Positive health: preventive measures and alternative strategies

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Edited by:

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Contents:

Introduction

Network for Animal Health and Welfare in Organic Agriculture (NAHWOA) is a Concerted Action Project funded by the European Commission. The main aim of the project is to provide a joint platform for research organisations and institutions involved in organic livestock production. The platform allows sharing of information and ideas along with development of new research priorities and the analysis of conventional research methodologies and their suitability to organic livestock research. It is hoped that the project will create a forum for an on-going discussion on animal health and welfare and their interrelationship within the framework of organic livestock production, and will be able to contribute to the development of organic regulations. The Network has 17 member organisations from 13 European countries.

The five thematic workshops planned for the years 2000–2001 are an important part of the project. The fifth and the last one of these workshops was held at the Rødding Folkhojskole in Denmark, on 11-13 November, 2001. Some 50 delegates, from 13 European countries and from the USA participated in the proceedings, working groups and field visits

The theme of the Fifth Workshop, positive health, is not an easily defined concept. The veterinary and research community have often defined health as absence of disease. The organic prinicipals and standards, however, require that posititve health is actively promoted in organic livestock production systems by breeding, feeding and husbandry practices. These concepts have been the themes of the previous three thematic NAHWOA workshops. In the course of the project, and as more data on organic livestock production has become available, its has become apparent that organic livestock do need therapy when diseased and that positive actions that are direclty realted to health management are needed in addition to feeding, breeeding and good general husbandry.

The first part of the Positive Health Workshop focused on the use and role of alternative or complementary therapy on organic farms. The current EU-standards on organic livestock production require that alternatives to chemically synthesised , conventional veterinary drugs are used when safe and efficacious. In addition to this principle, various disincentives involved with the use of conventional therapy (e.g. prolonged prodcut withhold times) encourage organic livestock producers to use alternative/complementary therapies. This shift from routine, veterinary-supervised drug use to new modalities is not easy or simple, particularly in the absence of widely available advise and support. The papers of the first part of these proceedings both describe these problems and seek solutions that will allow compliance with organic standards and regualtions.

The EU-regulation on organic livestock production (18104/99) also requires that organic farms base their positive health promotion on good planning. The second part of the Workshop generated a lively discussion on the format and procedure that this health planning should take. The general conclusion from the Workshop strongly supported the idea of formalised, written health plans that would allow evidence-based and dynamic health promotion on organic farms.

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Rødding Højskole and its principal, Annemarie Morris, deserve our wholehearted thanks for providing a venue with such a good atmosphere and interesting background information on the history of Danish folk highschool movement. Finally, all speakers and delegates are thanked for active participation, contributions and lively discussions that made the event a real workshop.

Part A:

Therapy and prophylactics in organic systems

Alternative therapy use on UK organic farms - constraints and pitfalls

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Introduction

According to the organic livestock production principles, the emphasis of disease control is on health promotion based on a broad, holistic approach. One of the aims is to create a herd/flock and a husbandry system that minimise health and welfare problems by optimising production levels and by using suitable breeds and animals for the farm in question (UKROFS, 2001; IFOAM, 2002; The Soil Association, 2000). Provision of feed and feeding and husbandry that promotes positive health is seen to contribute to this aim as well. Another aim is to reduce the use of conventional, synthetic veterinary medicinal products both as preventive measures and in therapy of diseased animals.

To promote the latter aim, current EU legislation requires that individual animals that are treated more than three times in any given year with conventional medicine, loose their organic status. The use of conventional medicine is further discouraged by preferred use of alternative medicines, such as phytotherapy and homeopathy, and by the requirement to use prolonged withhold times for products from animals medicated with licensed veterinary medicines (CEC, 1999). In the UK, the national organic standards further emphasise the need to limit conventional medicine use by requiring the implementation of written health and welfare plans that “allow for the evolution of a farming system progressively less dependant on allopathic veterinary medicinal products” (UKROFS, 2001). Whilst the general ethos of the standards encourages organic farmers to limit allopathic drug use and to switch to alternative therapies, in order to safeguard animal welfare, the standards also require prompt and effective treatment of diseased animals with best possible means. The Soil Association (2000) standards specifically state that “…failure to treat sick animal may result to withdrawal of certification" and that if the use of alternative products "…should not prove, or is unlikely to be, effective in combating illness or injury, and treatment is essential to avoid suffering or distress to the animal, chemically-synthesised allopathic veterinary medicinal products or antibiotics may be used under the responsibility of a veterinarian". Similarly, the standard requirement to give preference to alternative therapies is qualified with a statement "…provided that their therapeutic effect is effective for the species of animal, and the condition for which the treatment is intended" (UKROFS, 2001; CEC, 1999).

In the light of the restrictions set on conventional medicine use and the recommendations made on complementary medicine, organic livestock farmers are likely to explore the potential use of complementary and alternative therapies. Information and advice on the use of these therapies can, however, be difficult to obtain, particularly in countries where there is a limited tradition by the veterinary profession to use herbal or homeopathic products in farm animal medicine. In the UK, the veterinary profession has introduced homeopathy and acupuncture into their practices at a limited scale, mainly in small animal and equine practice. It is estimated that there are some 200 veterinarians (approximately 2% of the profession), who have a certificate or have received formal training in homeopathy use in the UK. Very few of these veterinarians offer homeopathic therapy to farm animal clients, however.

Whilst training in homeopathy use is available for the veterinary profession, no formal, and very little informal training in this area is available for farmers or stockpeople. In the absence of training and local veterinary advice, organic and conventional farmers wanting to use homeopathy on their farm livestock are often left to learn and make decisions on therapy choice on their own or have to resort to homeopathic pharmacies for help. Most of these pharmacies have little or no experience or knowledge on farm animal diseases, and are even less well informed on the legislation that covers animal welfare, health and safety regulations and public health regulations in livestock production.

The purpose of this paper is to examine some of the real and potential problems that arise from the lack of information and experience in alternative therapy use in farm animals. This is done in the light of four examples of homeopathy use on UK organic livestock farms.

Example 1: Mastitis treatment with alternative therapies

A survey of 16 well-established organic dairy farms from the south of England and Wales was carried out in 1997-1999, to investigate mastitis incidence and mastitis control strategies on these farms (Hovi and Roderick, 2000). The average farm size was just over 100 milking cows and 7 of the organic farms were matched with a conventional farm for additional data collection. Data on mastitis treatments on the farms were collected from the farm records during regular farms visits, by interviewing the herdsmen and by examining the farm records on purchased medicines and remedies. During the observation period, 1,266 cases of mastitis therapy were recorded on the organic survey farms and 779 cases on the conventionally managed farms.

On the conventional farms, virtually all mastitis treatments were carried out using antibiotics administered intramammarily (Figure 1). In the organic herds, antibiotics were used in 41% of the treatments. The most common alternative to antibiotics on these farms was homeopathy that was used in 51% of the treatments. Other alternative therapies, mainly udder liniments and frequent stripping, cold-water massage and intramammary Aloe Vera emulsions were used in 8% of the cases.

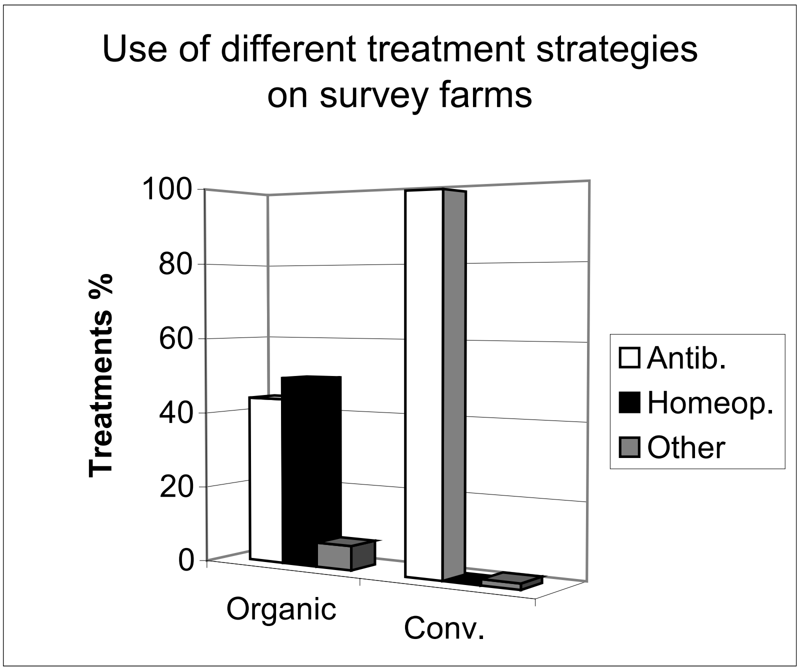

Figure 1. Use of different treatment strategies (Antib. = antibiotics; Homeop. = homeopathy; Other = frequent stripping, udder liniments, cold water massage, Aloe Vera) for mastitis on 16 organic and seven conventional (Conv.) dairy farms in the UK.

On a closer examination of the different treatment strategies, it was noted that the duration of treatment with antibiotics was similar on organic and conventional farms, whilst the durations of homeopathic and other alternative treatments were significantly longer than when using antibiotics (Table 1). Withdrawal of milk from the bulk tank and from consumption was, however, significantly shorter when using the alternative therapies. This meant that milk was often included in the bulk tank when the therapy was still continuing. Whilst it is accepted that homeopathic therapy for acute conditions can sometimes be prolonged with "constitutional treatments" beyond the persistence of clinical symptoms, a withdrawal period of 2.5 to 3 days following a case of clinical mastitis appears short. It is unlikely that somatic cell counts in an affected quarter return to levels below 200,000 cells/ml within this period. It could also be suggested that, in many cases, clinical symptoms may have encouraged the continuation of treatment, and that milk was, in effect, included into the bulk milk too early. As the UK legislation requires that no milk from a "diseased" animal should be used for human consumption, it could be argued that the organic farmers that routinely included milk into the bulk tank from animals undergoing therapy for mastitis were acting illegally. It is also likely that bulk tank somatic cell counts on the farms were considerably higher than they would have been, had adequate milk withdrawal been practiced, as bulk milk somatic cell counts were significantly higher on organic farms than on conventional farms in this survey.

Table 1. Mean duration of treatment total withdrawal (including treatment) of milk following different therapy options on 16 organic and seven conventional farms.

Treatment type	No. of cases analysed	Average duration of therapy (days)	Average duration of withdrawal (days)
Antibiotic/Conventional	779	2.7	5.5
Antibiotic/Organic	551	2.2	11.2
Homeopathy/Organic	627	4.0	3.1
Other/Organic	82	4.2	2.5

It is worth noting that 68% of all antibiotic treatments on conventional farms were administered in excess of the manufacturer's recommendations (ex-label), while, on the organic farms only 16% of antibiotic therapy was ex-label. None of the conventional farms practiced prolonged withdrawal of milk, as recommended by the National Office of Animal Health, following ex-label administration of antibiotics. The organic survey farms followed these recommendations by implementing the prolonged withdrawals, required by organic standards following antibiotic therapy.

Whilst the results of the survey suggest that consumers are less likely to be exposed to antimicrobial residues when drinking organic milk rather than milk from conventionally managed cows, it is of concern that they might be more likely to drink mastitic milk from organic cows due to the short withhold times used on these farms. If a greater shift towards using alternative and complementary medicine in therapy of diseased animals occurs among organic farmers, there is obviously a need to improve the farmers' understanding on the need and reasons for product withhold. In the case of dairy cows, the use of cow-side diagnostic tools (e.g. Californian Mastitis Test) are likely to be of help in determining when the milk should return to consumption after an event of mastitis.

Example 2: Preliminary results from a welfare survey

A total of 31 organic livestock inspectors from three different organic certification bodies in the UK responded to a questionnaire survey on animal welfare implications of organic standards (Hovi *et al.*, unpublished). Among other things, they were asked to give examples of cases where, in their judgement, animal welfare had been breeched on an organic farm due to restrictions caused by organic standards. A total of 34 examples were given. The largest group of the examples (13 examples, 38% of all given) referred to inadequate or inappropriate therapy of clinical conditions with alternative, inefficacious therapies. In ten out of the 13 cases, the inspectors specified that the observed breech occurred due to misinterpretation of the standards, i.e. the farmer had been in the belief that an efficacious, conventional therapy would not be acceptable.

Whilst it is very likely that similar breeches of animal welfare code occur continuously on all farms, whether organic or conventionally managed, it is of concern that misinterpretation of standards should lead to situations where animals are not given appropriate treatment for clinical disease or pain relief on organic farms. The responsibility of adequate interpretation and communication of this interpretation to producers lies clearly with the certification bodies that should find inspection results of this nature alarming. Clearer and more explicit guidance is obviously needed.

Example 3: The case of farmer X and his calf

The author acted as a scientific adviser to the defence in a case where a UK organic dairy farmer was charged for breeches of animal welfare legislation. This case illustrates some of the problems associated with homeopathy use on farms in situations where local veterinary expertise in homeopathy is not available. The farmer had a six-month old heifer calf that had developed septic arthritis in one tarsal joint. The farm's veterinary surgeon made the clinical diagnosis and recommended emergency slaughter on the basis of poor prognosis and animal welfare. The farmer had previously used homeopathy successfully in the treatment of other injuries and mastitis and wanted to attempt homeopathic therapy for the calf. The veterinarian reluctantly agreed to this approach, but as he had no expertise in homeopathy, the treatment and choice of remedies were left for the farmer to decide. He obtained advice from a homeopathic pharmacy by phone, and was told that the treatment would probably take a while to have an effect.

The calf was placed in a near-by field where it was fed, watered and observed several times a day by the farmer and his family members and received a series of homeopathic treatments over the following two weeks. Throughout this period, the calf had good appetite but was reluctant to move and did not put weight on the affected limb even though the swelling of the joint subsided. After two weeks, a neighbouring farmer, who had been observing the situation, reported the calf to the police, suggesting that the animal was suffering and asking for intervention. The police arrived on the farm at a time when the farmer was absent and euthanised the calf in the field on animal welfare grounds. Subsequently, the farmer was charged for breech of animal welfare code and the case was brought to the local magistrates court where, eventually, a charge was also brought against the farm's veterinary surgeon, who had allowed the events to take place on his client's farm.

The main thrust of the persecution was that the farmer had used a therapy that had not been scientifically proven to be efficacious against the condition in question and had allowed an animal to suffer pain during the prolonged treatment period. The defence pointed out that there was no feasible, conventional treatment for septic arthritis in farm conditions and referred to the initial veterinary judgement on poor prognosis. The charge against the farm's veterinarian was based on his responsibility to guarantee good welfare for the "animals in his care". As he admitted to having agreed, albeit reluctantly, to "experimental" homeopathic therapy, he was seen as being responsible for the treatment of the calf even though he had no expertise in homeopathy. Both the farmer and the veterinary surgeon were found guilty but a lenient sentence of warning only was passed on the grounds of mitigating factors, such as the facts that the calf had had a good appetite throughout the two-week treatment period, the farmer had initially contacted the vet, and euthanasia would have been the only alternative to homeopathy. It was also pointed out that the veterinarian would have not been found guilty, if he had had formal expertise in homeopathy and had administered and recommended the therapies on the basis of this expertise.

One of the main lessons to be learned from this case is that that veterinarians, who have no formal training in homeopathy use, can put in the difficult position of not being able to take responsibility of the "animals in their care" if the farmer chooses to use homeopathy. The veterinarian's predicament is made even worse by the fact that his advice not to use alternative therapy in a particular case is often not seen as correct advice by the farmer for the very reason that he, the vet, has no expertise in homeopathy! This vicious circle needs to be broken to avoid alienation between the farm and the veterinarian. Basic training in homeopathy for the veterinary profession is needed in one form or another to allow vets to be involved, at least, in monitoring homeopathy use on his/her client farms.

Example 4: Code of conduct: homeopathic pharmacies

As most homeopathic pharmacies operating in the UK have traditionally provided services mainly to the human homeopaths and mainstream pharmacies that have stocked human homeopathic remedies, farm animal practice is a new and emerging market for them. Some pharmacies have personnel who have, over the years, specialised in farm animal medicine and advice farmers, in most cases, over the phone on how to treat various farm animal diseases. Whilst the pharmacies are operating on the verge of good and bad practice by diagnosing disease without actually seeing the animal or knowing the farm conditions, there has been an unwritten understanding between the pharmacies and the farmers on how the responsibility over the animal's care is divided.

Recently, a new homeopathic pharmacy was set up in the UK. This pharmacy differed from the other homeopathic pharmacies in that it was established by a farmer and a homeopath jointly and it advertised itself as being a specialist in farm animal homeopathy. The pharmacy offered starter "kits" for different types of farms and promoted its work among the farming community actively. The homeopath had very little previous experience in farm animal medicine, however. This was immediately evident in the manner the company promoted homeopathy. On its web-site front page, it was suggested that homeopathy was particularly suitable for farm animal medicine for two reasons: firstly, because there was no need to record treatments with homeopathy, and secondly, because no product withhold was needed after homeopathic treatment. Both of these statements are legally wrong (the UK law requires that all treatments of farm animals have to be recorded and that products should not be sold for human consumption from diseased animals) and, from good practice point of view, questionable. The latter statement in particular was damaging to the clients, as they were encouraged to embrace a new treatment modality without being advised to monitor its successfulness simultaneously.

Whilst the pharmacy in question withdraw its advertisement immediately on receiving a complaint about it, it is of concern that the introduction of homeopathy into farm animal animal medicine would happen in such an uncontrolled and haphazard way, leaving the farmers at the mercy of bad advice and legally vulnerable, as seen in Example 3.

Conclusions

In conclusion, it is suggested that farmers who want to start using homeopathy should:

- keep on listening to the advice of their own veterinarian, even when he has no expertise in homeopathy;
- get training in homeopathy use, preferably from an "independent" body, such as producer co-operative or homeopathic veterinarian; and
- check that the advice given by the pharmacy that sells the homeopathic remedies is correct and takes into account welfare and health and safety regulations.

Veterinarians, whose clients start using homeopathy, should:
- preferably get some basic, formal training in homeopathy;
- not shy away from advising the farmer on matters like welfare, health and safety, and control of zoonotic diseases; and
- encourage the client to get in contact with a homeopathic vet who could advise the farmer alongside with the local veterinarian, thus solving the problem of responsibility on decision-making.

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Mastitis treatment and production losses in organic dairy herds

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Introduction

Minimal use of antibiotics and good health is an important goal in organic livestock production. Selection of cows that will have a maximum benefit from a treatment and choice of appropriate methods of treatment are important for the udder health in the herd and the resulting use of antibiotics (Osteras, 1982). Udder infections result in decreased milk yield and other production losses (Hortet and Seegers, 1998a; Hortet and Seegers, 1998b). Clinical mastitis affects milk yield (Bartlett *et al.,* 1991; Houben *et al.,* 1993). Other studies have shown a comparable or even greater decrease in milk yield as a result of high somatic cell count (SCC) or subclinical mastitis (Bartlett *et al.,* 1990; Hortet *et al.,* 1999) than seen as a result of clinical mastitis. Milk losses caused by mastitis are, however, not always obvious in a herd if primarily high yielding cows are affected, or if the decision to treat infected cows depends on actual or expected production (Ostergaard and Grohn, 1999).

The positive correlation between milk yield and mastitis occurrence makes it difficult to determine the effect of mastitis on milk yield (Rajala-Schultz *et al.,* 1999). The effect of mastitis on milk yield can furthermore vary depending on stage of lactation and parity (Lescourret and Coulon, 1994). A number of treated mastitis cases will be the result of chronic infections. In this situation, the production could be affected before a clinical case is detected.

The level of somatic cell count (SCC) varies with parity and stage of lactation. The relationship between SCC and parity and stage of lactation is different for infected and non-infected quarters (Detilleux *et al.,* 1999). Both high SCC and mastitis have a carry-over effect from one lactation to the next (Fetrow *et al.,* 1991). The loss of milk production is related to the course of the infection. An optimal treatment strategy must be a weighing of the costs of treatment, milk loss and the risk of spread of infection and selection for antibiotic resistance (Osteras *et al.,* 1999). Different farmers and veterinarians will select different strategies based on their priorities. The purpose of this study is to quantify the effect of antibiotic treatment of cows with mastitis on milk yield at herd level.

Materials and methods
Thirty-seven organic dairy herds, participating in a herd health scheme, were randomly assigned to two groups of 19 and 18 herds. The first group participated in an individual herd health scheme over a period of 18 to 24 months from March 1999 to March 2001. The second group served as a control group. Another group of 10 herds with at least 5 years of organic production participating in a cross-sectional study on use of veterinary medicine were also included in the analysis. Monthly registration of milk production, SCC, veterinary treatments, reproductive events and culling were available at cow level from the Danish Cattle Database.

In Denmark, treatment of dairy cows with antibiotics must be initiated by a veterinarian. In organic dairy herds, antibiotics can only be handed out to the farmer for calves under six months of age. Records for every treatment are entered in the central Danish Cattle Database. In this study, data on disease treatments were crosschecked using the milk and meat withdrawal notes filled-in by the local veterinarian in the herd.

Separate models for parity one, two and older cows were used. In this paper, only the model for parity 3 and higher will be discussed. A total of 34,688 test day records from 6,244 lactations in 49 herds were available. Calving season was grouped as month 1 to month 12.

Statistical analysis
A three-parameter piecewise random coefficients linear model was used to model the milk yield through lactation. The monthly milk yields (energy corrected milk, ECM) were used as the outcome variable. MlwiN 1.10 was used for the analysis. Two explanatory variables were used to model the shape of the lactation curve: DIMun60 = DIM-60/60 for days in milk (DIM) = <60 (0 for DIM>60) and DIM60 = DIM-60/245 for DIM>=60 (0 for DIM<60). The regression model provides an intercept estimate that predicts the "peak" production at 60 DIM, DIM 60 estimates post-peak slope and DIMun60 estimates pre-peak slope.

The basic model is:

$$ECM_{\text{cons, lactid, herd}} = \beta_{0\ \text{cons, lactic, herd}}\text{Cons} + \beta_{1\ \text{lactid, herd}}\text{DIMun60} + \beta_{2\ \text{lactid, herd}}\ \text{DIM60}$$

$$ECM_{\text{cons, lactid, herd}} \sim N(X\text{B}, \Omega)$$

Random coefficients were allowed for the intercept estimate, DIMun60 and DIM60 at herd and lactation levels. This means that it is possible to draw individual lactation curves at cow level and at herd level.

Results and discussion
Descriptive statistics for parity three and older cows is presented in Table 1. The data show that mastitis is the major cause for antibiotic use.

Table 1. Descriptive statistics

Herd level					*Test-day level*				
Parity 3+					Parity 3+				
n = 49					n = 34688				
	Mean	Q1	Q2	Q3		Mean	Q1	Q2	Q3
ECM	26	23	25	27	ECM	25	21	25	30
SCC	410	350	420	490	SCC	440	90	188	440
MAST	5.2	2.6	4.8	6.5	MAST	5.2			
AB	1.3	0.9	1.2	1.7	AB	1.3			

Q1, Q2, Q3 = lower quartile, median, upper quartile.
ECM = Energy corrected milk per day, kg.
SC C= Somatic cell count (x1000 cells/ml).
MAS T= Mastitis treatment (% of test days with treatment since last test day).
AB = Other antibiotic treatment (% of test days with treatment since last test day).

The full model includes main effects, polynomials and interactions for breed, milk production and SCC in previous lactation, calving season, length of dry period and diseases other than mastitis. In this paper, the variables and interactions regarding mastitis in early lactation are discussed. The variable mastitis treatment within the first 60 days of the lactation (Masttrt60) and its interactions with DIMun60 are included in the model as fixed effects and random coefficients at the herd level, allowing to estimate the effect of mastitis in early lactation at herd level (see Figure 1 for details).

$$\text{ecm}_{cons,\ lactid,\ herd} \sim \text{N}(XB,\ \Omega)$$

$$\begin{aligned}\text{ecm}_{cons,\ lactid,\ herd} = {} & \beta_{0cons,\ lactid,\ herd}\text{cons} + \beta_{1lactid,\ herd}\text{dimun60}_{cons,\ lactid,\ herd} + \\ & \beta_{2lactid,\ herd}\text{dim60}_{cons,\ lactid,\ herd} + \beta_{3herd}\text{masttrt60}_{lactid,\ herd} + \\ & \beta_{4herd}\text{dimun60xmtrt60}_{cons,\ lactid,\ herd} + 0{,}642(0{,}260)\text{dim60xmtrt60}_{cons,\ lactid,\ herd} + \beta_6 x_6\end{aligned}$$

$$\beta_{0cons,\ lactid,\ herd} = 29{,}339(0{,}239) + v_{0herd} + u_{0lactid,\ herd} + e_{0cons,\ lactid,\ herd}$$

$$\beta_{1lactid,\ herd} = -3{,}172(0{,}290) + v_{1herd} + u_{1lactid,\ herd}$$

$$\beta_{2lactid,\ herd} = -10{,}085(0{,}239) + v_{2herd} + u_{2lactid,\ herd}$$

$$\beta_{3herd} = -1{,}315(0{,}174) + v_{3herd}$$

$$\beta_{4herd} = 0{,}614(0{,}359) + v_{4herd}$$

$$\begin{bmatrix} v_{0herd} \\ v_{1herd} \\ v_{2herd} \\ v_{3herd} \\ v_{4herd} \end{bmatrix} \sim \text{N}(0,\ \Omega_v) : \Omega_v = \begin{bmatrix} 2{,}136(0{,}473) & & & & \\ 0{,}184(0{,}382) & 2{,}389(0{,}608) & & & \\ -0{,}875(0{,}353) & 0{,}362(0{,}363) & 1{,}684(0{,}430) & & \\ 0{,}425(0{,}217) & -0{,}227(0{,}242) & -0{,}475(0{,}212) & 0{,}240(0{,}176) & \\ -0{,}383(0{,}515) & 0{,}118(0{,}579) & 1{,}209(0{,}517) & -0{,}637(0{,}310) & 1{,}934(1{,}043) \end{bmatrix}$$

$$\begin{bmatrix} u_{0lactid,\ herd} \\ u_{1lactid,\ herd} \\ u_{2lactid,\ herd} \end{bmatrix} \sim \text{N}(0,\ \Omega_u) : \Omega_u = \begin{bmatrix} 15{,}107(0{,}336) & & \\ 3{,}587(0{,}443) & 30{,}207(1{,}042) & \\ -12{,}803(0{,}456) & -3{,}968(0{,}709) & 24{,}905(0{,}820) \end{bmatrix}$$

$$\begin{bmatrix} e_{0cons,\ lactid,\ herd} \end{bmatrix} \sim \text{N}(0,\ \Omega_e) : \Omega_e = \begin{bmatrix} 7{,}768(0{,}064) \end{bmatrix}$$

Figure 1. Model with fixed and random effects. Only basic variables and variables regarding mastitis treatment up to 60 days postpartum are shown. The estimates are derived from the full model, remaining variables are symbolised with the last part of the model $\beta_6 X_6$.

