Carcass traits also will not be affected by moderately reduced nutrient densities (Peter *et al.,* 1997b).

Table 3: Effects of dietary CP (AA) and ME on growth and feed conversion of "Label" broilers (Peter *et al.* 1997a)

CP (Met), g/kg	BW[1)] (56 days), g	BW[1)] (84 days), g	FCR[2)]
150 (3.2)	1441[a]	2525[a]	2.74
175 (3.8)	1559[b]	2683[b]	2.69
200 (4.3)	1762[c]	2780[c]	2.74
225 (4.9)	1799[c]	2791[c]	2.70
250 (5.4)	1804[c]	2786[c]	2.75
ME, MJ/kg			
10.9	1745[b]	2782[b]	2.98[c]
12.1	1662[a]	2705[a]	2.67[b]
13.3	1636[a]	2652[a]	2.52[a]

[1)] BW = body weight
[2)] FCR = feed conversion ratio
[a, b, c] = different superscripts indicate significant ($P \leq 0.05$) differences between group means

While protein and methionine contents of about 180 and 3.2 g/kg, respectively, are typical for organic fattening diets, variable protein and AA levels can be found in grower diets (up to week 5; Table 4).

Table 4: Grower diets for organic broilers, containing different amounts of conventional feedstuffs (Zollitsch *et al.* 2003, Weller 2004)

Component, %	Diet A	Diet B
Wheat, triticale, maize, barley	55.0	49.3
Peas, faba beans, lupins, soybeans	25.6	20.0
Expeller (sunflower, soybeans)	5.0	24.0
Maize gluten (conventional)	--	2.0
Potato protein (conventional)	10.0	--
Fat	1.8	1.0
Minerals + premix	2.6	3.7
ME, MJ/kg	12.3	12.1
CP, %	22.0	19.8
Met, %	0.39	0.39
Lys, %	1.25	1.02

Even if diets are exclusively based on organic grain legumes and oilseed cakes, dietary protein and methionine levels will probably satisfy the nutritional needs of adapted broiler strains. The current practice of growing organic broilers can, therefore, be used as a model for adressing nutritional challenges by a multifactorial approach, including the animals' genetic background.

A situation which is quite different from organic broilers is found in turkeys. Modern (conventional) turkey hybrids can be seen as the role model for high performing growing birds which are extremely difficult to feed under organic management. Heavy meat type hybrids have the potential to grow to weights of about 10 kg in 16 weeks (female) and 22 kg in 22 weeks (male). Alternative strains, which are frequently bronze coloured, typically reach about 78 % of these weights in the same time if they are fed with conventional diets (Table 5; BUT, 2004; Kelly-turkeys, 2004). Unlike with broilers, lysine can be expected to be the first limiting AA for growing turkeys. The recommended values for the first two phases (i.e. up to week 8) given in Table 5 are extremely unlikely to be reached with diets that comply with organic farming regulations.

Table 5: Recommended dietary nutrient contents for various turkey strains (BUT 2004)

Phase, weeks	ME, MJ/kg	Lys, g/kg	Met, g/kg	Met+Cys, g/kg
0-4	11.8	18.5	6.7	12.0
4-8	12.0	16.1	6.3	11.3
8-12	12.2	13.4	5.7	10.1
12-16	12.2	10.9	4.9	8.7
16-20	12.4	9.3	4.4	7.9
20-24	12.6	8.2	4.0	7.2

Scientific data on the consequences of AA undersupply of growing turkeys are scarce. Reports from farmers and extension personnel point to severe growth depression and highly variable body condition within the flock. The depression of feed intake, which is usually observed after ingestion of AA deficient diets, eventually ends in total feed refusal in the case of young turkeys. Feed manufacturers try to avoid these problems by including high quality protein feedstuffs in the compound diets, such as processed soybeans, potato protein, yeast, dried milk or egg products. These ingredients are, however, not always available from organic sources and/or are very costly.

Shortcomings and solutions

Based on the above information, the following major shortcomings can be identified:

- High probability for diets being (at least temporarily) deficient in AA for young turkeys and high performing laying hens.
- The situation will become even more difficult if conventional protein supplements cannot be used any more, due to the shortage of organic high quality-protein concentrates.
- Because of the linkage between genetics and nutrition, the use of conventional, high potential-strains is one of the key factors in this context.

The following options should be discussed, in order to cope with the above-mentioned shortcomings:

- Use of genetic strains with a moderately lower potential for protein deposition and egg production, together with optimization of the use of protein feedstuffs produced on farm, especially grain legumes;
- Identification of suitable bought in-protein supplements (e.g. oilseed cakes, milk and egg products); and
- Research and implementation of innovative nutritional strategies (e.g. increasing feed intake through lowered dietary energy density).

While the first option has been discussed for about a decade, broilers are the only major poultry category for which this has been implemented. In the case of laying hens, it seems unlikely that the major breeding companies will come forward with "organic layer breeds" in the near future, simply because of the limited size of the market (Damme, 2004). Turkey breeds, with a somewhat lower growth rate, are available, but even these strains require very high AA contents in their grower diets.

In the short term perspective, priority should, therefore, be given to the optimum use of protein feedstuffs available on farm. This can be done if information is provided concerning

- the actual nutrient content of different species and varieties of grain legumes;
- the content of secondary constituents of the respective plant feedstuffs and their potential negative effects on poultry;
- the suitability of processing technologies for improving the nutritive value of these feedstuffs; and
- maximum inclusion rates which can be derived based on the above information.

Data about the nutritive value of important organic protein feedstuffs is currently collected by researchers in several European countries. The potential variety in the feeding value of grain legumes can be demonstrated by preliminary data which were collected for different varieties of peas at the University of Natural Resources and Applied Life Sciences Vienna (Table 6).

Table 6: Nutritional value of peas (g/kg DM; Starz 2004).

Trait	**Variety**							
	1	2	3	4	5	6	7	8
CP	224	239	239	228	250	261	254	245
Fibre	71	72	70	67	69	77	75	72
Starch	531	529	514	539	519	479	479	514
Lys	15.4	16.0	15.9	16.1	16.4	17.1	17.1	14.1
Met+Cys	5.1	5.1	5.2	5.1	5.2	5.5	5.7	5.1
Thr	7.8	7.9	8.1	8.0	8.2	8.8	9.1	7.9
Try	2.0	2.0	2.1	2.1	2.1	2.2	2.2	2.0
Tannins	0.5	0.5	1.5	2.0	1.3	9.6	9.6	6.7

AA content may vary by 10 to 20 % for different varieties. In this study, the types that had highest protein content, had significantly higher amounts of tannins, which will limit their inclusion rates in poultry diets. Besides tannins (which are sometimes referred to as "bitter constituents"), other secondary constituents may potentially harm poultry if ingested in substantial quantities: protease inhibitors, hemagglutinins (lectins), saponins and cyanogens can be found in the seeds of many legumes. While their basic mode of action is relatively well known, it is not always clear to which extent they may harm the animals' metabolism if they are included in poultry diets. Several processing technologies are available, which will reduce their potentially harmful effects, but will also increase the costs of feeding. Costs and benefits should be considered carefully before deciding which technology to use for specific feedstuffs.

Even if home-grown protein sources are used in an optimum way, it will be necessary to balance the dietary AA pattern by high quality-protein components imported into the farming system. In this respect, beneficial effects can be expected for increasing the methionine content in poultry diets. Frequently, oilseed cakes (expellers) are used for this purpose. Other potential feedstuffs, which may be considered, are yeast and processed milk and egg products. Currently, protein extracts from different plant species, which are available as by-products from the production of plant fibres, are discussed as a potential feed resource for livestock. No scientific data could be found about the use of protein extracts as a component of organic poultry diets.

In contrast to this, the potential advantage of using synthetic methionine for organic poultry seems to be clear. Without a doubt, the formulation of "100 % organic" rations would be simplified if synthetic methionine was allowed to be used in organic livestock. On the other hand, the trend towards more intensive poultry production systems will be fostered by the general use of synthetic methionine (Zollitsch *et al*., 2004).

Finally, innovative nutritional strategies should be critically assessed in order to solve some of the problems addressed in this paper. In the case of organic laying hens, it can make sense to lower the energy density of the rations. This will increase feed intake (NRC, 1994) which will, in turn, help to maintain AA intake close to the requirement, even if the AA content of typical organic rations is below recommended levels. However, if this strategy is to be used successfully, young chickens and pullets have to be managed in a way that allows them to get used to ingesting greater amounts of feed than in conventional rearing regimes (Baumann, 2004; Joost Meyer, 2004).

In the case of fattening poultry, the influence of unbalanced dietary AA patterns on the quality of poultry meat should be analyzed. For pigs, significant beneficial effects have been shown on meat quality traits (Sundrum *et al*., 2000).

Conclusions

Several factors have to be considered if deficiencies in the protein supply of organic poultry are to be corrected. Both external and internal resources may help organic poultry farmers to solve these problems: poultry breeding, production of feedstuffs on farm, identification of external high quality feedstuffs, the development and implementation of innovative feeding strategies and consideration of effects on animal health and welfare, animal performance and product quality

have to be linked together in order to derive practical solutions for the problems raised in this paper.

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How to motivate laying hens to use the hen run?

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Introduction

In organic agriculture, hens are kept in free range systems. A free range is an enrichment for the hens and brings several advantages for them. Laying hens may show behavioural elements that are not possible in a poultry house. For instance, sunbathing behaviour is only shown in direct sunlight and not in artificial light (Huber, 1987). Hens spend 35.3-47.5% of their time with food searching (Fölsch and Vestergaard, 1981) and, in natural habitats, invertebrate food appears to be an importnat addition to the diet (Savory *et al.* 1978). Free range systems may also have an influence on animal health and product quality. Lopez-Bote *et al.* (1998) suggested that some constituents of grass might be of interest for the production of eggs rich in (*n*-3) fatty acids.

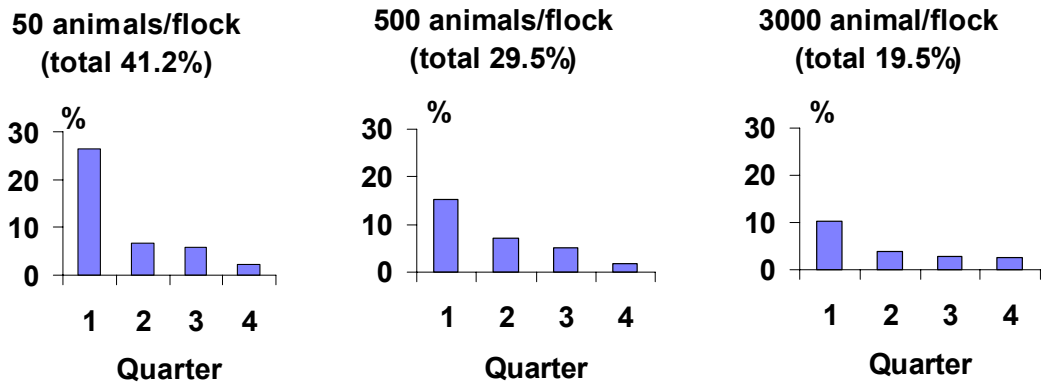
In flocks of free range hens, generally only a small proportion of the flock is outside at any one time, and most hens stay near the poultry house. In an account of the uneven distribution of the hens in the free range area, Menzi et al. (1997) found a nutrient and heavy metal overload on the frequently used parts of the run. For a better distribution, they, as well as several label programmes, recommend to structure the outdoor area with trees and installations providing shade and protection for the hens.

We attempted to determine management and structural factors that would result in more hens in the run and a more even distribution of the animals in several experiments, with a special emphasis on the idea that the hen run should be easily manageable for the farmer.

Experiments

In the first study, with four groups of 50, 500 and 3,000 laying hens, the use of the hen run was compared with flock size. During the time the hen-runs were available to the laying hens, birds in the smaller flocks used it more often, i.e. the use of the hen run decreased with increasing flock size. Most hens stayed in the quarter nearest to the stable. Even in the small flocks, only few laying hens used the most distant quarter of the run (Figure 1).

Figure 1: Percentage of flocks in the hen run for the different flock sizes and distribution in the free range area.

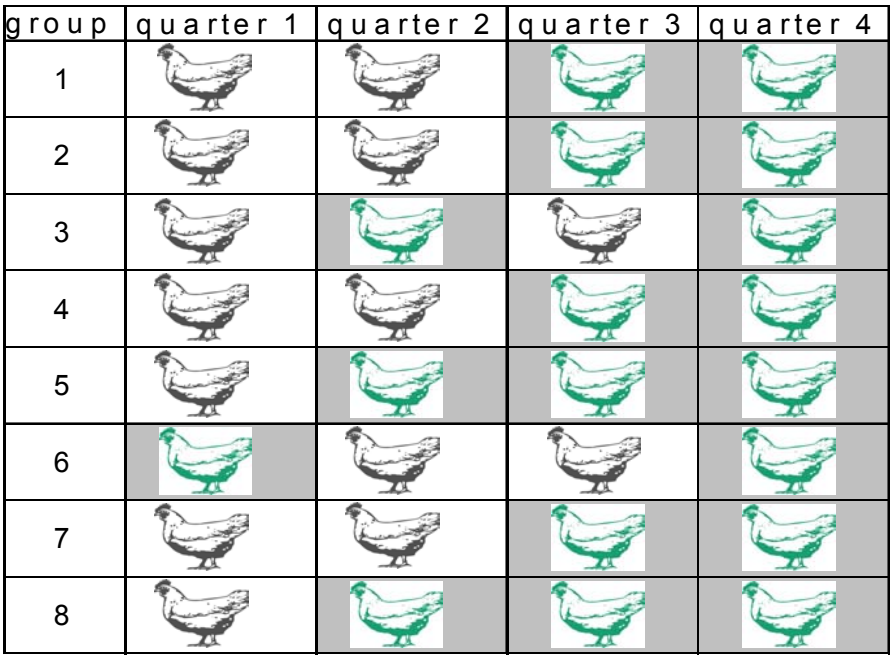


A further question addressed was whether it is possible to improve the use of the run by scattering grain in the outdoor area during the rearing period (flock customisation). The experiment was done on four rearing farms with at least two groups of hens (test and control group) on each. The test group received grains in the run, the control group received grains only in the bad weather run.

In the middle and in the end of the rearing period, the number of animals in the run was not different with and without flock customisation. Furthermore, there was no difference in the distance to the poultry house between the animals of the two groups. However, some differences in the behaviour occurred. We suggest that, with flock customisation, food search activity increased but other factors than scattering grains have a bigger impact on the use of the free range.

In a next step, the effect of roofed dust baths on the use of the hen run was tested experimentally. We had four groups of 500 laying hens in each, ones with and ones without roofed dust baths at the end of the hen run to structure the free range area. We found no difference in the number of hens in the free range area with and without structure, but there was an influence on the distribution (Figure 2). When structures were located in the furthest quarter of the run away from the house, more hens were there with than without structure. In the nearest quarter, there were more hens without than with any structure in the hen run.

Figure 2: Distribution of hens in the four quarters of the hen run for eight groups of hens. White fields indicate a higher percentage of hens without structure and grey fields indicate higher percentage with structures in the fourth quarter of the hen run.



As even this small and distant structure had an effect on the distribution, we tried to find out more about the preferences of hens for a certain kind and amount of structuring elements. Eight groups of 20 hens and a rooster had a hen run that was optically divided into two parts. Two experiments were carried out. First, one part of the hen run had a shelter in the size of 1% of the area. The other part had five such shelters. Second, the less structured part was supplemented with four different objects of the same size. These four objects were a perch on two levels, a pecking-tree (vertical trellis on a stake with hanging corks), a box with fir-cones for scratching and two small fir-trees .The other part was the same as with five shelters.

In this choice experiment, we found no influence of the amount of structures on the use of the hen run (Figure 3), but the hens preferred the part with various structures (Figure 4) and they stayed evenly beside, under or on all different structures.

Figure 3: The percentage of the hens in each group, which are observed on the part with 1% of the run area covered with structures and on the part with 5% of structures respectively.

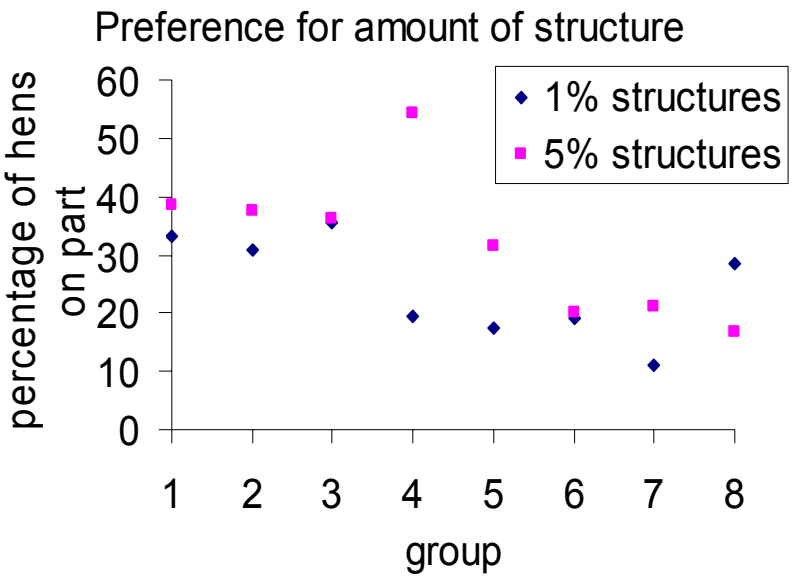
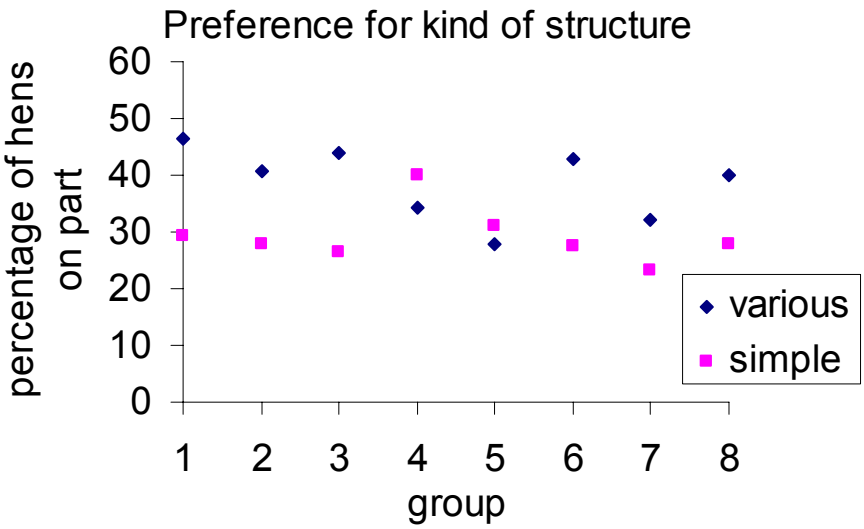


Figure 4: The percentage of the hens in each group, which are observed on the part with various structures and on the part with simple structure respectively.



Discussion

The flock size is important for the use of the hen run and therefore we should keep laying hens in moderate flock sizes. But even in the smallest observed flock size of 50 hens, only 41.2% of the hens are outside simultaneously. Probably this is due to the fact that time consuming behaviours, such as feeding and drinking, are performed inside the poultry house, and the birds have not the time to be outside for a longer period. The distribution of the birds in the hen run did not differ much in the three group sizes. To improve the distribution, it appears, therefore, necessary to change other factors than group size.

Scattering grains in the hen run to bring the hens further away from the poultry house had only an effect on the activity of the hens in our experiment. However, the distribution could not be improved with this management measure. On the other hand, even a simple structure could improve the distribution of the hens in the free range area. Our results demonstrated that the quality and variation of structures influence the use of the hen run more than the amount of structures. Probably this is due to individual differences in the hens, with some being attracted by some structures more than the others. There may also be different needs in different phases of a birds life.

In the last part of this project, we will try to improve the structure of several commercial farms according to these results and in discussion with the farmers and compare the use of the hen run of the "improved" group with a control group on the same farm.

Acknowledgements

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Part E:
Health and welfare assessment and certification at farm level

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Incorporation of existing animal welfare assessment techniques into organic certification and farming

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Introduction

The organic certification system – as it is currently implemented in the EU Council Regulations (EEC) No 2092/91 and 1804/99 and as is the case for most other farm assurance schemes – is based on assuring standards, which mainly describe resources, such as stocking densities or provision of straw. While the organic system has been designed and aspires to guarantee various outcomes (e.g. increased immunity, improved animal welfare, minimisation of residues in meat/milk, reduced damage to natural flora and fauna), the certification system does not take any legal responsibility over these outcomes. However, the outcomes are an integral part of the organic farming objectives and a major reason for continued consumer interest in organic products. While animal welfare is recognised as an important goal of organic production systems, there is an acceptance that little evidence of improved animal welfare exists (Hovi *et al.,* 2003).

It is important to bear in mind, that the assessment procedure during inspections for (organic) certification restricts the choice of methods. Particularly, the time available for inspection is often limited to one or two hours, restraint of animals is often not possible and methods, such as blood sampling, are too costly. Therefore, only some selected aspects of animal welfare can be assessed.

Input/resource assessment

The assessment of animal welfare at farm level can concentrate on 'inputs' (resources) and process quality in the following areas:

a. Stockmanship: training, skills, knowledge, empathy;
b. Environment: housing, diet;
c. Animal related inputs: breed/breeding.

These resources influence, in a complex way, the welfare of animals. For instance, different levels of stockmanship can lead to varying welfare status, even if the same breed and a very similar housing system is used.

In organic certification, assessment of inputs is commonly carried out during inspections. In Austria, a specific scoring system of mainly inputs, the Animal Needs Index (Bartussek, 1999), is an additional legal requirement on organic farms. There are some advantages in input-based assessment methodologies, such as good repeatability for some parameters (e.g. drinking points, length of feeding trough) and ease of assessment. However, some measures are poorly repeatable (e.g. amount of straw, cleanliness of floor) and, most importantly, there is no judgement of the actual welfare outcome.

Output/animal-based assessment

An alternative to input-based welfare assessment is the assessment of welfare outputs, also called animal-based welfare assessment. This type of assessment could be perceived to be associated with product quality and concentrates on:

a. Physical condition: lesion scores, cleanliness scores etc.;
b. Behavioural observation: flight distance, rising restrictions etc.; and
c. Medicine records: mastitis cases/100cows/year, lameness cases/100cows/year etc.: allow some judgement on the health and welfare status over time.

These parameters allow a more direct assessment of some aspects of animal health and welfare and are already used in on-farm research (e.g. Capdeville & Veissier, 2001; Leeb et al, 2001). Some of them are established and validated parameters (e.g. body condition score, MAFF, 1998), others are currently investigated for repeatability and importance to the animal (e.g. flight distance) in a large EU project (Blokhuis et al, 2003). Currently these parameters are rarely used for certification. Furthermore they could be an important part of evidence based/quantitative health plans, providing an opportunity for health plans to become valuable management tools (Gray and Hovi, 2001).

Methodology in this project

A DEFRA funded development project has, for the past year, been incorporating existing welfare assessment techniques for dairy and beef cattle, pigs and laying hens into organic certification and farming.

All measures of an existing protocol (RSPCA Freedom Food study; Main *et al*., 2003, Whay *et al*., 2003a, Whay *et al*., 2003b) were listed and evaluated by the authors:

- Each parameter was compared to corresponding paragraphs of the UK Compendium of Organic Standards (ACOS, 2002) and the Welfare of Farmed Animals Regulations 2000 (WFAR 2000).
- For dairy cows the prevalence of most parameter is known from previous work (Whay *et al.*, 2003b), for pigs and laying hens this data is not available yet.
- Within observer repeatability (different times of the day/year) and in-between observer repeatability (different trained observers) was assessed on a scale 0-3.
    - 0 not repeatable
    - 1 poor repeatability (intensive training/instructions necessary, no scientific evidence for repeatability)
    - 2 good repeatability (training/instructions necessary, some scientific evidence for repeatability)
    - 3 excellent repeatability (established/published method)

- Practicality (handling/access to animal) of the parameter was assessed on a scale of 0-2:
    - 0 hard: more than simple palpation, prolonged physical contact necessary
    - 1 moderate: requires palpation or questioning of owner
    - 2 easy: assessed visually only from 1m distance

- Time necessary to assess per animal/group of animals was known from previous work.
- Furthermore the importance of the parameter for the farmer (profitability) and the animal (health and welfare) were assessed on a scale from 0-10 (0: not important at all – 10: extremely important).

These scores were added to a total score and parameters ranked according to this score. The option of creating a long list and a short list was discussed, however, after final evaluation and discussion with the steering group, consistent of seven members of organic certification bodies and a member of DEFRA a medium length list of welfare parameters was established.

These assessment protocols were pilot tested on 25 farms for all species in England, Wales and Scotland during normal inspections or independently from that.