Figure 2 shows the effect of mastitis treatment within the first 60 days after calving in cows in parity 3+. The solid line is the average change for all herds. Cows treated for mastitis produce 1.9kg ECM less than comparable cows without mastitis. The lines, consisting of points, show the effect of mastitis treatment in 4 herds. The herds are numbered in relation to the prevalence of mastitis treatment in the project period.

In herd 49, 14% of all cows where treated between each test-day. In herd 46, 8.5% were treated. It can be seen that in both herds the effect on milk production is very small. At the beginning of the lactation, cows treated for mastitis produced even more milk than comparable cows in respect to the other variables included in the model. In herd 49, the conductivity is measured during milking, and milk samples are collected for bacteriological culture if the conductivity is elevated. This means that even mild cases of mastitis will be detected and treated. In contrast, the production loss in cows treated for mastitis in herd 1 and 2 are substantial. These two herds have a very low treatment frequency (0.2% of the cows were treated between each test day in herd 1 and 1.4% in herd 2). Homeopathic treatments were the preferred treatments for mastitis in both herds according to the farmers, and these treatments are not included in the central disease registration. Cases treated by the veterinarian, and included in this data, tend to be severe, acute cases or cases that do not respond to alternative therapy.

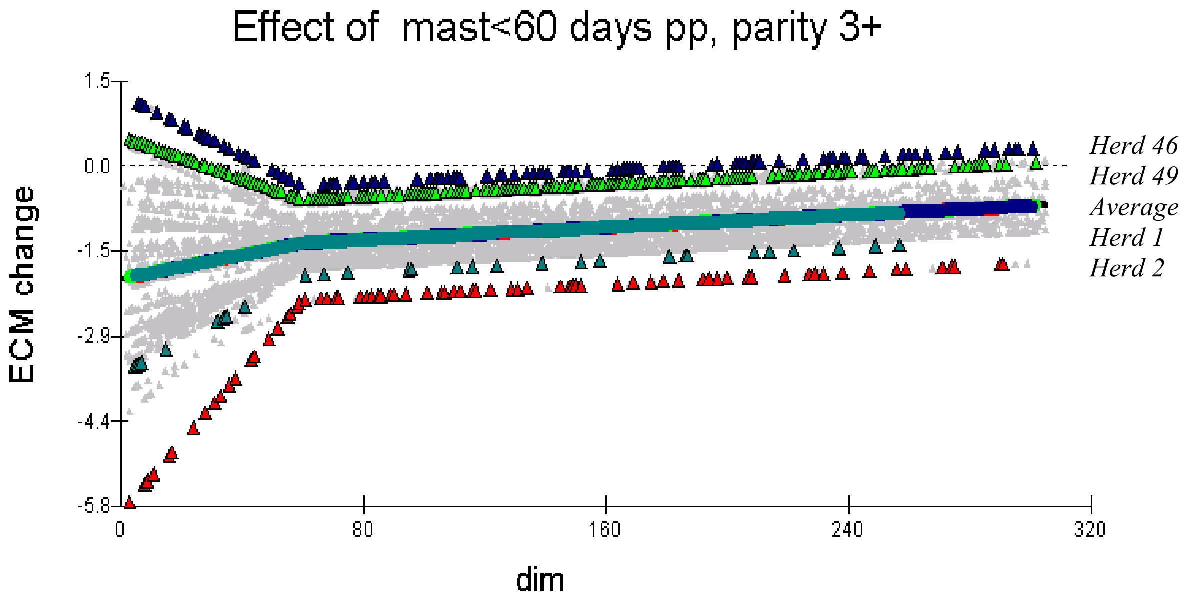

Figure 2. The effect of mastitis treatment in the first 60 days of the lactation on milk production. Solid line: Average of 49 herds. Points: Average of lactations for individual herds.

Conclusions

Estimation of the effect of mastitis on milk production is important when deciding on a treatment strategy in the herd. The evaluation of the effect of mastitis or elevated SCC on milk production at herd level can form the basis for a discussion of the actual strategy. The data from the 49 herds show that the actual treatment strategy and the resulting registrations have a major influence on the estimate of production loss. To decide on an alternative strategy, it is necessary to have information on the alternatives (e.g. the effect on production of non-treated cases of mastitis or cases treated with alternative medicine).

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Homeopathy as part of health management on organic farms

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Introduction
Homeopathic therapy was developed by the German physician and pharmacist Christian Friedrich Samuel Hahnemann, born in 1755 in Meißen and died in 1843 in Paris. His students and successors disseminated homeopathy all over the world. Today, homeopathy is very popular in Germany, France, South America and especially in India.

The beginnings of the homeopathic ideas are found in the works of Hippocrates, and later in those of Paracelsus and various physicians in the 18th century. Hahnemann developed the proving, a special method to find the picture or the idea of a remedy. The name "homeopathy“ consists of two Greek words, which describe the meaning of the therapy: homoios (similar) and pathos (disease/suffering).

In contrast to the word homeopathy, the word alloeopathy was developed. This term is composed of the Greek words alloion (different) and pathos (disease/ suffering). Hahnemann used the term alloeopathy for therapies causing an indisposition. These therapies cause symptoms completely different from the symptoms of the ill patient. Later the term allopathy was used to describe all non-homeopathic therapies [ORG §§ 52, 74, 75] (Hahnemann, 1986). The term allopathy is used in the EU regulation for organic livestock production.

Homeopathy is a regulation-therapy, which can always be used if it is possible to heal the body systems by stimulation (immune system, regulation of metabolism). It is not the method of choice, if the body system is exhausted, if a substitution therapy is necessary or if an organ is irreversibly damaged. Although it is not possible to substitute surgery in most cases, however, homeopathy can accelerate the healing after the surgery.

Practice of classical homeopathy involves a detailed anamnesic case-taking by the homeopath examining the patient. After the case-taking, the homeopath will analyse the whole picture and by comparing the symptoms to the known remedies, find the single remedy, which best covers the patient's expressed symptoms.

The principles of homeopathy are subdivided as follows:

1. *The individual clinical imagine*

   The totality of the symptoms represents the disease [ORG §§ 6, 7, 70].
   The symptom shows something that we cannot see directly. Therefore, it is a clue for an illness in the background (Hahnemann, 1986).

2. *The law of similars*

   In 1790, Hahnemann made his famous trial with cinchona bark. He ate a little bit of it and noticed similar symptoms as usually seen with malaria. His conclusion was that a remedy that produces symptoms similar to these of the disease would be able to heal this disease. In 1796, he published his famous work: *"Versuche über ein neues Prinzip zur Auffindung der Heilkräfte der Arzneisubstanzen nebst einigen Blicken auf die bisherigen".* In this work, he formulated the simile-principle for the first time: *Similia Similibus curentur*, translated: "Likes cure likes" (Hahnemann, 1796).

3. *The proving*

   The symptom expression of each remedy is discovered primarily through a standard procedure called "proving". Homeopathic remedies are tested for their effects on a group of volunteers with as good in health as possible. The symptoms are recorded and compared to obtain the information, which defines that particular remedy (medicine picture). This should be as similar as possible to the symptom picture. The medicine picture is as individual as the symptoms.

4. *The potentised medicine*

   Homeopathic remedies are produced by a special method called potentiation. The substances were diluted and raised to higher power. If the substances are diluted by 1:10, we call the remedies the D-potentised medicine, 1:100 the C-potentised medicine, some other dilutions also exist. This manufacturing procedure changes the efficacy and, in parts, the mode of operation. With the increased potentisation, the concentration of the substance decreases. Starting with D23 arithmetical no substance is left (Loschmidtsche Zahl). Potences up to D12 are called low potencies, those up to D23 medium and potencies over D23 are the high ones (Schmidt, 1995).

Other principles advanced by Hahnemann, like the miasma theory, will not be discussed here.

Legal situation in Germany and the EU

According to the European maximum residue directive [2377/90], is it possible to use homeopathic remedies starting with the D4 without withhold time. Individual proving records for 88 substances is currently being collated. These records will stipulate exact withdrawal procedures for individual remedies. For example, it is allowed to use Bellis perennis from the D0 or Phytolacca from the D3 without withold time. Only Aristolochia is registered in annex *IV of* this directive [2377/90]. It is forbidden to use Aristolochia in the EC, even when diluted beyond the Loschmid figure.

Homeopathic animal drugs, which are registered and typified with information about the species, the dosage, the withold time (if necessary) can be used for the specific species, if the recommended dosage is used. Because this medicine is freely obtainable at the chemist's shop, it can be obtained without a veterinarian's prescription. But only a few homeopathic remedies are already registered or licensed. Registration is a simplified license specific for homeopathic preparations. Due to the EU regulations 92/73 and 92/74, is it not possible to register homeopathic preparations that for use in farm animals. These regulations have not been converted into national law in all EC countries, except in Germany. Therefore, simplified licenses are not an option for farm animal homeopathy. As a result, the same few remedies have been in the market for years, and there is a need to introiduce new ones urgently.

The author suggests that it is important to abolish the need to register homeopathic remedies for farm animals, as the necessary safeguard aginst residues are given in the MRL-limiting values.

To avoid therapeutic deficiencies, it is possible in Germany to use human medicine. This often means that farm animals are treated with human, homeopathic remedies, under the supervision of the farms own vet. Farmers or non-veterinarian are not allowed to use the advice of health professions like "Tierheilpraktiker".

Since the 24th of September 2001, a new regulation has complicated the use of medicine in farm animals. This regulation is the national conversion of directives 96/23/EG and 90/676/EG. Because of this legislation the owners of farm animals are committed to document every use of a medicine that is only available from a pharmacy or a veterinarian. Therefore, the use of all homeopathic remedies must be documented immediately. This is also true in the use of medicine for horses if they are slaughtered later. This legislation makes impossible the use of human homeopathic remedies by the farmer, without consulting a veterinarian. This is especially important for organic farms. For these farmers it is sometimes difficult to find a veterinarian who would be willing to work with homeopathy. In some parts of Germany, farmers have received warning for storing homeopathic remedies intended for human use.

Basic principles of herd health management

Most health problems in farms are multifactorial problems, casually related to deficiencies of feeding, animal related techniques, management or housing systems. In most cases, long term healing is impossible without additional measures. A homeopathic or allopathic treatment alone will only cause temporary relief of the symptoms. Two hundred years ago, Samuel Hahnemann postulated that is not possible to heal diseases caused by social problems, bad hygiene and ecological damages. This is true for animals, too.

The basics of epidemiology have developed to a new form of herd management. Modern epidemiology for farm animals deals with crowding diseases, which are considered under the perspective of socio-economic systems (de Kruif *et al.*, 1998). In this context, diseases can be considered to have positive effects. They are linked with problems and disturbances in the system. Therefore, diseases should always lead the farmer to change something. For example, metabolic disorders are often an indication for inbalanced nutrition.

At first, we have to diagnose the herd and management problems underlying the manifest clinical problems. Primarily, we are not interested in therapy and healing of an individual animal but in the causes of the disease and correlations. Individual recovery is important but not our main goal. We have an array of diagnostic procedures, but in the following only the management factors are going to be discussed. For the author, animal care or stockmanship is the most important focus area when looking for disease factors. It is often impossible to have long-term success in herd health management without a committed farmer. Consequently, as a practitioner, I always ask first the farmer what he considered to be the biggest problem in the herd/flock. After analysing farm situation and data, it is often obvious that my judgment differs significantly from that of the farmer.

Feeding related issues are often underestimated by the farmer but, on most dairy farms, are a major cause of therapy failure. Many farms have problems with production and storing of feed. This results in minor faults in feed quality, e.g. mycotoxins and endotoxins. These faults can, however, cause mastitis and infertility and are capable of potentially blocking all therapies. Milking and feeding techniques or the influence of the floor on health of udder and claws, are further examples of compromised environment. Whilst pathogens have a clear role in disease causation, it has to be remembered that farm animals and pathogens are dependent on and influence each other. Infection pressure and infectivity of pathogens are obviously important factors to take into consideration when herd health situation is evaluated. It is, however, important to remember that the immune system is the balancing factor between the environment and the indiviual animal.

Hoemopathic anamnesis in herds

Veterinary homeopathic tradition is nearly as long as the homeopathic tradition in human medicine. The first paper about veterinary homeopathy was published in 1815 (Donauer, 1815). Also, Hahnemann wrote an article about homeopathic therapy in domestic animals. The document is owned by the university library in Leipzig and was first published completely in 1989. According to Hahnemann, animals could be healed by homeopathy in a similar manner to humans.

Nevertheless veterinary homeopathic therapy encounters special difficulties. As only a few provings have been carried out with animals, the symptoms of the imagines must be applied from humans to animals. Moreover, it is often difficult to ascertain the individual symptoms, because animals are not able to articulate their feelings or the characteristics of the pain they experience.

In homeopathic therapy, the herd is seen as as a system with individual animals and similar symptoms (Table 1). For acute diseases, homeopathic remedies are used on an organotoph or functiotroph level initially (for example at udder level or targeting metabolism). If necessary, more than one single remedy is used. That allows the use synergistic effects on different levels. If, according to the anamnesis, the symptoms are seen repetedly over a period of time, homeopathic principles to chronic diseases (miasma theory) are applied.

Table 1. Homeopathic anamnesis in cattle herds

- Clinical observations
- Pathology
- Epidemiology
- Characteristics of the affected animals
    - Age
    - Point of lactation
    - Performance
    - Feeding
    - Housing conditions
    - Technique

- Symptoms (>80% of the affected animals)
    - General symptoms
    - Modalities
    - Causes
    - Behavioural alterations
    - Local symptoms

The clinical and pathologic results are also a part of the homeopathic anamnesis. They are indicators for the severity of the disease. This can be important information for finding the right remedy. Every important symptom is considered if it is shown in 80% of the animals. Also, the occurrence of the symptoms under special circumstances is noted. Sometimes diarrhoea is only present directly after drinking, or coughing only occurs in the morning or in the evening. It is alos necessary to take a full anamnestic picture of behavioural changes into consideration. These features may not make a difference for the choice of allopathic therapy but are important in homeopathy. It also needs to be noted that in homeopathy it is important to know the cause of the disease, e.g. changes in diet, injuries.

Limitations to exclusive homeopathic therapy

There are certain limitations to exclusive homeopathic therapy. In most of the conditions listed in Table 2, homeopathy could only be used as a support therapy in addition to conventional treatment. To ensure good animal welfare, it is obvious that, for example, a post partum hypocalcaemia is treated with a calcium infusion to address the acute condition of the animal. Similarly, a calf with severe diarrhoea and dehydration needs allopathic rehydration therapy. In these cases homeopathy does not work fast enough. Other examples are cases where surgical treatment is needed, e.g. for fractures or displaced abomasum.

Table 2. Limitation of homeopathy as an exclusive therapy in cattle.

- *Homeopathy is contraindicated*
  - Life threatening situations
  - Hypocalcaemia / Hypomagnesaemia
  - Dehydration
  - Shock
  - Ileus, Intestine or Gastric dislocation
  - Fractures / Wounds
  - Incurable organic damages
  - Epidemic diseases

- *Homeopathy has restricted applicability*
  - Parasites
  - Chronic diseases
  - Behavioural disorders
  - Breeding diseases
  - Tumours

Treatment of epidemic diseases with homeopathy (e.g. FMD) is restricted by statutory disease control measures. In the author's experience, homeopathy is only partially helpful in parasitic diseases. There is no published evidence on the ability of homeopathic therapy to reduce faecal egg output, for instance. Pasture management appears to be a more appropriate method to address intestinal parasite problems in a herd.

For economic reasons, individual animals with chronic disease, e.g. chronic mastitis or long-term sterility, should not be treated in most cases. When chronic conditions are herd problems, the use of homeopathy may be financially sound, particularly in cases where allopathic treatments are not very successful. In most cases, the author would not treat genetic disease or diseases caused by inappropriate housing systems. When these problems arise, it is important to changethe system or breeding strategy to avoid the conditions in future. Farm animals seldom live long enough to suffer from cancer. The use of homeopathy for cancer therapy is, therefore, more important in small animal medicine.

Conclusion

Short-term high production levels cannot and should not be the aim for organic farming. Instead, animal health should be a primary aim, and production targets should be set for lifetime. Treatment of disease can only be successful if the ability for the body's self-regulation is not overloaded. Under organic production conditions, homeopathy can be a good complementary therapeutic tools in farm animal medicine to maintain health of both animal and man.

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Strategies for prophylaxis and therapy of bovine mastitis

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Introduction

Bovine mastitis is a serious and multi-factorial problem, which causes great economic losses in dairy herds. Mastitis in organic dairy production has been highlighted as a problem (Busato *et al.,* 2000; Offerhaus *et al.,* 1993). For more than four years, the Animal Health Division of the Research Institute of Organic Agriculture (FiBL) in Switzerland has been working on strategies for prophylaxis and therapy of bovine mastitis under organic management standards. The EU-Regulation 1804/1999/EU requires the maintenance of high health and welfare standards in organic agriculture. Using suitable breeds and implementing preventive measures in housing and feeding are the key approaches recommended by the Regulation. Complementary medicine is seen as a secondary measure. Conventional medicine should only be used as a last resort.

Most FiBL projects are field trials, concentrating on herd health management and mastitis treatments or drying off prophylaxis with complementary medicine. The research projects take place on a biodynamic farm with approximately 300 dairy cows in Germany and on a number of organic dairy farms in Switzerland. The Swiss herds have an average herd size of 15 to 20 cows.

Short description of projects and preliminary results

Therapy project I - Germany

During a field trial, about 300 cases of clinical mastitis were treated in a randomised division into two groups. One group received an intramammary antibiotic, the other group was treated with oral, combined homeopathic remedy. The evaluation was based on quarter-milk samples, results of the samples of the Breeding Association (milk recording), recurrences and stay in production. First results are based on quarter-milk samples. Quarters with a somatic cell count (SCC) below 100,000 cell/ml and a negative bacteriology examination were defined as "complete healing". The definition "bacteriological healing" was used for quarters with a negative result bacteriology examination and no clinical signs. Complete healing rates of 34% in the antibiotic group and 20% in the homeopathy group were recorded. After therapy, 51% of the antibiotic group and 41% of the homeopathic group were considered bacteriologically healed (Table 1). The most remarkable result was a bacteriological healing rate of over 70% after therapy change following primary therapy failure, independent of the type of the first therapy (Klocke, *et al.,* 2000; Klocke, 2000; Spranger *et al.,* 2001).

Table 1. Bacteriocytological and bacteriological healing rates after homeopathic and antibiotic treatment of clinicial mastitis.

Treatment	**Healing rate - homeopathic**			**Healing rate - antibiotic**		
Group	n	complete	bact.	n	complete	bact.
All	178	20%	41%	154	34%	51%
Cows	121	14%	36%	111	32%	50%
Heifers	57	33%	53%	43	40%	53%
Staph. aureus	23	17%	22%	15	47%	73%
Streptococci	30	7%	17%	22	32%	45%
E. coli	18	17%	61%	19	21%	58%
CNS	14	43%	79%	7	14%	57%
Non-specific	56	30%	50%	46	41%	50%
Cross-over	44	41%	73%	20	25%	75%

Satisfying healing rates were achived by homeopathy in the treatment of E.coli and coagulas negative staphylococci mastitis and in the treatment of non-specific clinical mastitis. The healing rates were, however, poor in cows and in the treatment of infections with *Streptococcus* ssp. and *Staphylococcus aureus* (Table 1).

Drying off prophylaxis project I - Germany

A placebo controlled double blind field study was carried out to evaluate the efficacy of an oral, combined homeopathic remedy applied before drying off and immediatly after calving. A total of 200 cases were randomly divided into a placebo and a homeopathy group. In severe cases, an intramammary, long-acting antibiotic was given as well. The evaluation was based on quarter-milk samples, milk recording results (SCC), recurrence and stay in production.

First results are based on the incidence of clinical mastitis during the first 60 days of lactation. The lowest rate (32%) was found in group of cows that received both homeopathic remedy and intramammary antibiotic. Cows treated with homeopathic remedy without intramammary antibiotic showed the highest rate (52%) of clinical mastitis after calving. In the placebo group, the clinical mastitis rate was about 40%, with very similar results when intramammary antibiotic was used alongside with placebo (Klocke, 2000), (Table 2).

Table 2. Effects of a homeopathic prophylaxis during the first 60 days of lactation.

Groups	Numbers of clinical mastitis during 60 days p.p.
All groups	
homeopathic prophylaxis and antibiotic	26/81 (32 %)
placebo and antibiotic	32/76 (42 %)
homeopathic prophylaxis without antibiotic	12/23 (52 %)
placebo without antibiotic	9/24 (38 %)
Good udder health state (SCC <200,000 cell/ml)	
homeopathic prophylaxis and antibiotic	3/16 (19 %)
placebo and antibiotic	10/18 (56 %)
homeopathic prophylaxis without antibiotic	7/16 (44 %)
placebo without antibiotic	7/19 (37 %)
Moderate udder health state (SCC 200,000 - 500,000 cell/ml)	
homeopathic prophylaxis and antibiotic	14/41 (34 %)
placebo and antibiotic	16/41 (39 %)
homeopathic prophylaxis without antibiotic	4/7 (57 %)
placebo without antibiotic	2/5 (40 %)
Decreased udder health state (SCC >500,000 cell/ml)	
homeopathic prophylaxis and antibiotic	9/24 (38 %)
placebo and antibiotic	6/17 (35 %)

**no cow without additional antibiotic treatment*

Dependent on the udder health status at the end of lactation, based on the SCC results from milk recording, positive effects of the homeopathic prophylaxis compared to placebo were noticeable in the group of cows with good udder health status prior to drying off and with additional antibiotic drying off treatment. Cows with a moderate udder health state at the end of lactation and without antibiotic had a higher rate of clinical mastitis after calving compared to the placebo group (Table 2).

Therapy project I - Switzerland

Twenty-seven farms with a total of 460 dairy cows participated in the study. During the field trial, 50 cases of clinical and 130 cases of subclinical mastitis were treated after randomized division at farm level. One group received an intramammary antibiotic; the other group received an oral, combined homeopathic remedy. Evaluation was based on quarter-milk samples, results of milk recording (SCC), recurrence and stay in production.

First results are based on complete healing rates of quarters. The definition of complete healing is a "negative bacteriology result and a SCC below 150,000 cell/ml in two control samples after treatment". Quarters with clinical mastitis showed healing rates of 27% in the antibiotic and 20% in the homeopathic group. Subclinical mastitis was healed in 48% of the cases after antibiotic therapy and in 2% of the cases after homeopathy. Healing rates of 71% (antibiotic) and 13% (homeopathy) were found after treating latent infections and 33% (antibiotic) and 23% (homeopathy) after treating non-specific subclinical mastitis.

Development of SCC pattern at cow level based on the milk recording data shows no difference between homeopathy and antibiotic after treatment of clinical mastitis. In cases of subclinical mastitis, the huge advantage of antibiotic treatment reduces with advancing time of therapy.

Herd sanitation project I - Switzerland

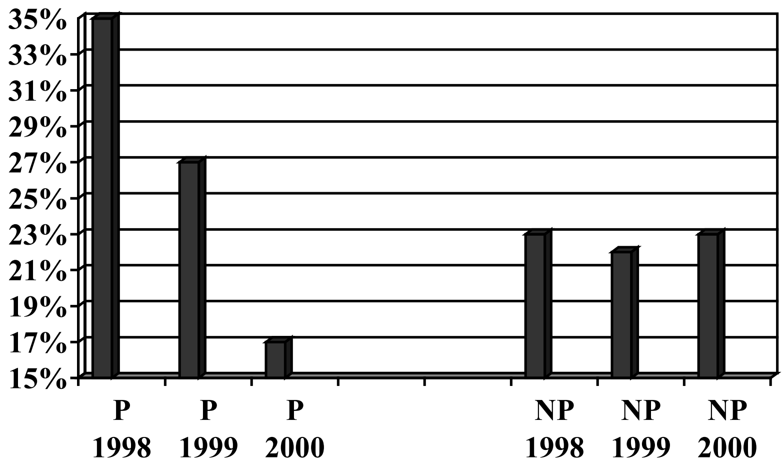
The same farms as in the "Therapy project 1 - Switzerland" participated also in the Herd sanitation project. Twenty farms were considered suitable for evaluation. Measures considered were control and optimising of milking technology, milking hygiene (see Table 3) and housing. Mastitis cases were treated as described in the "Therapy project 1 - Switzerland" section, and drying off therapy similar to that used in the "Dry off prophylaxis project - Germany", was applied. Several cows with chronic, persistent mastitis were culled.

Table 3. Development of milking hygiene during the Herd Sanitation project

	1998/1999	1999/2000
• Foremilking at first	7	14
• Correct cleaning of the udder and teats	5	18
• Correct stimulation	9	17
• Correct handling during applying the teatcup cluster	10	10
• Correct handling during taking the teatcup cluster down	20	20
• Disinfection of the teats after milking	5	13
• Quiet atmosphere	15	19
• Correct order of milking	7	15

The result of all measures was a reduction of cows with a SCC over 150,000 cell/ml from 35% in 1998 to 17% in 2000, based on milk recording data between January and May. The other dairy farms of the region did not show any improvement in this parameter during the same period (Figure 1). During the project, the number of treated mastitis cases per farm decreased from 10 cases (during the period December 1998 to May 1999) to 4 cases (during the period October 1999 to March 2000). It is noted that there is normally a higher mastitis rate in the period October to March than in December to May because of the regional calving season, which is mainly from October to January (Walkenhorst, 2001).