Results

Three protocols (cattle, pigs and laying hens) were produced within the project for welfare assessment in conjunction with routine organic inspections.
The assessment protocols consist of three parts:

1. **Animal Form**:
   a. Individual assessment: objective animal-based assessments of a representative number of individual animals and calculation of prevalence, using parameters such as:
      - body condition score;
      - overgrown claws;
      - injuries;
      - cleanliness; and
      - behavioural observation, e.g. lameness scoring, rising restriction and flight distance.
   b. Group assessment: Furthermore, the herd is assessed for presence of other signs of impaired welfare (e.g. coughing, skin irritation) and positive indicators (e.g. playing behaviour). These parameters are not quantified, as they are not repeatable enough or the presence of e.g. one obviously sick animal must lead to action.
   c. General impression: Qualitative descriptors, such as:
      - the apparent opportunity for the animals to perform normal behaviours;
      - the overall integrity;
      - physical appearance;
      - the mood of the herd;
      - suitability of animals; and
      - stockmanship to the individual situation is made.

This assessment is estimated to take approximately one hour on the farm.

2. **Medicine records** are used to calculate disease incidences and the
3. **Health plan** is assessed for completeness and effectiveness.

The assessment of medicine records and the health plan should ideally be carried out in advance of the visit and allows evaluation of implementation and effectiveness of the health plan during the inspection. Intervention guidelines are suggested for individual assessment and medicine

records, which originate, in the case of dairy cows, from a consultation with the British Cattle Veterinary Association members (Main, *et al.,* 2003). For other species, intervention guidelines are based on relevant literature, previous findings (Freedom Food laying hen and finishing pig data) and the opinion of the authors and were agreed with the steering group.

The following summary of the protocols can be made (Figure 1):

1. Animal-based measures:
   - Covers dairy cattle, beef cattle, finishing pigs and pregnant sows and laying hens;
   - Includes definitions & detailed assessment procedures for animal-based measures of performance;
   - Measures include health records and physical and behavioural observations;
   - The forms are available in paper format or completion directly onto computer.

2. Health plan assessment
   - Rigorous assessment of the preventative components health & welfare planning systems by examining the prevention and treatment protocols and associated monitoring systems for the most important concerns for each species;
   - Relates the preventative components with corrective action assessment (below).

3. Assessment of generic components such as use of advice, implementation of health plan, updating of health plan
   - Further investigation of potential problems
   - Defines potential problems by identifying which measures are above the intervention guidelines defined by the user (certification body).
   - Relates the animal based measures with welfare standards (organic, farm assurance or legal) ensuring further investigation of relevant welfare provisions.
   - Structured assessment of the farm's corrective action for potential problems that highlighted during the assessment including the farmer's perception, evaluation and action taken.

In addition, a web-based system was developed, linking together the data from assessment of medicine records, health plan and animal based observations. The system, Bristol Welfare Assurance Programme (BWAP), is capable of producing farm specific `benchmarking `reports, comparing each measure to the outcome on other farms. It also includes explanations of the significance of the findings, and links animal welfare assessment to organic standards and animal welfare regulations. The web-based system can be summarised as follows:

- Database, supporting information & updates
- A web-linked database of assessment results enabling establishment of "norms" for systems being examined.
- An open access web page will ensure transparent access to all components of the system (except the database of results).
- All forms (for farm assessment), definitions of assessment procedures, significance of the measures to welfare standards and significance for the farmer will be available in pdf format suitable for printing and on-farm use

- A registration system will ensure regular update of the results database from the user to the central database and of modification of assessment procedures.
- An individual report in printable, web page or email version will be generated for farms that have been assessed
- The report will give the summary of the results and provide information on their performance with respect to their peers.

Discussion and conclusions

It is believed that the benefits of welfare assessment can be significant. For instance, the results of welfare evaluation will educate farmers about their situation and compare it to similar farms, encouraging improvements. Intervention guidelines indicate specific welfare problems (e.g. lameness, feather damage) needing attention. Each problem can be dealt with individually within the health plan, while veterinarians and advisors can use the results to give guidance on how the situation could be improved. It is also believed that the assessment system provides a valuable tool for certification bodies and farmers to monitor and review their situation, which has the potential to shift the overall standard on organic farms towards higher welfare. This is seen as being particularly important in the light of the findings of another study that suggested that organic inspectors were reluctant to raise welfare concerns in their inspection reports in the absence of formal assessment guidelines (Hovi *et al.*, 2003). Furthermore, the goal of organic farming to ensure high animal welfare (ACOS, 2003) can be transparently demonstrated to the public.

Acknowledgements

This project would not have been possible without the funding by the Department of Environment, Food and Rural Affairs (DEFRA) and the previous Freedom Food study funded by the Royal Society for the Protection of Animals (RSPCA). Furthermore, we are particularly grateful for all contributions by participating farmers and the certification bodies.

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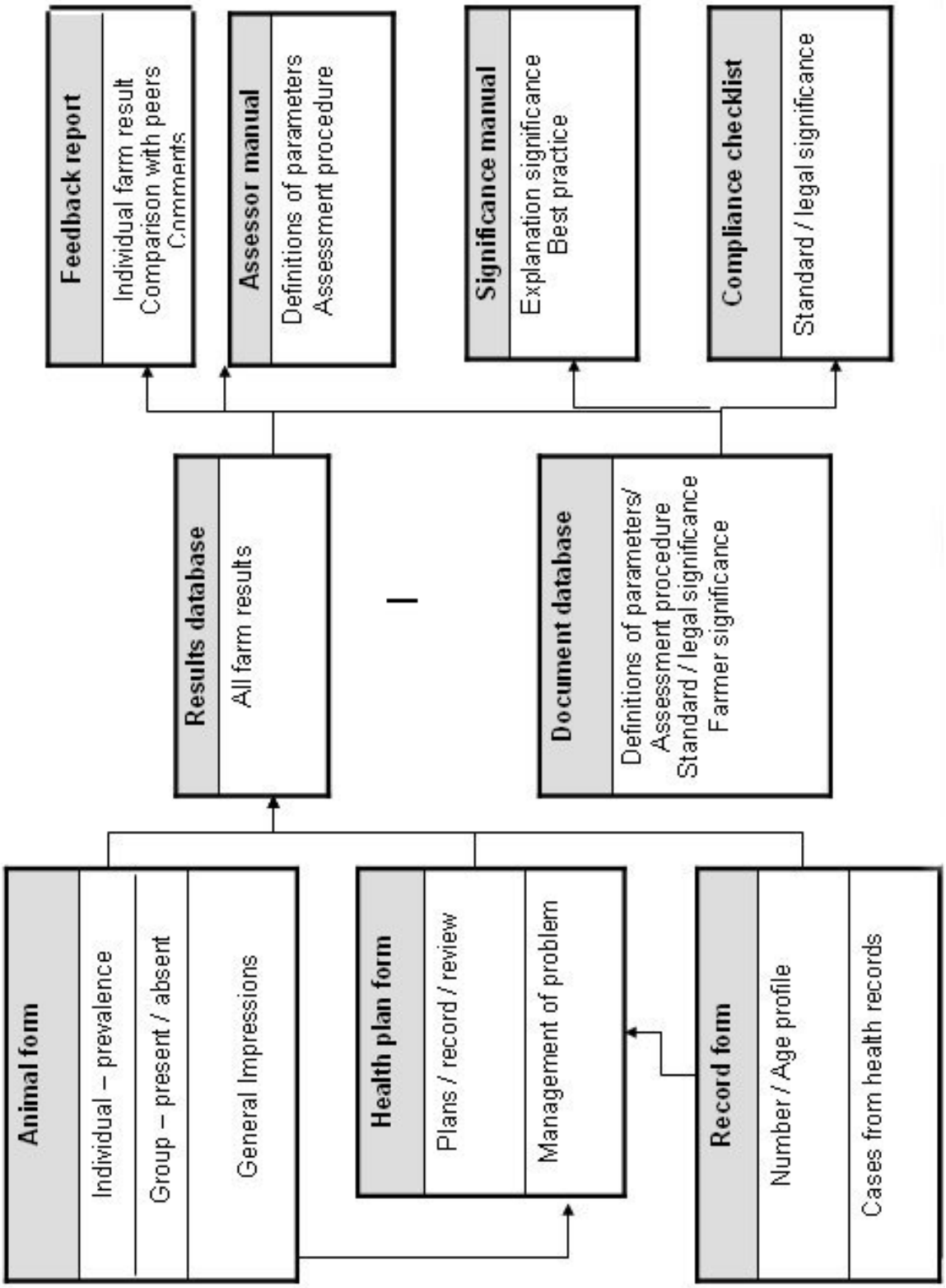

Figure 1: Overview of Bristol Welfare Assurance Programme (BWAP)

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Development of an advisory system that supports good animal welfare in organic milk production in Norway

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Introduction

An important objective of organic farming is to ensure the welfare of farm animals. Both national and international regulations for organic livestock husbandry aim to maintain a high level of animal health and welfare. Nonetheless, organic livestock husbandry has been criticised for cases of poor animal welfare. It is recognised that the regulations themselves cannot guarantee animal health and welfare and that the application of regulations by farmers and the general husbandry standards on the farm are decisive for good animal welfare.

The Norwegian government has an objective that 10 % of the farmland in Norway shall be converted to organic farming by the year 2010. The number of farms converting to organic agriculture will thus increase in the years ahead. Presumably, a broader range of farmers will convert to organic farming than earlier, from experienced, successful farmers to those who have been less fortunate, and want to try organic farming as a last chance. Organic livestock husbandry places some different demands on the farmer from those seen in conventional livestock farming. These differences are most pronounced with regard to housing, access to open-air runs, feedstuffs, disease treatment and breeding stock. Also, there are different risk factors in organic than in conventional livestock farming. The production system places stringent requirements on farm operations, surveillance and risk management. Thus, the dissemination of know-how aimed at the challenges inherent in organic farming methods are important in order to secure a high level of animal health and welfare.

Animal welfare advisory service in Norway

To meet the need for information and expertise, an advisory and development project ”Good animal welfare in organic dairy farming”[1] started in May 2003 and will last until the end of 2005. The project’s main goal is to develop and establish a permanent advisory service aimed at securing a high level of animal health and welfare in organic dairy farming.

The secondary goals are to:
1. Disseminate knowledge about organic livestock husbandry among experts working directly with livestock farmers (TINE Dairy advisers, veterinarians, etc.);
2. Develop and test an advisory system for use in organic dairy farming;

[1] “Good animal welfare in organic dairy farming” is funded by the Norwegian Agricultural Authority, and is carried out as a joint project between the Norwegian School of Veterinary Science (NVH), TINE’s producer advisory service and the Norwegian Centre for Ecological Agriculture (NORSØK). NORSØK functions as the project’s coordinator.

3. Develop and test a system of standards, assessment and documentation of animal health and welfare in organic dairy herds; and
4. Develop information material and templates for group counselling and for training farm advisers.

Danish studies have shown that farm advisers' and veterinarians' knowledge and understanding of organic agriculture, as well as good communication with the farmers, are important in order to ensure successful conversion to organic livestock husbandry (Vaarst *et al*., 2001). It is therefore important to develop know-how regarding the potentials and challenges of organic farming. The most active sources of expertise, and those that are in closest contact with dairy farmers in Norway, are TINE's Dairy advisers and local veterinarians. TINE BA is Norway's largest producer, distributor and exporter of dairy products. It is the sales and marketing organisation for Norway's dairy cooperative, but do also have a well established producer advisory service. The project will base the development of health and welfare systems on TINE's group counselling and existing activities in the Norwegian Cattle Health Service, which are working with improving general cattle animal health and welfare in Norway. The Norwegian Cattle Health Service has had a complete health card recording system since 1976, where the information is regularly sent to a main frame at a central database in Oslo, combined with other production data from the same herd (The Norwegian Dairy Herd Recording System). Every disease and treatment, whether by the vet or by the farmer, must be recorded. They also have different "health advisory packages" for members. The project will also use information from The Norwegian Dairy Herd Recording System that records information about milking yield, fodder, breed etc.

The advisory services in the future – a vision

Farm advisory systems will be designed for organic dairy farmers, and will include farm visits by advisers in order to evaluate herd health and welfare, as well as advice on disease prevention and the improvement of animal welfare. On the first farm visit, the adviser and the farmer jointly consider the status of herd health and animal welfare with the help of a welfare check lists and health reports of the herd records. Then, either directly during the visit, or afterwards, a plan for improving animal welfare is set up. On later visits, the implementation of new, or the revision or removal of existing welfare measures are evaluated on the basis of the developed plan. In addition, counselling meetings will be held with groups of farmers, production advisers, veterinarians and other advisers as a forum for discussions. Relevant topics of current interest may also be presented at the group meetings.

Developing the advisory service

In the early phase of the project, the scope of the advisory activities was formulated. This includes designing the dairy welfare check lists, in close cooperation with the Agricultural University of Norway and the Danish Institute of Agricultural Sciences. These check lists will be one of the project's main products. Furthermore, a template for the welfare plan, which will be used to maintain or further improve a farm's animal health and welfare status, and the design of the group counselling, will be developed. Later on in the project, the advisory system will be tested, and the experience from these trials will be used to adjust the system's design, as the project progresses.

The development and testing of the advisory service is being conducted in an area in central Norway, where there already is a lot of professional activity. The project includes 10 organic dairy farms, receiving a total of four farm visits each from selected veterinarians and TINE advisers. The first visits were conducted in late November 2003. Emphasis will be placed on determining how to measure the actual effect of welfare measures on animal health and welfare. This process will finally lead to a recommendation for the design of the advisory services.

Based on the cooperation between the involved experts and farm advisers, course and information material will be developed, adapted to the needs of advisers working with issues related to animal health and welfare in organic dairy production.

Expected results

The following results are expected from the project:

- Check list for the assessment of animal health and welfare in organic dairy production;
- Template for a health and welfare plan for organic dairy farms;
- Information material and design of group counselling meetings in the field of animal health and welfare in organic dairy production;
- Course and information material adapted to the needs of advisers working with issues related to animal health and welfare in organic dairy production; and
- Focus on animal health and welfare in publications and various press coverage.

How can we measure animal welfare?

We have chosen to base our animal welfare project on a welfare assessment system which has been tested in Denmark (Rousing, 2003). The parameters they considered were housing construction and design, the interaction between animals and humans, cow behaviour during milking and clinical studies of the animals. The welfare assessment routine tested on Danish dairy farms took two days to complete. However, we wish to limit the visit to one round of milking, thus limiting the scope of tests and measurements we can use. The system in Denmark was developed and tested in loose housing systems. Many of the Norwegian stables for dairy cows have tethering systems. The typical Norwegian dairy herds are also smaller than the dairy herds in Denmark. We therefore had to change some of the tests and registrations. Currently, we are recording four different parameters: general impression of the herd, animal behaviour, interaction between animals and humans and farm management and operating systems.

1) General impression of the herd

Animal health (or lack thereof) is considered to be an important welfare indicator. Often disease is linked with pain, discomfort and stress for the animals. Especially, acute painful diseases and long-term chronic ailments have an effect on animal welfare. We use data from The Norwegian Cattle Health Recording System in addition to a visual assessment during the farm visits. Such aspects as fatness, cleanliness, excrements, respiratory problems and various types of injuries are recorded.

2) Animal behaviour

Normal and abnormal behaviour are recorded during the farm visits:
Milking is a daily, routine operation. Thus, it is important that milking routines are not a source of stress for the cows. Discomfort during milking can be seen in such behaviour as leg stamping, kicking, tail switching and attempts to remove the milking machine. Reasons for such behaviour include social stress associated with loose housing or while waiting outdoors to be milked, discomfort during milking or fear of the stockman.

Rising is a frequent behaviour in dairy cows. If the cows are prevented from rising, or have any difficulties in carrying out this activity, this may indicate that rising causes discomfort or may lead to injuries.

Excessive oral contact with other calves, themselves or housing installations indicate that calves have not become accustomed to their situation. This could be due to such factors as isolation in individual pens, pail feeding or early weaning. Well-being is indicated by playfulness, i.e., jumping, kicking and nudging other calves.

Stereotypic behaviour may indicate environmental stress and that the animal is, or has been frustrated and not in command of the situation. One example is tongue-rolling in cattle, which may be linked to tethering heifers in cubicles and feeding too little fibre. Social factors, such as being tethered next to a superior animal, can also lead to frustration and stereotypic behaviour.

3) Interaction between animals and humans

The relationship between herd members and the human(s) feeding, milking and caring for them is of major importance for the animals' behaviour, welfare and performance. This relationship can be affected by such factors as genetic disposition, housing design as well as the frequency and quality of animal-human interaction. If the relationship is characterised by stress, animals will feel discomfort or fear each time they interact with humans. Various types of tests have been developed to assess human-animal relationships. We are using tests which record the reaction of an animal to a person slowly approaching it in order to attempt to pat the animal.

4) Farm management and operating systems

Information about operating systems and farm management is important in order to find the causes of different types of behaviour and diseases. During the visits, the farmers are asked about their farm operations, the routines of the dairy workers, while we also have access to data from The Norwegian Dairy Herd Recording System and The Norwegian Cattle Health Recording System. Also, data on livestock housing, technical installations and cleaning routines are recorded. Animal welfare is not only affected by the farming system itself, but also by how the system is used. Therefore, farm management can have at least the same effect on animal welfare as the actual farming system and housing design.

In the right direction

Organic agriculture wishes to emphasise animal welfare, and aims to be at the forefront with regard to promoting the welfare of farm animals. It is therefore important to increase the expertise in the field of animal welfare in organic farming systems among veterinarians, advisers and farmers. An advisory service that includes on-farm assessment of animal welfare will

contribute to securing a high level of animal welfare in organic production. The project described here focuses on organic dairy farming. However, it is conceivable that this concept can be adapted to other organic and conventional livestock production systems.

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Development of organic livestock production and certification in Latvia

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Introduction

During the last five to ten years, a new agricultural production system – organic livestock farming - has developed in Latvia, as in many other European countries. Previously, organic farming in Latvia had been constrained mainly to plant production.

It is clear that further development of these systems must be based on scientific investigations. The scientists at the Research Centre "Sigra" of the Latvia University of Agriculture have carried out investigations on animal food product quality (including organic farming products) over the years. It is clear that particular attention in organic systems should be paid to food chain critical points or risk factors. The higher the production standards, the better the technological solutions used and the better qualified staff, the less possible risk factors manifest and higher product quality is achieved.

To ensure product quality, the following critical points in food "chain" must be controlled: soil → plants → forage → animals → animal health → food → safety → processing → products labelling → delivery. Parallely to risk factors, animal welfare and bioethical considerations must be observed in livestock production.

Organic farming research at the Research Centre "Sigra"

The further development of organic farming is dependent on scientific support to it. Envisaging this, the Research Centre "Sigra" started research into "ecologically sound animal products" in Latvia in the early 1990s.

The content of heavy metals (Cu, Zn, Cd, Pb, Hg and As) was determined in samples of milk, meat and eggs in different regions of Latvia. Heavy metals are redistributed in the environmental by both geological and biological cycles. The biological cycles include biological concentration by plants and animals and incorporation into food chain. Human industrial activity may greatly increase heavy metals distribution worldwide. Metal contamination of the environment reflects both natural sources and contribution from industrial activity. For consumers, food sources probably represent the largest source of exposure to metals with additional contribution from the air.

During the years 1991-2001, 1,361 samples of milk, meat and eggs were analysed from different regions of Latvia for heavy metal content. Only in few samples of milk, Cu and Zn exceeded the

maximum permissible level (MPL). Heavy metals and arsenic MPL was not exceeded in any samples of meat and eggs. Investigations of 10 years confirmed that, in different Latvian regions, there was not observed milk, meat and egg contamination with heavy metals, and it is possible to produce organic animal food products in all rural areas without a risk of such contamination.

More recently, we have initiated investigations into organic animal product quality. The goal of our investigations is to develop feeding systems that are based on locally produced organic feedstuffs for different kinds of domestic livestock and to evaluate the influence of these feedstuffs on livestock productivity and product quality.

Milk production

Investigations were carried out in two neighbouring farms – one farm applied conventional feeding system, the other organic feeding system. Ten dairy cows in each farm were investigated. All investigated cows were complected according to previous year's milk yield, lactation month and age. The husbandry conditions were similar. Production indices for both farms are shown in Table 1. There was little difference in average milk yield, fat and protein content between organically and conventionally fed cows. ECM milk yields differed, similarly, very little.

Table 1: Cows productivity indices (based on 27 cows) on two neighbouring dairy farms in Latvia.

Farming system	Milk yield, kg^{-1}	Fat content, %	Protein content, %	Energy corrected milk, kg^{-1}
Summer (June, July, August = 92 days)				
Organic farming	16.9	4.3	3.19	16.90
Conventional farming	16.5	4.4	3.23	17.28
Winter (October, November, December = 92 days)				
Organic farming	14.8	4.4	3.13	15.82
Conventional farming	15.2	4.5	3.26	15.95

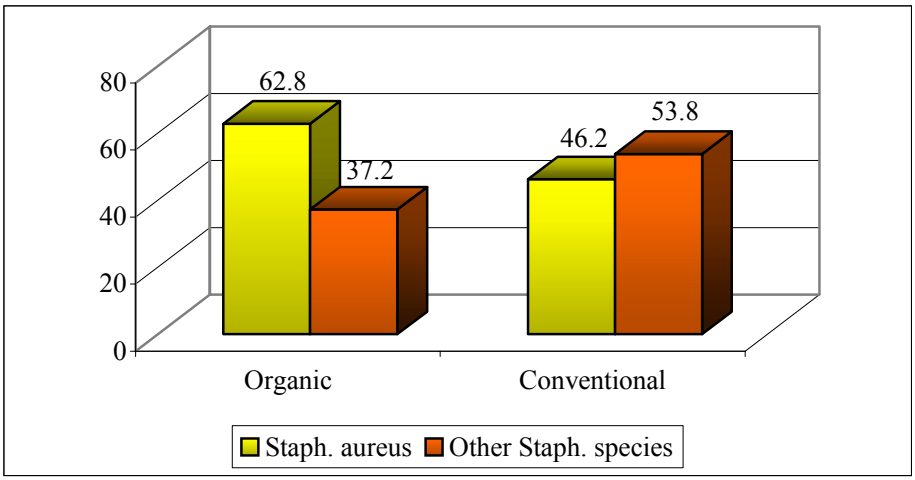
Bacteriological and hygienic quality of milk was higher in conventional farm (Table 2 and Figure 1). On the organic farm, lack of udder processing with chemical preparations before milking was considered as one of the reasons of the poor milk quality.

Table 2: Bacteriological quality of milk produced in an organic and a conventional farm in Latvia.

Farming system	TBC (CFU/ml$^{-1)}$	Somatic cell count/ml	*S. aureus* count/ml	Other *Staphylococcus* count/ml
Organic	55,000	789,000	7,341	2,790
Conventional	40,000	552,000	2,084	1,855

TBC – total bacterial count; CFU – colonies forming units count

Figure 1: *Staphylococcus* species in cow milk produced in an organic and a conventional farm in Latvia.

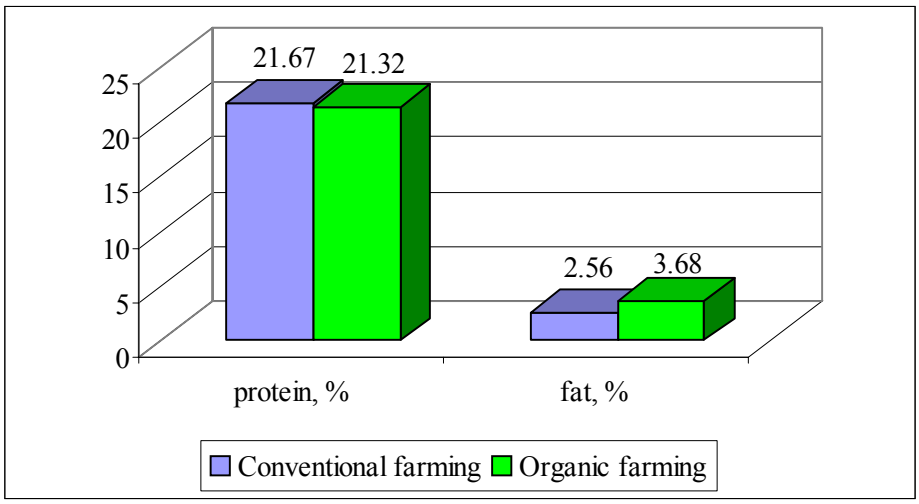


An analysis of cholesterol levels in the milk of groups of cows was carried out. Average cholesterol level in organically produced milk was 11.26 mg/100 ml and in conventional milk 13.30 mg/100 ml.

Pork production

Three conventional and six organic farms were involved in an investigation into pork quality in Latvia. For pork quality evaluation, 76 pigs from different organic and conventional farms were slaughtered and carcasses evaluation by using different chemical analyses (Figures 2, 3 and 4) were carried out.

Figure 2: Muscle tissue protein and intramuscular fat content in pigs from organic and conventional systems.