Figure 1. Results of milk recordings of the Breeding Association (% of dairy cows with a SCC >150,000 cell/ml - January to May).



P: Project farms **NP**: Non-Project farms of the region

Discussion and summary

The mechanism of homeopathic cure is not well understood, but it is clear that the homeopathic remedy used in these trials is not able to kill bacteria or any other micro-organism directly. It has been suggested that homeopathy could stimulate defence mechanisms and self-healing processes. It has also been maintained that an organism that is not able to react to homeopathy due to poor environment or high genetically based performance, has little chance of benefiting from homeopathic therapy. The defence mechanisms of the udder are not very efficient, especially when milk yields are high. Therefore, mastitis is probably not a good candidate for homeopathic therapy. However, mastitis is a considerable problem in organic milk production, and research is needed to evaluate not only on preventive measures but also therapeutic alternatives.

The use of combined homeopathic remedy as a therapy for subclinical mastitis was not successful. Cure rates with antibiotic and homeopathic therapy were comparable in cases of clinical mastitis. Cows with clinical mastitis may have a better chance to react against infections than cows with a subclinical mastitis.

Staphylococcus aureus avoids the defence mechanisms of the udder very effectively. This probably explains the poor healing rates achieved in this type of mastitis with homeopathy. On the other hand, the choice of combined homeopathic remedies may have been wrong; and therefore measures like the classic homeopathy, therapy with nosodes or other complementary therapies like phytotherapy should be assessed. It has also been suggested that, in *S. aureus*-cases, combination of antibiotic therapy and homeopathy could be efficacious (Spranger *et al.,* 2001).

A long-term healing success with any mastitis therapy appears elusive. Mastitis sanitation and preventive measures, especially optimisation of the production system with the type of cows in a particular herd, should therefore be the approach of choice in organic systems.

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Homeopathic medicine: research data from Italy

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Introduction

After Germany and Austria, the Kingdom of the two Sicilies (South of Italy) was the first European country where homeopathy was used. In 1825, Necker, Hahanemann's disciple, came to Naples with the Austrian army. Here he founded and directed a homeopathic clinic, and also taught this art to others doctors (Cosmo de Horatis, Giuseppe Mauro and Francesco Romani who was the doctor of Maria Amalia di Borbone, daughter of the king Ferdinando IV). Since that time, homeopathy has spread to all of the Italian peninsula.

During the 1830 to1860 period, homeopathy experienced great popularity and its use expanded rapidly. In his book about the history of Italian homeopathy, Lodispoto reported that, in 1834, there were some 500 homeopathic doctors in Italy. Homeopathy was popular in the Vatican State as well, as many Popes chose this form of therapy.

At present, there are many homeopathic schools in Italy, including those not officially registered. In Italy, there is now an established law concerning the practice of non-conventional medicine and an official recognition of homeopathy and homeopathic remedies. Veterinarians often study the same courses with medical doctors and pharmacists.

Ten mixed homeopathic schools could be find in Northern Italy, 7 in the Central and 4 in the South and the Islands (Sicily and Sardinia). There are two specific schools for veterinarians only:

1. Scuola Superiore Internazionale di Medicina Veterinaria Omeopatica "R. Zanchi di Cortona" (AR) - International School of Veterinary Homeopathy of Cortona.
2. Accademia Italiana di Omeopatia Veterinaria (NA).

The International School of Veterinary Homeopathy of Cortona was established in 1986 by a group of veterinarians of the Italian Association of Veterinarian Homeopaths (A.I.V.O). The Director is Franco Del Francia, who could be considered as the founder of the modern veterinary homeopathy in Italy. The foundation course in Cortona lasts for three years of part-time studies plus one year of specialisation.

At present, the School is doing research (with the Istituto Superiore di Sanità, the Istituto Zooprofilattico of Rome and the ASL- Roma B) on two flocks of Sarda ewes to study the influence of a "constitutional species remedy" on the immune status of the ovine species. Del Francia reported that, for each domestic species, there is a specific remedy, a sort of "*simillumum*", which can cure and prevent the majority of diseases. The School also carries out research with Tuscany Agency for the Development and Innovation in Agriculture (A.R.S.I.A.) on dairy cattle and ewes.

In this paper, we report some data about these two research studies.

1. Homeopathic veterinary approach in an organic and "high quality" dairy farm (Del Francia et al., 1999). International School of Veterinary Homeopathy of Cortona

The research methodology included the administration of a sequence of homeopathic remedies (OMEOLAT, firm OMEONATUS), via unifeed, each month for seven days. When necessary, single remedies or complexes were used. Del Francia divided 150 dairy cattle into two experimental groups: one treated with homeopathy and one kept as a control (conventional medicine). The experimental period lasted for 3 years.

The results showed positive effects on production and health parameters, and an increase of twin calving (accompanied by placental retention) (see Tables 1 and 2).

Table 1. Production parameters of the organic dairy herd

	Homeopathic group			**Control group**		
	1st year	2nd year	3rd year	1st year	2nd year	3rd year
Milk production (kg/ 305 days)	10,201	10,403	10,466	10,020	10,110	10,479
Fat %	3.70	3.59	3.65	3.48	3.56	3.56
Protein %	3.33	3.27	3.27	3.26	3.29	3.26
Calving interval (days)	404	417	412	429	417	414
Inseminations per pregnancy	2.62	2.81	2.91	3.00	2.89	2.94
SCC (1000/ml)	202	215	216	237	220	222

Table 2. Treated diseases (number of cases)

	Homeopathic group			Control group		
	1st year	2nd year	3rd year	1st year	2nd year	3rd year
Mastitis	7	2	2	18	10	16
Uterine infections	6	2	2	10	8	12
Placental retention	7	2	1	4	6	7
Metabolic syndromes	2	1	1	6	5	4

2. Organic sheep rearing and veterinary homeopathy (Del Francia et al., 2001), and haematological variations in a flock treated with homeopathy (G. Biagi et al., 2001). International School of Veterinary Homeopathy of Cortona.

In this case, the research methodology included oral administration of a “constitutional species remedy” (ZO, firm OMEONATUS), once each month. When necessary, single remedies were used. Del Francia studied two flocks of sheep in two different provinces (Pisa and Arezzo) with different characteristics. At Volterra (Pisa province), he used a flock of 200 Sarda ewes divided into two groups: one treated with homeopathy and one control (conventional medicine). At Arezzo, he employed 293 Sarda ewes divided into two groups: treated and control. The experimental period lasted 3 years.

The Volterra results showed no influence of the treatment on metabolic profile, with influence of homeopathy on the electrolytic profile (Table 3), and influence of homeopathy on milk quantity and quality (Table 4).

Table 3. Electrolytic blood profile

	Homeopathy	Control	Significance
Ca mg/dl	10.3	10,5	
P mg/dl	4.8	4.3	***
Ca/P	2.35	2.66	***
Mg µmol/l	1.67	1.58	**
Na+ µmol/l	152	150	***
K+ µmol/l	4.6	4.6	
Cl µmol/l	117	116	*
Ca++ µmol/l	1.08	1.14	***

The Arezzo results showed a good control of the parasites in the homeopathic experimental group, associated with a lower cost of the treatments in that group.

Table 4. Milk production

	Homeopathy	Control	Significance
Days of milking	170	179	
Milk production (kg)	295	285	
Fat %	5.89	6.58	**
Protein %	4.99	5.22	**
Lactose %	5.02	5.06	
SCC (1000/ml)	1239	1451	
Ca++ μmol/l	1.08	1.14	***

In connection with this study, at the Department of Animal Science in Florence, we carried out some research work during the period 1999-2001 on the use of the homeopathy in two herds (dairy and beef cattle) in the north of Florence province. The preliminary data of the first trial were reported at the 3rd NAWHOA meeting (Martini *et al.*, 2000).

3. Utilisation of homeopathy in dairy cattle. Department of Animal Science (University of Florence)

In the north of the Florence province, a Brown Swiss herd was divided into two groups: one treated with homeopathy and a control group (conventional medicine). We studied all productive and reproductive parameters, diseases incidence and effectiveness of treatments. We used the classical unicistic homeopathy (Kent and Ullman, 1979,) employing a homeopathic eugenics program, designed for these farms, to obtain healthier cows and calves (Table 5). Also, to prevent neonatal pathologies, all calves received a dose of TK 200 CH at birth.

Table 5. Eugenics program for a dairy herd.

Remedies and potency	Month of pregnancy
Sulphur 200 CH	3
Calcarea phosphorica 200 CH	5
Arsenicum album 200 CH	7
Sepia 200 CH	9

Milk production and milk quality data of the first 25 months (May 1999 to May 2001) were analysed by the three-ways ANOVA system (Calving (C), Months of trial (M) and Treatments (T): Homeopathy or Control) including the interaction among months and treatments. Milk production and milk quality data are shown in detail in Table 6. Quantity and quality of milk were good for an Italian Brown Swiss herd reared in this Appennines' area. The somatic cell count (SCC) level was sufficiently low to allow the admission to the “High Quality” EU programme (< 300,000 cell/ml). Calving and month of the trial, as expected, influenced milk production and fat and protein contents. Homeopathy influenced milk production.

Table 6. ANOVA results

DF = 589	**Average**	**C**	**M**	**T**	**M x T**
Milk (kg)	25.43	***	***	**	Ns
Fat %	4.02	*	***	Ns	Ns
Protein %	3.66	***	***	Ns	Ns
SCC (1000/ml)	274,79	***	Ns	Ns	Ns

C = Calving; M = Months of trial; T = Treatments (homeopathy or conventional medicine).
*P≤ 0,05; ** P≤ 0,01; *** P≤ 0,001; NS = not significant.

To demonstrate the effectiveness of the treatments, the number of cows eliminated or dead during the experimental period is shown in Table 7. There were no great differences between the two groups, but three cows died in the control group and only one died in the homeopathy group.

Table 7. Eliminated or dead cows

	Homeopathy	**Control**
5/99 - 12/99	-	-
1/00 - 12/00	2 eliminated	2 dead 2 eliminated
1/01 - 05/01	1 dead 3 eliminated	1 death 1 eliminated
Total	6	6

Homeopathy cured the majority of the diseases. The number of the principal diseases, occurred and treated in both groups, is reported in Table 8. The number of mastitis cases was similar, only one abortion occurred in the homeopathy group, but in this group the number of placenta retention was higher.

Table 8. Diseases occurred and treated in homeopathy and control groups

	Mastitis		**Placenta retention**		**Abortion**	
	Homeopathy	Control	Homeopathy	Control	Homeopathy	Control
5/99 -12/99	2	2	3	-	1	-
1/00 -12/00	4	5	6	2	-	-
1/01 - 05/01	6	4	1	2	-	-
Total	12	11	10	4	1	

Table 9 demonstrates the effectiveness of homeopathy. Only in two cases of mastitis, two cases of lameness and in one case of toxicosis the animals did not recover and were culled. One cow died from an acute case of mastitis (see Table 7).

Table 9. Effectiveness of cure in the homeopathic group

	Infertility and uterine infections		**Mastitis**		**Lameness and limping**		**Placenta retention and post partum problems**		**Toxicosis**	
	yes	no	yes	no	yes	no	yes	no	yes	no
5/99 - 12/99	1		2				3			
1/00 - 12/00	6		3	1	1		6		2	1
1/01 - 05/01	5		5	1	1	2	1			
Total	12		10	2	2	2	10		2	1

The remedies used for each syndrome, with the indication of their use frequency, are shown in Table 10 to present a sort of specific "Homeopathic Repertory" for this herd. This kind of data table is interesting because it allows to choose a restricted number of remedies that could be used in eugenics and preventive programs. Unfortunately, it was difficult to distinguish the remedies, which had a good outcome, because often, in veterinary homeopathy, we use many remedies, in sequence, to treat a syndrome, and it is difficult to attribute cure to any single remedy.

Table 10. Remedies utilised for each syndrome in the homeopathic group

Syndromes	**Remedies**
Abscess	Hepar sulphur, Silicea
Conjunctivitis	Hepar sulphur
Diarrhoea	Natrum muriaticum
High SCC	Silicea, *Bryonia*
Infertility and uterine infections	Phosphorus, Sepia, Lachesis, Apis mellifica, Pulsatilla, Calcarea carbonica, Calcarea phosphorica, Podophyllum, Sabina, Suphur
Lameness and limping	*Carduus marianus, Silicea,* Arnica montana, Calcarea carbonica, Causticum, Hekla lava, Lycopodium, Mercurius solubilis, Natrum muriaticum, Pulsatilla, Pyrogenium
Low starting lactation	Calcarea carbonica, Natrum muriaticum
Mastitis	Bryonia, Silicea, Phytolacca, Nux vomica, Belladonna, *Calcarea carbonica, Conium maculatum, Pulsatilla, Pyrogenium, Sepia,* Aconitum napellus, Apis mellifica, Arsenicum album, Calcarea phosphorica, Carduus marianus, Kali bicromicum, Kali muriaticum, Lachesis
Milk retention	Caulophyllum
Mycosis	Bacillinum, Natrum muriaticum, Sulphur
Placenta retention and postpartum diseases	Sepia, *Arsenicum album, Pulsatilla, Sabina,* Bryonia, Calcarea carbonica, Lycopodium, Pyrogenium
Respiratory infections	Kali carbonicum, Natrum muriaticum, Phosphorus
Telitis	Causticum
Toxicosi	Nux vomica, Phosphorus
Udder nodosities	*Conium maculatum,* Hepar sulphur, Silicea
Udder ulcer	Mercurius solubilis
Uterine fibroma	*Calcarea carbonica*, Silicea
Uterine twisting results	Arnica montana
Warts	Sulphur, Thuja

Times of remedy use: **Bold ≥ 3 times,** *Italic = 2 times*, Normal font = 1 time.

4. Utilisation of homeopathy in beef cattle. Department of Animal Science (University of Florence).

The second trial involved an organic herd of Charolaise cattle located in the north of Florence province. All animals were treated with homeopathy. We investigated animal performance before and after the homeopathy introduction, and, in the latter period, diseases incidence and the effectiveness of the homeopathic remedies. We used the classical unicistic homeopathy. We also used a homeopathic eugenics program, designed for these farms, to obtain healthier cows and calves (Table 11).

Table 11. Eugenics program for beef cattle farm

Remedies and potency	***Month of pregnancy***
Sulphur 200 CH	3
Calcarea carbonica 200 CH	5
Lycopodium 200 CH	7
Tubercolinum K 200 CH	9

In this trial, homeopathy did not seem to influence number of calvings (Table 12), but seemed to reduce calving interval (Table 13).

Table 12. Calving

Calving events	Jan.94/ May94	June94/ May95	June95/ May96	June96/ May97	June97/ May98	June98/ May-99	**June99/ May00 Homeo-pathy**	**June00/ May01 Homeo-pathy**
Total	2	21	33	31	35	39	**40**	**40**
Twin calving	0	0	0	0	2	1	**1**	**0**

Table 13. Fertility rate and calving interval

	Jan.94/ May94	June94/ May95	June95/ May96	June96/ May97	June97/ May98	June98/ May99	**June99/ May00 Homeo-pathy**	**June00/ May01 Homeo-pathy**
Fertility rate (% of cows calved/served)	6.9	72.4	79.3	81.6	82.5	84.4	**83**	**81.6**
Calving interval (days)			429	401	414	434	**410**	**391**

Homeopathy cured the majority of the diseases. The neonatal diseases were the greatest problem on this farm, but now it has been resolved using a new cow-shed, far from the old building, where the calves could be born in a healthier environment (Table 14).

Table 14. The most frequent problems in the herd.

	Jan.94/ May94	June94/ May95	June95/ May96	June96/ May97	June97/ May98	June98/ May99	**June99/ May00 Homeo-pathy**	**June00/ May01 Homeo-pathy**
Dead calves for calving	0	3	3	4	4	4	**3**	**0**
For neonatal diseases	0	0	0	1	0	4	**3**	**5**
For predators	0	0	0	1	2	0	**0**	**0**
For other causes	0	1	0	1	0	0	**4**	**3**
Total dead calves	0	4	3	7	6	8	**10**	**8**
Distocyc calving	0	3	2	4	7	3	**1**	**1**

Table 15 indicates the effectiveness of the homeopathic cures in this trial. Neonatal diarrhoea, often serious and acute, was rarely cured.

Table 15. Pathologies and effectiveness of cures

	Cured	**Not cured**
Toxicosis	all	
Neonatal diarrhoea	not many	many
Limping	many	not many
Rickets	all	
Strongilosys	all	
Tapeworms	all	

The remedies used for each syndrome are shown in Table 16. This kind of data table is interesting because it allows to choose a restricted number of remedies that could be used in eugenics and preventive programs.

Table 16. Remedies utilised for each syndrome

Pathologies	Remedies
Lameness	Silicea, Zincum phosphoricum
Neonatal diarrhoea	Arsenicum album, Camphora, Natrum muriaticum, Podophillum
Rickets and weakness of cow after calving	Calcarea carbonica, Cacarea fluorica, Calcarea phosphorica
Strongilosys	Cina
Tapeworm	Filix mas
Toxicosis	Carduus marianus, Lycopodium

Conclusions

■ In all the Italian trials the homeopathic cures resolved the most frequent diseases of the animals.
■ The homeopathic treatments influenced production and reproductive parameters.
■ It is concluded that homeopathy can be used on the organic animal production systems as an effective medicine. Also, using homeopathy can often reduce the costs of treatments.

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Controlled clinical trials used in the evaluation of clinical effect of homeopathic treatment in farm animals

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Background

The use of natural medicines and methods like homeopathy, phytotherapy and acupuncture is emphasised in the IFOAM standards (IFOAM, 2000), the EU-regulation 1804/99 (CEC, 1999) and, consequently, in the different national regulations. Simultaneoulsy, the use of traditional veterinary treatments is restricted. These factors may stimulate organic farmers to use unconventional treatment methods. There are, however, limitations to this use in the standards. The methods may only be used provided they are effective for the species of animal and the condition for which treatment is intended. Several studies of homeopathic treatment on both humans and animals exist although often criticised for low scientific quality (Kowalski, 1989; Vaarst 1996; Waller *et al*., 1998). Even if some of them give positive indications of effect (Kleijnen *et al*., 1991; Linde *et al.,* 1997) documentation of therapeutic effect for specific conditions and species is limited.

Assumed clinically effective, homeopathic treatment would have several positive implications. It is regarded as a therapy with minimal side effects to the animal and no negative environmental effects or danger of developing drug resistance in bacteria or parasites. The holistic idea of homeopathy also appears to be in accordance with the ideas of organic farming.

Extended use of homeopathic therapy, in a situation where it has no or limited effect, will, however, have negative effects on animal welfare, production and economy, and may allow the spread of contagious diseases. Public confidence in organic farming may also decrease if ineffective therapies are used.

The possible positive and negative implications of homeopathic therapy, the emphasis on homeopathy in the regulations and the limited documentation of effects of homeopathy are factors that call for research in this field.

Central principles of homeopathy

Homeopathic preparations are based on plants, animals or minerals. A substance that in high doses gives specific symptoms to a healthy individual will, in the homeopathic form, cure a disease with similar symptoms. This is the principle of **similarity**. To fulfil this principle, a complete picture of the symptoms of the patient is important. This may vary within the same traditional medical diagnosis, and **individual therapy** is thus essential in classical homeopathy, meaning that e.g. a cow with mastitis is not necessarily treated with the same remedy as another cow affected by mastitis.

The original substances are diluted and subjected to a specific “shaking” or activating process called **potensation**. The remedies are said to be more effective the more they are potensised. Usually the original substance is diluted beyond chemical detection level and just “energetic information” is left in the remedy.

There are no scientifically accepted explanations of how the remedies work. In homeopathy, health is viewed as being maintained through a vital force, and disease occurs when this vital force is compromised. Through an “energetic influence” from the homeopathic remedy, the vital force is stimulated to react and re-establish the balance of the patient. The treatment does not cure disease directly, but makes the individual itself able to fight the condition. It is important that the **environment** allows the patient to be in balance, and, thus, improvement of environmental factors is of great importance for a successful homeopathic treatment.

Homeopathy and research

Research into hoemopathy can be carried out on several levels, depending on the questions asked and the purpose of the research:

- Experimental research to document any effect of the diluted elements and explain mechanisms of action.
- Documentation of clinical effects of homeopathic treatment of disease.
- Research to develop the therapy itself and its practical use in animals.

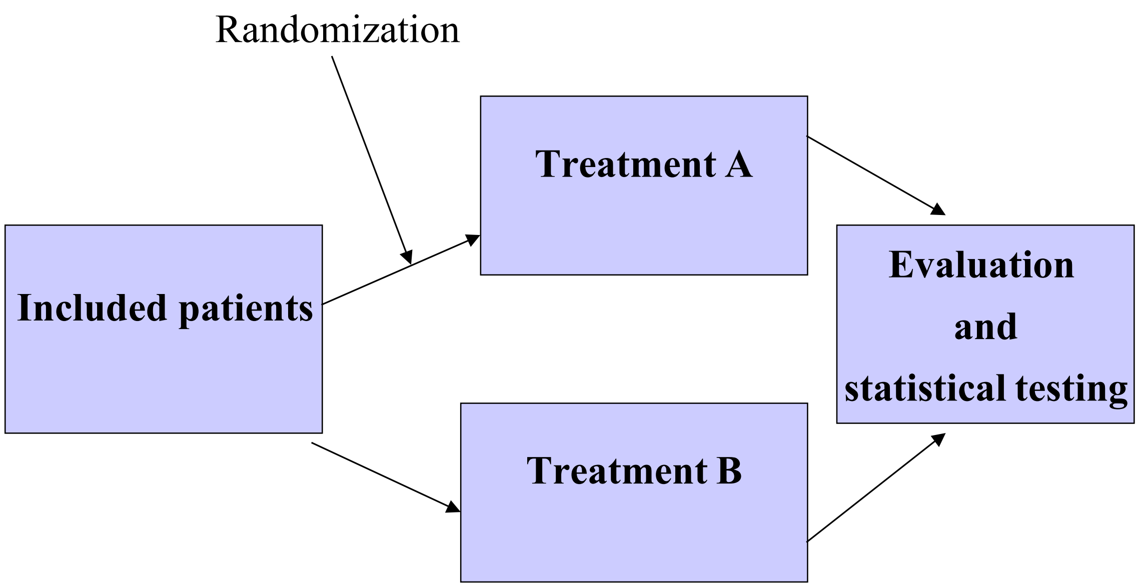
For the patient and the farmer it is obviously the clinical results that are of practical interest, and this paper will focus on this.

Use of homeopathy is mainly based on tradition, experience and case descriptions. This is, however, not seen as scientific evidence for effect of a treatment. In medicine, quantitative research methods dominate by tradition, and in the evaluation of pharmalogical products, the clinical controlled trial (CCT) is the golden standard (Altman, 1999). There are strict guidelines for conducting these trials (FEDESA, 1999).

Essential factors of CCTs are:

- Effect of one specific treatment is tested for one specific disease.
- Strictly defined inclusion and exclusion criteria.
- Comparable treatment groups.
- Use of control groups.
- Randomisation.
- (Double) blinding.
- Defined outcome variables.
- Statistical testing of hypothesis.

Figure 1 A simple CCT (parallel group design).



Keeping the central principles of homeopathy in mind, one can see various problems when investigating this therapy in the setting of a CCT. The most central conflicts will be mentioned in this text.

Individual therapy – testing of one specific treatment

In classical homeopathy, individual therapy is an important principle. A remedy is chosen based on the totality of symptoms, and one cow does not necessarily get the same remedy as another cow with the same medical diagnosis. This makes it difficult to evaluate a standard homeopathic treatment. as there is no standard treatment. It is, however, possible to use individual homeopathic treatments comparing homeopathy as one treatment group to other groups of treatment, e.g. compare homeopathic treatment of mastitis to antibacterial treatment of mastitis. This is, however, a great challenge to the person prescribing the homeopathic treatment. The results depend on his/her skills in choosing the right remedy. There is always the risk that the trial tests the homeopath rather than the homeopathic treatment.

Outcome variables - What can be evaluated?
As mentioned earlier in the text, homeopathy is a therapy with remedies with no chemically active substance, no scientifically explainable mechanisms of action. If any effect is detected, the homeopathic theory would attribute it to an energetic effect affecting the balance of the individual. Thus, the outcome of a homeopathic treatment is a patient in balance. Can this in any way be investigated in traditional research and evaluated by traditional scientific criteria? If the expected outcome is a patient in balance, is it possible to measure the balance of a human being or a cow? What is a cow in balance? What is a healthy cow? Is it just a clinically healthy cow?

In the author's opinion, we do not need to know the answer to these questions in order to evaluate homeopathic therapy. We can use a practical approach to the problem. By using mastitis as an example, the important outcome factors can be listed as:

- Animal welfare (disappearance of clinical disease symptoms like fever, reduced appetite, pain etc., the speed of recovery)
- Product quality (deliverance of the product, SCC → economy)
- Long term effects (production loss, chronical infections, residives → economy and animal welfare).

A treatment that has no measurable effect on these factors is not interesting for practical husbandry reasons, even if it may have an effect on the energetic balance of the cow. It is argued that the outcomes of homeopathic treatments can and should be evaluated by the same clinical criteria as any other treatment.

An environment that allows the patient to re-establish its balance
As mentioned above, an environment that allows the patient to be in balance is important for a successful homeopathic treatment. The importance of environmental factors is, however, not a specific idea for homeopathy. In traditional veterinary medicine, it is also an important part of the treatment to change environmental factors that cause or support disease and to give the animal the best possible conditions for recovery. We can all agree that the way we keep our farm animals is far from optimal from the animal's point of view. There are, however, limitations for what is practically and economically possible to do in today's livestock production environment. This is a common challenge to veterinary practice, independent of the therapy form used.

An environment that, in homeopathic sense, "makes the organism able to re-establish its balance" has not been defined. Is it enough to carry out practical changes like providing extra bedding, special food or extra care and attention, or are more fundamental changes needed? Is the way we keep our animals so unnatural that it is not possible to achieve this balance at all? A question arises, whether the demands to the changes in environment are so wide-ranging that they are not practically possible to carry out, and, subsequently, the therapy has no practical interest to livestock production. Even if this was the case, there may be valuable sides of the philosophy of homeopathy that we can learn from.

Scientific evaluation of homeopathic treatment of infectious diseases in production animal - Description of a study of clinical mastitis in dairy cows
Introduction
Looking back at the central factors of a controlled clinical trial, it should be possible to study homeopathic treatment in the setting of a traditional CCT:

- Effect of one specific treatment is tested for one specific disease – we can use individual homeopathic treatment as one treatment group.
- Strictly defined inclusion and exclusion criteria – can be defined, not a specific homeopathic problem.
- Comparable treatment groups – can be a achieved by stratification and randomisation, not a specific homeopathic problem.
- Use of control groups – can compare to placebo or traditional medical treatment.
- (Double) blinding – challenging for the homeopath when using individual therapy; alternatively observer-blinded studies can be used.
- Defined outcome variables – can use traditional outcome variables (see previous page).
- Statistical testing of hypothesis – should not be a specific problem using traditional outcome variables.

Increasing interest in homeopathy and the emphasis in the regulations of organic agriculture at the same time as lack of documentation of clinical effects is the background for this study. Evaluation by traditional scientific methods and parameters seem to be important to achieve acceptance of results from research in the field of unconventional medicine. Using designs in clinical controlled trials that are acceptable both to scientists and homeopaths would possibly be a contribution to improving communication between the two groups.

Objectives and design of the study
- Developing a model for clinical studies on homeopathic treatment that fulfil the guidelines for conducting CCTs at the same time as taking the basic ideas of homeopathy into account.
- Study clinical effects of homeopathic treatments of mastitis in diary cows.
- Gather informaiton about mastitis cases not treated by antibacterial drugs.

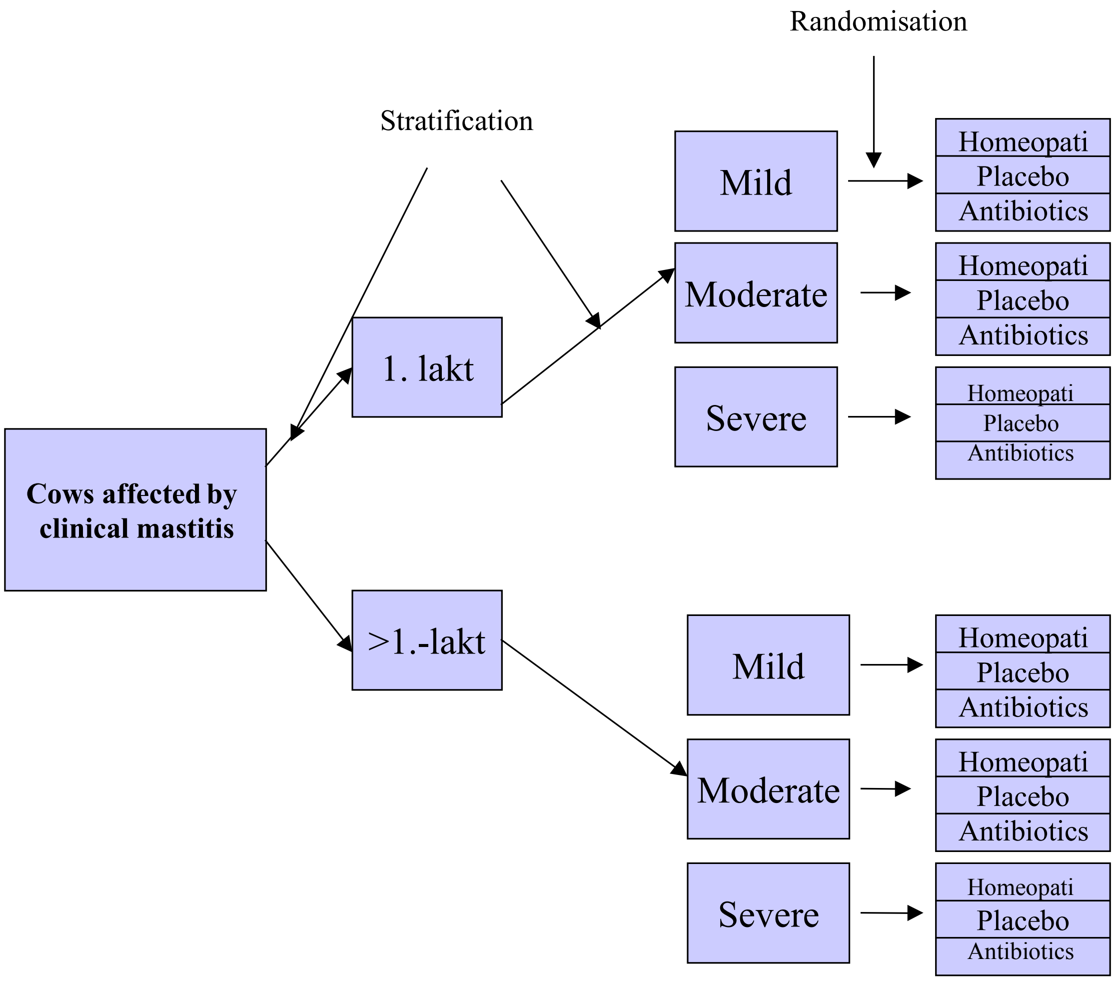
Mastitis was chosen because it is a disease of great importance, relative good information on the individual patient exist, homeopathic treatment is well established and used for this condition and the results of mastitis cases not treated by antibacterial drugs are interesting themselves.

A three-armed model based on a traditional parallel group design, comparing three different treatment groups, is used (Figure 2):
1. Homeopathic treatment (individual),
2. Placebo (for the homeopathic remedies, individual), and
3. Standard antibacterial treatment.

Lactation number, type of mastitis (mild, moderate and severe) and randomisation into one of the three groups stratify the included cows by a predefined list. The treatments are carried out blinded by a homeopath (group 1 and 2) or local veterinarian (group 3). The homeopath makes individual treatments from a selection of 64 different homeopathic remedies that exist in four identical sets of active homeopathic remedies and four identical sets of placebo. A veterinarian, who does not know, which type of treatments is given, carries out the clinical evaluation of the cows. The same veterinarian carries out all clinical evaluations.

The study is thus observer blinded for all groups and double blinded for the placebo - homeopathy groups. We chose not to use placebo to the antibiotic treatment because of practical and food hygiene considerations. The herdsmen follow the same procedures for extra milking of all affected cows. The cows are evaluated by clinical signs, milk quality, bacteriology, SCC and long-term effects (production, residives, SCC). The cows are examined at day 1, 2, 7, 28 and 35 post treatment. Additionally, examinations are made in cases of no response to treatment or worsening of symptoms in between the regular examinations. A semi-crossover model, where non-responders (decided by predefined criteria) are crossed over to the opposite treatment and followed further, is used.

Figure 2. The design of the mastitis study (semi-crossover not included).



In this design, we can compare three different treatments. The clinical effects of homeopathic treatment can thus be compared to both placebo and traditional treatment. The homeopathic treatment is individual. This is an important aspect of classical homeopathy. The use of the semi-crossover model is important to ensure that no ethical problems arise from using placebo or a treatment of uncertain effect. At the same time, we can investigate the possibility of success of treatment X, if treatment Y is not effective.

An important factor for this model to be useful is a skilled homeopath. There is a risk of testing the homeopath and not the homeopathic treatment. To achieve any effect of the treatment the homeopath has to choose the right remedy. If this is not the case, the trial does not measure the effect of the homeopathic remedy. It might also be a problem to the homeopath to use placebo preparations blindly. In the follow-up of the patient he/she does not know whether a lack of success is due to choosing the wrong remedy or because of using placebo. The design also involves many different actors, something that increases the possibility of destroying the blinding of the observer.

Ethical considerations

The use of placebo and, in this case also a treatment of uncertain effect (homeopathy), always rises ethical questions. Placebo will always be less effective than a known effective therapy and , subsequently, the treated animal may be deprived of the best known treatment. This must always be weight against what can be achieve by using a placebo. In this case, the placebo group gives interesting information compared to the homeopathy group. In addition, it is generally useful to study the outcome of mastitis cases not treated by antibacterial drugs.

The semi-crossover design, where patients defined as non-responders are given a different treatment, is essential to ensure high standards of animal welfare. The inclusion - and exclusion - criteria, the standardised milking out schedule and the regular examinations are also an important part of the ethical considerations.

Results and experiences so far:

1) The inclusion of patients is not ended and the blinding is not opened. Nothing can thus yet be said about differences between the groups.
2) The design however seems to be practically possible to carry out.
3) There seem to be small negative effects on animal welfare when following the schedule for the trial.
4) Most mastitis cases seem to recover quite well clinically, no matter which treatment is given. There might, however, be greater differences when taking long-term milk quality and production into account.

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Poster presentation

Use of alternative medicine in Norwegian organic husbandry

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Background

Organic standards recommend the use of natural therapeutic agents and methods. Little is known on the extent and use of such alternative medicine in Norwegian organic husbandry. This poster reports on a survey.

Aim and method

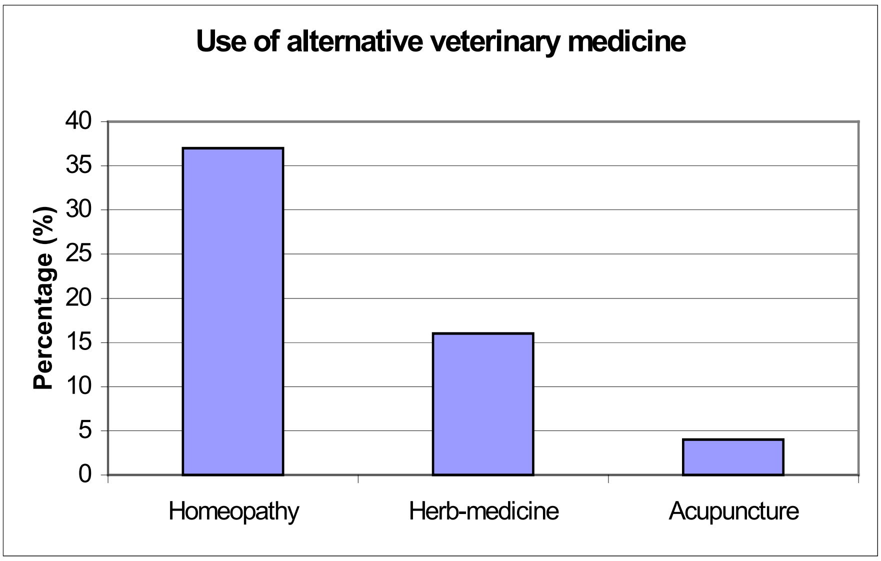
A questionnaire was sent to all organic (630) milk-, beef- and sheep farmers in Norway.
The following alternative treatments were included:

- homeopathy
- herb-medicine
- acupuncture

The questionnaire aimed at obtaining information on to what extent alternative medicine is used and why it is used. It was answered anonymously by the herdsman.

Results

The questionnaire was answered by 42.5% of the sample group. The answers represent an even spread throughout the country and an average national farm herd size.



1. Use of alternative veterinary medicine

The above figure shows that homeopathy was the most commonly used treatment. Use of alternative medicine was not dependent on attendance to courses on the subject. Furthermore, the use was independent of gender.

2. Reasons for the use of alternative veterinary medicine

a) Homeopathy

- Reasons for using homeopathy were: "More ecological, natural product, economical benefits, reduced medicine use, treatment with good effect".
- Reason for not using homeopathy was mainly: "Lack of knowledge".

b) Herb-medicine

- Reasons for using herb-medicine were: "More ecological, natural product, treatment with good effect".
- Reason for not using herb-medicine was mainly: "Lack of knowledge".

c) Acupuncture

- Acupuncture was used by very few farmers. The main reason given for not using acupuncture was: "Lack of knowledge".

Discussion report

Alternative treatment methods

Vaarst, M., Fossing, C. and Thamsborg, S.M.

Organisation of discussion about alternative treatment methods
The discussion was organised in the three following groups:
Group 1: Criteria for intervention and interactions between farmer and vet.
Group 2: Development of research methodologies for assessing efficacy of treatments.
Group 3: Role of alternative medicine in organic farming.

After group discussion, a plenary summary was made of one member from each discussion group, and a short discussion followed these summaries.

Criteria for intervention and interactions between farmer and vet
a) Degree of interaction between farmer and vet: clear roles and interdisciplinary team-work needed
There was a general agreement in the group that the interaction between farmer and veterinarian was poor, both on conventional and organic farms. It was suggested that vets should be partners to the farmers in broader terms than their clinical involvement currently allows, i.e. they should be open to discussions about alternative treatments, but with particular emphasis on the preventive measures and health plans. The efforts to create health planning and therapy regimes should be based on a more inter-disciplinary team-work. Herd problems will often lie in the border zone of different disciplines – therefore it is of importance to define the problems properly, discuss the goals and decide who should be involved in developing solutions.

b) Recording of disease and treatment: new modalities of treatment require good recording
Many organic farmers stop recordings of disease and disease treatments when they start using homoeopathic drugs for several reasons:
- They do not need to from a legal point of view.

- They do not want to make it look like they have problems.
- They do not know how to use the information in a systematic way.

It was agreed that alternative and complementary treatments should be recorded for several reasons:
- To help the evaluation of new treatment modality/to help the herdsman learn the new modality.
- To comply with organic standard requirements.
- To enable assessment of disease incidence on the farm.

c) Motivations for use of alternative treatment: indications and implementation should be considered carefully based on individual farm situation
When farmers want to treat homoeopathically, the first step is to discuss the motivations in a critical way. Depending on the problems present at the farm, it may seem unrealistic to begin homeopathic treatment – it may be more relevant to start solving the problem in other ways. If the main motivation for using e.g. homeopathy is to reduce withdrawal times, the outcomes of implementing the alternative therapy are likely to be poor, particularly, if the preventive needs are ignored.

d) Health plans the core of the interaction: veterinary involvement important
Any use of alternative treatment should be incorporated in a health plan accepted by farmer and vet, and where the preventive effort is also included. The framework for the collaboration should be discussed and defined in relation to this. In the discussion group, it was suggested that one core person should be connected to the farm as the 'main advisor', and this person should co-ordinate all advisory efforts. Organic health management needs the veterinarian to be involved in preventive medicine, and if expertises allows, in alternative therapy implementation. However, it is difficult to describe a model for collaboration common to all countries – different models are also used in conventional farming.

e) Improvement of the EU-regulation concering alternative therapy: compulsory training
It was suggested that farmers, who want to treat with homeopathy, should be better educated, and that they should involve veterinarians specialised in homeopathy in on-farm planning of homeopathy use. In general, all farmers who convert to organic farming should be required to get training or advisory support. A part of the financial support to farmers during conversion could be directed to training directly.

Development of research methodologies for assessing efficacy of alternative treatments
a) Communication between homeopathic and allopathic medical research needs to be improived
In this group there was agreement that communication between the homeopathic treatment methods and bio-medical treatment methods should be developed. There was disagreement about how this should take place, and what is to be measured.

b) It is problematic to evaluate homeopathy with methods that are comparable with allopathy research: new, innovative approaches are needed
Some of the research projects presented at the previous sessions were discussed in the group, and there was agreement that the various projects were not evaluating the same thing. In a study, that measures general mastitis nosode efficacy in a large number of herds in a blinded trial, homeopathy was not tested (a short presentation by M. Hovi; not documented in these proceedings). The design was considered adequate and the trial was considered to tests what it

proposes to test, i.e. the effect of a given remedy on the development of somatic cell counts and mastitis incidence. It was, however, not considered to test a truly homeopathic method of treating disease. In the study presented by Lisbeth Hektoen, the question was raised whether it tested homeopathy or the homeopaths. The small number of animals gave rise to serious concern in this research design. Another possibility, which was not discussed previously in this workshop, was to make provings on animals. This is the 'homeopathic way' of developing remedy pictures. Animal welfare will be of major concern if starting such provings.

The question was raised in the group, whether natural scientific methods – building on a certain paradigm and a health and disease model not comparable to the homeopathic model – could offer any design or method usable for testing of homeopathic remedies. Seen from this point of view, it was suggested that research in homeopathy should take its starting point in letting a number of homeopaths to define what they look at, evaluate from and which kind of information they use in their diagnosis. This information could then be used as a starting point of research design.

It was stated that based on the huge differences in the studies on homeopathy, which were presented in literature and in this workshop, conclusions cannot be made on the efficiency and how homeopathy works so far. Questions were raised whether it will be possible at all to communicate across borders when working with widely different ways of defining homeopathy, health, disease and healing. Ethical aspects of controlled trials using placebo were also mentioned as an obstacle for making trials in a natural scientific framework, seen from a homeopathic point of view (where it is unethical to make placebo treatments). Compromises must be made from both sides. If agreement can be made on how to define full recovery and what to look at, this can be a relevant starting point. A systematic description of homeopathic practice, treatment courses and results can also be helpful in making designs which can be agreed upon between homeopathic and bio-medical research environments, including properly followed-up case studies.

c) Lack of methods to evaluate recovery from disease
There was agreement that there was a general lack of methods to evaluate 'full recovery'. There is a need to developed standards for what is healthy and how to establish this.

d) Mastitis is 'the problem' - but also the most complex disease to work with in cattle practice
Mastitis is the 'most common disease' to focus on when discussing homeopathy in cattle practice. In the discussion group there was agreement that less complicated diseases in more simple tests should be preferred: a design where one remedy could be tested in relation to one disease. But mastitis is the main disease problem in dairy cattle herds, which lead the motivation for focusing on mastitis.

Role of alternative medicine in organic farming
a) Role of homeopathy in organic farming overemphasised at the expense of preventive measures
The working group made the following of its discussion:
- Alternative medicines have a formal role in organic farming due to the EU regulation.

- Prevention aspects are not sufficiently emphasised or mentioned in the EU regulation on organic livestock production. In general, there are insufficient guidelines for preventive measures.
- There is too much focus on single animal level compared to herd level, both in the regulations and when talking about homeopathic treatment. This should be more balanced.
- EU regulation should emphasize the importance of health plans and define better the efficacy of alternative medicines.
- The term 'functional medicine' should be used instead of promoting one or few methods that are favoured.
- Homeopathy can be said to have a 'historical role' in organic farming, both in philosophy (health/disease model, emphasis on health support and balance etc.) and from known use of homeopathic remedies, which have been favoured in organic farming during decades. This should be acknowledged and developed, but based on communication and more facts.
- The use of homeopathy on farm should be monitored and evaluated continuously, just like the use of conventional medicine.

b) EU regulation (1804/99) and other legislation on alternaive therapies immature and incidental

In general, the legislation on 'alternative treatment' seems immature and incidental. An expectation and a hope was expressed in the discussion that results in the future following a better communication about the use of alternative treatment would provide a better background for future regulations. A critical question is – however – whether we can expect significant results in time (i.e. within the next 3 years) which can support a better and more coherent legislation in this area.

c) Triaining and information needed if a wider role is to be given to homeopathy

Homeopathy – or any other treatment method – is not just 'bottles on the shelf'. Knowledge is required of the people who work with it. Work should focus on developing knowledge, and using the available knowledge. Training requirements that guarantee minimum level of skills and knowledge should be included in the regulation.

The homeopaths in the discussion groups pointed out that there is also a need to accept that the blanket use of 'homeopathic remedies' were not the same as using 'homeopathy'. It was felt that in many cases, on organic farms, conventional treatments are made using 'homeopathic remedies' without sufficient knowledge about homeopathy.

d) Mastitis not ideal starting point for homeopathy use on organic farms

The role of homeopathy in treatment and control of mastitis in organic dairy herds is problematic from the point of view of the standards, similarly as discussed in connection with trial designs. The use of antibiotics in mastitis is a well-recognised problem. There is an increasing concern over antibiotic resistance and residues in milk. Antibiotics are also spectacularly inefficacious in mastitis therapy. The shortcomings of antibiotic therapy in mastitis encourage organic producers to use homeopathy instead, even though it has been suggested that homeopathy is not an ideal therapy form for mastitis either.

e) Emphasis on preventive measures, health support and health plans needed

Until now, the veterinarian's role in organic farming has been 'firework support'. There is a need to change focus towards health support. The most important step is to make the farmer define what he wants to get out of this. Veterinarians are not properly trained to handle such discussions and to take their starting points in the goals of the farmers. A discussion was raised whether it would be best to train ‘local veterinarians’ or few ‘organic veterinarians’. In order to support the ‘organic thinking’ of veterinarians, it was emphasised that the organic associations and veterinarians should be involved in the conversion process. Organic associations should promote this new aspect of organic health management to all involved parties.

During the discussion, the emphasis on health plans and the health support effort was repeatedly mentioned. Using homeopathy does not solve any problems in itself – but the health and disease models and the ’ethical perspectives’ based on this way of thinking support the work for ’health’ in a broader perspective, which can be valuable for the development of organic animal production.

Part B:

Tools for holistic health planning

Strategies for internal parasite control in organic cattle

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Introduction

Internal parasites are an important threat to the production and welfare of cattle. Currently control of these infections is mainly achieved by a combination of grazing management and the prophylactic use of antiparasitics. This, for instance, implies that clinical parasitic gastroenteritis has become rare. Nevertheless, gastrointestinal nematodes still cause large production losses, in particular through a reduction in milk yield (Gross *et al*., 1999). On top of such subclinical production losses, clinical parasitic diseases, such as dictyocaulosis, fasciolosis, coccidiosis, cryptosporidiosis and neosporosis, still occur.

For several reasons it is more difficult to apply parasite control on organic than on conventional farms. The main reason is that the routine use of antiparasitics is restricted. Moreover, there may be a longer grazing season on organic than on conventional farms. This will diminish possibilities for control through grazing management. On the other hand, some aspects of organic farming may be advantageous. For instance, the longer life of dairy cows compared to conventional ones implies that a smaller proportion of the herd consists of susceptible young replacement animals.

The aim of this presentation is to discuss the options for parasite control in organic cattle. It will mainly focus on the strategies for nematode infections in dairy cattle.

Parasitic gastroenteritis

Clinical parasitic gastroenteritis mainly occurs at the end of the first grazing season. The most important cause is the abomasal nematode *Ostertagia ostertagi,* followed by the small intestinal nematode *Cooperia oncophora*. The main symptoms are decrease in weight gain or even weight loss, anorexia, rough hair coat and diarrhoea. In affected herds, morbidity is high but mortality low.

Subclinical infections are far more important than clinical outbreaks. Even low infections result in production losses, possibly because parasite induced anorexia already occurs under such conditions (Forbes *et al*., 2000). These subclinical losses are not restricted to susceptible animals in the first grazing season. In the Netherlands, a reduction in milk yield is more important than poor weight gain in replacement heifers (Ploeger, 1989). Obviously, reduced milk yield also occurs on organic farms. However, these losses cannot be reduced because it is not acceptable to treat organic dairy cows.

The basic epidemiological pattern of parasitic gastroenteritis in dairy cattle in Europe is as follows:

Calves infect themselves after turnout in spring. Infection levels at that time rarely are high enough to cause disease, except perhaps in Northern Sweden and Norway (Tharaldsen and Helle, 1984; Dimander *et al*., 2000). After the prepatent period of 2-3 weeks, eggs are shed in the faeces. When pasture infectivity levels are 'high' at the beginning of the grazing season, faecal egg counts reach peak levels approximately 2 months after turnout and decrease thereafter. At lower initial pasture infectivity levels, a more gradual build-up of faecal egg output occurs with maximal levels at the end of the grazing season.

The overwintered larvae on pasture rapidly diminish in numbers in spring, and in summer a non-grazed pasture is virtually clean. After contamination of the pasture with nematode eggs, it takes at least 4 weeks in the Netherlands before substantial numbers of larvae are present on the herbage (Eysker *et al*., 1998b). This explains why the 'midsummer increase' of pasture infectivity does not occur before July. After this increase the pasture has to be considered 'dangerous' for the remainder of the grazing season. Some data suggest that mowing during the grazing season reduces pasture infectivity (Eysker *et al*., unpublished data).

When calves are not exposed to sufficient infection in the first grazing season important production losses may be postponed to the second grazing season (Ploeger *et al*., 1990; Eysker *et al*., 2000). Thus, the aim of parasite control should not be a maximal reduction of infections but to achieve a balance between acquisition of infection and acquisition of immunity with minimal production losses.

Options for control of parasitic gastroenteritis on organic farms

The most important restriction on antiparasitic use on organic farms is that only therapeutic anthelmintic treatments are allowed when diagnosis has been confirmed (Thamsborg *et al*., 1999). It has to be stressed that parasitic gastroenteritis causes severe discomfort. This is illustrated by the reduction in appetite occurring already at low infections. Therefore, it is important to treat as soon as possible for ethical reasons.

Several alternative control options for anthelmintics are studied (Thamsborg *et al*., 1999). However, the only available option now is the use of grazing management perhaps combined with nutritional interventions.

Grazing management options to be considered are evasive and dilusive grazing. The first implies that susceptible herds of animals will be moved to clean pastures before they can re-infect themselves; the second option is the grazing of susceptible animals together or alternately with immune animals of the same species (cows) or with other host species.

Evasive grazing

Studies in Denmark indicated that one move to aftermath in July before the mid-summer increase in pasture infectivity may be sufficient (Nansen *et al*., 1988). However, in the Netherlands such a move should definitely be combined with anthelmintic treatment (Eysker *et al*., 1998a). A highly effective evasive scheme, implying moves to aftermath every 2-3 weeks, has been recommended in the Netherlands by Oostendorp and Harmsen (1968). More recently, it has been demonstrated that the interval between moves can be prolonged to one month (Eysker *et al*., 1998a). Because the first move is not needed before July, only three moves would be enough for a normal grazing season. An important aspect of Oostendorp and Harmsen (1968) recommendation is that calves are turned out on mown pasture after the middle of May. This considerably reduces primary infections and subsequent pasture contamination (Borgsteede, 1977). This is well recognised by Dutch dairy farmers and a late turnout of calves on a mown pasture is applied on approximately 70% the farms. Outside the Netherlands experiences with turnout on mown pasture only are available from Denmark (Nansen *et al*., 1997).