As is seen in Figure 2, pigs muscle tissue protein content did not differ in organic and conventional farming systems. However, intramuscular fat content differed significantly. Tryptophane content (Figure 3) had a tendency to increase in organic pigs group's muscle tissue. Oxyproline amount differed even more significantly. Cholesterol levels were significantly lower in organic pig muscle tissue (Figure 4). Increased intramuscular fat content in organic pigs can be explained partly by feeding systems that produced prolonged fattening periods and more intensive fat sedimentation in muscle tissue. Decreased cholesterol level in organic pigs can be as a result of mixed feeding type effect on biosynthetic processes of cholesterol. Increased average oxyproline level demonstrated that optimum fattening finishing ages, in some cases, were exceeded.

Figure 3: Muscle tissue protein quality indices of pigs from organic and conventional farms.

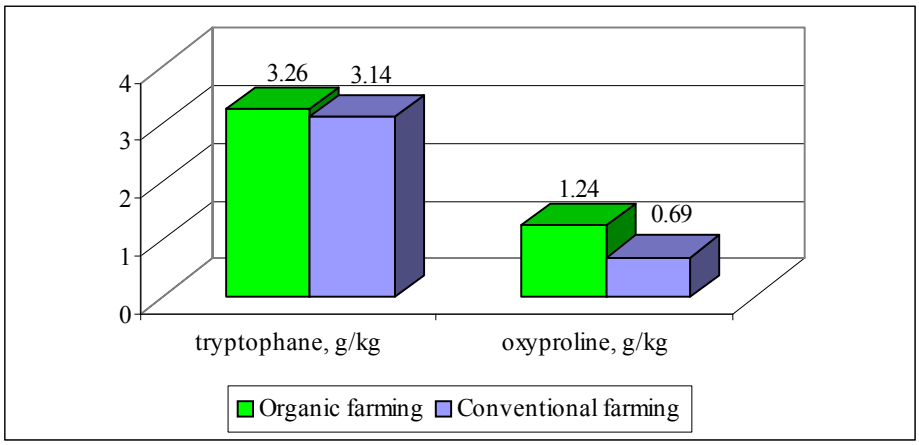
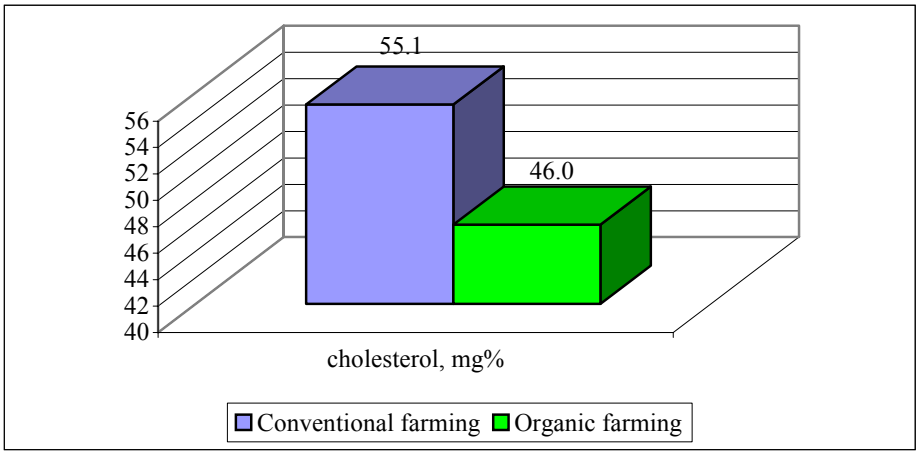


Figure 4: Muscle tissue cholesterol content in pigs from organic and conventional farms.



Egg production

Investigations have been carried out into the effects of an organic feed mix, developed in the Research Centre "Sigra", on layer productivity and egg quality, with a comparison with an equivalent conventional feed mix. Hens, with the age at the beginning of trial of 22 weeks, were used. Trial duration was 25 weeks. Feed composition, consumption, expenses, laying, egg mass, egg productivity and mass chemical composition were recorded, calculated and analysed.

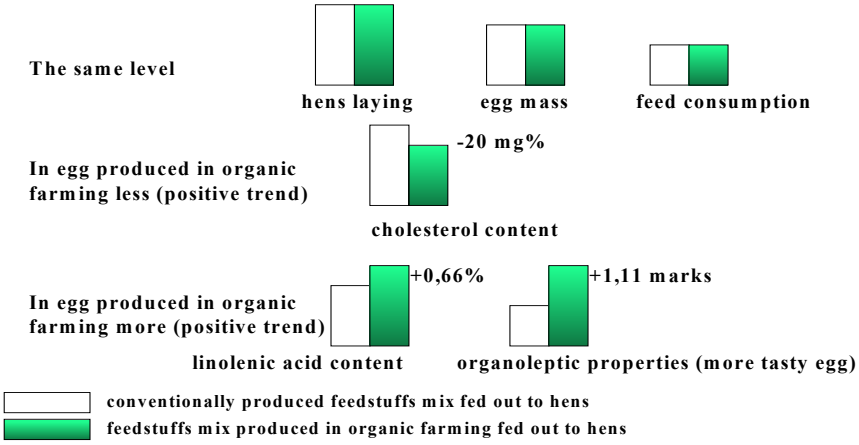
Laying intensity, average egg mass and obtained egg production was not influenced essentially by organic feed mix (Table 3).

Table 3: Poultry productivity and feed consumption using conventional and organic feed mixes.

Indices	Conventional feed mix	Organic feed mix
Laying intensity, %	90.71	90.08
Egg mass, g (average egg mass)	58.24	58.14
Feed consumption for 1 kg egg mass production, kg	2.26	2.27

Organic feed mix appeared to increase unsaturated fatty acids content in egg yolk (mainly caused by linolenic acid increase) but cholesterol level decreased in comparison with eggs produced by hens fed the conventional mix (Figure 5).

Figure 5: Hen productivity and egg quality in hens on organic and conventional feed rations.



Organic farming development in Latvia

Certification

The development of organic farming in Latvia is guided by the Agriculture Law that defines organic farming and charges Food and Veterinary Service with state supervising and control on organic certification. The organic farming development State programme is accepted by the Ministry of Agriculture.

Organic farming certification is carried out by two public organization: “Environment quality” and a public limited company “Agricultural equipment certification and testing centre”. The certification institutions accreditation documents were submitted in National Accreditation Bureau for accreditation till May 1, 2004. According to EU requirements, the Council of Ministers of Latvia has adopted regulations “Organic farming products circulation and certification order” and “Persons registration order involved in organic farming circulation and organic farming products circulation state supervising and control order”. Organic farming development and certification dynamics during the recent years and the current situation are shown in Figures 6, 7, 8, 9 and 10 and Table 4.

Figure 6: Number of organic farms in Latvia in 1998-2003.

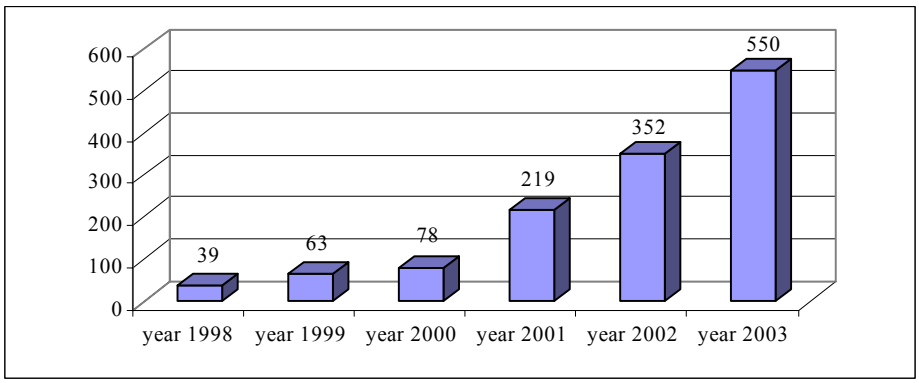


Figure 7: Certified organic land area in Latvia in 1998-2003.

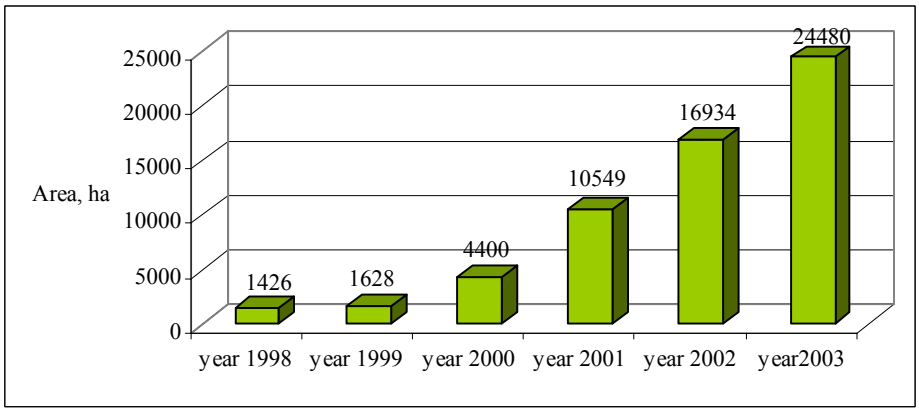


Figure 8: Status of organic farming enterprises structure in Latvia in 2001-2003.

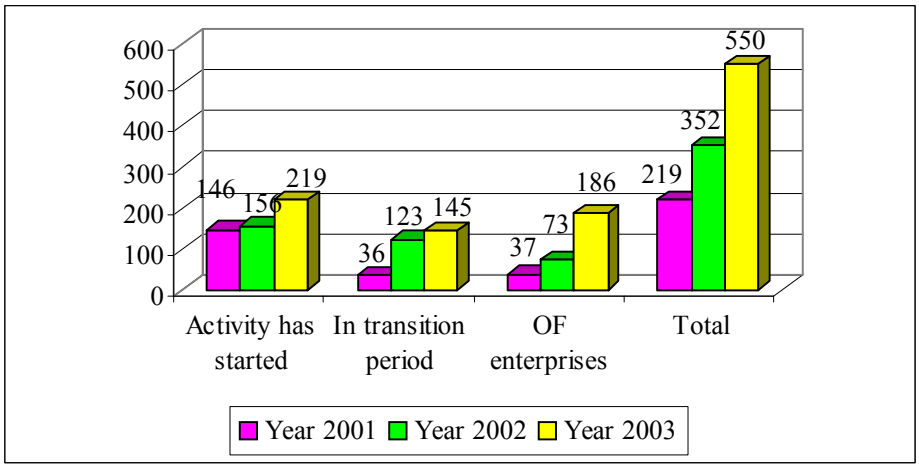


Figure 9: Organic farming enterprises by size of arable land in Latvia in 2003.

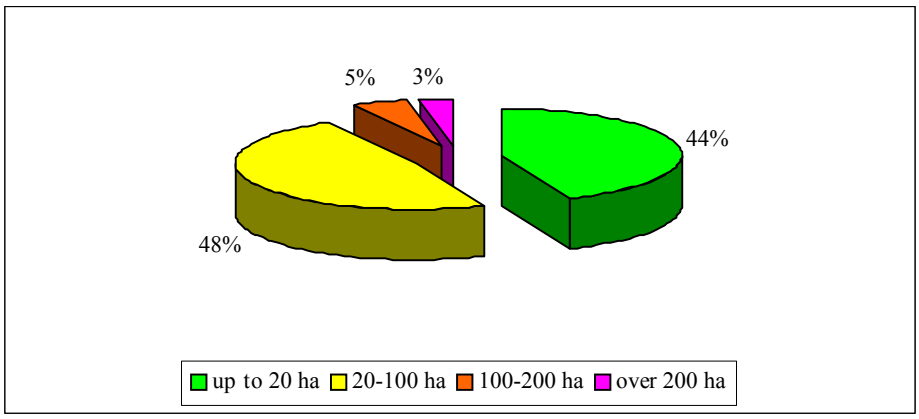


Figure 10: Certified organic livestock production farms in Latvia at the end of year 2003

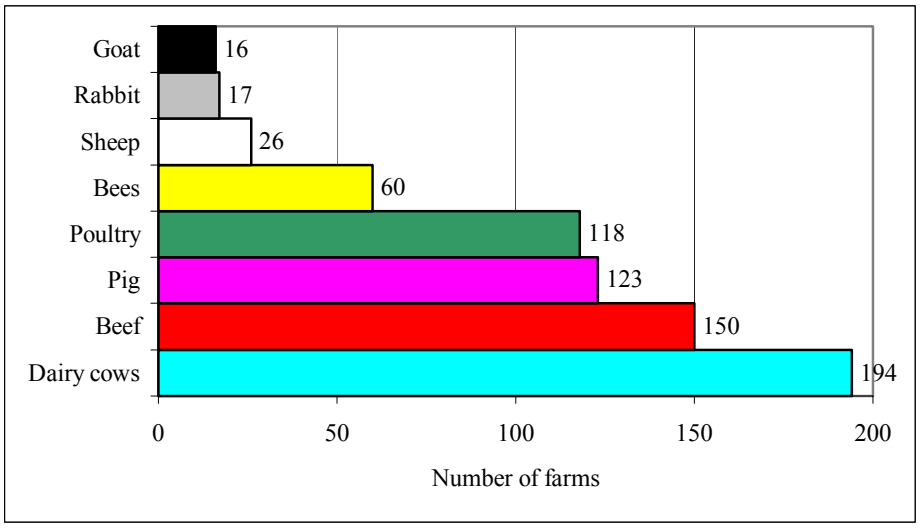


Table 4: Number and status of organic farms and land in Latvia in 2003.

	Activity to enter transition has started	In transition	Fully organic	Total
Organic farms (N)	219	145	186	550
Organic arable land (ha)	8,940	6,737	8,802	24,480

Conclusions

It is proposed that organic farming, including organic livestock production, can be developed in Latvia, if the following conditions are realised:

- Provide local market with necessary amount of organic products and explore possibilities for export;
- Develop organic products processing;
- Extend and develop scientific investigations and education system in organic farming;
- Elaborate balanced state subsidies programme for future organic development;
- Continue the development of the certification system.

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Problems and challenges with the certification of organic pigs

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Introduction

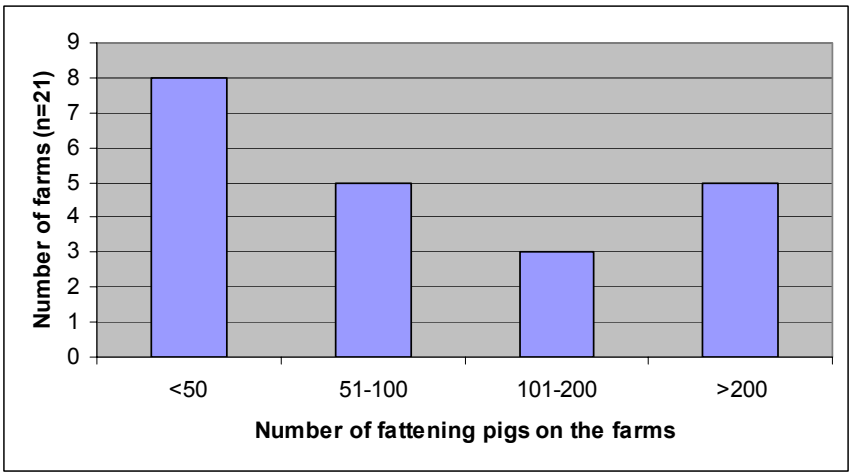
During the last decade, consumers demand for organic pork has steadily increased. Demands include not only low product prices but a harmlessness concerning the freedom of pathogens and residues as well as the implementation of housing conditions appropriate to the farm animals in relation to animal welfare (Bennet, 1996; Bruhn, 2002). Additionally, farmers are asked by the processing industry to provide a uniformed quality of the products. Due to a high variation in the diets used, there are hints that it might be a problem for organic pig production to fulfil these demands (Sundrum et al., 2000).

There is ,however, limited knowledge available on whether organic pig farms can meet the high expectations from consumer and processing. Investigations in Austria showed that organic farmers are not always aware of the health problems in their herds. While organic farmers were, on average, able to provide benefits in relation to respiratory diseases of fattening pigs, liver damages caused by endoparasites were on the same level with conventional pig production (Baumgartner et al., 2001). The objectives of the present study was to assess the animal health and quality status of organic fattening pigs in Germany and to identify difficulties and obstacles that should be taken into account in order to ensure a high level of animal health and pork quality.

Methodology

In total, 21 organic farms were included. The farms belonged to the organic farming associations of Naturland (8), Bioland (6), Demeter (4) and Gäa (3). Most of the farmers (16) derived their main income from farming, while 5 farmers had another full time job. Ten farmers indicated that pig fattening constituted less than 25% of their total income. Three farmers exclusively kept pigs. Farms, on average, were about 105 hectares in size, ranging from 26 to 315 hectares. On average, the farms had a capacity of 183 fattening places. This number ranged from 15 to 800 fattening places. All farms had in common that they delivered their slaughter pigs to the same abattoir. In Figure 1 the farms are categorized according to the number of fattening pigs.

Figure 1: Categories in relation to the number of fattening pigs on the assessed organic pig farms (n = 21)



The pigs were mainly housed in old buildings. The dimensions of the pig barns were usually generous. Although none of the farms had an air conditioning-system in place, deficits in the quality of stable climate were not recognized during the visits. The main problem in these old buildings was to maintain an acceptable status of hygiene. On almost all of the farms, the pigs were provided with a sufficient quantity of straw for bedding material. Straw was also used by the animals for thermal regulation in the completely unheated stables. Opportunities for the pigs to retire only existed if outdoor pens were offered.

The missing or insufficiently arranged outdoor pens represented the largest deficiency of the organic farms. In total, 13 of the farms did not have outdoor pens at all. On only 3 farms outdoor pens existed, which were equipped and dimensioned according to the requirements of the EEC-regulation. The outdoor pens were poorly structured, usually only supplied with a concrete floor and lacking materials, which could have tempted the animals to root or to get occupied differently.

In order to assess the management and the implementation of hygiene measures on the farms, a concept based on critical management points (CCP) according to Borell *et al*. (2001) was used. The animal health status on the farms was estimated by investigations of the carcasses at the abattoir. For the evaluation of the pathological findings, including liver lesions, a basic evaluation code developed by Blaha & Neubrand (1994) and modified by Schütte (1999) was used. This offered the possibility for a comparison between the farms by way of a scaling system. During the investigation period pathological findings of nearly 50,000 pigs were seized at the abattoir, of which 3,989 pigs came from the assessed organic pig farms.

Results

Animal health

Pneumonia, parasitic hepatitis (milk spots), pleuritis and pericarditis were the main findings. Additionally, skin lesions, arthritis, intestinal inflammation and lesions of the kidneys were assessed. A comparison between pathological findings in organic and conventional reared pigs is shown in Table 1. The percentage of organic pigs without findings was 19.3% (23.5% in the conventional group), 32.4% of the organic pigs had one pathological finding it carcass or organs (34.4% in the conventional group). With 32.5% of showing two pathological findings per animal, organic pigs were in the average clearly more burdened than conventional pigs (25.7%). Animals with 3, 4 and up to 7 pathological findings were found in both groups to a similar degree.

Table 1: Comparison between the number of pathological findings in organic and conventional reared pigs

Number of pathological findings per pig	Conventionally reared pigs (n = 46,535)	Organically reared pigs (n = 3,989)
No findings	23.9 %	19 %
One finding	34.6 %	32 %
Two findings	25.1 %	33 %
Three findings	11.5 %	11 %
Four findings	4.9 %	5 %

The results of pathological findings in the lungs, presented in table 2, provided a slightly better picture. 47.0% of the organic pigs had no pathological finding compared to 41.4% of the conventional pigs. Low-grade lung findings occured in 42.0% of the organic and 47.2% of the conventional pigs. Middle up to high-grade lung findings were seen in both groups at about the same level.

Table 2: Comparison between pathological findings in the lung of organic and conventional reared pigs

Pathological findings in the lung	Conventionally reared pigs (n = 46,535)	Organically reared pigs (n = 3,989)
No lung findings	41.4 %	47 %
Low-grade lung findings	47.2 %	42 %
Middle up lung findings	9.8 %	10 %
High-grade lung findings	1.6 %	1 %

Lesions of the liver (milk spots) were mainly caused by wandering parasites (*Ascaris suum*). There was a clear difference in the pathological findings between the two groups (Table 3).

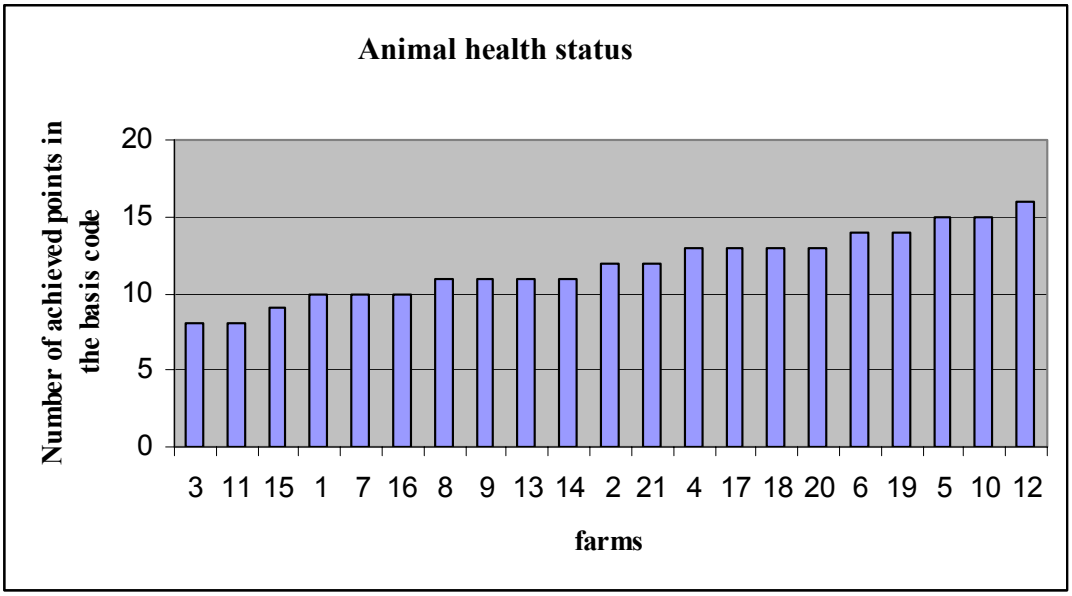
While 57% of the conventional pigs were not affected, only 36% of the organic livers were free of milk spots. 29% of the livers of the organic and 15.3% of the conventional fatteners had to be cut out, and 35% of the organic and 27.7% of the conventional livers had to be disposed of.

Table 3: Comparison between pathological findings in the liver of organic and conventional reared pigs

Pathological findings in the liver	Conventionally reared pigs (n = 46,535)	Organically reared pigs (n = 3,989)
No liver findings	57.0 %	36%
Low-grade liver findings	15.3%	29%
High-grade liver findings	27.7%	35%

The results of the assessment by an evaluation code are presented in Figure 2.

Figure 2: Scoring of animal health of the assessed farms (n = 21) on the basis of the valuation code by Blaha and Neubrand (1994), modified by Schütte (1999). (5–8 points = good; 9–12 points = moderate; 13–16 points = bad)



Feeding

Substantial deficits were found on the farms regarding the feeding management and the composition of the diets. In particular, the crude protein supply was partially deficient. The fatteners, nevertheless, achieved an average daily weight gain of 657g. The fattening period was 150 days on average.

Carcass quality

Carcass quality was rated with the EUROP-System. 46 % of the assessed organic pigs were classified as "E", 30 % as "U", 19 % as "R", 4 % as "O" and 1 % as "P". The lean meat percentage of the organically fattened pigs is significantly higher in variation ($p<0,001$) than the lean meat percentage of the conventionally fattened pigs. The average intramuscular fat content of organic carcass was at 1.53%, and nearly all organic carcasses (95.4%) reached a pH_1 in the muscle tissue of over 6.0.

Conclusions

In the survey, 21 organic farms were assessed with regard to animal health and carcass quality. Deficits existed in relation to the design of outdoor pens. Additionally, feeding management showed potentials for optimisation on many farms. Most of the farmers did not consistently carry out measures to decrease the parasite burden leading to a high degree of liver lesions. Low lean meat percentage was not compensated for by high sensorial quality of pork, as indicated by the comparable low intramuscular fat content.

The results indicate that the examined organic farms did not meet consumer demands. Obviously, the implementation of the EEC-Regulation is not sufficient to secure a high status of animal health and pork quality. Insufficient feedback through market price as well as missing health checks and quality controls are jointly responsible for existing deficits, but offer options for improving the current situation.

System-immanent conflicts of aims between production costs and management measures required for a good health status and a high sensory quality reduce the scope for the farmer to meet the demands. From on overall point of view, there is reason for the assumption that fundamental improvements require a change in the paradigm from an action (regulation) oriented to a result oriented strategy. Animal health and pork quality should be developed as marketable criteria so that they could be held in high esteem as cultural achievements and demanded by those consumers who are willing to pay premium prices that enable farmers to provide high process and product qualities.