The difference between Denmark and the Netherlands in the impact of applying one move in July teaches us that extrapolation of results from one region to another is dangerous. Going further north another situation emerges. Studies in Central Sweden suggest that the build-up of pasture infectivity is too slow to result in major production losses in calves after reinfection. However, next spring pasture infectivity can be high enough for disease in calves within one month after turnout (Dimander *et al*., 2000). Probably evasive grazing here rather implies that pastures used by calves in one year should be avoided in spring of the next year. A further advantage would then be control of severe *Eimeria alabamensis* infections (Svensson *et al*., 1994).

It is important to define which pastures can be considered 'safe'. For the Netherlands this would be all pastures in spring. Later, on safe pastures are those that have not been grazed by yearlings or by non-treated calves that have been outside for more than 3 weeks. Thus, cow pastures are considered 'safe'. However, infection levels in cows are often sufficient to cause reduced milk yield. Thus, some impact of parasites may be expected in calves grazing cow pastures. Moreover, grazing calves on cow pastures interacts with the organized control program for paratuberculosis, where a strict separation between cows and animals below one year of age is required. Thus, using cow pastures for calves is only possible on farms with a paratuberculosis-free status.

Dilusive grazing

Mixed or alternate grazing with sheep, horses, pigs and adult cows can be considered as a dilusive control measure. Mixed or alternate grazing with sheep is more effective for nematode control in sheep than in cattle (Niezen *et al*., 1996). A restriction on mixed or alternate grazing with horses is caused by the fact that a 'horse' pasture is not particularly attractive for a cattle farmer. In Denmark, promising results have been obtained through mixed grazing of cattle and pigs (Roepstorff *et al*., unpublished data). It is necessary to supply the pigs with nose rings to prevent rooting, but this might fit well in a mixed organic swine/cattle farm.

A scheme developed in the UK, using cattle only, is the leader-follower scheme. This is a rotational grazing scheme where the susceptible young calves are 'followed' by a group of older animals needing much more grass. A move occurs when the 'followers' have finished the grass. The 'leaders' therefore are moved before their grass is finished and they do not only have excellent grass quality but also can easily avoid the bushes around faecal pats where the infective larvae concentrate (Leaver, 1970). In Denmark, parasitic gastroenteritis in first grazing season animals was prevented by mixed grazing of first- and second grazing season animals (Nansen *et al*., 1990).

Recommendations at farm level

When sufficient data on the dynamics of the parasites are available, schemes like Oostendorp and Harmsen (1968), Leader-Follower (Leaver, 1970), Dose and Move (Michel, 1969) etc. can be recommended. However, usually these will not fit easily into the management on a particular farm. Rather than adapting pasture management to parasite control, parasite control can be adapted to fit the farm management. An attempt to achieve this has been made in the Netherlands by developing a flow chart for the control of nematode infections in the first grazing season (Werkgroep in- en uitwendige parasieten, 2000). This flow chart is based on the available data from the Netherlands, and whatever management applied the optimal recommendation will be obtained. Obviously, it is designed to produce recommendations on the safe side of risk. Thus, the use of it guarantees that no outbreak of parasitic gastroenteritis will occur, but not necessarily that sufficient nematode exposure occurs for immune development. The main problem for the use of the flow chart on organic farms is that most recommendations imply prophylactic anthelmintic treatments. However, using the flow chart on organic farms will allow to define the possible bottlenecks in nematode control and, when feasible, to seek for alternatives to cope with these. Therefore, the use of such flow charts should be recommended, although they should be adapted for the local conditions elsewhere. A translation of the flow chart as a dichotomous key is given in the text box.

Possible alternatives for the future

The following alternative options that are under study will be briefly discussed:

1) Biological control through application of the nematophagous fungus Duddingtonia flagrans.

2) Application of bioactive forages, in particular those containing condensed tannins.

3) Other nutritional manipulations to influence resistance and/or resilience of the host to nematode infections.

4) Vaccines.

5) Selective breeding.

Duddingtonia flagrans

In particular in Denmark, many studies have been done. When spores are given daily from 2-3 weeks until 2-3 months after turnout reductions in pasture infectivity of 60-90% have been observed (Larsen *et al*., 1995; Larsen, 2000). Although, this is important it may not be enough to control parasitic gastroenteritis and probably application of *D. flagrans* has to be combined with other measures. A problem is that spores have to be applied for a long period and that each animal should receive enough spores. Therefore, it is not yet clear if *D. flagrans* application is a viable option.

Bioactive forages

An effect of condensed tannins (CT) on resistance and resilience against gastrointestinal nematodes has been described (Niezen *et al*., 1995; 1998). Most studies have been done with sheep and the impact of CT on cattle parasites is not yet clear. The most promising CT containing plants are legumes like *Lotus pedunculatus*, *L. corniculatus*, *Hedysarum coronarium* and *Onobrychus vicifolia*. Although, some promising results have been obtained the following problems have to be solved:

- Cultivars of promising forage plants with the right content of the appropriate CT have to be selected.
- In vitro and in vivo studies should be done to evaluate the potential of these cultivars under controlled conditions.
- Pastures or/and fields with these cultivars have to be established.
- The effect has to be evaluated in properly designed field studies.
- Considering this it will take some time before this option may become available.

Nutrition

Resistance and resilience against nematode infections can be influenced by nutrition. Coop and Kyriazakis (1999) postulated a framework that accounts for scarce nutrient resources between the various body functions of the host. This implies, for instance, that in young animals acquisition of immunity against nematode infections has the highest priority after maintenance of the body (survival). In older animals, maintenance of immunity has a lower priority than reproduction and lactation. This framework is based on the fact that, indeed, animals at high planes of nutrition are far better capable to cope with nematode infections than similar animals at low planes of nutrition. In particular, protein content of the diet is important. For organic farms, this means that a good protein rich diet will mask ill effects of parasitism. Protein rich nutrition of susceptible animals through supplementary feeding is, in fact, a feasible measure on most farms now. Another aspect is that supplementary-fed animals will consume less herbage, resulting in a lower infection pressure. This was a possible explanation for the low to moderate gastrointestinal nematode infections on organic farms in Sweden (Höglund *et al*., 2001).

Vaccines

The only vaccine available against cattle helminths is the lungworm vaccine. This is an attenuated vaccine consisting of irradiated larvae. A recombinant vaccine to replace it is under study. However, it is still far away if it comes at all. For gastrointestinal nematodes, vaccine research rather concentrates on sheep than on cattle nematodes. Several protective candidate proteins have been found in different species. However, these proteins have to be produced in large quantities, implying expression as recombinant proteins. So far, such recombinant proteins have not resulted in sufficient protection in vaccination trials (review by Dalton and Mulcahy, 2001). A more or less similar situation as for gastrointestinal nematodes exist on vaccine development for *Fasciola hepatica*. Several protective proteins have been identified, but recombinant proteins fail.

Breeding

It is well known that between and within breed variation in susceptibility against nematode infections exist. Albers (1981) demonstrated that this was highly heritable in experimental *Cooperia oncophora* infections in calves. This variation implies that a small proportion of the host populations harbours the majority of the parasites. Recent studies in the Netherlands indicated that such variation in faecal egg output is still present in cows with heritability levels comparable to those for milk production (Mes *et al*., unpublished results). In principle, this implies that breeding against susceptibility with the aim to reduce pasture infectivity levels on cow pastures is feasible. However, this will only be implemented when there is no interference with major production characteristics, and when markers can be found to define animals.

Lungworm

The main difference between the epidemiology of lungworm and gastrointestinal nematode infections is that in the sporangia of the fungus *Pilobolus* spp., infective lungworm larvae reach pasture within one week after faecal deposition. Furthermore, survival of larvae in summer is short and overwintering on pasture does not occur as a reliable phenomenon, except perhaps in the moist Atlantic regions of Ireland and the UK. Another important factor is that immune development is rapid. This implies that the patent period is short. For transmission of infection from year to year, carriers shedding low numbers of larvae in the faeces are very important. On most farms in the Netherlands, a small minority of cows are carriers in spring (Eysker *et al*., 1995). The occurrence of such carriers in cow herds is very important for maintenance of immunity because the infection will cycle at a low level in the herd annually.

Because primary infections in susceptible calves are usually low, either coming from low level excreting carriers or from overwintered larvae, a build up of infections needs to occur before disease is seen. This implies that calves get low patent infections after 3-4 weeks, re-infect themselves from one week later, and outbreaks start to occur when these worms reach maturity, approximately 8 weeks after first exposure. This explains why outbreaks usually occur in summer or autumn. Probably associated with the massive use of prophylactic anthelmintic treatments in young stock, an increase has been observed in the incidence of lungworm disease in dairy cow herds (David, 1997).

Considering the epidemiology of infections it would be possible to use grazing management to control infections. When calves would be moved to clean pastures every week they can return to the first pasture after approximately 6 weeks because the larvae will then have died. However, the use of such evasive scheme would not protect against parasitic gastroenteritis. Therefore, no alternatives for the use of anthelmintics for the control of lungworm disease can be recommended, except, where available, vaccination. Thus, the recommendation for organic farms and conventional farms would be 'vigilance and treat'. This implies that an anthelmintic should be used in animals suspected of lungworm disease. This should be done before confirmation of the diagnosis through faecal examination or serology, because signs can aggrevate rapidly. Farmers of treated animals should be warned that signs may deteriorate temporarily after treatment.

Fasciola hepatica

The presence of *F. hepatica* infections on an organic farm depends on the occurrence of suitable habitats for *Lymnaea truncatula*. Control through prophylactic treatments is not possible on organic farms. Farmers will know if their farm is fluky through the condemnation of livers. On infected farms, snail habitats may occur throughout the farm, on part of the pastures or perhaps even only in foci around relatively small wet areas. In case the whole farm is affected, it is not likely that much can be done. In the Netherlands, lowering the ground water table has resulted in a large decrease in the incidence of fasciolosis in the last 40 years. However, political trends now are that this rather will be reversed with the most likely result that fasciolosis will be more important again in the future. When only a relatively small proportion of the farm is snail habitat, evasive grazing, or perhaps even fencing some areas, will be options to diminish infection pressure. However, defining the snail habitats should precede this.

Protozoal infections

Neosporosis

Neosporosis is a major cause of abortion in cattle (Wouda, 1998). It is a heteroxeneous coccidian with the dog as final host (McAllister *et al*., 1998) and other mammals, in particular cattle but also the dog itself, as intermediate host. The most common route of infection in cattle is transplacentary. However, the dog has been identified as a major risk factor for abortion storms (Bartels *et al*., 1999) and recently it has been shown that feeding the placenta of seropositive cows to dogs results in oocyst shedding (Dijkstra *et al*., 2001). Control on organic problem farms implies the same measures as on conventional farms. The aims are to reduce the proportion of seropositive cows by selective culling and by not using their offspring as replacement heifers. In addition, attempts should be made to interrupt transmission of infection from dogs to cattle and vice versa. However, as long as the transmission patterns from dogs to cattle are not fully understood the measures applied should be conservative.

Coccidiosis

Coccidiosis by *Eimeria bovis* and *E. zuernii* are primarily occurring in housed calves above 1 month of age. No specific prevention methods should be taken unless disease problems occur. Chemotherapy then should be applied and suitable hygienic measures should be implemented to prevent re-occurrence.

E. alabamensis causes diarrhoea in calves between 5 days and several weeks after turnout (Svensson *et al*., 1994). So far it mainly has been diagnosed in northern Europe, in particular Sweden. Probably it is under diagnosed elsewhere. In the Netherlands, for instance, it has not been diagnosed but high excretion of oocysts around 10 days after turnout certainly occurs. Disease is associated with turning calves out on the pasture that has been used for turnout of calves the previous year. Oocysts are long-lived and even the feeding of hay may still lead to disease. Prevention may be achieved by not using the same pasture for turnout of the calves in subsequent years. Probably, it is also important to prevent that young calves are turned out on the same pasture as older calves earlier that season.

Cryptosporidiosis

Cryptosporiodiosis caused by *Cryptosporidium parvum* is a common disease in calves in their first weeks of life. On farms where this has been diagnosed as a problem, strict hygienic measures should be the most likely route to go. However, even on farms that apply such measures problems may be persistent (Huetink *et al*., 2002).

Conclusions

The fact that no prophylactic antiparasitic drugs can be used on organic dairy farms affects the control of parasitic gastroenteritis and fasciolosis. For the other parasitic infections mentioned, control does not differ much from that on conventional farms. When clinical outbreaks of parasitic diseases occur, the appropriate antiparasitic drugs should be used.

Evasive and dilusive grazing are now the most appropriate alternative options for control of parasitic gastroenteritis. On most farms, this will probably not be a problem because the susceptible group of first grazing season replacement stock is relatively small, and finding sufficiently safe pastures is often feasible throughout the grazing season. A flow chart on parasite control like developed in the Netherlands may help to define the restrictions for control at farm level.

Alternative options for control of parasitic gastroenteritis, such as biological control, the use of bioactive forages, vaccines and breeding programs, may evolve in the future. These then should be used in integrated control programs.

Fasciolosis is only a problem in 'fluke' areas. Depending on the situation, and on the expertise of consultants to locate the 'snail' habitats, it will be possible to diminish production losses through evasive grazing.

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Text box. Key for the control of gastrointestinal nematode and lungworm infections in the first grazing season.

1. Calves are turned out
   No -- *Don't be concerned on parasitic gastroeneteritis or lungworm disease. Next year the yearlings should be treated as calves.*
   Yes ---*2*
2. Calves are grazed for more than 2 months
   No ---*3*
   Yes ---*4*
3. Calves outside < 2 months and turned out on pasture that has been grazed earlier by worm egg or larvae excreting young cattle (subsequently referred to as **seeders**)*
   - **Non-treated calves turned out at least for 3 weeks; Treated calves at least 3 weeks after efficacy of anthelmintic finishes; Non-treated yearlings**

   No ----- *No anthelmintic treatment needed.*
   Yes ---- *Treat with anthelmintic with residual effect (macrocyclic lactone) 3 weeks after turnout.*
4. Calves set-stocked or rotationally grazed on some pastures where they return without intermediate mowing.
   No ---*9*
   Yes ---*5*
5. Calves set-stocked, turned out on pasture grazed earlier that year by seeders.
   No ---*6*
   Yes----- ***(PGE)*** *Pasture infectivity may be high from 2 months after beginning grazing season. Treat then, but not later than August 1 with macrocyclic lactone.*
   *Repeat treatment every 6 weeks until one month before housing**. (LW)***
   Vaccinate before grazing season or use vigilance and treat.
6. Calves set-stocked, turnout on mown pasture not grazed earlier by seeders.
   No ---*8*
   Yes ---*7*

7. Calves set-stocked, turnout on mown pasture before June 1
   No ---- ***(PGE)*** *Treat two months after turnout with macrocyclic lactone.*
   (LW) *Use vigilance and treat or vaccinate before grazing season.*
   Yes --- ***(PGE)*** *Treat with macrocyclic lactone around August 1. Repeat treatment, when required, 6 weeks later but not later than 1 month before housing.*
   (LW) *Use vigilance and treat or vaccinate before grazing season.*

8. Calves set-stocked, turnout on non-mown pasture before June 1.
   No ---- ***(PGE)*** *Treat once with a macrocyclic lactone at turnout or 3 weeks later. Application of short acting anthelmintic 3 weeks after turnout is also possible.* ***(LW)*** *Vaccinate before grazing season or use vigilance and treat.*
   Yes --- ***(PGE)*** *Use at turnout a long acting device (bolus) or use a macrocyclic lactone at turnout and 6-10 weeks later. The choice should depend on length of the grazing season. An alternative could be to treat 2 months after turnout with macrocyclic lactone and to repeat treatment every 6 weeks until one month before housing.* ***(LW)*** *No separate measures needed, but vaccination may be considered when Paratex Flex Bolus is used.*

9. Calves not set-stocked, After July 1 they are consequently moved within 3 weeks to pastures that have not yet been grazed by seeders. (Moved to aftermath).
   No --*10*
   Yes --- ***(PGE)*** *No anthelmintics needed.* ***(LW)*** *Vaccinate before grazing season or use vigilance and treat*

10. Calves moved only once in July to a mown pasture that has not been grazed by seeders **or** calves moved more than once after July 1 but grazed for longer periods than 3 weeks on (mown) pastures that have not been grazed earlier that season by seeders.
    No ---- Calves moved after July 1 to pastures that have been grazed earlier by seeders.
    (PGE) *Treat with macrocyclic lactone when they are moved to this pasture or 3 weeks later. Repeat treatment when calves stay on the pasture longer than 6 weeks.* ***Or****: Use a long acting device at turnout; the choice depends on the length of the grazing season.* ***(LW)*** *When for pge the first option or the Paratext Flex Bolus is selected calves can be vaccinated before the grazing season or vigilance and treat. When for pge other bolus systems are used no separate measures are needed for lungworm.*
    Yes --- ***(PGE)*** *Apply anthelmintic treatment at the (first) move in (after) July (1). It is not necessary to use a macrocyclic lactone.* ***(LW)*** *Vaccinate before grazing season or use vigilance and treat.*

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Strategies for parasite control in organic pigs

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Introduction

In the last half of the 20th century, pig husbandry has developed from small, traditional backyard production systems with poor hygiene and often with access to outdoor runs for the sows, to large, highly intensive industries, in which the pigs are exclusively indoors on totally slatted floors without bedding material. Together with the increasing use of efficient antiparasitic drugs, this dramatic change in the surroundings of the pigs has had profound influence on the parasitic infections by having eliminated several parasite species totally and reduced the infection rates of the majority of the remaining species (Nansen and Roepstorff, 1999). The appearance of organic pig farms, in which preventive medication is prohibited, and bedding material and access to outdoor facilities are obligatory, is thus a return to a more parasite favourable production system (Nansen and Roepstorff, 1999; Thamsborg *et al.,* 1999). At the present time, few studies have been carried out on parasite infections in organic pigs (Roepstorff *et al.,* 1992; Carstensen *et al.,* 2001), showing moderate to high parasite infection levels. However, even the most recent data were obtained from relatively newly established farms and this may have influenced the results as introduction of several parasite species may not have occurred yet and because the infection levels may not have built up (often the pigs had not returned to previously used pastures).

Very little practical experience exists on how to control parasite infections to acceptable low levels in organic swine husbandry, and very few experimental studies have been conducted on potential control strategies. Nevertheless, a range of potential means of intervention has been identified and these may prove useful in future control strategies. In this paper, three groups of parasites (ectoparasites, coccidia and helminths) will be dealt with separately. However, first some characteristics of the pig host will be presented briefly to emphasise why many years of experience with parasite control in pastured ruminants cannot be used directly when tailoring a control strategy for pig parasites.

Pigs as parasite hosts

A brief comparison between pastured pigs and ruminants is presented in Table 1. Ruminants normally live of the grass, they avoid their own faeces and if they get access to large areas (low stocking rate) they utilise these areas efficiently. It may be seen from Table 1 that pigs utilise the pastures completely differently. Thus, pigs primarily live of fodder given in troughs, in supplement to which they root a lot in search of roots and invertebrates, ingesting considerable amounts of soil (Mejer *et al.,* 1998) and eating less grass than ruminants. Pig pastures are, therefore, often depleted of vegetation due to rooting. In sows, the rooting behaviour may be reduced and replaced by grazing by means of nose-rings (Mejer *et al.,* 2000), and, due to the normally used high stocking rate, the grass is often rather short (personal observation). If pigs have large areas available (low stocking rate), they do not utilise the most remote areas but tend to stay for longer periods of time on the feeding/hut area, which is often depleted of vegetation. Pigs usually have particular defaecation areas and do not avoid their own faecal deposits (Mejer *et al.,* 1998).

Ectoparasites

The most important ectoparasites of pigs are mange mites (*Sarcoptes suis*) and lice (*Haematopinus suis*). Both parasites are primarily transmitted by contact between pigs, as both mites and lice are able to survive for only short periods of time in the environment. Consequently, organically reared pigs should not be at particular risk of infection compared to conventional pigs. Both parasites are host specific, whereby wild boars are the only source of infection within the free-living fauna. Especially *Sarcoptes* infections may interfere seriously with animal welfare and may cause a significant production loss, and thus control of ectoparasites is needed.

In a Danish survey, *Sarcoptes* infections have been shown to have a high prevalence in organic pig farms. One farmer had even got several pigs condemned at slaughter due to mange (Roepstorff *et al.,* 1992). When a new herd is planned, it is important to buy pigs from a mange-free indoor herd (this will also reduce the introduction of other parasites). If the parasites are present within a herd, total eradication should be considered by two to three treatments with an effective drug administrated simultaneously to all animals, just like the common and successful eradication in many conventional herds. Such intensive treatment may seem unacceptable to organic farmers, however. Unless other effective strategies are identified, the only ethically acceptable alternative is regular medication, which may be even more unacceptable.

Table 1. A comparison of behaviour of pigs and ruminant on pastures

Pigs	Ruminants
Pigs are primarily fed by the farmers (grass is merely a supplement) and are in general grazing at a high stocking rate.	Ruminants primarily live of the vegetation thereby needing larger areas than pigs.
The pigs do not utilise large pastures efficiently but tend to stay for extended periods of time in the feeding area thereby increasing the effective stocking rate.	Ruminants fully utilise the pasture areas by preferring previously ungrazed areas.
Pigs have a strong rooting behaviour thereby destroying the grass vegetation. Rooting may be prevented by nose-rings.	Ruminants do not root, and if the stocking rate is reasonable low, the lush grass cover around faecal pats will remain ungrazed.
Pigs often have particular defaecation areas without vegetation.	Ruminants spread their faeces throughout the pasture.
Pigs do not avoid their own faeces.	Ruminants avoid their own faeces if possible.

Coccidia

Intestinal coccidia encomprise *Isospora suis*, which is highly pathogenic to young piglets (reviewed by Lindsay *et al.,* 1997), and *Eimeria* spp. that are most frequently occurring in older pigs (Roepstorff *et al.,* 1998). The latter coccidia are normally not considered very pathogenic, although clinical infections have been observed in pigs turned out on heavily contaminated areas (Alfredsen and Helle, 1980). Transmission takes place by oocysts in the environment, and as the parasites are host specific, wild boars may be the only reservoir hosts in the wild fauna.

Isospora suis appears to occur more frequently in intensive indoor systems (Roepstorff *et al.,* 1998) than in the outdoor organic herds (Roepstorff *et al.,* 1992). The latter authors report a case of a large breeding herd that, during the first year of observation, was an indoor specific pathogen free (SPF) herd with a prevalence of 51% *I. suis* infection in the piglets. No *I. suis* oocyst could be found in the piglets within the second year of observation when the herd had become organic and the sows were farrowing in movable huts on a pasture. Some of the organic herds in the survey of Roepstorff *et al.* (1992) had, however, high *I. suis* prevalences, when the farrowing huts were not moved before farrowing, or when the sows were farrowing indoors, while herds with movable farrowing huts had low prevalence rates. In contrast to *I. suis*, the *Eimeria* species seem to dominate in outdoor production systems (Roepstorff and Nilsson, 1991), and routine pasture rotation may help controlling the *Eimeria* transmission rates to acceptable levels.

Helminths (Table 2)
The dominating helminths of domestic pigs are *Ascaris suum* (large round worm), *Trichuris suis* (whipworm), *Oesophagostomum* spp. (nodular worms), *Hyostrongylus rubidus* (red stomach worm), *Strongyloides ransomi* (threadworm), and *Metastrongylus* spp. (lungworms). They are all host specific and they all have a direct life cycle, except for *Metastrongylus* sp. that has earthworms as intermediate hosts. The latter is thus exclusively found in outdoor production systems. However, and as reviewed by Nansen and Roepstorff (1999), all species are more common in outdoor than in indoor pigs.

In indoor production systems, straw bedding and infrequent dung removal are among the most important risk factors, and thus deep litter, which is common in organic herds, is one of the most important risk factors (Holmgren and Nilsson, 1998).

On pastures, infective larvae of *Oesophagostomum* sp. and *H rubidus* may be able to survive for a maximum of one year (Larsen, 1996), while *Ascaris* eggs may survive for five years (Müller, 1953) and *T. suis* eggs for 11 years (Burden *et al.,* 1987). These long potential survival times indicate that pasture rotation may have little effect on the transmission rates. However, recent quantitative cohort studies revealed a high mortality rate of *A. suum* and *T. suis* eggs even within the first 6-12 months (Larsen and Roepstorff, 1999; Kraglund, 1999). Therefore, pasture rotation must reduce the transmission. However, controlled studies to identify, how fast an acceptable low level of contamination may be obtained, are lacking. It is thus unknown whether pigs should be moved to safe pasture one or two times per year, and when it is safe to re-utilize a previously contaminated pasture.

As pigs often spend a lot of time in the feeding areas, these areas have a high effective stocking rate, and this part of the pasture may be a high risk area for parasitic infection with high numbers of parasite eggs/larvae accumulated in the soil (Roepstorff *et al.,* 1992; Carstensen *et al.,* 2001; Roepstorff *et al.,* 2001). Nevertheless, the feeding areas and the defaecation areas do not seem to be extremely highly infective ‘hot spots’ compared to other sections of the pasture (Thomsen *et al.,* 2001; Roepstorff *et al.,* 2001), presumably due to an unfavourable environment for egg/larval survival due to urination and lack of vegetation.

Nose-ringing of organic sows is very popular among farmers, as the vegetation is kept intact and may contribute to the economy. Nose-ringing is still allowed in Denmark. The grazing behaviour should, in principle, reduce the risk of obtaining infective eggs and larvae from the soil (particularly *A. suum* and *T. suis*) but increase the risk of infection with parasites that have larvae located in the vegetation (*Oesophagostomum* sp. and *H. rubidus*). One single study has been conducted to elucidate the effect of nose-rings (Mejer *et al.,* 2000), however, the results were not conclusive. Nevertheless, many Danish sow herds have very low infection levels with *Oesophagostomum* sp. (Carstensen *et al.,* 2001) and this may partly be due to the effect of nose-rings.

When sows have nose-rings, it is possible to have heifers and sows together on the same pastures. In a 3-year study, this has been shown to increase the performance of the sows, although the most important effect was to reduce *Ostertagia* infection levels of the heifers and increase their weight gain (Roepstorff *et al.,* unpublished). In some years, infective larvae of *O. dentatum* and *H. rubidus* may overwinter in very low numbers on Danish pastures. However, several studies have shown that even heavily contaminated pastures may be totally clean the following spring (Roepstorff and Murrell, 1997a; Thomsen *et al.,* 2001; Roepstorff *et al.,* 2001). Therefore, these parasites may theoretically be effectively eliminated from a herd in some years by a 100% effective anthelmintic treatment of all pigs during the winter, however this has to be proven in practice.

Daily administration of predacious fungi (*Duddingtonia flagrans*) in the feed has been proven to reduce the transmission rates of *O. dentatum* and *H. rubidus* by 70 to 80% (Nansen *et al.,* 1996). Such administration should actually be more easy to pigs than to ruminants, because pigs are fed by the farmers. No trials have yet been carried out on egg-parasitizing fungi, although such fungi have been shown to kill *Ascaris* eggs under laboratory conditions (Lýsek, 1978; Lýsek and Krajci, 1987).

Feeding the pigs with easily digestible carbohydrates has been shown to reduce the worm burdens and female fecundity of *O. dentatum* significantly (Petkevicius *et al.,* 1996, 1997, 1999) and some effect has been observed on *A.suum* (Petkevicius *et al.,* 1996). This promising principle has to be applied at field conditions.

Table 2. Options for helminth control in outdoor organic pigs

Control measure	Efficacy
Pasture rotation	probably rather effective in reducing the transmission rates to acceptable levels, however, controlled studies on optimal strategies are lacking.
Reduced stocking rate	*not* very efficient, although it may help.
Nose-rings	*not* very efficient, although future studies may show that nose-ringing may reduce transmission.
Co-grazing nose-ringed sows and heifers	rather effective for controlling parasites of sows and especially heifers.
Winter anthelmintic treatment	probably effective in eliminating *Oesophagostomum* sp. and *H.rubidus* in outdoor herds.
Predacious fungi	promising results on reduced transmission of *Oesophagostomum* sp. and *H.rubidus* on pastures.
Manipulation of the source of carbohydrate	highly promising results obtained on *O.dentatum* and a little on *A.suum.*

Conclusions

The present paper has emphasized that very little documentation exists on how to control porcine parasites in organic pigs. It may be reasonable to utilise the experiences of the large numbers of pasture studies of ruminant parasites. However, the epidemiology of the most important pig helminths is not comparable to the ruminant parasites, and furthermore pigs utilise the pastures completely differently, giving rise to much more complex transmission patterns. Therefore, there is a need for controlled pasture studies to answer the most importnat questions on pasture rotation strategy, stocking rate, etc. Research is alos needed to establish how other potential control measures, like diet and predacious fungi, may be integrated with pasture management.

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Parasitism in organic sheep farming

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Introduction

The production of organically farmed lamb requires good control of disease to comply with organic farming ethics and meet its specifications. Parasitic infestations are an important threat to the health of small ruminants, and are particularly difficult to control in livestock farming conditions.

Several treatments with chemicals are necessary to control the different parasitic infestations contracted at pasture. If too many of such treatments are used, the practice prevents the marketing of lamb as 'organically farmed' produce. On the other hand, too few treatments can lead to health problems and poor zootechnical performance (reduced growth, insufficient fattening, etc.), and heavy infestation of grazing areas by the large numbers of parasite eggs excreted by parasite-bearing sheep. Continuous grazing for eight to 12 months maintains infestation in both ewes and lambs.

Many studies have shown, how this pathological condition evolves during the summer season (Mage, 1998). All of them have demonstrated the need to implement allopathic treatments, often repeatedly, to curb *Moniezia* plus *Strongyles* plus *Fasciola*.

In organic farming, disease prevention is the keyword, and it is necessary to search for and promote livestock rearing and grazing patterns that entail the least possible risk of parasitic infestation.

Objectives of the study

⇒ Diagnosis of rearing, grazing and anti-parasite treatment patterns for the production of grass-fed lambs in order to provide means for analysing livestock management and help in deciding on most appropriate treatments.

⇒ Collection of references concerning organic sheep farming practice in order to propose improvements.

Materials and methods

✓ *Survey and monitoring of 34 sheep farms practising organic farming:*

- Structural data on the farm, size, livestock, etc.
- Description of flock management, births, sales, body score, feeding.
- Identification of the mode of ewe and lamb grazing management.

✓ *Parasite epidemiology*

After identifying the management types, six livestock farms were monitored epidemiologically as follows (Table 1, Figure 1):

- Parasite excretion of sheep by coproscopic examination (10 lambs and 5 ewes per farm):
  - Lambs: one month before weaning, at weaning, and one month to one and a half-month after.
  - Ewes: at weaning, one month before mating and in winter.
- Parasitic infestation

  Parasite counts to obtain a complete inventory of all the parasites present on the sheep. These examinations were carried out on four weaning lambs and four lambs ready for sale in each farm.
- Zootechnical performance measurements were also recorded:
  - Body score on sheep at turn-out, weaning, and mating.
  - Growth of lambs: from birth to weaning, and weaning to sale.
  - Monitoring of grazing.

Table 1. Example of collected data on every monitored farm**.**

1) Parasites

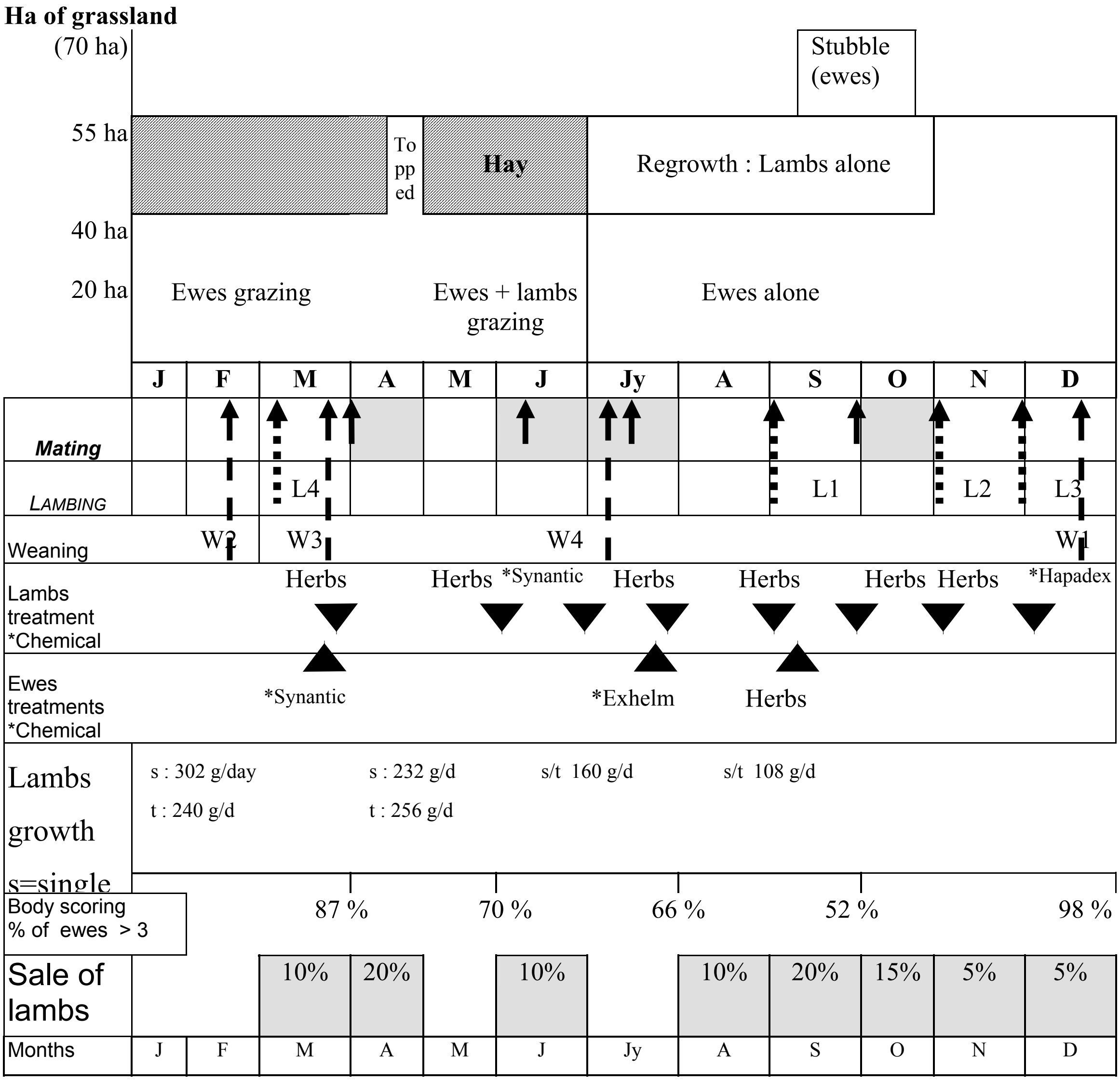
	Time	9/05/01	17/06/01	9/07/01	2/09/01	19/09/01	23/12/01
Average of eggs numbered by coproscopic exam (epg) on ewes	Digestive tract stongyles			273	10		505
	Verminous bronchitis			0	0		0
	Liver fluke			30	8		78

Average of eggs numbered by coproscopic exam (epg) on lambs	Digestive tract stongyles	73	63			2567	
	Verminous bronchitis	0	0			0	
	Liver fluke	0	0			0	
	Moniezia	2	0			0	
	Ookystes of coccidiosis	9120	3000			2600	

	Average of parasitic assessments on lambs by post-mortem evaluation			
	17/06/01		19/09/01	
	Nb of * lambs	Nb of Parasites	Nb of * lambs	Nb of parasites
Digestive tract stongyles	4/4	2145	3/3	30366
Verminous bronchitis	1/4	1	3/3	13557
Liver fluke	0/4	0	0/3	0
Moniezia	3/4	7,70	3/3	1,70

* Nb of infested lambs / Nb of autopsy.

Figure 1. Grazing and flock management.



Results

Lambing

- The lambing period(s) determines the management pattern adopted by the livestock farmer.
- The risks of parasitic infestation of flocks are not the same for lambings in early winter (December) and in spring (March).
- The market demand is very strong in spring, summer and winter, but low in autumn.
- Lambings must produce lambs according to distribution of demand to obtain best prices.
- As shown in Figure 1, five main classes were identified. Lambings in December-January and January-February concerned two-thirds of all lambings, and early spring lambings a quarter (15 February-15 April). Continuous and autumn lambings together made up only 10% and hence they were not very representative.

- *Grazing management and sale of lambs*
- The rearing of lambs essentially in pens (with a short period out to grass) made up 25% of sales and mainly concerned winter births (December - January).
- Three quarters of the lambs were grass-fed with or without concentrate supplementation.
- In all cases, the grazing management was of the rational grazing type in periods of three to six days on the same plot.
- Three main grazing patterns were identified according to how the lambs were fed after weaning:
    - Continuous annual grazing of ewes and lambs.
    - Grazing of 'healthy' (mildly infested) grass regrowth after weaning of lambs.
    - Grazing of contaminated regrowth.
- These three management patterns imply different periods of commercialisation for lambs born on close dates.
- Flock management was not very different from conventional practice (non-organic). However, due to the reduced number of treatments, the growth periods were longer and the sales more widely spread out, especially when no concentrate feed source was dispensed during grazing.

Parasitic epidemiology (Mage et al., 1998)
- Coproscopy :
    - Roundworms: prevalence was 70% in ewes and 80% to 100% in lambs. *Oestertagia* accounted for 34% of the parasite population.
    - *Moniezia*: prevalence was 10% to 80% in lambs.
- Infestation count:
    - All the lambs presented abomasum and intestinal round worms.
    - Verminous bronchitis was found in only one region.
    - In addition, 72% to 86% of them were infested with *Moniezia* (8 to 17 scolices per lamb)
    - There was no *Fasciola*, but *Dicrocoelium* was present in some farms.

Growth rates of lambs
- This was fairly good before weaning (160 to 290g/day for singles), and then strongly regressed (95 to 110 g/day) owing to shortage of spring grass and parasitism.

Antiparasite treatments
- Many livestock farmers use agents based on medicinal herbs, essential oils or trace elements to fight parasitism, in addition to chemical treatments, although their effects are not precisely known.
- We tested seven herb-based commercial products using the method applied to allopathic agents (coprology on lambs on D0 – D10 – D22 with treatments as prescribed by the suppliers) and compared their efficacy: [(excretion on D0-excretion on D10 (22) / excretion on D0)] x 100.
- In all cases the efficacy was nil or very low. Only one agent was found to be active against *Taenia*.
- Farmers generally apply the first treatment before weaning or at weaning, and then a second treatment one month before sale.
- In ewes, a treatment before mating and for the others individual treatment accords to their body scores or health status.

Conclusions

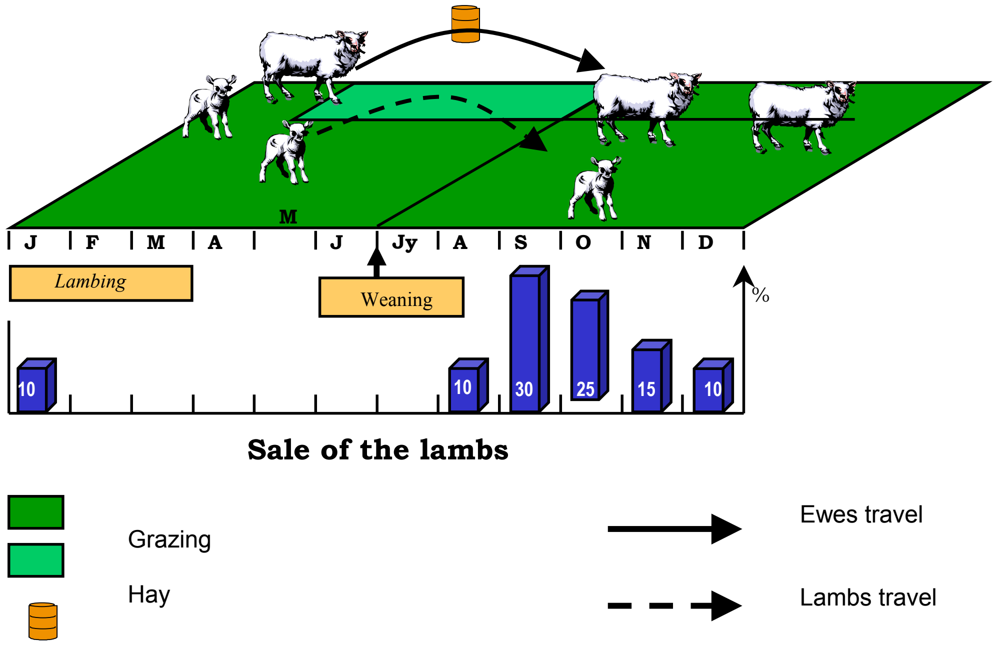
Many studies have shown a mild infestation by *Strongyles* in lambs grazing before July. Hence:

- It is possible to market well-managed lambs (single-born, with concentrates supplied) before this period with no treatment.
- At this date an allopathic treatment is generally necessary and the lambs must therefore be weaned and taken to parasite-free grazing plots.
- Before July many lambs are affected by *Moniezia* and can be treated with plant-based medicinal products that are compatible with the specified requirements for organic agriculture. However, if the farmer's grazing management makes sure of having a sufficient grass height when the sheep leave the plot (5 - 6 cm), then contamination is much lower.
- Dispensing concentrated feed to grazing lambs reduces ingestion of grass (and so of parasites), improves growth and lowers age at sale, which favours lower contamination of pastures.
- There are also diarrhoea indices that can serve as indicators of parasitism.
- For several years a protocol that helps rid plots of *Fasciola hepatica* has been proposed to farmers. Its implementation has resulted in a marked reduction of contaminated areas. An immunological screening test can be carried out, along with a report on the state of the ewe's liver after slaughter. In our observations no centre of contamination was identified.
- Monitoring of body score is most important because ewes >3-3.5 generally need no treatment.

Typical patterns of livestock management

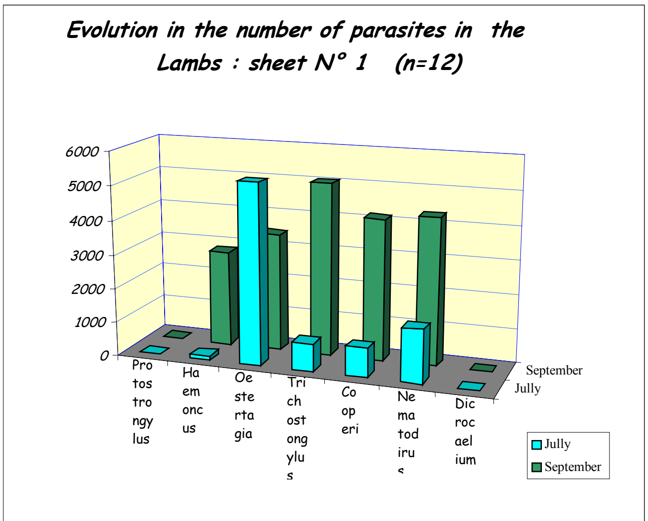
To help prganic farmers in the management of parasites in lamb production, diagnostic data sheets for typical examples identified form the results were produced. These are presented in the following section, with recommendations on how to manage the system in order to avoid losses from parasite infections.

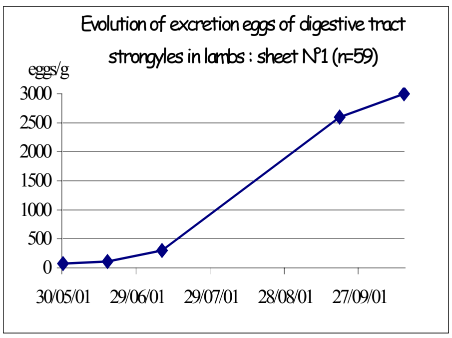
DIAGNOSIS DATA SHEET N°1



Livestock management

- Continuous grazing of ewes (and lambs) all year.
- Lambings from December to March according to the case and weaning in early July.
- Sales from August to January.
- Grasslands that are to be mown are topped from March to April.
- Certain lambs receive a concentrate supplement, others none.
- The ewes are treated against *Strongyles* once or twice a year.
- Early lambs born before March can be sold before July with only a single treatment or no treatment at all. The late sold lambs generally need three or more treatments and are excluded from organic sale. Between the two it is possible to manage lambs with two treatments up to August, but hardly any later.





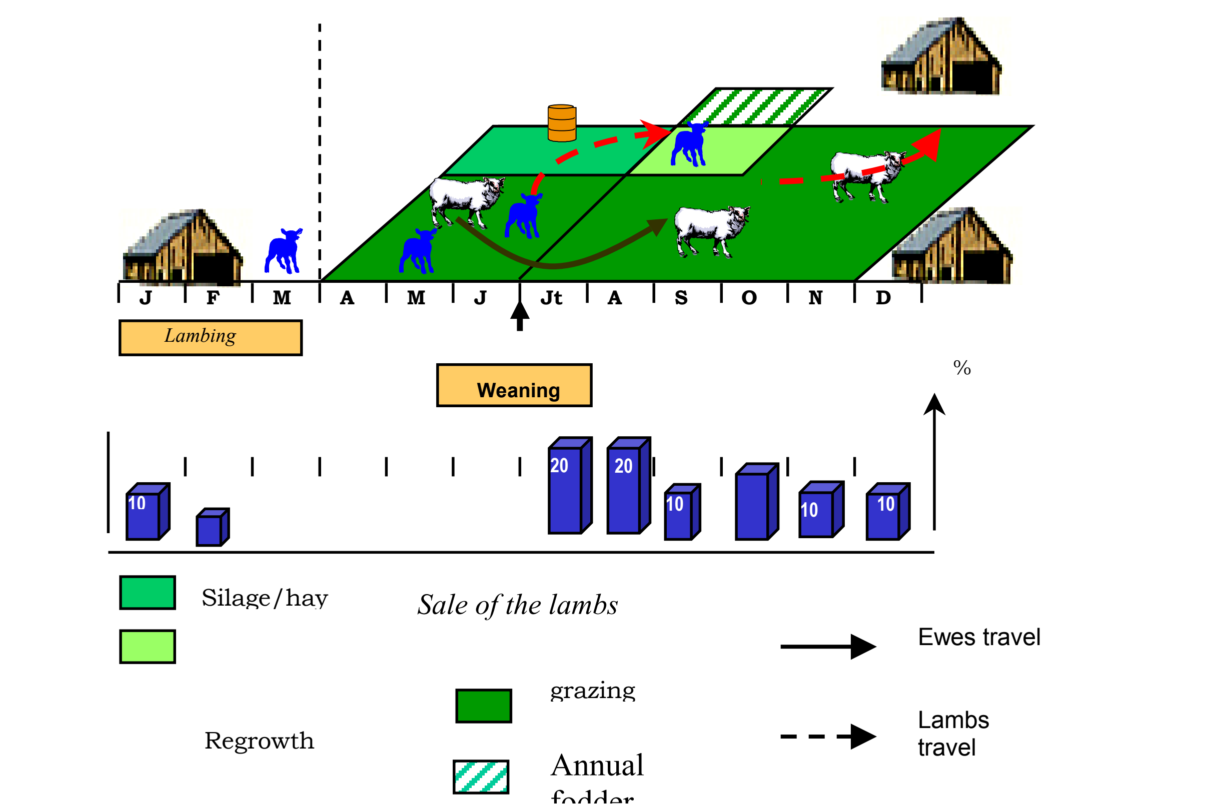
Analysis and comments

- This management pattern maintains a high level of contamination of grazing areas by ewes (end of gestation, lactation) and lambs (after weaning). Many infesting larvae and eggs of digestive-tract *Strongyle*, *Taenia*, and other internal parasites can be observed on pastures.
- Growth of lambs is poor because of parasitism and sometimes shortage of grass in summer.
- Production of quality organically farmed lambs in this context is difficult or even impossible for the late-sold lambs.

Proposal for livestock management

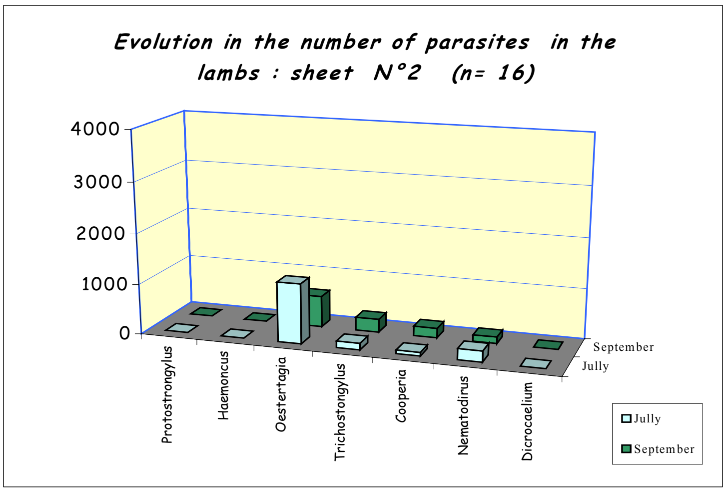
- Lambing can be kept in this period. However, during the end of gestation and the start of lactation pastures will be heavily contaminated by the build-up of excreted parasite eggs by ewes. At this time they should therefore be put on pastures that are to be ploughed in the spring to plant cereals or annual crops (fodder-colza, red clover, cereal/vetch etc.).
- Plots that are to be mown for hay or silage should not be topped, and be given to weaned lambs after regrowth (June – July). Fattening of lambs should be improved by grazing on pastures sown in autumn or spring and not yet grazed.
- The provision of 25 to 30 kg of cereals per lamb limits grass ingestion, and so of infesting larvae, strongly improves growth and reduces excretion of parasite eggs onto pastures.
- The autumn grazing sequence (early October) should no longer include lambs.
- The lambs can be treated against *Taenia* using a plant-based agent (May at weaning and September for unsold lambs).
- Dry ewes and lambs receive a chemical treatment and are put separately on parasite-free plots.
- One month before mating the weakest ewes are treated against *Strongyles*. The presence or absence of liver fluke is diagnosed by immunological examination.
- Lambs unsold in September cannot be left in the organic circuit because they need a third treatment and sometimes further ones.

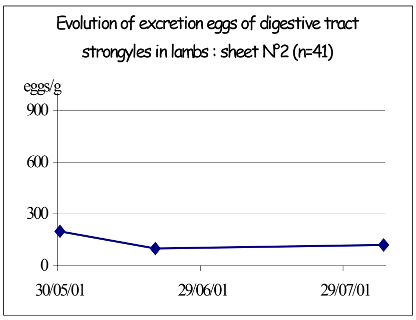
DIAGNOSIS DATA SHEET N°2



Livestock management

- Ewes are brought into pens in early December until 15 – 31 March.
- Lambing takes place in the pens.
- Ewes and lambs graze together from March to July. After weaning the lambs feed on hay regrowth. The late sold are fattened in pens. Some may be given concentrated feed during grazing.
- Anti-parasite treatments for both ewes and lambs are generally two or sometimes three in number. Not all of them are applied at the right time (before putting to grass, for example).