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Part F:
Poster presentations

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Assessing dairy cow cleanliness, milk hygiene and mastitis incidence during winter housing on organic and conventional farms in the UK

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Introduction

Hygiene scoring of dairy cows records the degree of contamination of various anatomical areas with dirt and faecal matter, thus giving an overall assessment of the cleanliness of the whole animal (Hughes, 2001; Cook, 2003). Cow cleanliness has been used as a possible indicator of welfare status, and has been found to influence bacterial contamination of milk, and both clinical and sub-clinical intra-mammary infection incidence (Sanaa, *et al.,* 1993; Valde *et al.,* 1997; Ward, *et al.,* 2002; Bowell, *et al.,* 2003; De Rosa, *et al.,* 2003; Schreiner and Ruegg, 2003; Whay, *et al*., 2003). Housing design and faecal consistency, which in turn reflects cow nutrition, can affect cow cleanliness (Bowell, *et al.,* 2003; Ward, *et al.,* 2002; Grove-White, 2004). Organic farming standards stipulate basic criteria for dairy cow housing and for the feeding of a minimum of 60% of the dry matter intake as forage, to provide a basis for optimal dairy cow comfort and health (UKROFS, 2001). There is increasing interest in measuring animal health and welfare indices and particularly whether organic farming provides a humane and sustainable system (Soil Association, 2003; Whay, *et al.,* 2003). This study aimed to validate a hygiene scoring system and investigate whether organic and conventional dairy cow cleanliness affects the hygiene parameters of the milk produced and the clinical mastitis incidence.

Materials and methods

Dairy farms (14 organic and 14 conventional; approximately matched for herd size) in the northwest of England were visited in January 2004. A proportion of randomly selected cows in all lactating and dry cow groups were assessed for cleanliness based on an estimated expected prevalence of 10% of cows being classed as excessively dirty (Ward, *et al.,* 2002). Cows were scored using a method based on previous studies (Hughes, 2001; Bowell, *et al.,* 2003; Cook, 2003). Four areas were observed on each cow: the flanks, the legs, the tail and the udder, with an overall whole-cow score calculated by summation of scores from these sites. Scores for each area were assigned on a 1 to 5 scale (score 1 = very clean, no dirt; score 5 = heavily soiled with dirt and/or faeces) with a whole-cow score therefore ranging between four and 20. One observer determined and recorded scores throughout, with study animals compared to model animals depicted on colour photographs. Within-observer repeatability was assessed by duplicate scoring of 43 lactating dairy cows not enrolled in the main study. Immediately following initial scoring, repeated scoring was completed without access to the first set of scores. Milk quality information comprising bulk tank somatic cell count (BTSCC) and Bactoscan count (BS) for the preceding

months and the number of clinical mastitis cases (cow cases) that had occurred in the preceding months were recorded.

Data analysis

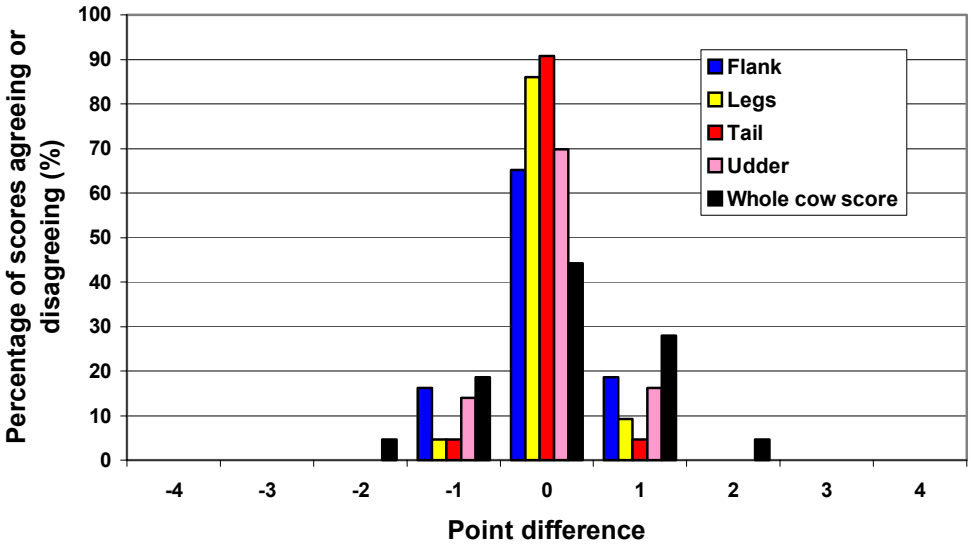
Hygiene score data were entered into a computer spreadsheet programme (Microsoft Excel 2000) and analysis was conducted using Microsoft Excel and SPSS software. Within-observer repeatability was assessed by calculating the number of score agreements and disagreements for the 43 duplicate-scored cows by subtracting the second set of data from the initial data for all sites. Thus, complete agreement would result in a difference of zero between score sessions. The percentage agreement or disagreement for all scores was calculated. Kendall's coefficient of concordance (*W*) was used to test observer agreement for the 43 repeat-scored cows and was considered highly significant when $p<0.01$ and moderately significant when $0.01<p<0.05$. The median herd whole-cow hygiene score was calculated for lactating cows from each study farm. Milk quality data were entered into a database programme (Microsoft Access 2000) and analysed using MINITAB and Excel (Microsoft) software. A general linear model was constructed to compare BTSCC, BS and the lactating cow clinical mastitis incidence between organic and conventional farms in the three-month housing period up to, and including the study month. A difference was considered significant if $p<0.05$. Complete analysis to compare organic and conventional farm hygiene score results accounting for farm level confounding is on-going.

Results

Repeatability of within-observer assessment

Complete within-observer agreement for repeat scored cows occurred on 65%, 86%, 91% and 70% of occasions for the flank, legs, tail and udder sites respectively (Figure 1). For total whole-cow scores, complete agreement occurred on 44% of occasions. The results of Kendall's *W* test showed highly significant agreement ($p<0.01$) in leg, tail, udder and whole cow scores and moderate agreement ($p=0.15$) in flank scores.

Figure 1: Comparison of distribution of within-observer differences in cow hygiene score for 43 duplicate scored cows (observation 1 - observation 2)



Study herds' lactating cow hygiene results and milk hygiene parameters

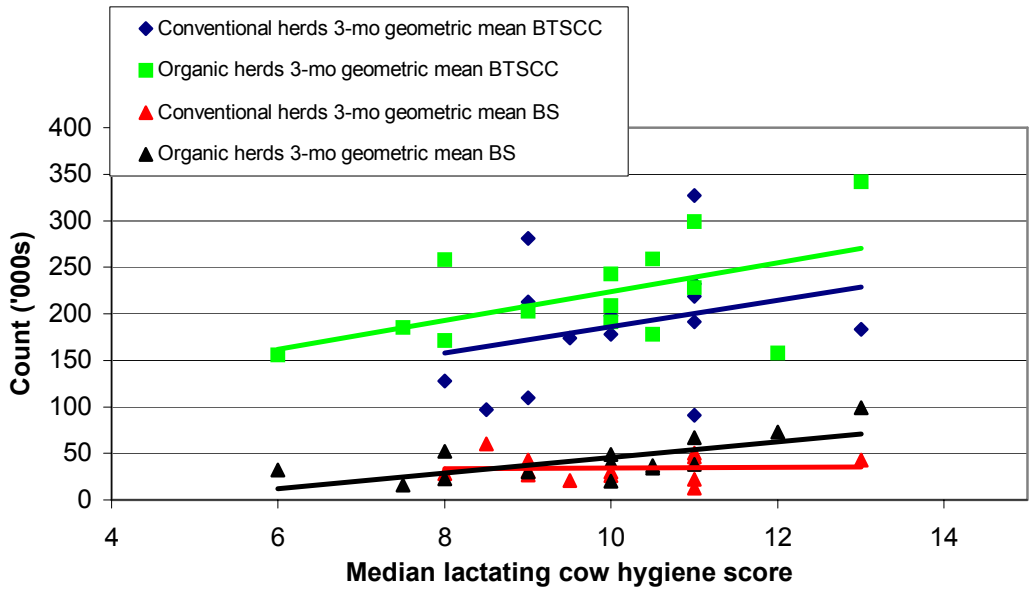
There was no significant difference in the average three-month geometric mean BTSCC or BS count between organic and conventional herds during this study period (Table 1). However, there was a significantly lower mean (SD) 3-month lactating cow clinical mastitis incidence on organic farms compared to conventional farms of 3.5 (1.8) versus 5.6 (2.9) cases/100 cows in milk (Table 1). Increasing herd median lactating cow hygiene score was associated with increasing BTSCC (Figure 2). No clear relationship between hygiene score and lactating cow clinical mastitis rate or BS count was suggested (Figure 2.) However, these data are yet to be fully analysed.

Table 1: Average three-month BTSCC, BS counts and lactating cow mastitis incidence in study herds

	Average 3 month mean (SD) for each farm type	
	ORGANIC (n=14)	**CONVENTIONAL (n=14)**
BTSCC (cells/ml) (geometric mean)	220,000 (55,000)	187,300 (67,500)
Bactoscan/ml (geometric mean)	44,000 (23,000)	34,000 (13,000)
Mastitis incidence (cases/100 cows in milk)	3.5 (1.8)[a]	5.6 (2.9)[b]

[a, b] Difference between farm type is significant ($p<0.05$) BTSCC=Bulk tank somatic cell count

Figure 2: Herd 3-month geometric mean BTSCC and BS data plotted against herd median lactating cow hygiene score



Discussion

This study indicates that hygiene scoring to assess dairy cow cleanliness by one observer is highly repeatable. As in previous studies (Valde, *et al.,* 1997; Ward, *et al.,* 2002) there is a suggested positive relationship between increasing average lactating cow hygiene score and higher BTSCC, which is most likely to reflect an increasing level of sub-clinical mastitis. Interestingly, at this stage in the analysis, there is no obvious relationship between lactating cow clinical mastitis incidence and hygiene score, however analysis is continuing. During the winter housing period in the current study there was a significantly lower lactating cow clinical mastitis incidence on organic farms, which concurs with other work (Hovi and Roderick, 2000). The poor correlation of BS counts and herd hygiene scores may be a reflection of the sensitivity of BS to pick up contamination from other sources apart from the cow; for example if there is a problem with cleaning the milking machine. In the current study, several farms grouped lactating cows according to yield, so more detailed analysis according to management group and housing design, including the dry cows is planned. Additionally, milk hygiene and mastitis incidence data in the months following hygiene scoring are being collected for analysis. Hygiene score data from different anatomical areas may help identify specific sources of contamination in different systems, and further analysis to weight the scores from different sites to reflect different risk levels is planned. Overall, hygiene scoring is a repeatable, easy to use technique, which reflects a number of factors on-farm and can be an indicator of milk quality via BTSCC and thus give some information on sub-clinical mastitis.

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Comparison of cattle production on organic and conventional farms in Poland

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Livestock density and type of livestock enterprises

The livestock density of animals in organic farms should be 0.5-1.5 LU per 1 recalculated ha (Sołtysiak, Tyburski, Tyszka, 2003). In investigations carried out in 60 organic farms in Poland during 1993-1994, the average livestock density was a little over 80 LU/100 ha of agricultural land (Table 1). On over half of examined farms, the livestock density of animals was near the recommended level, i.e. 81-160 LU/100 ha agricultural land. Farms (38% of examined) that were in conversion had low livestock density, below the recommended level (Szafranek *et al.*, 1999).

Table 1: Livestock density of animals in 60 organic farms (in LU/100 ha agriculture lands) and percentage of farms with livestock in 1993-1994 (Szafranek *et al.*, 1999).

Animals	Livestock density		Farms with animals (%)
	LU/100 ha farmland	%	
Cattle	52.1	64.4	100
- including: cows	33.4	-	-
Pigs	21.5	26.7	57.1
Horses	7.2	8.9	50.0
Other animals (sheep, goats)	0.05	-	9.5
Total	80.85	100	-

In 1997, the livestock density in investigated organic farms was 45.5 LU/100 ha (Wasilewski, 1999) (Table 2) and was about 20.4% higher than in conventional farms.

Table 2: Livestock density and structure of animals population in organic farms on the field of conventional farms - 1997 year (Wasilewski, 1999)

Animals	Conventional farms		Organic farms		
	LU/100 ha farmland	%	LU/100 ha farmland	%	% conventional
Horses	-	-	0.8	1.8	-
Cattle	32.7	86.5	36.9	81.1	112.8
Pigs	5.1	13.5	6.6	14.5	129.4
Sheep	-	-	1.2	2.6	-
Total	37.8	100.0	45.5	100	120.4

Dairy production

The main branch of animal production in Poland in both organic and conventional farms is cattle breeding. The average size of dairy herd was 5.2 cows in organic farms and 6.6 cows in conventional systems. Cow longevity in both types of farms was very long: 10 years on organic farms and 9 years on conventional farms. The longevity of cows was associated with low annual milk yields of 4,000-4,500 l of milk, above which the vitality of cows and the number of lactation decreased (Preuschen, 1993).

The most popular breed of dairy cattle was lowland black-white breed (ncb) on over 50% of the farms, and in over 23% farms the cross of lowland black-white (ncb) x HF (Table 3). Average efficiency of milk production from cows was higher on organic than on conventional farms (Table 3). According to an economic estimation by Okularczyk and Borecka (2003), these efficiencies were low, bordering on low economic profitability according to actual milk prices. Gains of investigated beef and pig systems were comparable (Table 3).

Table 3: Characteristic of dairy production in organic and conventional examined farms.

Specification	Farms		Reference
	organic	conventional	
Number of farms	61	53	(Siudek, 1998)
Average size of basic herd (heads)	5.2	6.6	
Breeds of cows (%)			
- lowland black-white	56.5	58.0	
- lowland black-white x HF	23.6	36.0	
- HF	7.2	0.0	
- other	12.7	6.0	
Period of cows utilisation (years)	10	9	
Dairy production from cow (kg/305 days)	3854	3459	
Milk (litres/cow)	3600	3270	(Szafranek,
Beef production (kg/head/day)	0.7	0.5	Trebno,
Pork production (kg/head/day)	0.6	0.5	Gotkiewicz,
Eggs production (eggs/hen)	156	148	1999)

During summer feeding, the basic roughage both on conventional and organic farms was green forage (85% and 100% of farms), hay (51% and 47%) and in organic farms root crops (23%) (Table 4). Home-grown concentrates were used on over 60% of all farms, bought fodder only in 6% of organic farms. During winter feeding, the basic roughage on both types of farms was hay (87%), straw on tuck (*ad libitum*) - more in conventional (over 70% and 58%), root crops (70%), silage - also more in conventional - 47%, while in organic 36%. Home-grown concentrates were used in over 85% of examined farms, instead of bought feeds in 13.2% organic farms and over 20% of conventional. The additives of vitamins and minerals, often salt fodder throughout the year, were used similarly on both farm types.

Table 4: Percentage of farms using in dairy cattle feeding respective fodder (Siudek, 1998)

Specification	**Farms**			
	organic		conventional	
	summer	winter	summer	winter
Roughage				
- green forage	85.0	0.0	100.0	0.0
- hay	50.9	86.8	46.9	87.8
- straw at libitum	47.2	58.5	32.7	73.5
- root crops	22.7	73.6	6.1	71.4
- silage	13.2	35.8	12.2	46.9
Concentrates				
- produced on farm	64.2	84.9	59.2	87.8
- bought (from purchase)	5.7	13.2	12.2	20.4
Vitamin-mineral supplements				
- mineral lick	86.8	86.8	79.6	81.6
- polfamiks	1.9	3.8	8.2	14.3
- MM	7.5	9.4	12.2	18.4
- others	5.7	7.5	4.1	4.1

Both in the summer and the winter period, most organic farms used twice a day feeding (Table 5). On small farms, the most common grazing system was picketing (on the chain tie) (56%). On bigger farms, a rotational grazing system was most common.

Table 5: Systems of feeding and grazing on Polish dairy farms (Siudek, 1998)

Specification	Dairy cow		Meat cattle	
	Farms			
	organic	conventional	organic	conventional
	Feeding systems (%)			
Summer				
- l time a day	22.6	25.0	0.0	18.8
- 2 times a day	64.5	62.5	88.2	56.2
- 3 times a day	9.7	12.5	11.8	25.0
- 4 times day	3.2	0.0	0.0	0.0
Winter				
- l time a day	2.9	0.0	0.0	5.6
- 2 times a day	76.5	73.7	84.2	66.7
- 3 times a day	14.7	23.7	10.5	22.2
- 4 times a day	5.9	2.6	5.3	5.5
Grazing systems (%)				
- free	19.3	18.8	18.8	14.3
- picketing	56.1	54.2	56.3	28.6
- rotational	24.6	22.9	12.5	35.7
- dosed	0.0	4.1	6.3	0.0
- no grazing	0.0	0.0	6.1	21.4

During the summer period the cattle were watered twice a day in cow-shed, before exit and after return from pasture, where there are no natural water courses (Table 6). On bigger farms, with large number of animals and distant pastures, the water is often brought to pasture (17%-15%). The advantage of this system is unrestricted access of animals to water and good water quality.

Table 6: Comparison of watering manners of animals (% of farms) (Siudek, 1998)

Specification	Dairy cow		Meat cattle	
	Farms			
	organic	conventional	organic	conventional
Summer				
- on pasture – natural access	34.6	40.0	12.5	28.6
- on pasture – water brought on pasture	17.3	15.6	12.5	19.0
- in cowshed	48.1	44.4	75.0	52.4
Winter				
- pail – water from well	8.0	15.2	22.2	14.3
- pail - water from supply	34.0	39.1	33.3	38.1
- automatic drinking bowl	46.0	43.5	37.0	47.6
- other	12.0	2.2	7.5	0.0

Microbiological quality of milk in research study by Siudek (1998) and Karwowska (1999) was better on organic than conventional farms (Tables 7 and 8). In a simultaneous study on the state of health of cows, the conventional farms had more cases of mastitis than the organic ones (Karwowska, 1999).

Table 7: Milk quality in organic farms (Siudek, 1998)

Specification	Farms	
	organic	conventional
Percentage of particular classes of sold milk (%)		
- I	95.7	85.7
- II	0.0	2.4
- I and II	4.3	11.9
- classless	0.0	0.0
Fat content in milk (%)		
- summer	3.9	3.8
- winter	4.3	4.0

Table 8: The number of microbes in examined milk samples (Karwowska, 1999)

Examined parameters	Farms			
	organic		conventional	
	summer	winter	summer	winter
Number of samples	136	136	112	112
Positive reductase test (%)	34	48	30	53
Number of microbes (1 ml)				
- below 500 thousand (%)	32	66	30	27
- 500 thousand - 4 million (%)	62	30	70	18
- above 4 million (%)	6	10	20	65

The differences in pathogens found in milk from organic and conventional farms are presented in Table 9.

Table 9: Proportional occurrence of bacterium strains and funguses in examined milk samples from organic and conventional farms (Karwowska, 1999)

Bacterium strains/funguses	Farms	
	Organic %	Conventional %
Bacterium		
Streptococcus agalactiae	7.06	12.40
Streptococcus faecalis	74.08	78.06
Staphhylococcus aureus	1.05	3.06
Escherichia coli	2.16	1.08
Pseudomonas aeruginosa	4.07	3.98
Prot. vulgaris	-	1.05
Neisseria sp.	8.07	0.45
Corynebacterium sp.	3.51	-
Funges		
Aspergillus sp.	28.53	15.02
Penicillium sp.	54.07	47.06
Candida sp.	6.05	10.02
Saccharomyces sp.	5.05	9.54
Other	6.03	18.36

The variety of bred moulds and yeast from milk samples was large (Karwowska, 1999). The moulds from *Aspergillus* and *Penicillium* genus in samples of milk from both types of farms were found. Fungi, with potential ability of cancerigenic aflatoxines creation (*Aspergillus ochracens, Aspergillus fumigatus*), were found in samples of milk from four organic and two conventional farms. Yeast from *Candida* genus in four cases accompanied to bacterium - to streptococcuses and staphylococcuses in milk from conventional farms, instead in 2 samples of milk from organic farms determined counterweight for saprophytic corynebacterium - (100 thousand of corynebacterium and 600 thousand similar to yeast funguses - *Candida ulbicans*). Independently the presence of moulds and yeast, mostly in winter season suggests that housing, feeding and milking conditions are not ideal.

Health of cows

In investigation of 81 dairy cows (from 3 to 11 years of age) of the lowland black-white breed (Karwowska, 1999), in both types of farms suggested that mastitis was more common on conventional than organic farms (Table 10).

Table 10: Somatic cells of milk examined with indirect method (test TOK) (Karwowska, 1999)

Examined parameters	**Farms**			
	organic		conventional	
	summer	winter	summer	winter
Negative test TOK (%)	70	64	60	35
Positive* test TOK from quarters of udders (%):				
I	14	12	2	6
I + II	7	10	6	10
I + II + III	5	7	10	15
I - IV	4	7	20	34

* Positive results of test testify about increased number of somatic cells in milk.

The number of red blood corpuscles, hemoglobin and hematocrit value of blood of all cows from both types of farms were often on the borderline of physiological norms. The level of hemoglobin and number of erythrocytes in blood in pasture season increased about 5-10% in comparison to confinement period at all cows. In winter period decrease of the hemoglobin level with reference to physiological norms was observed at 3% cows from organic farms and at 5% cows from conventional farms (Table 11).

Table 11: Hematological parameters of 81 cows on organic and conventional farms (Karwowska, 1999)

Examined parameters	Organic farms		Conventional farms	
	summer	winter	summer	winter
Erytrocytes ($10^6/mm^3$)	6.600	5.900	6.400	6.200
Hematocrit (%)	37	35	37	37
Hemoglobin (g/dl)	13.5	12.8	14.1	13.1
Leucocytes ($10^3/mm^3$)	4.6	5.4	4.9	5.8

Significant differences in numbers of neutrocytes of cows in both types of farms were found. Increased numbers (above 35%) of neutrocytes (symptom of line defence of immunological system) in 36% of cows from organic farms during grazing season, and in 31% of cows in confinement season were observed. Percentage of cows with neutrofilia in conventional farms was even higher (84% in grazing season and 90% of cows in confinement season). Exacerbated neutrofilia and increased number of somatic cells (positive TOK test), together with presence of *Streptococcus* bacteria in milk appears to confirm the clinical mastitis findings on conventional farms. On organic farms, most of the cows with neutrofilia had a negative TOK, with no signs of clinical mastitis. Tests also showed that neutrocytes, isolated from the blood of cows from organic farms, had greater ability to phagocytosis and NBT (nitratetrazol blue test) reduction in comparison to neutrophiles isolated from cows from conventional farms. Efficiency of immunological system of lymphocytes, isolated from the blood of cows from organic farms (from 29% of blood samples in grazing season and from 47% samples in winter season), was higher than that on conventional farms.

Increased protein content in serum (hypeproteinemia) was observed during grazing season in 10% of cows from conventional farms and in 8.7% of cows from organic farms, while in winter season the same was observed in 9% of cows from conventional and at 2.5% cows from organic farms.

Serologic test for antibodies for tuberculosis, brucellosis and leukemia in serums of examined cows confirmed occurrence of leukemia in 5 cows on one conventional farm. All other test were negative.

Beef production

Production and breed parameters for organic and conventional beef farms in Poland are presented in Table 12.

Table 12: Chosen parameters of animal husbandry of fattened cattle in investigated farms (Siudek, 1998)

Specification	Farms	
	organic	conventional
Average size of basic herd (heads)	3.8	4.1
Breeds (%)		
- lowland black-white	67.9	59.3
- Charolais	7.2	11.1
- Simental	7.1	14.8
- Limusin	10.7	0.0
- other	7.1	14.8
Mass of animals (kg):		
- at the beginning of fattening	143.8	130.3
- at the end of fattening	488.6	511.0
Length of fattening period (months)	16.3	24.5
Gains during the fattening period (kg/day)	0.705	0.518

The usage of forage on organic and conventional beef farms is outlined in Table 13. Data on feeding and watering systems are presented in Tables 5 and 6.

Table 13: Comparison of utilizations of different fodders in fattened cattle feeding in investigated organic and conventional farms (Siudek, 1998)

Specification	**Farms**			
	organic		conventional	
	summer	winter	summer	winter
Roughage				
- green forage	43.4	0.0	44.9	0.0
- hay	39.6	47.2	28.6	40.8
- straw	28.3	35.8	20.4	30.6
- root crops	9.5	35.8	8.1	30.6
- silage	1.9	17.0	8.2	20.4
Concentrates:				
- own (produced on farm)	35.8	47.2	34.7	42.9
- bought (from purchase)	3.8	7.6	8.1	10.2
Vitamin-mineral supplements				
- mineral lick	43.4	43.4	34.7	36.7
- polfamiks	0.0	0.0	4.1	6.1
- MM	1.9	1.9	2.0	8.2
- others	1.9	3.8	0.0	0.0

Conclusions

On the basis of the limited data from the farms studied, it is suggested that the level of organisation of animal production on Polish organic farms is higher than on conventional farms. The higher numbers of livestock in organic systems farms are likely to be a result of the need for organic fertiliser.