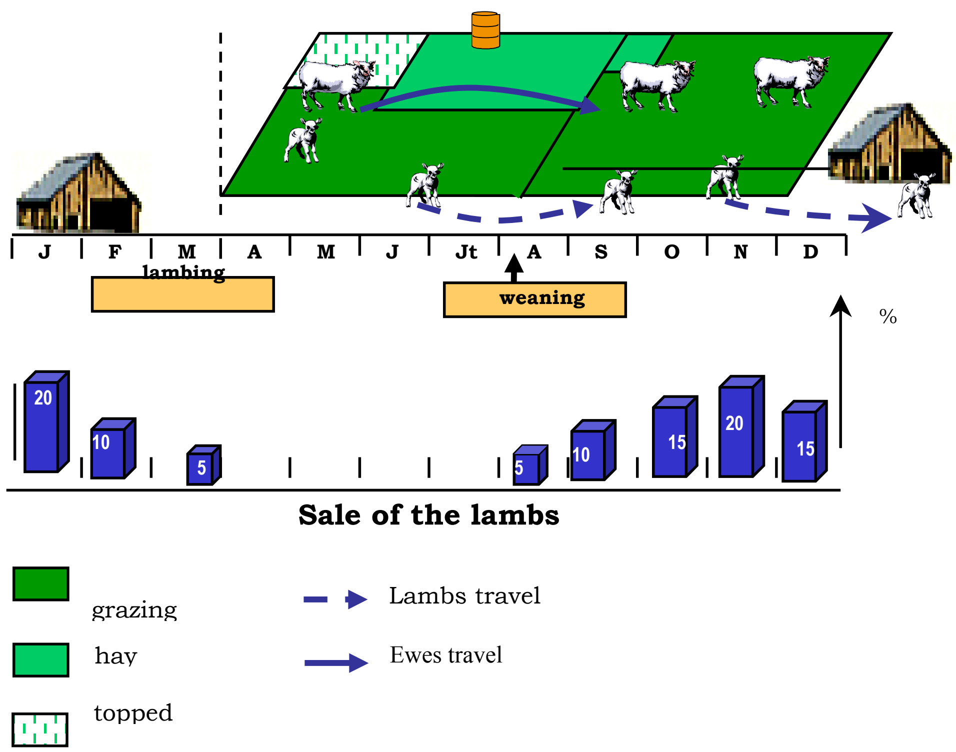
Analysis and comments

The management pattern offers numerous advantages: lambing and early growth indoors. This is the most favourable situation for reducing the risk of parasitism. Anti-parasite treatments carried out after penning are worthless because they are unsuited to the epidemiology of the main sorts of parasitism.

Proposal for livestock management

- *Moniezia* infestation in lambs can be controlled by treatment with plant-based agents, and if necessary by allopathic medication at weaning.
- The dispensing of cereals to lambs (25 kg) enables shorter stays on pasture and lower contamination of plots, and affords more grass for the ewes after they have been taken off earlier.
- Allopathic treatments in the pen are unnecessary and the ewes can be given a single chemical drug before mating.
- At weaning (July) the lambs are given (in the pen) their first chemical treatment against *Strongyles* and *Taenia*. At this time they are grazing hay and silage regrowth on parasite-free pastures. A lower stocking rate on the ewes' pasture increases grass availability and reduces infestation. Lambs unfattened in September can be repenned and fattened there.
- The presence or absence of liver fluke is diagnosed serologically.

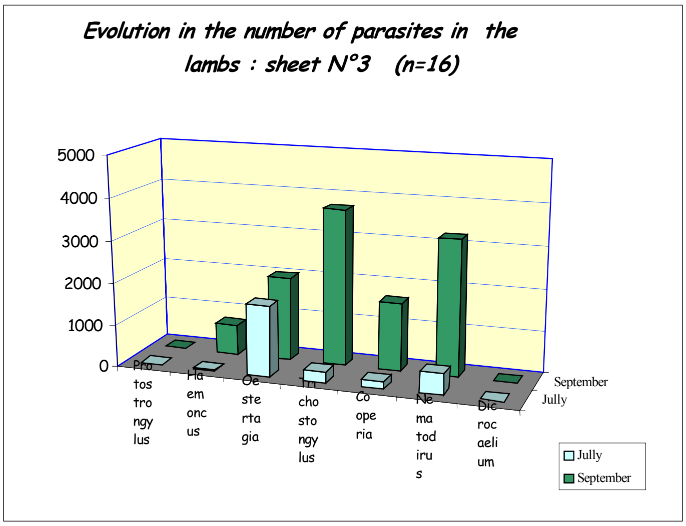
DIAGNOSIS DATA SHEET N°3

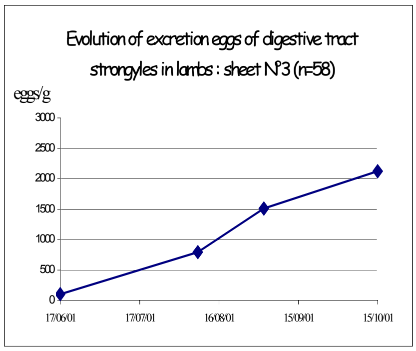


Livestock management

Lambing is in February to April; the pastures are topped. Lambs and ewes graze together until weaning in July. Afterwards the lambs graze the same pastures as in spring. Growth is very slow and the fattening of lambs very late (January – February) for one third of them.

Analysis and comments





Some farms carry out no anti-parasite treatment. Only a trace-element enriched supplementation is provided to increase the ewes' immune resistance. The grazing management after weaning entails a high risk of infestation of lambs. Treatments based on non-remanent chemical agents are inefficacious because the lambs are continuously reinfected, as in data sheet N°1.

Proposal for livestock management

To avoid excessively slow rates of growth in dry summer periods (15 July – 1 September) owing to late births (March-April). It is desirable for most of the lambs (> 60%) to be sold before the end of July. For this reason a good complementation of grazing lambs is necessary, together with a strict management of grass height when plots are opened (12 cm with a grass meter) and avoidance of too-close grazing of grasslands (5 cm with a grass meter) when the sheep are taken off.

Lambs unsold in mid-July have imperatively to be left to graze on regrowth after mowing, which is less parasite-bearing. For farmers who do not want to treat their sheep (which appears a difficult option), it is absolutely necessary to give some concentrated food to lambs during grazing and to fatten them on annual forage crops planted in the previous autumn or spring. However, at least one annual treatment seems necessary.

For farms with extensive grasslands used as pasture in spring and autumn, on which ewes can graze culm after cropping, the risk of parasitic infestation is considerably lowered.

Final conclusions

This study shows that:

- It is possible to fight *Taenia* efficaciously using a plant-based agent that is useful for livestock farmers.
- In most situations infestation by *Strongyles* is low before early July, but *Taenia* is abundantly present.
- Lambs that after weaning graze plots already consumed in spring are very rapidly and permanently infested, and it is difficult to rear them with only a small number of treatments.
- Complementation with concentrates during grazing increases lambs' growth rate, reduces their degree of parasitic infestation and their stay time on pasture, which offers greater availability of less contaminated grass for ewes.
- To fatten ewes after weaning, the ideal solution is to have newly sown pastures or annual forage crops, sown after cereal and rationed out. Under these conditions growth is optimal, and treatments minimal.
- When the protocol for ridding pastures of parasites is implemented it is possible to eliminate liver fluke.

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Parasite control on organic sheep farms - options and limitations

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Introduction

Parasitic infections cause problems in most sheep production systems. Many parasites have a universal distribution and to what extent the infections become a problem on a particular farm depends on several factors of which biosecurity, management procedures and climatic conditions are probably the most important. Most infections have a predominantly subclinical course and will remain undetected despite a reduced level of production. However, if the infections are ignored and preventive measures are not taken to limit the impact, clinical disease and significant welfare problems may be an outcome. Control of parasitic problems has for a long time relied on the regular use of anti-parasitic drugs. Therefore, many organic production systems become even more vulnerable because the use of preventive medication is prohibited. Organic production systems have longer withdrawal periods after use of medicine, the grazing period may be longer and possibilities of supplementation on pasture may be limited depending upon national standards. Non-chemotherapeutic measures of control have been investigated in the last two decades due to increasing problems with parasiticide resistance. These results should now be put into practice on organic farms in an integrated approach.

Several parasitic infections may limit sheep production, but the following are regarded as the most important in the EU context:

- Gastrointestinal nematodes/parasitic gastroenteritis
- Coccidiosis

- Sheep scab (*Psoroptes ovis)*
- Liver flukes (*Fasciola hepatica*)

Gastrointestinal nematodes and coccidia have an ubiquitous distribution and cannot, with few exceptions, be excluded from any farm. Coccidiosis is often associated with intensive production. Sheep scabies cause severe dermatitis and skin irritation that may lead to secondary infections and auto-mutilation. This must be regarded as a major welfare problem in a sheep farm if left unattended. The infection can only be removed from infected farms by means of one or repeated treatments with approved drugs. Prevention should be aimed at a high level of biosecurity (e.g. by avoiding close contact to animals of unknown status like common grazing) and introduction of infected animals to the farm. Fasciolosis is a sporadic problem seen only on farms close to wet areas where the intermediate host, a fresh water snail lives. The build up of immunity is rather limited and infections accumulate with age. Control can be achieved by avoiding access to wet areas, notoriously known for risk of fasciolosis, but this is often impractical and use of relevant anthelmintics becomes necessary.

In the present paper, the emphasis will be on non-chemical control of gastrointestinal nematode infections.

Basic epidemiology of gastrointestinal nematodes

Knowledge of a few essentials of epidemiology is necessary in order to understand the rationale behind most control measures. The group of gastrointestinal (GI) nematodes comprises a number of different species adapted to different sections of the sheep gut (abomasum, small and large intestines). Although some differences exist in pathogenicity, in the rate of development and in larval bionomics, these nematodes are generally regarded as one group. In the following sections, species and genus will be mentioned only when relevant.

GI-nematodes have a direct life cycle (i.e. there are no intermediate hosts). With very few exceptions, infection of sheep takes place only from pasture. Eggs from the adult female nematodes in the gut are excreted with the hosts faeces. They develop in the dung through two larval stages (L1 and L2) to infective larvae (L3). L3 larvae are transmitted to the grass by random movement in a film of water and probably rain splash dispersal, as documented in cattle. L3 larvae are eaten by the sheep with the grass. The survival of L3 larvae on pasture depends on temperature, humidity and age. In general, in northern temperate areas L3 larvae survive on pasture during the winter and up to late June in the following year. *Nematodirus* spp. have an extremely long survival on pasture as the egg is capable of hatching after more than one year. If exposed, immunity establishes in lambs at 4-9 months of age, depending on species of nematode (e.g. immunity to *Nematodirus* spp. builds up after 4 months).

The nematode species *Haemonchus contortus* represents a special case in relation to control without use of chemotherapeutics. This is mainly a subtropical-tropical parasite but it does occur and cause problems as far North as Norway (Helle, 1973). *Haemonchus* is very prolific resulting in very high faecal egg counts (thousands of eggs per g of faeces (epg)). Due to a relatively fast development on pasture, the infection builds up rapidly (3-5 weeks) if conditions are warm and humid. The infection is highly pathogenic and causes high mortality. Severe blood loss and hypoproteinaemia are characteristic of this infection. Diarrhoea is not a clinical feature in contrast to *Ostertagia* and *Trichostrongylus* infections. *Haemonchus* has a poor winter survival in northern areas which makes anthelmintic treatments during housing effective in controlling the infection on farms. However, anthelmintic resistant strains occur commonly, and organic farms, where a routine treatment during housing is often not performed, may risk a build up of infections. Some evidence indicates that this is actually the case (Lindquist *et al.,* 2002; Thamsborg *et al.,* 2001).

Options for control of gastrointestinal nematodes

The options for control of GI-nematode infections that do not rely on the routine use of anthelmintics can conveniently be grouped as follows:

a) Management procedures:
- monitoring and intervention with anthelmintics;
- grazing management;
- level of nutrition;
- bioactive forages (e.g. condensed tannins).

b) Biological control:
- nematophagous fungi.

c) Selection for genetic resistance in sheep
- within breed/use of selected breeds

d) Vaccination.

Several management procedures are known to reduce the impact of parasitic infections. However, this paper deals with procedures that specifically aim at the control of nematodes, including the prospects for use of bioactive forages. Biological control is a means of control that may become commercially available within the near future. Selection for genetic resistance in sheep is practised routinely in several places in Australia and New Zealand. The approach conforms closely with the intentions of organic farming, and if flocks are large enough, this would be very useful. The selection of the best-suited breed should always be kept in mind in organic farming in the EU where generally several breeds of sheep are used and within breed selection is not the only relevant approach. There is little tradition for research in this area in the Scandinavian countries and the issue is not dealt with any further, although it is important. Research on a useful vaccine against nematode parasites has been on-going for several decades, and although many results are promising, there has been no breakthrough and a commercial product is presently not available.

Monitoring and intervention

Monitoring of faecal egg counts and intervention by anthelmintic treatments if the mean count of a particular group of animals (lambs or ewes) is above as certain limit (e.g. 400 epg in lambs) is being advocated increasingly. This is true particularly in Denmark where anthelmintics are on prescription and a diagnosis by a vet is required before treatment. In most cases, clinical disease will be avoided and the selection for anthelmintic resistant nematode strains is minimal. However, the approach is not proactive. The large production losses due to subclinical infections are not avoided if the farmer has no other means of control. In some cases where disease occurs before massive faecal egg counts, it may be too late for treatment intervention.

Another approach is monitoring of clinical conditions e.g. anaemia in the case of infection caused by *Haemonchus contortus.* In South Africa, the FAMACHA-card assessing the colour of eye mucosa (score 1-5) has been developed (Van Wyk *et al.,* 1997). It is used selectively in a flock on a monthly basis by drenching all animals with a score of 3 or above. By this method the majority of the high faecal egg counts can be avoided, the risk of anthelmintic resistance is minimised; and by culling all ewes or lambs treated more than once it is possible to increase the level of natural resistance in the flock with time.

In cattle, monitoring of serum pepsinogen in first-season grazing calves 6-7 weeks after turn-out has been suggested as a means of determining the size of the overwintering infection on the pasture and therefore the need for a move to clean pasture later in the season. *Ostertagia* infections in the abomasum are the only cause of an increase in pepsinogen and this nematode is particularly important in cattle. In sheep, other nematode species also play an important role in parasitic gastro-enteritis and furthermore, the serum pepsinogen increase is not so prominent. For these reasons, the approach is presently not relevant in sheep.

Grazing management
A basic concept in the use of grazing management for control of nematode infections is the 'clean pasture'. Clean pasture is a pasture where the risk of an accumulation of infection to pathogenic levels is minimal because the herbage contamination (number of L3 larvae in the herbage) is nil or very low when the sheep are introduced on the pasture. The maximum numbers of larvae allowed on a clean pasture varies with the predominant nematode species and the climatic conditions, in particular the longevity of L3 larvae. In the northern temperate areas where several nematode species survive the winter period, the following guidelines can be used:

- Clean pastures at turn-out in spring:
  - pastures not grazed by sheep the year before;
  - new ley i.e. newly sown pasture and never grazed.
- Clean pastures at mid summer (after 1 July):
  - pastures after the first cut for silage/hay and not grazed by sheep the same year;
  - pastures grazed by other species (e.g. cattle) same year.

'Safe pastures' has been used to designate pastures with a slightly higher risk compared to clean pastures (e.g. pastures grazed by dosed, dry ewes in the previous year) but such designations should be based on local epidemiological knowledge. Dutch studies have indicated a beneficial effect of mowing a pasture being grazed permanently by cattle but little data on this approach exist for sheep (M. Eysker, unpublished data).

The principles of grazing management to control GI-nematodes can be grouped as follows (see Barger, 1997 and Thamsborg *et al.,* 1999 for more details):

a) Preventive grazing
In essence this approach means turning out parasite free animals on parasites free pastures. This has been developed into the 'clean grazing' concept for sheep in Scotland. This is easier to practise in cattle herds where the calves grazing for their first season every year are parasite-free whereas in sheep flocks, effective deworming of ewes before turn-out is needed in order to have parasite-free animals. For this reason it may be difficult to practice on organic farms where preventive medication is not allowed. Furthermore, this approach may select strongly for anthelmintic resistant nematode strains because the nematodes that can survive the anthelmintic treatment will make up the population on the new pasture after turn-out.

b) Evasive grazing
Having contaminated pastures at turn-out, the ewes and lambs inevitably become infected by the overwintering infection. The excretion of eggs in early season will form the basis of the dramatic rise in pasture contamination usually seen in end of June or early July ('mid-summer rise'). This rise in infection levels in the sheep can be evaded by moving the animals to clean pasture. The animals are often treated with anthelmintics at the same time and this method was developed as the Weybridge 'Dose and move' system for cattle and later for sheep.

Sometimes further treatments are needed on the new pasture. Alternate grazing with other species, for example, the case where sheep and cattle swap pasture by the 1 July, can also be regarded as evasive grazing. Recent studies have indicated that the move to clean pasture can be performed successfully without dosing with anthelmintics (Githigia *et al.,* 2001) but only in the case where *Haemonchus* is not present. However, there is no doubt that repeated moves to clean pastures without treatments in many cases will be a viable and effective means of control.

c) Diluting procedures
Less susceptible animals will become heavily infected if the ratio of susceptible to resistant/immune stock is decreased. This is the principle used in mixed grazing (i.e. grazing sheep together with another) non-susceptible species on the same pasture, or when older, immune sheep (e.g. dry ewes) are grazing together with weaners. Reducing the general stocking rate (number of sheep per unit area) will also result in less problems with nematode infections (Thamsborg *et al.,* 1996). Reducing the stocking rate is generally not regarded as a management procedure in worm control but rather as an important risk factor. Management should aim at securing sufficient feed on the pastures at all times. Stocking rates above or even very close to the carrying capacity of plant production should be avoided.

Importance of level of nutrition/supplementation
Supplementation, particularly protein supplementation has, in the last decade, been shown to be able to reduce establishment and alleviate the pathogenic effects of nematode infections (Abbott *et al.,* 1988). The effect is primarily seen when the protein level in the diet is low whereas little or no beneficial effect is seen if the supply meets the requirements (see Coop and Kyriazakis, 1999 for further discussion). Rumen by-pass protein has the best effect but the availability may be limited in organic farming, particularly after the ban on fishmeal. Again, provision of plenty of pasture at all the times is imperative.

The timing and group of animals that are relevant for supplementation while on pasture will depend on production system. Some examples are:

- Ewes that lamb on pasture or during early grazing season;
- Lambs that are finished on pasture;
- All stock, in case of drought;
- Ewes and replacements, if kept on pasture throughout the winter.

It has been demonstrated that protein supplementation of ewes around lambing may limit the peri-parturient rise in faecal egg counts depending on the protein level during pregnancy. The epidemiological importance of this depends on the time of lambing in relation to turn-out. Supplementation during finishing of lambs is likely to have a marked impact on production as nematode infections generally build up in late season and may contribute to reduced performance. Whether grazing is supplemented by feeding roughage, concentrates (energy- and/or protein-rich) or by-pass protein will depend on availability and cost-benefit considerations. Urea is not used in organic farming.

Bioactive forages
Bioactive forages can be characterised as forages containing secondary metabolites, substances that may lead to a specific effect in livestock (e.g. elimination or prevention of an infectious disease or deficiency, correction of a mineral deficiency or improvement of product quality). In contrast to many temperate medicinal plants with a putative anthelmintic activity, the bioactive forages are generally non-toxic and correct dosing is not a crucial issue. It

should be possible to feed the bioactive plants as a major part of the diet, either cut or grazed and should preferably be cultivable in the crop rotation.

Studies in the southern hemisphere have shown that certain leguminous forages with a relatively high level of condensed tannins (CT)(3-8% of DM) fed to sheep may lead to lower faecal nematode egg counts and worm burdens (Niezen *et al.,* 1993, 1995, 1998). This has led to other investigations throughout the world using different herbages. The CT-content is in general close to 0% in most grasses, around 5% in some temperate fodder legumes and up to 40% in some tropical browse plants. The relevant leguminous forages in temperate regions include greater trefoil (*Lotus pedunculatus*), birdsfoot trefoil (*Lotus corniculatus*), sulla (*Hedysarum coronarium*), sainfoin (*Onobrychus viciifolia*) and dock (*Rumex obtusifolius*). In other regions of the world, sorghum, cottonseed, quebracho, grape seed and, Faba-bean may be relevant. In most species, it is evident that the CT-content varies considerably with cultivar, soil, year, season etc.

Studies in UK using a model CT (quebracho) in the diet have confirmed this effect in *Trichostrongylus colubriformis* infections. Quebracho used as a drench (8% of DM intake for 7 days) resulted in 30% reduction in established *T. colubriformis* burdens (Athanasidou *et al.,* 2000a). Adding quebracho to the diet (3.4 to 6.8% in DM) gave 58 to 65% reduction in *T. colubriformis* establishment (Athanasidou *et al.,* 2000b) while quebracho (5% of diet) in a low protein diet reduced faecal egg counts of *T. colubriformis* by 50% (Butter *et al.,* 2000). *In vitro* studies using the larval development assay have indicated a direct effect of purified condensed tannins on preparasitic stages of ovine nematodes (Kahiya *et al.,* 1999).

Lambs that were artificially infected with *Ostertagia circumcincta* (2500 L3/day) and *T. vitrinus* (2500 L3/day) while grazing pure stands of sulla and sainfoin for 5½ weeks have shown a 50% reduction in mean nematode faecal egg counts and 34% reduction in worm counts compared to a reference diet of white clover (Thamsborg *et al.,* 2002). Auto-infection was avoided by repeated moves to clean forages. A Swedish study in lambs found no effect on mixed infections of 15% *Lotus corniculatus* in the diet compared to white clover (CT 0.1% of DM intake) (Bernes *et al.,* 2000). Although a very low proportion of birdsfoot trefoil was used, the study is in accordance with other studies showing no effect of this legume. However, grazing lambs on pastures with *Lotus corniculatus* in Wales over a whole season have resulted in lower faecal egg counts (C. Marley, personal comm., 2000).

The following problems and tasks have to be addressed for a future, successful application of tanniferous forages in nematode control in temperate areas:

1. Species better suited to local conditions should be found – reliable production levels each year are needed. Sainfoin has a low productivity and a poor competitiveness with other legumes and grass, particularly in organic farming without herbicidal use. The seeds are expensive. Sulla, a Mediterranean plant, does not overwinter.
2. Seasonality of growth in relation to parasite epidemiology is important – can conserved feed be used?
3. The efficacy is relatively low. Knowledge of the mechanism of action may indicate ways of improving the efficacy. Selection of appropriate cultivars or growing conditions is needed.
4. A spectrum of activity in different ruminant species (cattle, goats) needs to be investigated.
5. The forages need to be integrated in other systems of control; most likely repeated moves or biological control.

Preliminary results with tanniferous forages in ruminants have been promising, but much work is needed before practical application. The implementation is governed by the seasonality of the forages and the epidemiology of the parasite infections. In monogastric animals (e.g. out-door pig production) tanniferous plants are not relevant and other options have to be investigated. Inulin-rich chicory (*Cichorium intybus*) cultivars may be relevant here, as diets with a high percentage of soluble fibre may lower establishment and fecundity of *Oesophagostomum* spp. (Petkevicius *et al.,* 1999). Chicory may also have a role to play in control of sheep nematodes but results so far have not been conclusive.

Biological control

The majority of research performed in the area of biological control has focussed on the use of nematophagous microfungi, in particular the species *Duddingtonia flagrans,* a normal inhabitant of sheep and cattle dung and compost. *D. flagrans* has been isolated in several countries around the world - both temperate and tropical. At present, the fungus is being produced in large scale in Denmark and Australia but it is only available for experimental purposes. The research work on *D. flagrans* has been reviewed extensively (Larsen, 2000) and only few selected issues will be presented here.

Like other nematode trapping fungi, *D. flagrans* forms 3-dimensional nets when it grows in the faeces. These nets catch and kill L1, L2 and L3 larvae. High numbers of larvae stimulate more net formation. A characteristic and important feature of this fungus is the formation of chlamydospores. The chlamydospores are able to survive the gut passage in most domestic species and if kept dry, they have a relatively long shelf life. Dose-titration studies have indicated that 100,000 - 1,000,000 spores per kg body weight fed to infected sheep result in a reduction in number of infective larvae by 70 to 95% (as determined by *in vitro* cultures). As an example, faeces with 400 eggs per g (epg) may result in about 360 L3 produced per g faeces but if fungal chlamydospores are mixed in the faeces, only 20-110 L3 are produced. Similar reduction percentages have been observed in plot studies with dung spread out on herbage. Faeces with eggs has to be deposited on the pasture together with the fungal spores, otherwise there is no effect. If eggs are deposited 2 weeks earlier than the spores (or vice versa), the herbage contamination will be similar to controls with no fungus application (Faedo *et al.,* 2000). It is, thus important that the fungus and eggs are applied at the same time and consequently, the fungal spores have to be fed on a daily basis (mixed in the supplementary feed or in a feed block) or dosed by a ruminal sustained release bolus, lasting for example 1-2 weeks. From a single large scale field study without *Haemonchus*, reductions in herbage contamination of 70 to 80% have been observed late in the grazing season when nematode infections were high (Githigia *et al.,* 1997).

To get a significant reduction of nematodes, the administration of the fungus in concentrate supplementation under group feeding conditions or in molasses blocks has to secure that the vast majority of the animals gets sufficient fungal material on a daily basis. The administration on a group basis seems to be more complicated in sheep compared to cattle, probably because sheep are more selective (unpublished data). This approach is truly preventive. If sheep are dosed with the fungus in the spring, e.g. the first 2½ months after turn-out, the overwintering infection will not be affected (e.g. *Nematodirus battus* infections). Overwintering infections will establish and persist in the animals similar to the untreated situation. However, the herbage contamination derived for the faecal egg output from ewes and lambs in these months will only to a very limited degree develop into infective larvae and thus, the dramatic 'mid-summer' rise will be largely avoided. This clear-cut picture, observed and documented in several studies in cattle, still needs to demonstrated in sheep.

In organic farming, the use of biological agents may be questioned because it can be considered as an external input to the system. A very important aspect is any possible environmental impact, like unwanted effects on soil nematodes and competition with other potentially beneficial fungi. Studies performed so far indicate no persistence of the fungus in the environment (which accords with no sustained effect on parasitic nematodes) and no detectable influence on the soil nematode fauna (Faedo *et al.,* 2002).