Systems of feeding of dairy and beef cattle in organic and conventional systems were similar. The biggest difference was the lower utilisation of purchased concentrates on organic farms.

The average efficiency of dairy cows during lactation and obtained body gains of beef cattle on organic farms were higher than in conventional systems. Also, the milk quality and the state of health of cows from organic farms appeared better than those on conventional farms.

It is suggested that as the knowledge of organic farming among farmers in Poland increases, the number of farms and processing plants will also increase. In 2002, Poland had 1,977 organic farms with a combined area of 53,515 ha. A total of 22% of the farms were larger than 10 ha, 23% with an area of 10-20 ha, 28% with 5 ha, and remaining 27% of farms with 5-10 ha (Zastawny, Jankowska, Wróbel, 2003).

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The production of organic table birds in England: a study of commercial flocks

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Introduction

Compared with other organic livestock systems, the development of poultry meat production systems is very much in its infancy. Consequently, there have been few studies describing production trends and husbandry factors. The objectives of the study described in this paper were to examine an existing organic table-bird (broiler) system so as to identify the constraints, develop best practice, provide recommendations and promote production.

The production system

Four flocks were included in the study. All of these flocks were producing birds under contract to an abbatoir. This contract involved farmers being supplied with day old chicks, feed, health care and field support. The farmer supplied the land, labour, housing, equipment, electricity and water. The production cycles involved approximately 500-1000 birds per batch in 7-28 day cycles. Day old chicks were reared to approximately 24 days in temperature and ventilation controlled units under strict hygiene conditions. After this, birds were moved to mobile finishing units with outdoor access until they reached a minimum slaughter age of 70 days. In accordance with organic regulations, maximum house stocking rates of 30 kg per m^2 were adopted.

Slow growing breeds were used. These were mainly the Hubbard J-pac, which are a cross of JA57 hen and Colorpac cockerel. The Hubbard 657 breed was also used in some batches at the start of the study period. All flocks were kept on mixed enterprise family farms in mobile houses. All flocks received the same diets. Each diet was divided into starter and finishing diets, consisting of compounded feed with wheat, beans, lucerne, fishmeal, peas, soya. The starter diets were of 20.5% crude protein and the finisher diets were of 17% crude protein. Both were compliant with organic regulations. All flocks received coccidiosis vaccination during the first week.

The four farmers had been involved in organic poultry production for 16, 15, 7 and 8 months respectively at the start of the data collection.

Methodology

The study used retrospective data from four organic table bird flocks plus informal interviews with producers. As part of the contract agreement, all farmers were conducting weekly recordings of live-weight of birds, mortality and feed intake. The start and finish dates of each cycle were also recorded. Retrospective data collected between December 2000 and March 2002 were analysed from all four flocks. Complete data were only available from one flock for the entire period analysed. Estimates of mortality rates, growth rates and feed conversion were made. Both mortality rates and feed conversion were estimated at a flock level so as to avoid bias introduced

by deaths occurring at different stages of the production cycle. Bird days were used as a denominator to estimate mortality rates, and the total feed consumed by all birds in a flock, including those dying during the production cycle, were used to estimate feed conversion efficiency. Flock and season were investigated as potential factors influencing productivity.

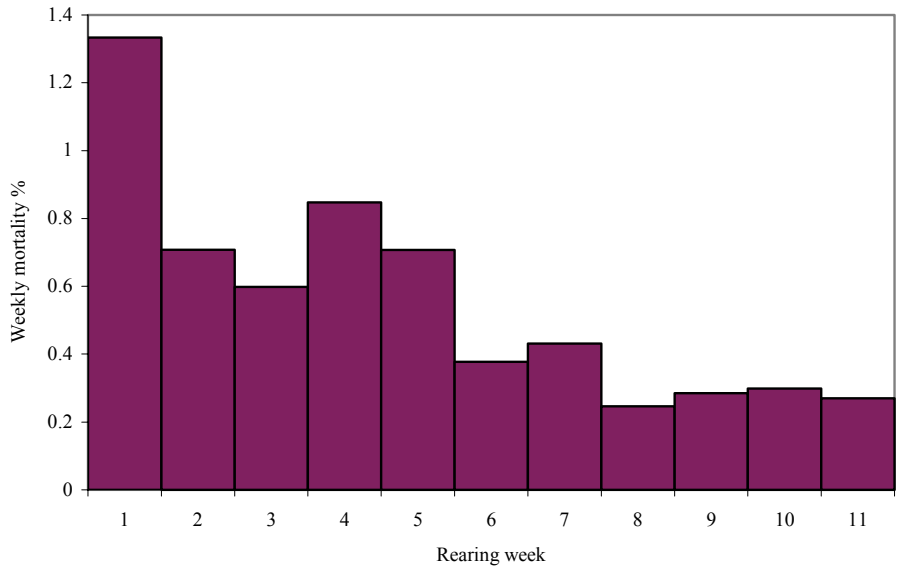
Informal interviews were conducted with each farmer in order to gain specific information on husbandry and management issues as well as more general views on the production system.

Results

Mortality

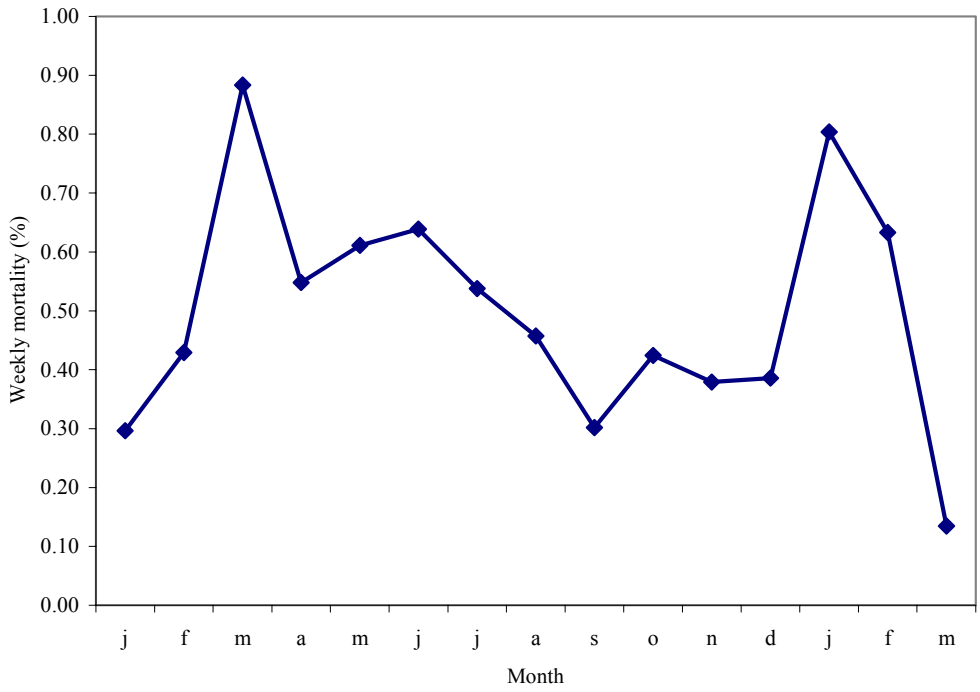
The mean mortality rate over the entire production cycle, for all flocks, was 5.87%, ranging between 4.26 and 7.67%. Peaks of mortality occurred during the first week and during the stressful period when birds were moved to finishing houses (Figure 1).

Figure 1: Average weekly mortality rates for all four flocks.



Temperature control and biosecurity were viewed as critical in week 1 when mortality risk was highest. The first week mortality rate was estimated at 1.17%, ranging between 0 and 16.67%. There were seasonal fluctuations in average weekly mortality rate in the one flock that was recorded for a full one year. Mortalities were highest during late winter and lowest during late summer (Figure 2). During the finishing period, when birds had outdoor access, predation was the greatest mortality risk.

Figure 2: Seasonal variations in average weekly mortality rate (one flock)



Food conversion & growth

Patterns of growth in the four flocks are illustrated in Figure 3. There were fluctuations between flocks in the proportion of birds reaching a desired slaughter weight at the end of the production cycle. The mean weight at slaughter was 2.33kg, and ranged from 2.17 to 2.67kg. Mean feed intake was 7.40 kg/bird sold (range 6.94 to 7.65 kg/bird sold). There were large seasonal variations in food conversion ratio (range 2.60 to 4.33), with the highest occurring in winter (Figure 4). This may have been a consequence of summer grazing or additional winter maintenance requirements. There were insufficient comparative data and too many confounding factors to investigate breed as a contributing factor. Mortality rate and age at mortality was a contributing factor to feed conversion, as this was estimated at the flock level i.e. late mortality had more impact than early mortality.

Figure 3: Average growth curves for four organic table bird farms

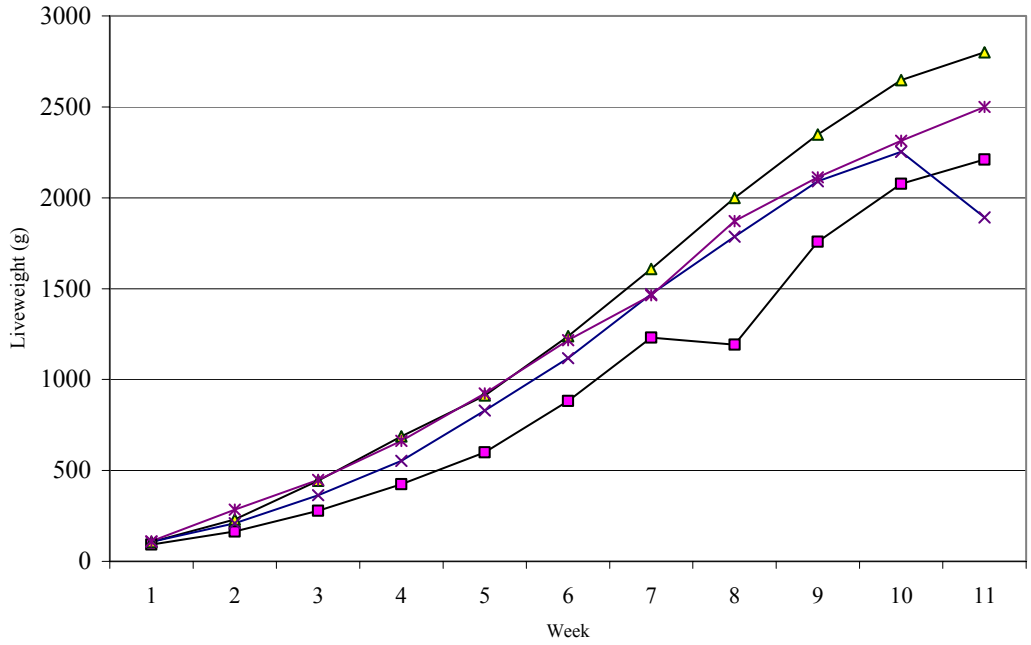
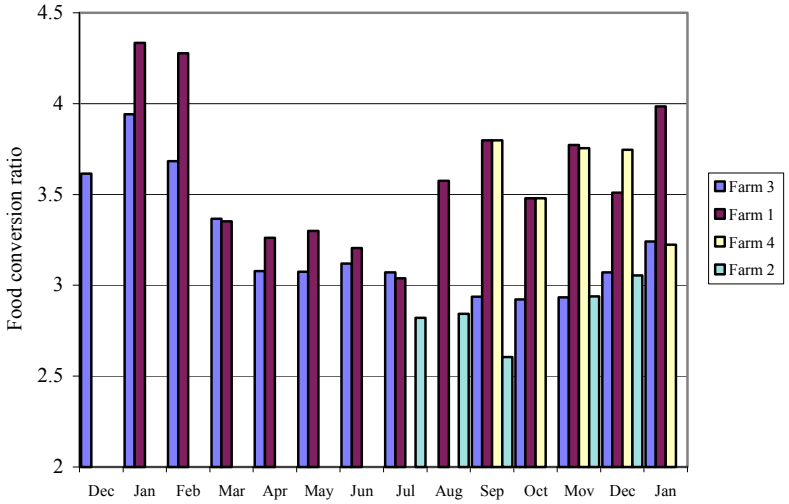


Figure 4: Average monthly food conversion ratio in four flocks (kg feed per kg bird sold)



Housing
There were three different types of house used: Mod-Arks (in sections with no floor); APS houses (floored) and home-made arcs. One of the distinguishing features was the relative area of "pop-hole" or exits. These ranged from 16% to more than 50% of the house length. Cost, housing type, labour requirement, risk of dampness and composting qualities were also considerations regarding choice of bedding. Overall, straw was considered to be preferable to wood sawdust. Moving mobile houses during winter periods was more problematic than summer, as a consequence of wet and muddy conditions.

Access to outdoor range
All systems had daytime access to unrestricted range. Most ranging activity was observed to take place during morning and evening. All farms were using objects to encourage birds to range. These included wooden pallets and cut fir-trees. At the time of the survey, the birds were not part of the crop rotation on any of the farms. This was partly as a consequence of poultry production being a new enterprise on all farms. All farms were using temporary grass leys as a range resource, and all farms had birds mixed grazing with cattle and/or sheep. All of the farmers viewed poultry as being a part of their future crop fertility-building strategy. To some extent, this limited the provision of a natural environment for poultry as permanent natural features were not possible. One farmer felt that weed control in fields following birds was a potential problem.

Health management
There was no specific disease problems recorded, although there had been isolated instances of yolk sac infection in week 1. These incidents were related to breeding and hatching and not the production systems. Regarding health management and husbandry, one producer expressed concern over the potential health risks associated with multi-age sites and disease build-up. Apart from coccidiosis vaccination, routine use of conventional medication was absent from these systems. The choice of breed, hygiene and environmental control and biosecurity during the early weeks and consistency in feed quality were also mentioned as important factors. Reducing stress at critical stages of the production cycle was also expressed as an important husbandry factor. One farmer had had success using homoeopathy to reduce stress when moving birds to finishing units.

Whilst the pop-hole length was viewed as a contributory factor in enhancing access to outdoor, there were also some comment regarding wet bedding during periods of rain, and the associated health risks, particularly blisters, in those houses with a higher proportion of pop-holes. All of the farmers were investigating means of deterring predatory foxes and birds of prey, including the use of electric fences, shelter and overhead fishing line.

Labour and economics
All farmers found this a profitable enterprise, although the large capital outlay was viewed as a potentially restrictive factor limiting expansion of this sector of organic production. High levels of stockmanship and intensive management were generally felt to be necessary. Labour inputs were estimated at approximately 28 hours/week per 750 birds. An established and structured market was also felt to be important in achieving sustained profitability. Unsocial working periods were created by the requirement to get birds to the abbatoir location early in the morning on slaughter days. All producers felt that this system of production could provide an income per unit area superior to other land-based livestock systems.

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Reducing ammonia and mineral losses in organic pig production

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Introduction

The growing awareness of food safety, improving animal welfare and reducing environmental pollution is the reason of rapid increase of organic farming in The Netherlands. Organic farming is considered environmentally beneficial due to ban of artificial fertilizers and pesticides and by creating a mineral cycle in agricultural production. However, scientific evidence of the environmental impact of organic farming is scarce. From a research, carried out in Denmark, it is concluded that organic pig production has a lower N-efficiency and a higher N-surplus per kg meat than conventional pig production (Dalggard *et al*., 1998). In that connection outside yards for pigs might give considerable losses of N as emitted ammonia to the air. Furthermore, manure deposited by grazing sows on the paddock may be difficult to utilize and causes nutrient surpluses and losses of nutrients.

The aim of this project was to define ammonia emissions from fattening pigs in organic farms as well as nutrient loads on the paddock of sows.

Materials and methods

This study was carried out on three commercial organic pig farms at different locations in The Netherlands. We focused our interest in fatteners with live weight 45 kg and 80 kg and pregnant sows. The experiment was carried out in 2003, during two periods – spring-summer and autumn-winter, in two pens per farm, one pen per live weight group.

There were three different ways of cleaning the floor of the outside yards on the farms. In farm 1, manure of fatteners was removed by handcar, with frequency every two weeks. In farm 2, a part of the floor was slatted, situated on both sides of the yard. In farm 3, there was a scraper for daily cleaning of manure from outside yard.

Ammonia concentration was measured using a dynamic chamber (Aarnink et al., 2002). Ammonia emission was calculated from the ammonia concentrations of the outgoing and incoming air and from the ventilation rate. Data were analyzed in a factorial model using restricted maximum likelihood method (REML) of Genstat – Release 7.1.

Average quantity of nutrient output on the paddock was calculated from the average volume of urine and faeces produced per sow per day on the paddock, the content of N, P and K in urine and faeces and the days in 7 months, during which the paddocks were used, to get the yearly nutrient load.

Results

Ammonia emissions from outside yards of fattening pigs

In Table 1, ammonia emissions are presented per m^2 and per pig place per year, respectively. There is a big variation in ammonia emissions. The effect of farm on ammonia emission per m^2 and per pig is highly significant (P<0.001). The effect of live weight was not statistically significant.

Table 1: Effect of farm, weight and period on ammonia emission per m^2 and per pig place per year.

Farm	Weight	Period	NH_3 emissions $g.day^{-1}.m^{-2}$	NH_3 emissions kg.pig $place^{-1}.year^{-1}$ (1,2)	Effects	P value	S.E.D.
1.	45 kg	1	19.3	11.7	Farm	P<0.001	2.0
		2	7.3	4.4			
	80 kg	1	16.5	10.2	Weight	n.s.	1.6
		2	5.3	3.3			
2 (3)	45 kg	1	3.3	2.1	Period	P<0.001	1.6
		2	2.5	1.6			
	80 kg	1	3.6	2.6	Farm.weight	n.s.	2.8
		2	1.8	0.9			
3.	45 kg	1	0.2	0.1	Farm.period	P<0.001	2.8
		2	6.7	2.9			
	80 kg	1	2.5	2.1	**Weight.period**	n.s.	2.3
		2	2.2	1.6			

(1) NH_3 emissions (kg.pig $place^{-1}.year^{-1}$) = NH_3 emissions ($g.pig^{-1}day^{-1}$).0.9.365/1000.
0.9 is the coefficient for occupation of the pen by pigs.
(2) Standards of ammonia emissions for regular pig farming – not more than 3.5 kg.pig $place^{-1}.year^{-1}$ (Anonymous, 2002)
(3) Emission from manure pit not included

Period had a significant influence on ammonia emission per unit area (P<0.01), and per pig (P<0.001). The significant interaction effect between farm and period shows that, in the two studied periods, differences in ammonia emission between farms were not the same.

In the same table, the means of ammonia emission per pig for the three farms were converted into ammonia emissions per pig place per year, compared with standards, according to Dutch regulations for conventional pig farming (Anonymous, 2002). It is clear that, in the first farm, the emissions were far above the permissible level of 3.5 kg.pig $place^{-1}.year^{-1}$, exceeding permissible levels markedly in the first period (11.7 and 10.2 kg.pig $pleace^{-1}.year^{-1}$). In farms 2 and 3, measured ammonia emissions generally fulfill standards for fattening pigs.

Table 2: Predicted means of ammonia emissions inside and outside the building.

Farm	Inside the building[(1)]		On outside yard[(1)]	
	$g.day^{-1}m^{-2}$	$g.pig^{-1}day^{-1}$	$g.day^{-1}m^{-2}$	$g.pig^{-1}day^{-1}$
Farm 1	7.7^{a}	8.0^{a}	17.6^{a}	14.5^{a}
Farm 2	1.9^{b}	2.0^{b}	3.6^{b}	3.5^{b}
Farm 3	0^{b}	0.4^{b}	5.0^{b}	4.7^{b}

[(1)]Means within a column without a common superscript letter differ significantly (P<0.05).

In the second model the effect of location was added as a source of variance to obtain the difference between farms in aspect of indoor/outdoor emissions. The difference between farms is highly significant (P<0.001). A highly significant effect of location on ammonia emissions per m^2 and per pig was found as well (P<0.001). From the results from Table 2, we can draw the conclusion that emissions inside the building are less than on outside yards in all farms, about two times in farm 1 and 2. In farm 1, ammonia emissions inside and outside were much higher, comparing to farm 2 and 3.

When fouled area was added to the model as a source of variance, the effect of fouled or not fouled area was highly significant (P<0.001). Farm had a significant effect (P<0.001) on the emissions from clean and fouled areas. The effects of period and location were significant, but not very big (P<0.05). The effect of weight was not significant.

Nutrient load on the paddock of sows

The data about nutrient load on the paddock are presented in table 3. From the data it is seen that in farm 1 with a paddock area of 89 m^2 per sow nutrient output of nitrogen on the paddock is much higher than permissible standards (420 vs170 kg per hectare per year). In farm 2, where the paddock area per sow is bigger (289 m^2 per sow), comparing to other two farms, nutrient output of nitrogen is lower than maximum permissible levels. In farm 3, in which the sows had limited access to the paddock, in contradiction to the other two farms, we found a little excess of standards of nitrogen supply on the paddock. About phosphorus output on the paddock in our study, it is clear that in two of the farms permissible levels of 100 kg P_2O_5, which is equivalent to 44 kg P per ha per year, were exceeded, in farm 1 even 2,5 times. In the opposite, in farm 2 the estimated value of 20 kg P $hectare^{-1}year^{-1}$ is more than 2 times below the standard level of 44 kg..

Table 3: Average output of nutrients (N, P, K) on the paddock of sows.

Farm	Number of sows	Area m^2 per sow	Output of nutrients, $kg.year^{-1}$			Total area, m^2	Output of nutrients, $kg.ha^{-1}.year^{-1}$		
			N	P	K		N	P	K
1	55	89	180	47	105	4270	420	110	246
2	38	289	68	21	30	10200	66	20	30
3	43	65	135	43	103	2500	180	57	138

*Maximum standards: N - 170 $kg.ha^{-1}.year^{-1}$, P – 44 $kg.ha^{-1}.year$.

Discussion

Ammonia emissions from outside yards of fattening pigs

In pig production, ammonia mainly volatilizes from urine-fouled floor areas and from the surface area of slurry in under-floor storage channel (Aarnink *et al*, 1996). In theory, a linear relationship between the area of ammonia source and the ammonia emission is expected (Elzing *et al*., 1992). Urinations done on solid or slatted floors consequently increase emission from the floor. This increase is caused by the high activity of the enzyme urease on fouled floors (Elzing and Swiestra, 1993), which catalyses the hydrolysis of urea in the urine to ammoniacal N. Within this research, highly significant effect of the urine fouled area on ammonia emission was found. Furthermore, straw inside the building polluted with urine and faeces caused higher emissions per m^2, than a fouled paved yard. Straw probably gives a larger emitting area than a paved yard. Moreover the temperature inside was higher than the temperature outside and it has been shown that temperature is an important factor influencing NH_3 emission (Aarnink et al., 1998; Elzing and Monteny, 1997). Frequency and efficiency of yard cleaning might be additional factors important for emissions from outdoor yard areas (Monteny and Erisman, 1998). Airoldi *et al*. (2000), studying outside yards in cattle, reported that more frequent manure removal (daily as opposed to weekly or monthly) was extremely important when trying to reduce NH_3 emissions.

In our study, effect of farm on ammonia emissions is highly significant. The mean reason for differences seems to be the strong influence of manure management. Much higher ammonia emissions were measured in farm 1, where manure is manually removed every two weeks, comparing with farm 2 and 3 (Table 1, 2). The quantity of manure at this farm, collected during long time, was too large and was spread all over the yard, forming a deep layer of manure. Regular addition of fresh urine from urinations of pigs, coming at any time of the day and getting in touch with this manure, is responsible for much bigger rate of ammonia volatilization. The smaller quantity of NH_3 emissions, measured at farm 2 and farm 3, was due to different ways of cleaning and regularly removing of manure. In farm 3 urinations and defecations of pigs were done only on the place, cleaned daily by a scraper. In farm 2 most of urinations and defecations were done above the slatted floor. Misselbrook *et al.* (1998), carrying out research with cattle, also found that the most influencing ammonia emission parameters are the amount of urine and faeces deposited on the yards, urease activity and the efficiency of removal of urine and faeces.

To compare to standard (Anonymous, 2002), we converted ammonia emissions in emissions per year, but our measurements might not be fully representative, because the variation in ammonia emissions during the day is high. Except of randomly chosen moments of measuring (and no

measuring during the night), ammonia emissions were measured only in two periods (spring-summer and autumn-winter), but not the whole year. The calculated ammonia emissions per pig place per year in two of studied three organic pig farms were below the standard of levels in The Netherlands for conventional pig farming (3.5 kg per pig place per year). According to this standard, values of 3.2 kg (with the added calculated emissions from manure pit) and 1.7 kg per pig place per year in farm 2 and 3 are realized. Only in one farm, with an average value of ammonia emissions of 7.4 kg, the standard for ammonia emissions is exceeded about two times.

Ammonia emissions indoor and outdoor were significantly different ($P<0.001$). They were smaller inside, because of limited number of urinations and defecations inside the pen causing a smaller polluted area. A larger area outside was polluted, comparing to area inside, because of the natural behaviour of pigs, when they have choice, to separate lying and dunging place (Aarnink *et al*., 1996, van Putten, 2000). In all farms, pigs had a preference to excrete on outside yard and to keep inside lying area clean.

As a whole, significance of effect of period (Tables 1 and 2) could be explained with different temperatures during the measurements in the two periods. As it was mentioned, temperature is an important factor for ammonia emission from outside yards. The difference in the temperatures in our study was not too big, but higher temperatures during the first period (end of April –June 2003), comparing with second (end of September-October 2003), were measured, and they might have influenced the amount of ammonia emitted.

Nutrient load on the paddock of sows

Animal management practices can influence N excretion and patterns of N distribution. These practices include sow behaviour in terms of preferences for certain locations for excretion and resting as well as feeding. In our study, according to the system of organic pig farming in The Netherlands, the pasture was a part of the whole system, including a building, a paved yard and a paddock. Under these conditions, N excreted by sows has been spread between these parts. Even in that case, when sow manure was collected in manure pit and also from outside yards and used as a fertiliser on the farmers' arable land, a considerable amount of nutrients went to the paddock (Table 3). This amount was distributed between uptake in crops (predominant clover in three farms), leaching losses, ammonia volatilisation (Sommer *et al.,* 2001), denitrification (Petersen *et al.,* 2001) and storage in the soil organic pool (Eriksen and Kristensen, 2001). We did not measure this different distribution of N, as we were only interested in the total mineral load of to the paddock. According to regulations about organic farming (Council Regulation No 2092/91), the amount of manure applied to farmer's arable land may not exceed an equivalence of 170 kg of N per ha per year. From the results about nitrogen and phosphorus on the paddock (Table 3), it is seen that it actually varies a lot between organic pig farms.

We found that total output of nutrients is much higher than permissible standards in farm 1. In farm 3 they exceeded standards, but not markeldy. In farm 2, nutrient load was below permissible levels in European standards and could fulfill future standards. In this farm, the available area of paddock per sow is much bigger than in other farms (289 in farm 2 vs. 89 in farm 1 and 65 m^2 in farm 3). Also, the whole system was different – except the paved yard, sows at farm 2 had a sandy yard available and a long sandy road to the paddock. As a consequence, faeces and urine were more spread in the whole system, and relatively little amount of nutrients went to the

paddock. It was interesting that in farm 3, sows had less area available than in farm 1, but surpluses of nutrients were not too high. It is assumed that this was caused by the fact that, in this farm, paddock was available for sows only after 15.00-15.30 h in the afternoon, until sunset, because of the clay soil. In farm 1, where the type of the soil is sandy, the great excess of nutrients is really a risk of nitrogen and phosphorus pollution.

Conclusions

Ammonia emissions from paved outside yards and nutrient load on the paddock in organic pig farms are variable between farms. They can exceed standards considerably. A good manure removal system (slats or scraper) can reduce ammonia emissions. Good management on the farm and appropriate density of animals guarantees success of organic farming in preventing overloading of soils with nitrogen and phosphorus.

References:

Reference list is available from the authors on request.

Influence of forage on microbial activity in the hind gut of pigs and potential benefits to soil biology

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Introduction

Outdoor systems for pigs enable the animals to express their natural behaviour to a high degree. On the other hand, this production method carries risks of nutrient losses. The question arises, whether nutrient losses can be reduced by increasing the microflora in the hind gut of the pigs, as pigs have the ability to effectively utilise dietary fibre. Microflora in the large intestine of pigs contain all of the predominant ruminal cellulose degrading bacteria, particularly in adult animals (Kichgessner et al., 1994; Varel and Yen, 1997). The microbial activity in faeces can be an indicator of fibre degradation in the large intestine of pigs. There are reasons for the assumption that faeces of pigs, with high microbial activity, will contain more nutrients for microbial growth in the soil.

The objectives of the trial described here and carried out between October to December 2003 were to determine the microbial activity in pig faeces with or without the offer of forage under outdoor conditions and the effect of different types of pig faeces on the microbial activity in the soil. The experiment is based on the hypothesis that forage can improve the microbial activity, not only in pig faeces, but also in the soil.

Material and methods

Experimental design

An experiment was conducted on the experimental farm 'Staatsdomäne Frankenhausen' and the laboratory of the Department for Soil Biology and Plant Nutrition, Faculty of Organic Agricultural Science, University of Kassel between September to December 2003.

Ninety three pigs with an average live weight of 75 ± 10 kg were used in the experiment. The pigs were de-wormed one week before starting the experiment. The microbial activity in the faeces of pigs was measured at the beginning of the experiment and after 30 and 40 days. The animals had free access to water. The experiment consisted of three treatments with different amounts of the same concentrated diet and with or without forage plants.

The experimental treatments were following:

a) Control with concentrate diet, 110 % according to the requirements without forage in the plot (one group of 19 pigs),
b) Experimental treatment with 80 % concentrate diet and with Jerusalem artichoke (Heliantus tuberosus L.) in the plots (two groups of 19 pigs per each group),
c) Experimental treatment with 100 % concentrate diet and Turnip-like rape (Brassica rapa var rapa) in the plots (two groups of 18 pigs per each group).

Six pigs per each group were randomly selected to take part in the experiment; six samples were taken at each sampling time except for the last sampling time, which was of five samples per group. The pig faeces samples were taken directly from the rectum.

The pig faeces, after 30 days, were used to investigate the effect of pig faeces on the soil. The soil was collected close to the experimental area, but without pig outdoor management. After sampling, the soil was transported to laboratory and sieved to 2 mm granules. The fresh faeces were added to the soil and mixed. The treatments used were following (n=5):

a) Control treatment with only soil
b) Soil plus faeces of pigs fed with concentrate diet in a plot without forage (S+ fWoF)
c) Soil with faeces of pigs fed with concentrate diet in a plot with Jerusalem artichoke (S+fJa); and
d) Soil plus faeces of pigs feed with concentrate diet in a plot with Turnip-like rape (S+fTlr).

The soil and pig faeces were mixed the first day of the experiment and the samples were analysed after 21 days of incubation at 15oC. The treatments consisted of 60 g of soil plus 4 g of pig faeces as described in Table 1. Five repetitions per treatment were used, and repetitions were taken from a single pig per treatment.

Table 1: Treatments description of laboratory incubation of pig faeces in soil.

Treatment	Description	Component of the mixed (grams)	
		Soil	Pig faeces
Control	Only soil	60	
S+ fWoF	Soil plus faeces from pigs without forage	60	4
S+fJa	Soil plus faeces from pigs with Jerusalem artichoke	60	4
S+fTlr	Soil plus faeces from pigs without Turnip-like rape	60	4

Chemical analyses

The measurement of microbial activity in pig faeces under outdoor management and soil laboratory incubation was carried out by adapting a technique used to determine soil microbial activity described by Bay et al (1988) and Dyckmans and Raubuch (1997). This technique is

based on the measurement of the adenylates in cells [adenine-tri-phosphate (ATP), adenine-di-phosphate (ADP) and adenine-mono-phosphate (AMP)].

Statistical analysis

Data from the adenylate contend were analysed using (SAS, 1986) GLM procedure as a randomized design with one way arrangement.

Results

Results of total adenylates in faeces of pigs feed with concentrate diet and with or without the offer of forage are presented in Figure 1. At the beginning of the experiment no differences were found between treatments (P>0.01). Compared to the control group, a significantly higher adenylate content was found in faeces of pigs feed with Jerusalem artichoke at 30 and 40 days (P<0.01) (fig. 1). In the laboratory, the incubation of pig faeces improved the adenylate in the soil compared to the control (P<0.01). There was a tendency toward an improvement of the microbial activity by using faeces from pigs fed with Jerusalem artichoke (Figure 2).

Figure 1: Total adenylates in pig faeces samples kept in outdoor management with and without forage.

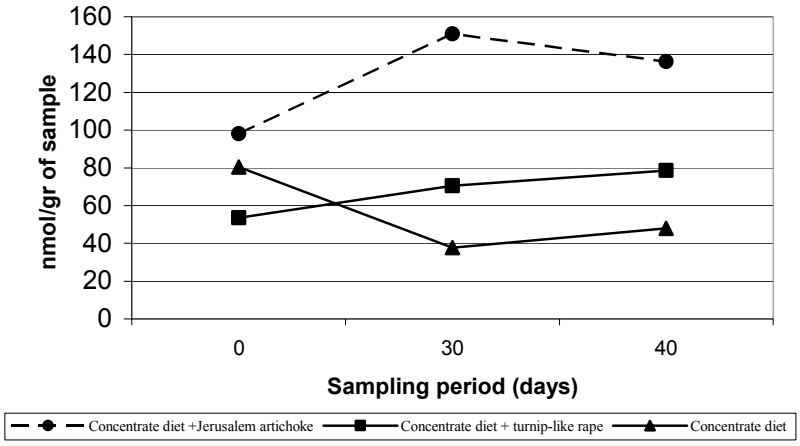
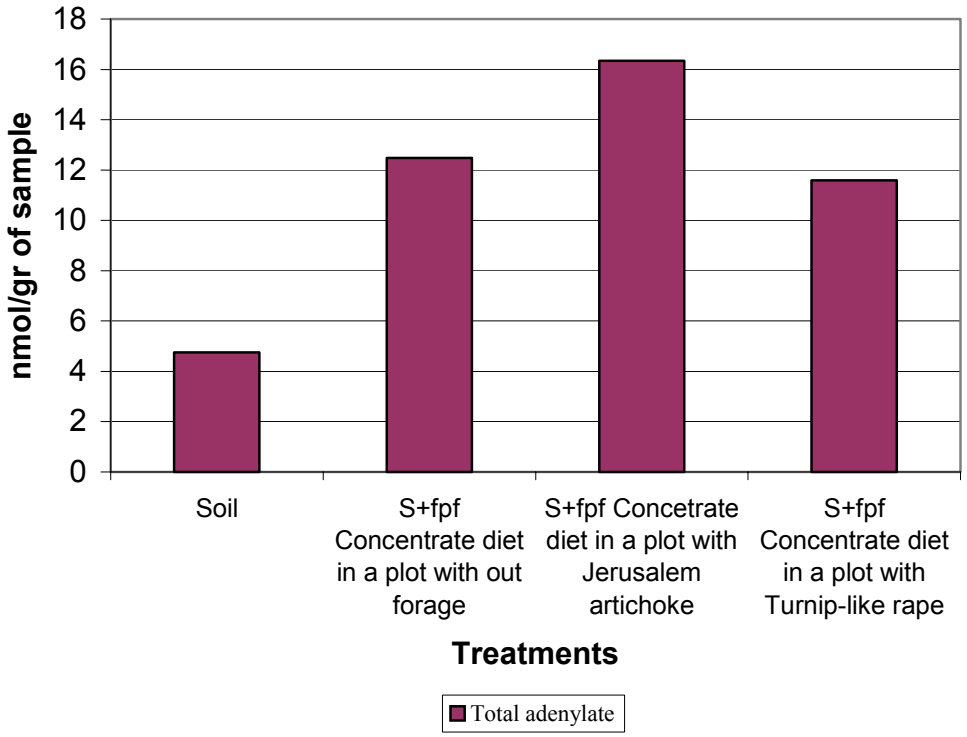


Figure 2: Total adenylates in soil (after 21 days incubation period) with and without faeces from pigs kept 30 days in outdoor plots with and without forage.



S+fpf= soil plus faeces of pigs feed with

Discussion

After 30 and 40 days of feeding Jerusalem artichoke, a higher microbial activity was found in the faeces of pigs compared to the control and the Turnip-like rape treatment ($P<0.01$). The higher microbial activity can be explained by the fructans within Jerusalem artichoke. Fructans are fermentable carbohydrates that have a prebiotic activity and consist mostly of fructose and glucose molecules. Inulin is the active ingredient of fructans found in *Helianthus tuberosus* (Vijn and Smeekens, 1999). Prebiotics are nutrients that are used by specific bacteria to increase the chance to thrive in the intestine as opposed to probiotics that are foods that contains live bacteria. They selectively promote the growth and activity of beneficial bacteria (such as bifidobacteria and lactobacilli). Bifidobacteria can inhibit the growth of potential pathogens, stimulate components of the immune system, improve the bio-availability of certain nutrients such as

calcium and aid the synthesis of B vitamins (Jenkins *et al.*, 1999). The increase in production of this beneficial bacteria results in an increased faecal biomass, decreased ceco-colonic pH, and production of short-chain fatty acids.

Reduction of pathogens in pigs' hind gut will reduce the risk of intestinal bacteria translocation. Intestinal bacterial translocation has been postulated as an important risk factor for the development of multiple organ failure (in absence of a definite focus of infection) (Lemaire *et al.,* 1997). Stress during transportation of slaughter pigs can lead to an increased level of translocation of endotoxin from the gut into the systemic circulation (Zucker and Krüger, 1998). The contend of fructans in *Helianthus tuberosus* may play an important role not only in relation to nutrient losses but to gut protection against potential pathogens.

The absence of bio-active substances in Turnip-like rape and the low amount available of this plant in the plots during the experiment can explain the low adenylates in faeces of pigs fed with Turnip-like rape. The interaction of the amount of concentrate diet and the available forage was identified as an important factor in relation of microbial activity in faeces of pigs. There is need for further investigations, including feed intake measurements.

Conclusions

The offer of forage improved the microbial activity in pig faeces. This tends to improve the microbial activity in the soil. The different effect of forage on microbial activity in pig faeces needs further investigations.

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Methods to control parasite infections without recourse to antiparasitic drugs

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Introduction

Infections with internal parasites are considered to be, throughout the world, one of the most important causes of economic losses in grazing livestock. In organic production systems, legislation reduces radically the possibility to use, for prevention, chemical antiparasitic agents, and so, without using alternative approaches, the risks of infections and production losses generally increases (Box 1).

Box 1: A summary of the EU and Italian legislation and standards for antiparasitic agent use in organic farming systems.

from **Council Regulation (EEC) No. 1804/99:**

►"The use of chemically synthesised allopathic veterinary medicinal products or antibiotics for preventive treatments is prohibited"
► "The withdrawal period between the last administration of an allopathic veterinary medicinal product to an animal under normal condition of use, and the production of organically produced foodstuff from such animals, is to be twice the legal withdrawal period or, in a case in which this period is not specified, 48 hours".

from **Italian Agriculture Ministry Departmental order 4/8/2002, in application of Council Regulation (EEC) No. 1804/99**:

► "Taking into account common farm uses, maximum two antiparasitic treatments can be carried out during the year, included those chemical treatments for external parasites applied by injection or externally".
► "The molecules to be used for these treatments have to be characterized by low environmental impact, rapid metabolization, low toxic effects and withdrawal period shorter than ten days".

For these reasons, strategies to control endoparasites without recourse to parasiticides are getting more important. In broad terms, these strategies consist of agronomic and feeding techniques, genetic selection, appropriate grazing and pasture management (Table 1 and 2). These methods are expected to give good prospects for control, especially if applied as parts of integrated plans, well adapted to specific environments.

Table 1: A summary of the strategies to control endoparasites in grazing stock without recourse to parasiticides.

Animal:	genetic selection
Feeding:	nutritional supplementation diet composition, administration of nematophagous fungi
Pasture management:	composition of pasture, bioactive forages, ploughing and agronomic operations
Grazing techniques with one species:	stocking rate management, pasture rotation, dosing grazing time and moving to clean pastures
Grazing techniques with more than one species:	alternate grazing, mixed grazing

The aim of this poster is to illustrate briefly some of the experimental approaches considered, focusing on those that appear particularly promising for future development in controlling endoparasitic infections.

Genetic selection

Animals exposed to infection show to be resistant to parasites when their faecal egg Count (FEC) is low. In Australia and New Zealand, breeding is a common practice carried out using the value of FEC. The strategy is aimed at reducing susceptibility to parasite infection of sheep exposed to high levels of parasites. Breeding to obtain low FEC also contributes to the reduction of pasture infectivity and is very useful, particularly in large flocks. The disadvantage of the method is the slow progress of genetic improvement, making it difficult to evaluate the successfulness of the strategy.

Use of nematophagous fungi

Several field trials show that the fungus *Duddingtonia flagrans*, administered to animals as a feeding additive during the expected rise in pasture infectivity, could be a valid approach to control most of the gastro-intestinal parasites of grazing livestock. However, more studies need to be carried out to find new delivery mechanisms and to identify new fungal strains that are active against more parasitic species and stages. One of the disadvantages of the use of nematophagous fungi concerns the lack of activity on parasites already moved from faeces to vegetation. For this reason it is important to keep the infectivity burden of pasture low with other allowed means, and

use the nematophagous fungi as a part of an integrated strategy aimed to limit the effects of parasitic infections.

Diet composition

It is well known that in pigs high level of insoluble dietary fibres have resulted in the increase of helmintic infections in comparison with pigs fed with diet poorer in fibres and richer in easily digestible carbohydrates and proteins. In ruminants, high protein concentration, especially using rumen bypass proteins, seems to decrease the effects of nematode infection. Further studies are, however, necessary to operate in field conditions, adjusting the diet according to the periods during which the animals are more exposed to infections. Cost-benefit consideration needs also to be carried out to evaluate the cost of a change in the diet and the benefits achievable.

Pasture composition

Not many studies regarding the interaction between parasites and herbages at pasture level are available, even if it is known that grazing some particular forages contributes to the body weight development in lambs. More studies are available regarding the interaction between parasites and plants at digestive system level. Certain leguminous forages containing relatively high levels of condensed tannins, have showed to improve substantially weight gain in parasitized lambs. The reason seems to be linked to the larger protein availability at gut level, but the mechanism is not completely clear. Research should be carried out to ascertain the possibility of decreasing parasitic infections in the different animal species, by feeding forages with anthelmintic properties.

Table 2: A summary of references to current research into non-parasiticide control strategies for internal parasites in grazing animals by country and region.

EXPERIMENTAL METHODS	INTERESTED COUNTRIES	SPECIES & REFERENCES
Genetic selection	Australia, New Zaeland	Sheep, cattle (Eysker, 2001; Niezen et al., 1996; Michel, 1969; Thamsborg, 2001).
Diet composition	Denmark	Cattle, sheep, pigs (Eysker, 2001; Roepstoff and Meyer, 2001; Thamsborg *et al.,* 1999; Thamsborg, 2001;)
Administration of nematophagous fungi	Denmark, New Zaeland	Cattle, sheep (Niezen et al., 1996; Roepstoff and Meyer, 2001; Thamsborg *et al.,* 1999; Thamsborg, 2001)
Composition of pasture, bioactive forages	New Zaeland Australia, UK	Sheep (Eysker, 2001; Molan et al., 2000 a; Niezen et al., 1996; Robertson et al., 1995, Thamsborg *et al.,* 1999; Thamsborg, 2001)
Ploughing and agronomic operations	Sweden	(Svensson et al., 2000)

Stocking rate	Northern Europe	Cattle, sheep, pigs (Dimander et al., 2000; Hoglund et al., 2001; Michel, 1969; Roepstoff and Meyer, 2001; Thamsborg *et al.,* 1999; Thamsborg, 1996)
Nutritional supplementation	Northern Europe	Cattle, sheep (Hoglund *et al*., 2001; Svensson *et al*., 2000)
Dosing grazing time and moving towards clean pastures	Northern Europe, UK, Australia, Tropical countries	Cattle, small ruminants (Githigia *et al*., 2001, Thamsborg *et al.,* 1999)
Pasture rotation		Ruminants, monogastrics and poultry (Eysker, 2001; Michel, 1969)
Mixed grazing more than one species	Denmark, Northern and Central Europe	Cattle-pigs (Dimander et al., 2000; Lampkin, 1990; Svensson *et al*., 2000; Eysker, 2001; Roepstorff et al.)
Mixed grazing one species different ages		Cattle,sheep, monogastrics (Dimander et al., 2000; Lampkin, 1990; Svensson *et al*., 2000)
Alternate grazing more than one species	Northern Europe	Cattle-sheep; cattle-pigs (Svensson *et al*., 2000; Thamsborg *et al.,* 1999)

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Development of organic farming in Estonia

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History

Organic farming in Estonia started to develop in 1989 when Estonian Biodynamic Association was established. First organic standards were based on IFOAM recommendations and first organic label "ÖKO" was used to mark organic products.

Organic movement became more popular again in 1997 when the first Estonian "Organic Farming Act" came in force. Since 1998, national organic label called "MAHEMÄRK" (Figure 1) is used and, since 2000, government subsidises organic production. In 2001, a new "Organic Farming Act" based on the EU Regulation 2092/91 was implemented in Estonia.

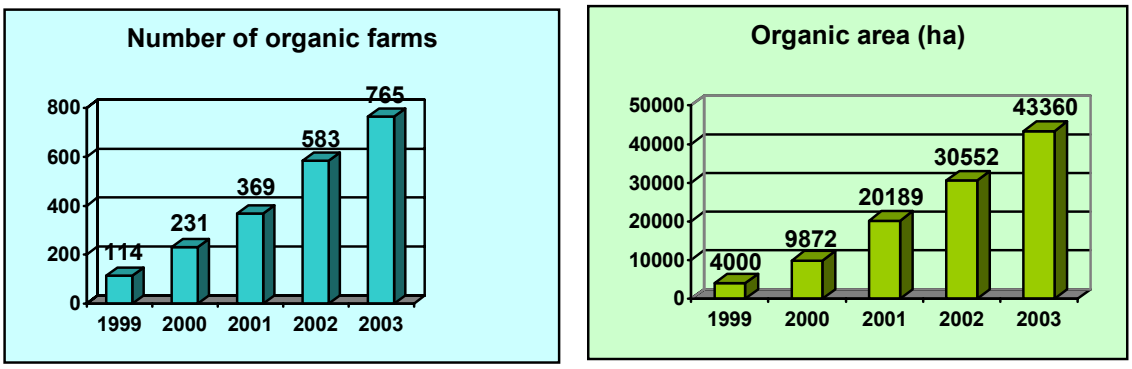
Figure 1: "MAHEMÄRK" – national organic label of Estonia

Statistics

Total agricultural area in Estonia is estimated to be 1,433,100 hectares, from which arable land and grasslands are about 25% and natural grasslands about 20 %. It is estimated that only 1 million hectares of the total agricultural area is in use and that 3 to 4% of this land is organic or in conversion.

In 1999, there were only 114 organic (including in-conversion) farms having all together around 4,000 hectares of agricultural land (0.3% of the total agricultural land) in Estonia (Figure 2). At the end of 2000, there were 231 organic farms (including in-conversion farms), with 9,872 hectares of land. In 2003, the number of organic farms (including in-conversion farms) has grown to 765, with about 43,000 hectares of land, which is approximately 3% of the total agricultural land and 4% of the total agricultural land in use.

Figure 2: Development of organic farming in Estonia (1999-2003)

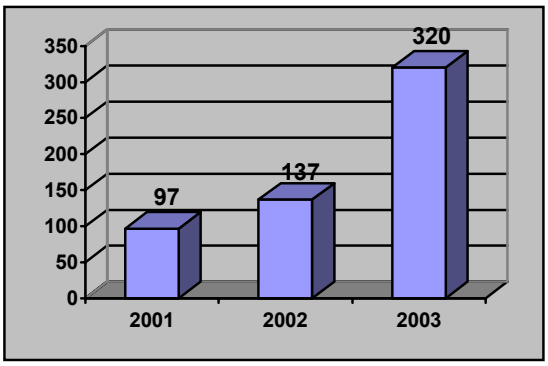


The rapid development of organic farming during the recent years was mainly due to the government interest and financial support to organic farming. Also, active promotional and educational activities in the field of organic agriculture have been carried out by local organic organisations (Centre for Ecological Engineering, Estonian Biodynamic Association, Estonian Organic Farming Foundation).

Organic livestock production

Currently, approximately 42% of all organic farms in Estonia have animal production. The sudden rise in this year (Figure 3) is most likely due to the new system of grassland support – the subsidy rate for grasslands is higher, if at least 50% of farm's LU is managed organically. Grassland subsidies are paid only to the farms with stocking density of a minimum of 0.2 LU per hectare.

Figure 3: Number of organic farms (1999-2003) with animal production (organic + in-conversion).



Shown in Table 1 are the most common animals on organic farms, with cattle and sheep as the most common enterprises. Approximately 15% of sheep (including goats) and 3% of cattle (2% of milking cows) are managed organically.

Table 1: Number of organic (including in-conversion) animals (2001-2003).

Year	Farms	Cattle	Sheep & Goats	Pigs	Poultry	Horses	Honeybees (no of hives)
2001	97	3365	934	124	836	63	196
2002	137	4392	1919	218	1375	265	333
2003 estimated	320	7620	5510	400	3190	500	410

Certification

Organic farming in Estonia is under a state inspection system. Producers are certified by the Estonian Plant Inspectorate and processing organisations by the Estonian Veterinary and Food Board. All organic farms in Estonia are visited at least once a year by an inspector from the Estonian Plant Inspectorate. In addition to those visits, the inspectors can make also unannounced visits throughout the whole year in order to verify that everything is up to the standard.

Processing and marketing

Although the production is increasing rapidly, processing and marketing are still poorly developed. This situation probably has retarded the further development of organic farming, especially animal production in Estonia. Plant products, especially vegetables can be sold directly from the farm, while most animal products will need further processing before marketing. Until this year, there were no slaughterhouses certified by the organic standards. There is only one dairy farm in Estonia, which is certified to process organic dairy products. Therefore, the main part of organic animal products are processed and sold as conventional, and consumers cannot find any organic products in the shops. In order to promote organic meat production and marketing, Estonian Organic Meat Association was established in July 2003.

Education and research

Farmer and advisor training has been carried out by the local organic organisations, mainly by the Centre for Ecological Engineering, Estonian Organic Farming Foundation and Estonian Biodynamic Association. In many cases, foreign advisors and lecturers have been involved to the training activities. For educational purposes, a Journal of Organic Farming – Mahepõllumajanduse leht – is published by the Centre for Ecological Engineering since 1996.

At the moment the only agricultural university in Estonia has no special curricula or even courses of organic farming in the study programme. There are just few courses that include the basics of organic farming in the course programme. More attention to organic farming issues is paid in the new Masters Programme of Agroecology, which is open for new students in autumn 2005.

Research in organic farming has been very limited in Estonia. There have been few activities, implemented mainly by the Centre for Ecological Engineering, Estonian Agricultural University and Jõgeva Plant Breeding Institute. All the research projects carried out so far mainly concerned the plant production. Nothing has been done in organic animal production. The rapid development of organic farming during the last years indicates the great need for a research work in the whole chain of organic farming.

Food safety

The Veterinary and Food Board supervises processors of organic farming products and the importation of organic farming products pursuant to the Organic Farming Act. Also, infectious animal disease control, regular monitoring of contaminants and genetically modified organisms is carried out by the same organisation.

Further information on organic farming in Estonia

Centre for Ecological Engineering
http://www.ceet.ee/

The Ministry of Agriculture
http://www.agri.ee/

The Estonian Veterinary and Food Board
http://www.vet.agri.ee/

The Estonian Plant Production Inspectorate
http://www.plant.agri.ee/

Animal production and marketing for the diffusion of organic farming in the natural parks of Tuscany in Italy

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The pilot project

The Pilot Project on the Development of Agriculture and Organic Livestock Production in the Regional Parks of Tuscany was enforced following the protocol of agreement among the Councillorship for the Environment, the Councillorship for Agriculture, ARSIA (Tuscan Regional Agency for the agriculture development and innovation), the Tuscan Association of Organic Producers (CTPB), the Park Service of the Alpi Apuane, the Park Service of Maremma, the Park Service of Migliarino, San Rossore, and Massaciuccoli. The Project had a duration of three years, from September 1997 to September 2000, with regional funds of 200 million lira (about €100.000) per year.

Objectives

The project's objective was that of promoting organic agriculture in the Parks, in order to reach the conversion of 30% of the farms in the parks, with an organic UAA (Utilised Agricultural Area) that represented 20% of the total (Migliorini P., 2000; Battino V. *et al*., 2000).

Actions

The technicians of the Tuscan Association of Organic Producers, CTPB (agronomists, livestock production experts, veterinarians), together with ARSIA and the Park Services, performed the following actions:

1. Information and dissemination of the techniques of organic agriculture, in order to favour the conversion of the farms in the parks through contacts with the farmers, field visits and meetings.
2. Technical support and live demonstrations to agronomics, livestock productions and veterinary medicine, for the farms already converted to organic production or currently in the process of conversion.
3. Promotion of organic products in the parks and identification of possible commercial outlets.
4. Activity of co-ordination and promotion of the project.

Park of Alpi Apuane
Area: 20.598 ha
Provinces: Lucca, Massa Carrara
Since 1985

Territory
The territory of the Park is made up of the area of the park and by a contiguous area, as identified by the Regional Law 65/1997, in which there are 230 farms, with a medium age of the managers of about 53 years. The farms are mostly small or very small, often family-run, with prevalent use of spare time remaining from other main activities.

Principal production
Livestock production in the area is characterised by the presence of cattle and sheep farms, mostly in the areas adjoining the park. The animal products consist of pork sausages, beef, sheep and goat meat, rabbits, fresh milk, cow, sheep and goat cheese, ricotta cheese, trout, honey, beeswax, bee propolis, royal jelly and bee pollen. The most important agricultural products are fresh chestnuts, chestnut flour, wheat flour (corn, spelt), firewood, potatoes, beans, tomatoes, forage for animal use, apples, pears, herbs, wine, oil and undergrowth products such as wild strawberries, mushrooms, blueberries and raspberries.

Project activity
Chestnut flour: the food chain project concerned with saving the chestnut groves through free-climbing techniques, forming an association of producers and saving a historical stone water mill.

Principal results
1. The conversion of 5 farms to organic production.
2. The creation of semi-free livestock production of Cinta Senese (autochthonous pig breed), and production of organic Lardo di Colonnata.
3. The creation of a fruit arboretum with autochthonous species.
4. Production of organic chestnut flour using the ancient water mill.

Park of Migliarino, San Rossore, Massaciuccoli (MSRM)
Area: 24.000 ha
Provinces: Lucca, Pisa, Livorno
Since 1979

Territory
The Regional Park of MSRM, founded in 1979, covers about 24.000 hectares along the coastline between Viareggio and Livorno. Although it is in the centre of a highly urbanised area, this territory has maintained remarkable natural characteristics, and it is one of the rare examples of a coastline which has not been built up.

Principal production
The agricultural surface inside the Park is of 9.400 hectares, with an utilisable agricultural area (UAA) of 7.000 hectares. In the Park Estates (Coltano, Tombolo, Padule Nord, Padule Sud,

Migliarino, San Rossore) the main products are grain, forage, livestock production, industrial cultivations of fruit orchards and horticulture.

Principal activities
In 1999, the following activities were complete:
1. High-quality tomato in protected cultivation
2. Potato cultivated in open fields
3. Precocious peach trees
4. Strawberries in protected cultivation
5. Veterinary homeopathy

Main results
Since the beginning of the project, 4% of the active farms within the census have converted to organic production:
1. 6 farms within the Park and
2. 2 farms in the adjoining areas.

The total converted UAA was 600 hectares, representing 8.5% of the park's SAU:
Present situation:
1. 1.200 hectares of organic UAA within the Park
2. 17% of the total UAA

Park of Maremma
Area: 18.000 ha
Province: Grosseto
Since 1975

Territory
The territory of the park extends along the Tirrenian coast from Principina a Mare to Alberese and to Talamone. Significant geographic points are represented by the Ombrone River, the mountains of Uccellina, the swamp area of Trappola, as well as the marine coast. The protected area and the adjoining area are part of the Municipalities of Grosseto, Magliano in Tuscany and Orbetello, for a total of 18.000 hectares.

Principal production
In the park, there are a high numbers of areas cultivated with grain (mostly durum wheat), sunflowers, olive trees and forage, those connected to the livestock sector for the production of milk and meat from cattle (for meat the Maremmana breed, for milk the Italian Holstein) and to a few sheep farms (the Sardinian breed). Other production in the park includes fruit (grape vines and peaches) and vegetables.

Main activities
1. Trials with olive tree fly abatement methods, using mass trapping and «poltiglia bordolese» (an organic insecticide, composed of sulphate-copper and slaked lime) in small doses.

2. Trials of cultivation in open fields of watermelon, using beneficial insects.

Principal results

The farms converted from the beginning of the project were 19 (30% of the total from the census) for a converted UAA of 742 hectares, equal to 27% of the convertible UAA. The number increased to 20, with the conversion of the Regional Farm of Alberese, a UAA of 1,232 hectares equal to 50% of the convertible UAA.

Future developments

The Region of Tuscany has recently published a new three-year program for the Development of Organic Agriculture in the protected areas and in the areas of the Ecological Network of Tuscany. Among the different initiatives, ARSIA will co-ordinate a new project that foresees the participation not only of the three Regional Parks but also of the protected Areas of the Provinces, enlarging the area of participation and the number of possible farms participating in the project. The Project will have a duration of three years, from October 2003 to September 2006, with regional funds of €309.000.

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Part G:
Working group reports

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Working group report:

Animal health and welfare on the farm: Identification of common and country-specific problems and potential solutions

Dairy production

Compiled by C. Winckler and G. Smolders

In a workshop, with 17 attendants from 10 different countries, the following main health problems for dairy cows were highlighted.

- *Mastitis*: in most countries the main problem and also the main culling reason. The levels of mastitis do not appear to have declined in organic systems when compared with local conventional systems.
- *Metabolic disorders* (milk fever, ketosis, rumen acidosis) were seen to be problems in some systems due to limited availability of/restriction on farm-grown feedstuffs, low energy contents in the diets and poor feeding management.
- *Lameness* was highlighted as a problem in some countries only. The main causes in organic systems were seen to be poor housing conditions, feeding and breeding.
- *Selenium and vitamin deficiencies* were seen as serious problems in some countries.

These problems also contribute to a lack of longevity in most dairy populations (average productive life span only 3.5 years). Furthermore, problems originating both directly and indirectly from the organic farming regulations are expected. This refers, for example, to the 100% organic feeding requirement, which will make it difficult to ensure adequate protein levels in the diet. This requirement will put emphasis on feed prices as a limiting factor for balanced rations.

While these short-term problems have their main reasons in imbalances and poor management, dairy cattle health should also be sustained by long term approaches such as improving:

- resistance, immune system (including the role of mother-offspring interactions; learning ability of the immune system during rearing);
- early diagnosis and preventive measures; and
- alternative/complementary medicine

The working group decided that single health problems should not be discussed but to put the main emphasis on long-term strategies for improvement of the overall health situation on organic farms. This discussion is summarized as follows:

- More work should be done to understand the role and mechanisms of the immune system (including organ specific immune functions; e.g. in the udder) and factors involved in it. For a more holistic approach, it could be useful to identify all factors that affect resistance and

immune status, starting, for example, with animal-farmer relations, harmony between animal and farm conditions, stress, suckling/rearing system, feeding, hygiene etc..

- With regard to breeding, improvements could be achieved by specifically considering data from animals on organic farms for breeding value estimation. However, the number of animals in organic systems is still very limited and heritabilities of diseases are not very high. Selection of bulls on other traits than milk yield and fat and protein content is developing (functional traits such as mastitis index, longevity index, fertility index). A feed/forage intake index would also be helpful in organic farming.
- On the other hand, fewer problems can be expected, if farmers implement good practice in organic farming (e.g. welfare friendly housing, feed and feeding management optimisation, herd health management plans). There is already a substantial body of evidence on the risk factors for diseases, however knowledge about the impact in organic farming is at least partially lacking. In practice, most farmers seem to act only if they do have pressing problems. Farmers generally know what should be done to keep animals healthy but are not convinced of the advantages of preventive measures and early diagnosis. Additionally, in some countries organic farms are so scattered that advisory services hardly reach them.
- With regard to future research, there was no common view on the methodological approaches to be taken. On one hand, there is already knowledge available on risk factors for most health problems. Furthermore, it is also quite likely, that, for example, in the case of mastitis, general approaches derived from epidemiological studies have already reached their limits and that further improvements can only be obtained by individual farm strategies. On the other hand, it was also emphasized, that futher epidemiological studies within the organic farming system could provide insights in system specific risk factors which are not well known so far, e.g. for metabolic diseases.
- Future research could focus on systems that work well (especially good management practices), early diagnosis and a more analytical approach to problems. Intervention studies on practical farms would help in proving valid preventive measures.
- Potential actions to be taken on the farm should be discussed with all people involved (farm wide) and laid down in farm specific plans on top of a good basic management (see also working group report on health and welfare planning).
- Knowledge transfer to farmers should also be one of the main topics for future workshops (i.e. ;why don't farmers act the way we want them to act?').

Sheep and goats

Compiled by G. Arsenos and H. Hoste

The working group on sheep and goats was composed of 11 participants from 8 different European countries (UK, Norway, Latvia, Germany, Italy, Spain, Greece and France).

The participants discussed the different health problems encountered in production systems across Europe. After an initial round table presentation of the current situation in each country, it was recognized that most of the problems at farm level were similar, apart from some distinctive differences between northern and Mediterranean countries.

The main diseases/problems encountered in organic sheep and goat production systems were:

- External and internal parasitism;
- Lameness in sheep (mainly footrot);
- Mastitis in dairy ewe and goats; and
- Nutritional deficiencies.

The common view of all members was that, compared with the experiences from conventional systems, the above diseases do not appear specific to organic systems. It was agreed that, at farm level, the incidence and severity of diseases were related to the modes of control and management practices. Abortions and perinatal mortalities, as well as other "orphan diseases" (see below), were also mentioned but less frequently. For most of the diseases, participants identified common methods of control available in organic farms in their home countries. However, for some "orphan diseases", as present in various countries, alternative control measures (apart from the preventive use of chemical treatments) were not available. These included flukes and nematodiriasis of lambs in the UK, and external parasite infections (e.g. *Psoroptes ovis* infections in sheep or *O. ovis*) in sheep in southern Europe.

In the UK, organic sheep production is mainly extensive; characterised by outdoors systems that focus on meat production. There is no dairy sheep production, whereas goat production comprised of small, family based enterprises for milk production. Internal parasites, lameness, sheep scab, tick and flies as well as nutritional deficiencies were the major problems. Protein nutrition and in particular quality of protein was an issue of concern.

In Norway, organic sheep are reared for meat production and are kept indoors during the winter months. In the summer, it is common to let them out unfenced in the mountain area. There are some organic goats flocks for dairy production. The challenges for both are parasitism and the use of preventive anthelmintic treatments without egg sampling, the lack of straw for bedding, and possible nutritional deficiencies and underfeeding of animals during the winter months (especially in sheep production).

In Germany, apart from parasites and footrot-lameness problems, there have been cases of abortions (chlamydia). Lack of health management plans and the use of "blind" routine anthelmitic treatments against gastrointestinal parasites (2-6 times per year treatments for parasites were reported) were also identified as a major problems.

In Spain there have been cases of selenium deficiency, high incidence of white muscle disease and brucellosis, high mortalities of lambs and kids due to diarrhoea during the 1st week of age, whereas. There were no major problems with parasites.

In France, parasites, mastitis, lameness, milk quality and protein nutrition were identified as the major problem in organic sheep and goat production systems.

From Italy, it was reported that there have been incidences of anthelmintic resistance. Veterinary services to organic farmers have been described as poor. Welfare problems were identified because organic farmers are not skilled to treat sick animals. Bluetongue and generally infectious diseases were also a problem, which has been characterised as a political problem.

In Latvia, the problem with both internal and external parasites and the use of multiple antiparasitic treatments due to the absence of specific, alternative recommendations was a major problem. Milk quality was compromised because of high somatic cell counts. The issue of global warming and its consequences on tick population and the emergence of tick borne diseases in northern European countries were mentioned.

In Greece, external parasites and footrot in sheep and mastitis in both dairy sheep and goats were the major problems. Regarding mastitis, lack of knowledge to deal with it by organic farmers was emphasised as well as the absence of the health plans at farm level.

Current methods of prevention and treatment of health and welfare problems were also explored:

- Homeopathy and phytotherapy. Both methods are used against mastitis and parasitism. It has been suggested that research should be developed on plant therapy, in particular on those originating from tropical countries, in order to favour the dissemination and implementation of these methods in other European countries.
- Conventional treatments. Current organic standards encourage the avoidance of preventive use of chemical drugs. These conventional drugs should be reserved to treat animals, which suffer severe infections. The working group insisted on the need to avoid any "blind therapy", without relying on a clear diagnosis. The need to promote standardisation of the diagnostic methods has also been underlined as well as the necessity to inform farmers on the right interpretation of the diagnosis tests. The objective to improve diagnostic methods and to make them more simple for a more selective and more pertinent use of chemical drugs was identified as an interesting theme for research.
- Hygiene measures are time consuming and labour intensive. However, the group emphasized the fact that several methods of control based on hygiene are essential to implement in organic farms in order to limit the negative impact of diseases, either in young ruminants, (e.g. coccidiosis or neonatal diseases and diarrhoea) or in adult sheep or goats (mastitis, lameness).
- Grazing management by lowering stocking densities was seen as a way to reduce problems with internal parasites.
- Nutritional management was also mentioned as a way to control parasitic diseases.
- Genetic improvement of resistance to disease should have a higher status among organic approaches to disease control. In some cases, such as lameness, the "natural" resistance of some local breed is suspected in several areas of Europe and the working group consider that such examples are in favour of conservation programmes set up in various countries aiming at preserving endangered breeds and their genes. Moreover, for some diseases, like mastitis, OF farmers seem to rely on early elimination of the infected dairy ruminants, which, in a way, correspond more or less to a programme of genetic selection.

The following recommendations were made by the working group:

- In some European countries, especially candidate countries, there is a shortage of easily understandable information for farmers. Communicating the appropriate information effectively at farm level could solve most of the problems regarding health and welfare of animals. The prophylactic use of disinfectants and the adoption of "all in-all out" systems, especially for newborn lambs and kids, will reduce the high mortality rates.
- For some of the diseases that have limited options of control (i.e. Psoroptes ovis), bio-security on a national basis could be a method of control.

- Application of any antiparasitic treatments should be based on regular faecal analysis and "blind" therapies should be abandoned.
- An appropriate monitoring protocol should be developed for early diagnosis of diseases (i.e. regular examination of milk tank samples, periodic blood sampling of groups of animals).
- Mastitis should be addressed by monitoring of the udder health on farm and the combination of homeopathy with management (e.g. choosing animals of specific breeds with genetic resistance to mastitis).
- Any disease-suspected animals should be immediately isolated and kept out of pasture to avoid spread of disease.
- The farmer should be constantly advised to make appropriate management changes.
- Bio-security aspects of disease are not fully understood by the farmer. Hence, there is need to provide information on how to brake the cycle of specific disease (e.g. how to brake the cycle of lameness).
- There is need for organic feeding tables that will provide information about the nutritional composition and chemical analysis.

Pig production

Compiled by M. Bonde

The working group on pigs had participants from 11 different European countries (Austria, Bulgaria, Britain, Estonia, Germany, Italy, Norway, Slovenia, Spain, Sweden, Switzerland).

In Denmark, the organic pig production predominantly consists of relatively small herds on farms integrating breeding and finishing of pigs. The pigs are conventional breeds. Most sows are housed outdoors, while fattening pigs are kept indoors with outside runs – or occasionally on pasture. The weaning age is seven weeks. The main health problems are diarrhoea, parasites and leg problems.

In Sweden, the organic pig production has experienced problems relating to the retailer section, and poor profitability for farmers. One problem involved the coordination of demand and supply of organic pork. However, joint efforts and cooperation among the slaughter and processing industry and the retailers have resulted in more efficient use and distribution of the carcasses, better availability of organic pork for consumers and better prices for the farmers. Consumers show an interest in organic pork, which is perceived as more welfare-friendly. In Sweden, there is only a small number of specialised pig farmers. All organic pigs must have access to pasture during summer and weaning age is seven weeks. The most important health problems during the summer are related to parasites, leg problems due to *Erysipelothrix*, and hoof lesions. In the winte,r there may be problems with supervision and care-taking of the animals if housed in outdoor huts. However, there is evidence of improved respiratory health and less abcesses compared to conventional pigs.

In Norway, there are only a few organic pigs.

In Italy, about 90 % of the pigs are reared for typical ham production (heavy pigs). Slaughter age is nine months and the slaughter weight is 160 kg live weight. The farmers and associations focus

on typical production and show less interest in organic pork. In the south of Italy and in central Italy organic free-range production systems with local breeds prevail, while organic pigs in North Italy are housed in pens with outside runs. As the pigs are fattened to the age of nine months, farmers still buy conventional piglets and keep them for at least six months, after which they sell them as organic pigs. This practice results in the import of conventional health problems, especially respiratory and gastrointestinal diseases. In outdoor housing, there can be a problem with heat stress as well as sunburn in the summer.

In Switzerland, the organic pig-production is 2 % of the whole pig production. The consumers have a minor interest in organic pigs – the ruminants, especially the cows are more important for organic farming. The farms are specialist farms for breeding and finishing pigs for slaughter. Most of the pigs are housed in pens with concrete outside runs. For sows, a rooting area or access to pasture is required. The weaning age is six weeks. The health problems are similar to conventional farms, like weaning diarrhoea, *E. coli* problems and the control of parasites by anthelmintics are also seen. The breed is usually conventional. At the moment, the animal welfare implications of castration are discussed.

In Germany, the organic production system is similar to the system in Switzerland. The pig production takes most commonly place in indoor systems with concrete outside runs, and farms are specialised for breeding and finishing pig production, respectively. The main health problems are parasites, diarrhoea and respiratory problems.

In Bulgaria, there are no specific welfare standards for organic pigs. A current problem is the import of cheap pork from Poland and Germany. This will imply that the good quality pig meat from extensive housing systems in Bulgaria will become too expensive for Bulgarian consumers. Housing consists to a large degree of extensive free-range systems with native breeds (crossing with wild boars). Subsequently, health problems are totally different from intensive organic pig production. One problem is transmission of infectious diseases from wild boars and other wildlife. The vaccination standards of other countries should not be adapted because of these special conditions. However, the former mandatory vaccination against swine fever will be prohibited from 2005 and problems may arise because of this.

In Austria, the standard organic pig production is similar to Germany and Switzerland. There are specialist pig breeders and specialist finishing pig herds, and pigs are housed in pens with concrete outside runs. Consumers are interested in organic pork. Health problems are conventional problems, like weaning diarrhoea and problems with joint diseases, parasites and mange, if preventive treatments are neglected. On the positive side are improved lung scores of organic pigs.

In Britain, the suitable soil and climate enable a substantial conventional outdoor pig production. The slaughter weight ranges from 70 kg live weight to 110 kg, without castration. There is only a low percentage of organic pork production. Most organic pigs are integrated in the farm cycle. Organic pigs are housed on pasture – only occasionally they are finished indoors for the last month before slaughter.

In Estonia, there is a share of 400 organic pigs of a total of 300,000 pigs. Estonia has no marketing of organic products in supermarkets. The housing is extensive and not specialised.

In Slovenia, there is no marketing of organic pigs. 500,000 conventional pigs are produced per year. The traditional livestock production is based on cattle breeding, but it would be easier to produce feed for pigs and poultry because of limited available land.

The following conclusion can be drawn from the above:
- Organic pig production is a niche production in most European countries. The main constraints are perceived to relate to the production costs, meat classification, market features as well as the problems with environmental pollution associated with outdoor pig production.
- It is not possible to define common problems areas in animal health at the farm level for the different countries, because of the huge differences in production systems employed.
- The housing systems for pigs range from free ranging (South and Central Italy, Bulgaria) to outdoor pasture (Sweden, UK) to housing in pens with concrete outside runs (Northern Italy, Switzerland, Austria, Germany, Denmark).
- Organic pork producers are supplied with piglets from their own sow herd, an organic breeder herd or even conventional sow herds.
- The slaughter weights, and subsequently the health and welfare problems vary, from 70 kg to 160 kg live weight.
- The different housing systems employed cause different problems as listed in Table 1.

Table 1: Health problems in different housing systems for organic pigs.

Housing system		
Free range	**Outdoor pasture**	**Indoor with outside run**
Infectious diseases from wildlife	Parasites	
	Lameness – joints, hooves	Weaning diarrhoea
Climatic problems • Summer: sunburn, heat stress • Winter: potential malnutrition and insufficient supervision		E. coli problems
		Respiratory diseases
		Lack of possibilities for natural behaviour

- According to the amount of ´conventional management´ (e.g. buying conventional piglets, using conventional breeds) conventional problems are seen on organic pig farms. In this case, the quality of antiparasitic treatment and vaccination affect the prevalence of endo- and ectoparasites as well as diseases such as e.g. erysipelas.

The following recommendations were made:
- Future research should be directed at prevention of diseases by means of nutrition, e.g. type and amount of forage or bioactive plants, and the choice of pig breeds in organic production.
- Development of herd health plans is recommended, which allows farm specific herd health management.
- The standard EC-Regulations in organic pig production could constitute a problem. Uniform organic standards are preferable for most animal welfare requirements. However, considering regional differences in production systems (e.g. amount of access to outside area), one

uniform standard could constrain organic pig production in some countries. Therefore, local standards may be necessary to support regional production.

- The objectives of the EU organic standards as regard to animal welfare should be evaluated to agree on a common frame acceptable to all EC-countries and to ensure the same outcome in respect to animal welfare. It has to be discussed, which basic principles should be applied in all countries. In particular the following areas should be considered: housing, especially accessibility and quality of outdoor area, farrowing accommodation, vaccination, permitted mutilations such as e.g. nose ringing and castration, and use of different breeds.

Poultry

Compiled by U. Knierim

The working group on poultry had participants from 5 different European countries (Austria, Britain, Finland, Germany, Netherlands) and the US).

In Germany, there is a rise in organic poultry farming. However, the share of the total poultry market is only about 1.6 % in laying hens and less in fattening birds, except for turkeys and geese. There are only few institutions working on organic poultry production. The main health problems with laying hens include relatively high mortality due to various problems, feather pecking and cannibalism. Improvement of the rearing of hens, general health control, such as disease prevention and reduction of predation are, therefore, among the points of concern, as additionally, feeding poultry 100% organic feed. The formulation of the feed is also important. More training programs, such as are in existence in Switzerland, are needed. Questions on the conventionally kept parent and grandparent stock should be addressed. Waterfowl husbandry can be challenging, particularly in organic systems, where the expectation of farmers to provide bathing water is higher than in conventional.

In the UK, the trend of organic broiler production is to look at integration with crop production. Eggs are mostly produced by conventional farms, and there is a need to increase market access for organic egg layers. A study on flocks that supply supermarkets is in progress to evaluate the impact of feed on day-old table birds. Key problems include defining the critical periods in poultry husbandry and linking farmers successfully with feed producers. The UK organic national standards require that all flocks, even those that were establsihed prior to 1999, will have to comply with the EU Regulation stocking densities by 2005. There is an urgent need to introduce breeding and rearing stadards for organic breeding flocks and pullet production to avoid poor welfare image: 90% of organic laying hens have been reported to have their beaks trimmed, as they origninate from conventional rearing systems for free range birds where beak trimming is a routine procedure. - There was an idea presented on encouraging the use of innate immunity and provision of amino acids for poultry through their consumption of insects.

In the US, organic standards issued by the National Organic Program went into effect in October of 2002. The primary need in the U.S. is to define the details for these standards (ex. What does ‘access to outdoors’ mean? Should the use of synthetic amino acids be permitted in feed?). Answering such questions will restrict a phenomenon in the US where many organic operations

look too much like conventional farms (i.e. they meet the restrictions on feeds and medications but do not take into account animal welfare).

In Austria, organic eggs and meat production are run on an integrated basis. One of the challenges is to solve the difficulty of marketing organic poultry products. For example, there are only two chains taking 80% of the organic product so there is not enough retail competition. At the farm-level, health problems include cannibalism and feather pecking given the rearing system of pullets. In broilers, there are issues with coccidia, vaccine use, and the use of perches (in the case of perches, farmers are hesitant as they feel it may lead to breast blisters). In turkeys, problems include blackhead disease, coccidia, salmonella and campylobacter. Knowledge transfer is growing slowly as some individual schools have joined organic farming efforts, especially in animal science research.

In Finland, there is a need for more advice in organic poultry production, particularly with respect to free choice feeding. Finland currently has 75,000 organic laying hens but need access to ecological pullets for this trend to increase. The breed for organic poultry production presents a problem, as broilers are harvested at 81 days and are too big for the slaughter machines. Few turkeys and waterfowl are being produced organically. In general, consumer demand is not as strong as in other countries, so the market is limited. One health challenge is the supplement of feedstuff with protein. Fishmeal could be an option but would need a way to procure ecological fishmeal. Major needs to be addressed include the rearing of pullets, a good breed for ecological production and a strong Scandinavian network of farmers.

In the Netherlands, there are currently 14 organic broiler farms (and one organic turkey farm) that produce only what the market is prepared to buy. This limits the ability of new farmers to produce organically as there is no predictable expansion of the market. Food safety research is needed. Coccidia and limited access to organic feed are significant challenges. The idea of combining broilers with arable land should be looked at closely. There are 200,000 organic laying hens with the majority converting 5-7 years ago. Mortality is 10-11% and often caused by cannibalism. Feather pecking, growing feedstuff locally and establishment of an advisory service are at various stages of development. New monitoring results indicate that dioxin level in organic eggs might constitute a problem. Possible underlying mechanisms are under discussion.

Following the reporting from each participant country, our discussion moved onto identify problems with poultry production that were common to the entire group.

- Feather pecking: The group discussed this in the context of using insects as natural forage (as suggested by one UK participant) to reduce feather pecking behavior, potentially increase use of outdoor runs, and as a means to deliver nutrients in poultry farming. It was argued that this could be done through natural, commercial production of insects (e.g. 'beetle banks') and a significant biomass would be required to obtain a possible benefit of reduced feather pecking. This is in an early stage of research and much information will be needed to determine the feasibility and practicality of such an approach. One interesting point was made about the underutilization of natural immunity in organic production and there is a study in progress looking at the role of compost in heightening disease resistance.
- Mobile housing: Benefits to mobile houses include rotation for increased pasture fertility, the feasibility of housing 1,000 hens per house with multiple houses in operation at a given point

in time and individual access to outdoors. However, the major mobile housing needs to be addressed include:
  - Solving the problem with mixed-age sites as some farmers question build up of pathogens and would like to know for how long land should be 'rested'
  - Farmers are hesitant to implement due to pathogen exposure
  - Economic limitations as market price does not pay back labor and inputs (one suggested solution could be horizontal integration where the cost of feed, etc. is distributed)
  - Appropriate marketing strategy so consumers can identify eggs or meat produced in mobile units
- Free-range: The two main challenges identified with free-range were disease exposure and predation. Pathogens (such as Avian Flu) from wildlife exposure are significant and screening programs should be in place to prevent whole flock contamination. Again, the possibility of using compost to increase natural immunity was offered. Predation strategies will require innovative on-farm practices such as cover areas.

The followig areas were identified as areas where future attention was needed:
- Develop general disease resistance in young poultry;
- Further investigate the presence of dioxins and its implications for organic poultry farming (for example, is there a certain deficiency in feed that we do not see in the production level that provokes increased consumption of soil?);
- Designate realistic strategies for combating predation in free-range chickens (e.g. fishing line between houses as deterrent, does more cover necessary mean decreased mortality?);
- Research and implement market mechanisms to promote small-scale organic farm products; and
- Provide on-going advice to farm community to guarantee progress and implementation on the farm level as solutions become available for organic poultry challenges (e.g. distributing knowledge that good breeds for organic broiler lines have become available).

To address these pressing areas, the group recommends:
- The use of a systems approach to address the long time frame and overlap between the separate production issues and to shear complexity. A truly interdisciplinary approach will be difficult given such intellectual complexity; however, a systems approach can be utilized via a concentrated effort with high availability of time and resources.
- The current state of research has been on the individual level (e.g. diets), but animal health at the farm level requires a multifactorial approach, communicated to the farmer through the transfer of knowledge and science.

Working group report:

Solutions to farm level constraints in ensuring high health and welfare status

Management solutions

Compiled by G. Smolders

Parasite control

Grassland management against parasites links between farming and management. In France, scientists are working with alternatives to anthelmintic treatments, like bio-active plants and usage of fungi to protect against internal parasites due to the increasing resistance to anthelmintics. Also, parasite control through grassland management should be promoted. One of the biggest problems is grazing of young stock on too small and heavily infected areas. If possible, moving the stock to clean pastures during the season is one way of prevent parasite infections. It is important to realise that there always will be parasites outdoors. Combinations of evasive/alternate grazing and other preventive factors should be used.

Competence in disease prevention

Farmers converting to organic farming have difficulties in changing from curing to prevention of diseases. In some countries, it has been observed that newly converted organic farmers stopped using anthelmintics after conversion without taking preventive measurements instead. This resulted in massive disease problems. The reasons for doing this were lack of knowledge and blind faith in the healthiness of organic farming. It is recommended to develop an obligatory course in preventing diseases in organic farming. This course should be part of a conversion plan and all farmers who want to convert should attend this course. The course should be carried out in co-operation between older organic farmers and the organic advisory systems. In Norway, anyone who works with animals must have an animal welfare certificate. We hardly ever tell farmers not to convert, even if his farm/the system is not suitable for organic farming.

Feeding management

Feeding management with 100% organic feed can be/are a problem in some countries. This is primarily due to lack of vitamins and/or proteins in the fodder. The use of lupine in diets for cattle was mentioned. Use of eggs as a fodder to chickens and feeding old hens and eggs to lactating sows was mentioned as a solution for the lack of protein, but the ethics in such an arrangement was discussed and, in general, this solution was rejected. In some countries, it might be a solution to feed small piglets with eggs to increase protein in the diet. In general, good feed storage and good feeding practice are very important factors and should be highlighted in organic standards further.

Making standards accommodate local management practices

It was discussed if European standards could be differentiated between regions. At the moment, EU standards are the same all over and it may not fit in all regions. One of the factors of big difference between regions are dry/wet conditions but also regional legislation causes differences.

In Germany, pig production in forests is forbidden, in France, it is allowed. In Scotland, it serves two purposes, production of pigs and also forest renewal. In the Check Republic, only small farms (10–15 dairy cows) are able to convert to organic farming. On the other hand, one should not point at differences between regions but stress the common things.

Housing management
Finding solutions in pig production for human/animal relations and for environmental friendly management could be a future research area. Moreover, diminishing NH_4 emission in outdoor run areas by learning pigs defecate on certain spots, usage of cleaning systems for outdoor runs to prevent animal welfare and pollution/emission. Farmer attitudes towards better management should also be encouraged in beef production, probably by financial incentives (separation/adding animals to the group, weaning, adopting calves)

Standards (50% non-slatted floors) at many farms do not contribute to animal welfare in dairy cattle. More research is needed in housing dairy cows in barns without the cubicles itself but with the advantages of cubicle housing.

In general focus at farm level on clean space indoors and outdoors, more space (lower stocking rate), good conditions,

Poultry solutions
Compiled by W. Zollitsch

Organic poultry production shows a high variability throughout Europe. This refers to the economic importance of poultry to the organic farmer and hence the stage of specialization, the structure of production and marketing, the average flock size, the farming conditions, etc.

Despite these regional differences, there are some aspects which European organic poultry producers have in common:
- Traditionally, organic farms poultry were kept in small flocks alongside other livestock species. During the last decade, a number of organic farmers have started to specialize in poultry production and to manage larger flocks of both layers and broilers (from 500 to several thousand birds per flock). At the same time, large scale conventional producers have begun to diversify into organic farming, seeing this as a promising market situation.
- This development has been accompanied by changes in marketing strategies: while traditional organic poultry farmers mainly rely on marketing directly to consumers, specialized organic poultry farmers supply super markets and retailer chains with organic poultry products.
- Typically, higher premiums can be gained for organic broilers than for organic eggs. There tends to be more competition between the organic egg market and other “free-range” systems.
- In some countries organic poultry production has been organised through vertical market integration. While this cannot be considered to be a "typical organic structure", vertical integration may have advantages with regards to managing scarce resources.
- Despite regional differences in organic poultry production, the main problems which are reported by farmers seem to be very similar for most countries and involve both external and internal resources.

Both external and internal resources may be factors that limit animal health and welfare, food safety and the economic profit of poultry producers:

- Feather pecking and cannibalism: the question of breeding goals and breeding programs for organic laying hens still remains unsolved. A sound concept for rearing of organic pullets is also needed in order to solve this problem.
- Animal welfare and product quality: While there is relatively little contradiction regarding systems for organic layers, there is a need for the further development of husbandry systems and management concepts for broilers (e.g. use of perches, litter management). Parasites and breast blisters were highlighted as main problems in this respect.
- While suitable broiler breeds are more readily available, there is an urgent need to clearly define the term "slow growing birds" within the organic standards. It is felt that currently there are no breeds available which are suitable for organic turkey production.
- The disposal of spent laying hens is quite different in different countries. It is proposed that markets for products from spent hens should be developed (this includes slaughter houses for spent layers as a very specific problem in some countries) rather than developing methods for "animal friendly euthanasia".
- Nutritional needs of poultry: A very critical factor is the shortage of feedstuffs rich in protein to cover the high requirement of poultry for essential amino acids. While some farmers advocate the use of synthetic amino acids, it is strongly recommended that the focus should be on identifying and utilizing internal resources (such as cakes from different oilseeds, extracts from algae and other plants, soybeans) rather than relying on external resources.
- Economic constraints: There is a major concern that the higher price for organically raised pullets will not be compensated for by premiums on organic eggs. A further critical point is the increasing demand for organic feedstuffs, which will inevitably lead to higher prices. The concept of "horizontal integration" could be a system-compatible supplement, or even an alternative, to vertical market integration. Both formal and informal linking of farms and resource and cost sharing may assist organic farmers to gain a better control over external resources and hence improve efficiency whilst ensuring advances in the health and welfare of poultry flocks.

Health and welfare planning

Compiled by M. Bailey and C. Leeb

The group began by allowing each participant to speak on the status of health and welfare planning in each represented country. Discussion followed to identify the major challenges in health and welfare planning and the session closed with the group proposing next steps and solutions for overcoming the most pressing planning challenges.

In the UK, there is a requirement for health plans at the farm level in both the organic and some conventional farming sectors. However, there is variability in the breadth and depth of plans on different farms. Additionally, their effectiveness as regularly updated tools to ensure animal health and welfare has not been investigated. There are also a myriad opinions on how farmers view these plans (i.e. do they fully implement them? Is it just more paperwork!!) and on whether farmers use welfare assessment in the formation of their health plan. Additionally, veterinarians

are not independent to inspect farms for adherence to plans as the farmers and vets are in a client-based relationship. Inspection of farms by certification bodies in the 'checklist' fashion is not always a guarantee of welfare. Questions such as ‘Are the farmers really implementing their written plans?’ and ‘How can 'checklist' health assessment provide useful feedback to the farmer?’, ‘Can Health Plans be demonstrated to be useful to the farmer (i.e. economically)’ and ‘How can vets better sell their knowledge and advice to organic (& conventional) farmers?’ must be addressed.

In the US, health and welfare planning seems to vary widely from moderate plans that take into account some welfare indicators to those that are solely based upon health. Thus, there is little continuity, in most cases, between the idea that planning for health has potential to increase welfare and vice-versa. One of the barriers to overcome will be improving veterinary attitudes in the U.S. toward integrating welfare and health at the farm level.

In Slovakia, both conventional and organic farms have existing health plans that are subject to inspection two times per year. The major needs are to formally identifying welfare parameters and to establish disease prevention plans. A system of recording such information would also be useful.

In the Netherlands, health and welfare plans are not required for farms. All medication administration and treatment is recorded but there is no future prevention planning with farmers in an advisory role. There are individual programs for certain diseases and a service where welfare problems can be reported.

In Finland, there are farm specific plans. However, there is a need to standardize the content and indicators included. This is true of conventional and organic where standards are lacking for both types of farming systems. Planning should include production measures, environmental measures, food quality (e.g. presence or absence of drug residues) and animal health (e.g. udder health). As a primer for these plans, Finland does have a good herd recording system and registration system. One major need is the transfer of knowledge about organic to veterinarians.

In Germany, no health and welfare planning is required. According to a recent survey, the extension services even do not seem to be aware of the necessity and usefulness of the approach and health aspects are only partially addressed in the advisors’ work.

In Austria, there is no formal health planning at farm level. There is a legal requirement for welfare 'checks' for organic farms (ANI/TGI) to assess things such as housing conditions. However, the assessors do not look at the animals themselves in a quantifiable way. There is a clear difference in this assessment (which is used as an advisory tool) and a plan (which is written and implemented by the farmer).

In Latvia, overall planning is done to ensure safe and healthy animal products. Recently, Latvia has started investigating the organic farms as a good fit for such planning and as a way to improve product quality.

The following challenges to health and welfare planning were identified:

- Lack of an adequate, well-trained advisory board to provide advice, follow-through and ensure that 'rules' are abided by. However, it was argued that a health plan should be seen as a management tool for the farmer to use rather than as an outline of rules and regulations. This will encourage buy-in from the farmer.
- The concepts of product quality and animal health and welfare issues are disconnect and this needs to be resolved for plans to be holistic.
- A "whole farm plan" should integrate animal health and welfare, management of arable land (e.g. crop rotation), environmental issues (ammonia, overgrazing) and interests of the farmer (quality of work) and discuss potential benefits and conflicts.
- Standards for key problem areas for each species (e.g. in dairy cows, fertility, mastitis, lameness) are lacking and this makes good planning difficult.
- Farmers may not always understand the economic impact of disease which, if understood, could be an incentive to follow protocols and health plans.
- To date, planning has mostly incorporated reactive protocols (e.g. as a reaction to a disease outbreak). Planning must include preventative measures in conjunction with these protocols (e.g. some of the areas of the BCVA herd health plans do cover preventive health measures).
- Many existing plans only include disease prevention but need additional welfare goals (e.g. reduction of abnormal behaviour, possibility to exhibit normal behavior).
- The monitoring of risk factors in planning is non-existent.
- Do we/how do we prioritize the outcomes of assessments as there will always be 'good' and 'bad' points on each farm? Are intervention guidelines useful to highlight specific areas requiring action?
- There is a lack of knowledge among the veterinary community with regard to organic farming in general and this is due to a lack of communication between certifying bodies, veterinarians, and farmers.

The following steps are recommended for developing improved health and welfare planning in organic animal production:

- Invoke a requirement of having health and welfare plans and utilize a systems approach to meet this rule, i.e. incorporation of this requirement into organic standards.
- Farmers must feel ownership over their farm plan for it to be successful and strategies should be developed to accomplish this goal.
- Health and welfare plans should be subject to regular review and incorporate both quantitative and qualitative data from farm assessments.
- Both prevention mechanisms and disease outbreak information should be integrated into a yearly review of the plan by the farmer-veterinarian team. A requirement for review and update as part of standards encourages the HHP to be used rather than filled away and allows positive feedback.
- The goal of the plan should be to improve animal health and welfare. This should be achieved by improved management (stockmanship, husbandry/grazing, nutrition, breed) rather than dependency on input substitution (i.e. medication, deworming, vaccination).
- Animal based welfare assessment (e.g. lesion scoring, observation of lameness, medicine records) should be used to allow monitoring of the effectiveness of health plans. Comparison to other farms ("benchmarking") could encourage improvements.
- Strengthen the relationship between farmers, advisers and veterinarians. This will also require an exploration of how this relationship varies with different farming systems and who becomes responsible for implementing the health and welfare plan.

- Knowledge transfer between organic certification bodies, farmers, advisors and veterinarians must be improved. This could be achieved by increased education of veterinarians and advisors (e.g. training of vet students on organic standards), increased involvement of veterinarians in organic certification (e.g. for assessment of health plans) and constant communication between those parties (e.g. seminars, farm walks).

Report from the SAFO Co-odinator

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The SAFO Network on its way forward - a report from the coordinator

M. Vaarst

Introduction

The EU-funded concerted action project Sustaining Animal Health and Food Safety in Organic Farming (SAFO) was initiated 1st March 2003, and the first workshop within the network was held in Florence in September 2003. It served also as the first meeting between the partners. In March 2004, almost exactly a year after the first meeting of the SAFO Steering Committee, the second workshop took place in Witzenhausen, Germany. This gave more room for a common exploration of the field and a further cultivation and specification of the goals of the Network. The purpose of this short report is to give background and understanding for decisions taken with regard to the future communication and effort in the Network, seen from the point of view of the coordination.

A view into a diverse world of organic animal husbandry in Europe

At our partner meeting on the 26th of March, 2004, in connection with the 2nd SAFO workshop in Witzenhausen, all present partners gave an impression of organic farming in their country. The common impression was of a wide diversity inside Europe with some main trends:

- In some countries, organic farming represents a fairly new idea, a new way of farming and has developed, in some cases, slowly and, in some cases, fast. Many of the countries where the development of organic farming has been slow, were countries that have recently joined the EU.
- Some countries have a large organic sector, and a relatively long tradition of organic farming. These countries mainly came from Central and North-Western EU countries The development also differs between countries. For example, a number of countries have recently experienced growth in stockless organic farming, whereas in some countries stagnation of the sector was experienced, possibly related to low prices of food.

It was clear that there are also different main focus areas within the field of organic farming, e.g. that the Mediterranean countries have many common interests, such as the importance of small ruminants and the mountain areas tend to have their special foci of production. There are also differences in farm system development, e.g. in a number of countries, the average size of farms is moving towards larger farms, whereas, in other parts of Europe, the development is towards smaller farms.

Expectations among partners to what a network like SAFO can contribute

All partners had the opportunity to express expectations in relation to the SAFO network, both in terms of what the partners and their organisations can contribute to strengthen the network, as well as how the network can contribute. The expectations fell into three main categories:

1. Development of organic farming under diverse conditions

To contribute to the development of organic livestock production systems under diverse conditions, mainly through exchange of knowledge, experience, results and solutions. Box 1 shows a more detailed list of specific suggestions. Box 2 presents expectations as to how SAFO can act as a contact network.

Box 1: Major areas of concern and interest of the SAFO partners for further development of organic livestock production and animal food production in their countries, March 2004.

- Strengthen the philosophical basis and understanding of organic livestock production, e.g. the concept of naturalness
- Ideas on animal welfare in organic livestock farming
- Animal health issues and concerns in organic livestock production
- Animal disease treatment, especially homoeopathy
- The combination of animal ethology and grassland management
- Ideas on weed control (in particular toxic weeds) as an integrated part of organic farming
- Development and exchange of experiences with 'the best possible extension system'
- Problems with organic animal production systems
- Aphlatoxins
- Focus on practical problems and bring 'common sense' into the development of organic farming and research in organic farming
- Knowledge on mineral nutrition and supplementation
- Stimulate research in food safety
- Put quality of organic food for human consumption in focus
- 'Conversion of researchers' towards insight into the goals and philosophy of organic farming
- Go from problem identification to solutions

2. To create a link between animal health and food safety issues in organic farming

To create a bridge between the disciplines connected to animal health and welfare and food quality with special focus on food safety. This area will the specific focus of the coming two workshops.

Box 2: Partners' suggestions how to use, benefit from and improve the SAFO network

- Exchange of students and PhD students between partner institutions
- Form a Mediterranean group with focus on small ruminants
- Make a list of resource persons and their competences related to the focus areas of the network
- Make common courses, e.g. for organic livestock production in Mediterranean or mountain areas, candidate countries

- Exchange good ideas, e.g. some institutions have written small leaflets on organic farming for farmers, which could be useful for others
- Find a common position how interpret and improve the organic standards
- Translate, exchange and distribute SAFO material. There is no copy right on any material distributed via SAFO, and all proceedings can be translated and used freely

3. Focus on standard development and bridge between research and stakeholders

To create a bridge between research, regulation and extension services towards a common understanding of organic animal food production. As a part of this the network aims to be a forum where a 'common voice' can be found and where there is space to discuss organic regulations and how they are used under diverse conditions. Through the SAFO network, contact to certifying bodies can become more goal directed, specific and clear than if each partner would be communicating only on a national level. The SAFO network's discussions about the EU regulations and our recommendations to the EU commission about standard development forms an important part of this bridge.

What action will the network take in order to meet the aspirations?

Based on the discussions above, it has become clear that the aspirations of the SAFO Network are diverse. We have the great advantage of having the opportunity to use personal meetings (workshops) as well as to use the web-site in many different ways to meet these aspirations.

Firstly, the need to create a more integrated approach to food safety in connection with animal health on organic farms is obvious and a core focus area of the Network. In order to do this, experienced researchers from various disciplines must collaborate and exchange results, ideas and experience. This can be done both at workshops and on the internet. So far, it has been difficult to overcome the gap between disciplines, but a major effort will be made in next two workshops, where the areas of food safety and food quality will be major topics for presentations and group discussions. A discussion e-mail list, focusing on issues related to animal health and food safety, will be created on the internet.

Secondly, the need for a continuous development of organic livestock production techniques still exists. The arguments for an extended effort in this areas within the Network are many. The Network consists of a group of researchers with insight into our own country's farming and food production and the organic sector. The resources of this group can and must be used to the benefit of all partner organisations and the development of organic animal production and the related standards. A way of doing this is exchanging results and experience and increasing the knowledge in this field among the participants. The understanding of the diversity is necessary to understand and implement solutions to the problems, which can potentially influence animal health and welfare as well as food safety. A second discussion e-mail list will be created for the exchange about issues related to organic livestock production in general. As seen in Box 2, suggestions were made to create groups focusing specifically on the Mediterranean and mountain areas. These groups may be formed, but it is also important that we all participate in the discussion at the European level to gain better understanding of the diversity within the sector of organic livestock production.

Thirdly, there is a need to consider the existing organic standards and to make recommendations to the EU Commission with regard to the development of the standards. The first Standard Development Report (published in the proceedings of the first SAFO workshop) raised some important questions and defined the stakeholders of interest for this work. The next Standard Development Report will focus more specifically on identifying critical areas and focus points for further recommendations given by the partners and the Network. A third discussion e-mail list, focusing on standard development, will be created for a discussion among partners, stakeholders and others interested in the area.

Based on the discussion and inputs above, we are forming the three different discussion e-mail groups on the internet as explained above. It is our intention that the discussions on the lists will form background for discussions at the forthcoming workshops. For more information on the development of the Network and activities, the SAFO web-site at www.safonetwork.org will be regularly updated, and it will be possible to subscribe for the newsletter as well as for participation in the discussion groups from there.

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