In summary, use of fungus as biological control seems to be within reach in the near future but several problems related to the administration of fungus have to be solved. Furthermore, the timing, length of dosing and relevant group treated have to be determined under different epidemiological and management conditions. Finally, the price of a commercial product is largely unknown and therefore cost-benefit analysis cannot be determined.

Conclusions

The control of gastrointestinal nematodes by "natural" means will inevitably result in larger parasite-associated production losses compared to control based on extensive use of chemotherapeutics, such as sustained release boluses with anthelmintics. However, non-chemical control aiming at avoiding clinical disease and heavy production losses may be feasible through:

- use of repeated moves to clean pastures;
- ensuring appropriate feeding at all times (supplementation if needed);
- stocking rates matching the carrying capacity of plant production.

Despite these efforts, in *Haemonchus* endemic areas it may be very difficult to achieve control without anthelmintic treatments.

At present, the following alternatives show some promise: nematophagous fungi, bioactive forages and breeding. More research is needed on methods of administration of the fungi and also the expected production benefits under practical conditions need to documented. The practical use of bioactive forages is, at present, hampered by a relatively low efficacy and unstable productivity of the legumes in question. Breeding animals for resistance is definitely feasible but requires a certain critical mass of livestock on a farm, and the necessary infrastructure for breeding value determinations and exchange of breeding material between farms.

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Pasture management and composition as a means of minimizing mineral disorders in organic livestock

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Introduction

The minerals that are essential for animal health are calcium (Ca), phosphorus (P), potassium (K), magnesium (Mg), nitrogen (N), sodium (Na) and sulphur (S). The trace elements that are essential for animal health are iron (Fe), manganese (Mn), copper (Cu), zinc (Zn), cobalt (Co), selenium (Se), iodine (I) and molybdenum (Mo). The trace element boron (B) is not essential for animal health but its absence can affect the survival of certain pasture species, in particular clover. This element will be included in the discussion for this reason.

In organic farming the main sources of minerals and trace elements for livestock is the soil itself and the waste materials from the farm which are recycled on to the pasture. The available mineral and trace element concentrations in the different soil types are dependent on the concentrations in the parent material and on the chemistry of the soil. In rare cases acute deficiency or toxicity may occur and remedial action may be complex and difficult. In the majority of cases good management practices can increase the supply of minerals and trace elements for livestock.

In this paper the effect of good management practices such as drainage, liming, building up the soil organic matter, grazing management, nutrient budgeting and the use of grass and herb mixtures in pastures on the mineral and trace element supply for livestock will be discussed.

The nutrient balance in the soil

In organic livestock farming soil fertility has a broad meaning. An adequate supply of plant nutrients is important. The balance between the different nutrients is equally important. The concentration of an individual nutrient in the soil can affect the uptake of another by the pasture herbage and ultimately cause chronic or acute deficiency in livestock. The ranges of major and trace elements in well balanced soil and pasture is shown in Table 1 and Table 2.

Table 1. Ranges of major nutrients in soil and herbage of organic grassland

Major nutrients	Soil concentration (mg/kg)	Herbage concentration (%)
Nitrogen (NO3)	80-150	2.5-5.0
Phosphorus (P)	4-9	0.25-0.50
Potassium (K)	70-150	2.5-4.0
Magnesium (Mg)	80-200	0.11-0.30
Calcium (Ca)		0.50-1.45
Sulphur (S)	25-40	0.17-0.30
Sodium (Na)		0.15-0.65

The soil concentrations of major nutrients and trace elements are given as available levels (Byrne, 1979). Herbage values are given as total concentrations. In Table 1 soil values for Ca and Na are not given. Ca availability is dependent on soil pH. Na concentrations are affected by rainfall and proximity to the sea.

In Table 2 soil values for Fe, Se and I are not given. As with Ca soil values for Fe bear little relationship to the herbage values. Se and I are easily leached and the soil concentrations are reduced by rainfall. I values are also affected by proximity to the sea.

Table 2. Ranges of trace elements in the soil and herbage of organic grassland

Trace element	Soil concentration (mg/kg)	Herbage concentration (mg/kg)
Iron (Fe)		50-150
Manganese (Mn)	50-250	25-250
Copper (Cu)	5-8	7-9
Zinc (Zn)	2-10	20-60
Cobalt (Co)	3-10	0.05-0.15
Selenium (Se)		0.03-0.30
Iodine (I)		0.08-0.30
Molybdenum (Mo)	1-2	2.0-5.0
Boron (B)	0.8-1.5	2.0-10.0

Drainage

Free draining sandy or gravelly soils are low in trace elements. The low status of these soils is associated with a low clay, oxide and organic matter content rather than with the leaching of trace elements from the soil profile (Shuman, 1979; McLaren & Crawford, 1973.). These soil constituents contain important sites onto which the trace elements are bound. The exceptions are Se, I and B. These are relatively easily leached by rainfall. Application of farmyard manure and inclusion of species containing high concentrations of trace elements in the pasture can increase the supply of trace elements to grazing livestock.

Poorly drained soils affect the trace element supply to livestock in two ways. Firstly, poor drainage can increase the concentrations of some trace elements in soil and in pasture species (Mitchell *et al.,* 1957; Mitchell, 1960; Kobota *et al.,* 1963; Walsh and Fleming, 1978). Secondly, poor drainage can increase soil ingestion by livestock and this can lead to induced deficiency of Cu.

Table 3 combines the data of the above authors to show the effect of poor drainage on the herbage concentrations of Fe, Mn, Co, Cu, Zn and Mo in perennial ryegrass, cocksfoot and red clover. Of the six trace elements shown in Table 3 only Zn was unaffected by drainage. High Mo and Fe can induce Cu deficiency in livestock. Many soils contain high Fe concentrations and special attention should be paid to drainage improvement in these soils. High Mo is less common in soils but causes induced Cu deficiency more readily than Fe. Good drainage is essential in soils with high Mo so as to reduce the risk of this disorder in livestock. The effect of soil ingestion on animal health is discussed below.

Table 3. Effect of drainage on trace element concentrations in herbage

Species	Drainage	Fe	Mn	Co	Cu	Zn	Mo
Perennial ryegrass	Poor	47	80	1.07	3.2	21	1.1
Perennial ryegrass	Good	34	58	0.15	2.6	25	1.0
Cocksfoot	Poor		113	0.73	4.8	18	1.4
Cocksfoot	Good		60	0.13	4.3	22	1.2
Red clover	Poor	78	73	0.93	10.2	37	2.8
Red clover	Good	49	59	0.13	8.9	35	1.5

Grazing management

An investigation by McGrath et al. (1982) showed that sheep could ingest up to 400g/kg body weight between May and early November. Soil ingestion was greater at high stocking rate (3 LSU/ha) on loam soil than at low stocking rate (1.6 LSU/ha) on sandy loam. Soil intake in May and October was greater than during the four months of June to September combined. Total Fe in the sandy loam and loam soil was 1.5% and 2.4% respectively. Total Cu was 9 and 15 mg/kg respectively. Assuming a feed intake/LSU of 8 kg DM/day, the amount of elemental Fe ingested by the sheep was calculated and is shown in Table 4.

In the case of the loam soil the amount of elemental Fe ingested over the six month period of the experiment was 4.2 kg at the low stocking rate and 7.8 kg at the high stocking rate compared with 2.63 g and 5.05 g Cu at the low and high stocking rate respectively. In the sandy loam the amount of Fe ingested at the low and high stocking rate was 1.7 kg and 2.5 kg respectively. At least 50% of the Fe was ingested in the first and last month of the grazing period. Soil ingestion was highest in wet weather. It is unlikely that all of the Fe ingested was retained within the bodies of the animals. Most was undoubtedly excreted. Never the less such a high rate of Fe ingestion constitutes a high risk of induced Cu deficiency (Jarvis and Austin, 1983). The above data suggests that soil ingestion can be minimized by using low stocking rates and removing the sheep from the pasture in wet weather especially in the case of soils that are low in Cu. Feeding silage or hay in portable feeders in the field during wet weather also reduces the risk of induced Cu deficiency.

Table 4. Elemental iron ingestion by sheep in a loam and sandy loam (Fe ingested per month (g)).

Stocking rate (LSU/ha)	Soil type	May	June	July	August	Sept.	Oct.	Total
1.6	Sandy loam	252	144	144	216	288	647	1691
2.0	Loam	1612	461	345	345	576	863	4202
2.3	Sandy loam	288	252	252	360	540	1151	2543
3.0	Loam	1381	863	806	979	1266	2533	7828

(McGrath *et al.,* 1982).

Lime application and soil pH

The soil pH affects the availability of trace elements for uptake by pasture species. Over time leaching by rainfall causes the soil pH to fall and this affects the balance of trace elements in the soil. The soil pH can be adjusted upwards by the application of lime. A soil pH of 6.5 is considered to be the optimum for a soil containing trace elements in well-balanced amounts. At soil pH values below 6.5 the availability of Mo and Se is reduced and the availability of Fe, Mn, Co, Zn and B is increased. Low soil Mo concentrations can lead to poor clover establishment (Anderson, 1956). Se deficiency can cause white muscle disease and retained afterbirth in livestock. At low soil pH Yorkshire fog, crested dogtail and bent grasses assume dominance over other grass species. Yorkshire fog can accumulate high concentrations of Mo compared with other grasses thus increasing the risk of induced Cu deficiency in livestock (Fleming, 1965). At soil pH values above 6.5 the availability of Fe, Mn, Co, Zn and B is reduced and that of Mo and Se is increased (Fleming, 1965; Mitchell, 1960).

Soils that are high in Mo and Se should be limed to a pH which does not exceed 6.0 to reduce the risk of induced Cu deficiency or Se toxicity in livestock. The pH of soils which are low in Mn, Co, Zn and B should not be allowed to exceed 6.0. Over-liming of soils low in Co can result in Co deficiency and ill thrift in sheep. A high soil pH can also causes B deficiency. B deficiency results in poor establishment of clover (Kehoe, 1981). In organic grassland the presence of clover is essential for the provision of N. Severe Zn deficiency results in poor pasture growth. The poor growth is due in part to poor utilization of N within the plant when Zn is low (Mac Naeidhe, 1991).

Soil organic matter

Organic matter (humus) is an important constituent of every soil because it is the most chemically and biologically active of all the soil phases. It is of particular importance in organic farming because the farmer is dependent on inherent soil properties to support crop and livestock growth. In the early years of the last century before the advent of manufactured fertilizers the importance of organic matter in successful farming was widely recognized.

For this reason the scientific publications on soil organic matter from this period are numerous. Buckman and Brady (1969) have summarized some of the beneficial effects of soil organic matter as follows:

1) Improves soil structure.
2) Improves the water holding capacity of a soil.
3) Adsorbs from 2 to 30 times as many cations as other active soil phases.
4) Depending on content accounts for 30 to 90% of the adsorption power of mineral soils.
5) Improves the ease of interchange of plant nutrients with soils.
6) Can extract plant nutrients from the mineral phases of the soil.

The organic matter content of a soil is dependent on climate and soil type. In wet temperate regions soil organic matter is high. In arid regions soil organic matter is low. In heavy clay soils the organic matter tends to be high. In light, sandy or gravelly soils organic matter is usually low. The range of values across regions and soil types varies from less than 1% to over 15%. Values above 15% indicate poor drainage. At soil organic matter values greater than 20% soils are classified as peat soils. Intensive cultivation and liming causes a reduction in soil organic matter. Soil organic matter content is greater under permanent grassland than in arable land.

Soil organic matter is strongly associated with the transfer of trace elements from the soil to the plant (Stevenson and Ardakani, 1972). Although trace elements may be fixed by the well decomposed organic materials such as the humic acids, the less well decomposed organic acids, polyphenols, amino acids, peptides, proteins and polysaccarides carry trace elements in loosely bound chelated form which are easily available to plants. From 98 to 99% of Cu, 84 to 99% of Mn and 75% of Zn are carried on organic complexes within the soil. It is clear from the above that practices that build up the organic matter in a soil will also increase the mineral and trace element supply to livestock. A low livestock density (1.0 to 1.5 LSU/ha) prevents over grazing and a reduction of organic matter input to the soil. The soil pH should be at 6.5 or slightly below. Adequate moisture supply should be available to pasture herbage. Over-drainage in pastureland should be avoided.

Nutrient budgeting and farmyard manure

Nutrient budgeting using farmyard manure (FYM) has been successfully used to supply the major nutrients (N, P and K) in adequate amounts to pasture (Mac Naeidhe, 1997; Watson and Stockdale, 1997). At the Johnstown Castle Experimental Farm and at a number of pilot farms in the south east and north midlands of Ireland the tonnage of FYM required to replace nutrient offtakes by silage and losses through leaching and volatilization has been calculated. The calculation was carried out by recording the silage dry matter yields and the nutrient content of the silage over a period of six years at each farm. The nutrient content of the FYM was also recorded and the tonnage of FYM applied was adjusted to replace the N, P and K removed by the silage. At the Johnstown Experimental Farm the average tonnage required over the six year period of the study was 18.3 T/ha. The mean silage dry matter yield at the farm was 5.28 t/ha.

The mineral and trace element contents of the silage and FYM are shown in Table 5.The nutrient inputs from the FYM and the offtakes by the silage are shown in Table 6.

Table 5. Mineral concentrations in farmyard manure and silage (g/tonne)

Source	Ca	Mg	Na	Mn	Cu	Zn	Mo
FYM	24685	5625	5625	9	2.61	22.1	0.49
Silage	14800	3500	4700	80	8.30	20.6	1.40

Table 6. The mean mineral inputs and offtakes in organic silage production

	Ca (kg/ha)	Mg (kg/ha)	Na (kg/ha)	Mn (g/ha)	Cu (g/ha)	Zn (g/ha)	Mo (g/ha)
Inputs	130.6	29.7	29.7	47.8	13.8	116.6	2.6
Offtakes	38.1	18.5	24.8	416.0	43.9	90.8	7.4
Balance	+ 92.5	+11.2	+4.9	- 368.2	-30.1	+25.8	-4.8

Table 6 shows that whereas the application of 18.3 tonnes of FYM was sufficient to replace the offtakes of Ca, Mg, Na and Zn there was a considerable shortfall of Mn and a small shortfall of Cu and Mo. The Mn, Cu and Mo concentrations were lower than those normally found in FYM (Atkinson *et al.,* 1954). The pasture from which the silage was made was predominantly a ryegrass sward with less than 10% clover. Further research is needed to test the effect of a larger amount of clover and other broad-leaved species in the sward on the Mn, Cu and Mo concentration in the manure.

Trace element concentrations in pasture species

Perennial ryegrass (Lolium perenne) responds well to fertilizer application. It is palatable to livestock and is a vigorous grower. No other grass species fulfills the above role in European agriculture so well. Its popularity as a pasture species was always high. When the use of manufactured fertilizers increased some decades ago its use increased further and it is now grown as a monoculture on many modern farms. Perennial ryegrass carries lower concentrations of several trace elements in its tissue compared with other pasture species.

The increasing incidence of trace element problems in livestock has been attributed to its use as a monoculture in modern pastures. The heavy applications of fertilizers used in modern intensive farming are also in part responsible for this problem. Reith *et al.* (1984) has shown that application of N causes a reduction in the herbage concentrations of Cu, Co and Mo in perennial ryegrass, cocksfoot (Dactylis glomerata) and red clover (Trifolium pratense). Fleming (1987) found similar results with Cu, Se and Mo in ryegrass and clover.

Rough stalked meadow grass (Poa pratensis) contains higher concentrations of Fe, Mn, Cu, Co and Mo. Cocksfoot contains higher concentrations of Mn, Cu, Co and Mo. Italian ryegrass (Lolium multiflorum), crested dogtail (Cynosurus cristatus), timothy (Phleum pratense) and meadow fescue (Festuca pratensis) are generally low in trace elements. Red and white clover (Trifolium repens) have higher concentrations of Fe, Cu, Zn, Co and Mo than perennial ryegrass. Broadleaved species that survive well in pasture are buttercup (Ranunculus acris), cat's ear (Hypochoeris radicata), ribworth plantain (Plantago lanceolata), yellow rattle (Rhinanthus minor) and sorrel (Rumex acetocella). All have high concentrations of Cu compared with perennial ryegrass.

The inclusion of grass and herb species with high concentrations of trace elements in pasture can increase the intake of trace elements in livestock. In particular rough stalked meadow grass and clover have high trace element concentrations and should be included in grass seed mixtures.

Stage of maturity and time of year can have an effect on the concentrations of trace elements in pasture species. Numerous papers have been written on this subject but the results are difficult to summarize due to the different conditions under which the experiments were carried out, the different dates on which the yields were recorded and the different locations of the experiments. Much of the data suggests that the concentration of Fe, B, Cu, Zn and Mo are high in April and May when pasture is growing vigorously. This is not surprising.

Trace elements are most active in young growth in spring and concentrations are high in the young tissue during this period. Concentrations of Fe, Cu and Zn fall slightly in June and reach a peak again in September and October. Data from Fleming shows herbage molybdenum falling gradually as the season progresses, but Jarvis and Austin (1983) found that molybdenum reached a peak in herbage in July and August. Herbage Mn concentrations fall gradually as the season progresses. Herbage Se increases as the season progresses.

The concentration of different trace elements in various pasture species is shown in Table 7. The data is taken from many sources including some not yet published. Among the nine trace elements listed perennial ryegrass has the highest concentration of I.

Table 7. Trace element concentrations in pasture species

Species	Fe	Mn	Cu	Zn	Co	Se	I	Mo
Perennial Ryegrass	55	87	5.0	23	0.05	0.01	1.46	0.31
Meadow grass	153	119	12.3	16	0.06		0.14	0.59
Italian Ryegrass	148	65	4.3	11	0.05		0.85	0.29
Crested Dogtail	109	78	5.9	28	0.03		0.07	0.62
Timothy	34	97	5.5	24	0.04			0.35
Cocksfoot	53	252	8.1	24	0.07	0.01	0.17	0.45
Red Clover	74	74	11.9	31	0.11	0.01	0.40	0.35
White Clover	88	87	8.4	28	0.10	0.01	0.91	0.41
Meadow Fescue	295	29	4.3	22	0.03			0.34
Cat's Ear			18.2					
Ribworth Plantain			17.3					
Sorrel			10.8					
Buttercup			16.6					
Rhinanthus			13.0					

Conclusions

The data presented in this paper shows that an appropriate balance among the major nutrients and trace elements is important in providing adequate trace element for the health and welfare of organic livestock. Maintaining the correct balance is more difficult in organic farming because the regulations do not permit the use of manufactured fertilizers for correcting such an imbalance except in extreme situations.

A high level of management skill is needed to put an effective system of actions in place that will ensure an adequate supply of trace elements for livestock. Most of the actions are interdependent and interrelated and the effect of each action on the other must be carefully assessed so as to ensure a balance and to avoid extremes. Further research is needed to quantify more precisely the combined effects of these actions on the trace element supply.

Soil organic matter has the capacity to supply by far the largest amount of easily available trace elements to livestock. It is important to create the conditions that promote the build up of organic matter to the optimum level. This can be achieved by using a low stocking rate so that damage to pasture does not occur, by keeping the correct moisture levels in the soil and maintaining the correct pH. This may require action on land drainage and lime application. A low stocking rate also reduces the risk of high soil ingestion and induced Cu deficiency. Liming to the correct soil pH avoids deficiencies of Fe, Mn, B, Zn and Co and toxicity of Mo and Se.

An efficient drainage system is necessary to correct high soil moisture when rainfall is high. High soil moisture increases soil concentrations of Fe and Mo. High Fe and Mo can cause induced Cu deficiency in livestock. With an efficient drainage system soil moisture will decline during dry weather. Low soil moisture causes the depletion of soil organic matter. Trace element uptake from a dry soil is also restricted. Various measures can be taken to control moisture loss in dry weather. These include the use of dams, sluices and sub-irrigation through existing drainage canals (Lucas, 1982).

Additional investigations on the effect of water table, stocking rate and lime application on soil organic matter and trace element supply are necessary. Recycling of farmyard manure on to silage land can restore the input/output balance of trace elements in pasture with the possible exception of Mn.

As the Cu and Mo are also slightly low investigations in raising the trace element concentrations of the manure by including trace element rich pasture species needs investigation. Clover in particular has high trace element concentrations compared with most of the grass species. Many of the broad leaved species are high in Cu and Se (Fleming, 1965). Some survive well in competition with pasture grasses. The effect of those that do on the concentration of trace elements in livestock when included at different seeding ratios in pasture should be investigated.

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Preventive measures for animal health and practical means for management support on organic dairy farms in the Netherlands

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Introduction

Farmers' motives to take measures to prevent animals getting sick depend on a variety of reasons: national or organic rules and agreements (some measures are in laws and regulations), the effects on animal welfare (some diseases are very painful, others are not), the ease to take the necessary measures (does it cost much labour, is it simple), the availability of information (urea, SCC, scoring systems, bacterial determination), the effect on production (clinical mastitis cost more milk than not coming in heat again at 50 days), the effects on economics (some measurements cost a lot of effort), the interests and ideas (attitude) of the farmer (what place does the animal and animal health have in the total farm design) and the effect on image of dairy farming (some farmers care and some do not).

In 1997, the research project Bioveem started on five organic dairy farms on sandy soil and was expended in 1998 with five farms on peat, clay and clay/pat soil. The research objectives were related to soil fertility, fertilisation, grassland management, crop rotation, feeding and animal health. The overall objective was to monitor, demonstrate and develop systems for sustainable organic dairy farming, both in economical and ecological way.

For the components of animal health, data were collected on calvings, cullings, inseminations/matings, diseases and treatments (diagnosed by the veterinarian or the farmer and recorded by the farmer) and body condition score (BCS) by the farmer. The dairy factory recorded somatic cell count in bulk milk (SCCB) every month. Somatic cell counts of individual cows (SCCI) were collected every four weeks by a specialised laboratory (Melkcontrolestation Nederland), individual milk yield, individual quarter milk samples for bacterial determination and for somatic cell count (SCCQ) and urea in bulk milk. During two housing periods, in three periods of one week each, average feed intake of the cows was determinated by weighting all feed supplied and feed refusals. Teat end callosity was determined at four farms according to Neijenhuis et al. (2000) and locomotion was scored on four farms according to Manson & Leaver (1998). All data were collected in an Access database.

Results

An overview of the farms is given in Table 1. The farms differ in number of cows, total area, in breed and housing system. Some farmers were very experienced in organic farming (at the start of the project, five years or more of organic mangement) while some others had just converted to organic farming. The intensity of the farms varied from 5,200 to 11,200 kg milk per ha and from an average milk yield per cow per year from 5,500 to 11,500 kg. Housing conditions varied from a stanchion barn, two straw yards to seven cubicle stalls. Most farms used 100% HF, farm number 4 uses crossbreeds of Dutch Red&White with Montbeliard and farm number 9 uses crossbreeds with Flechvieh and Simmental. The average age of cows varied between 4 years and 4 months and 5 years and 10 months. The ration for the dairy cows during the housing period (October to April) consisted of wilted grass/clover silage, maize silage and concentrates. A limited number of farms used a greater variety of foodstuffs (fodderbeet, potatoes, and whole plant silage).

On average 76 % of winter ration for dairy cows was roughage. Between April and October cows were grazed on grass/clover and supplemented by some concentrates depending on the yield. Farm number 8 grazed the cows only in daytime. All cows were milked in a herringbone milking parlour. The mean efficiency of feeding, given as input of energy and protein as percentage of output, was 108% and 113% respectively. The mean efficiency of N-conversion from feed into milk was 25% and varied from 21% to 35%.

Table 1. Overview of the BIOVEEM-farms and average figures about production, intensity, rations, efficiency of feeding and mean cumulative incidence per year in the period 1998-2000

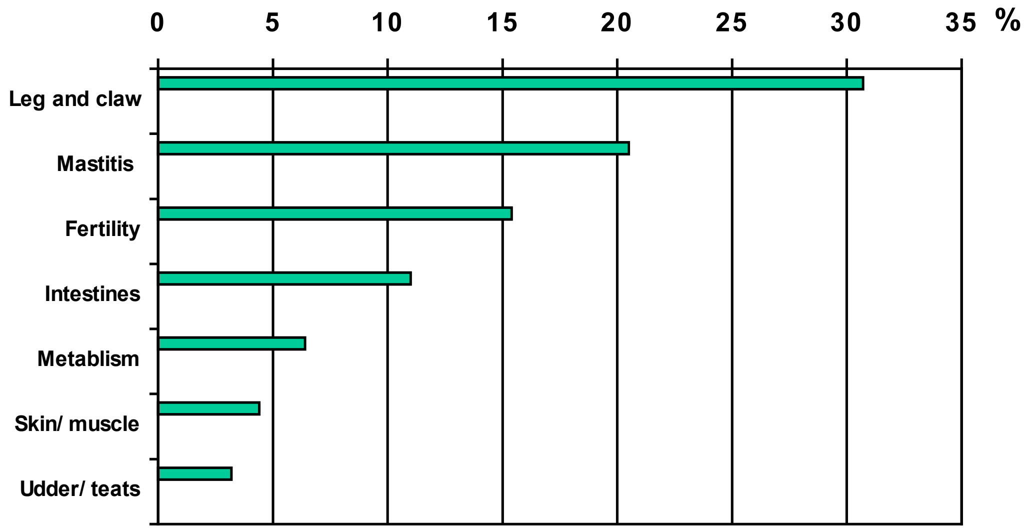
Farm	1	3	4	5	6	7	8	9	10	11
Soil type	peat	sand	clay on peat	clay on peat	sand	clay	sand	sand	sand	sand
Organic since	1998	1993	1990	1994	1994	1998	1994	1989	1999	1989
Total area (ha)	25	36	54	62	34	38	45	43	54	31
Productive grassland	24	27	32	48	34	25	28	25	37	24
Nature grassland (ha)	1	0	18	14	0	10	8	5	0	7
Arable land (ha)	0	9	4	0	0	4	9	13	17	0
Housing type	cub	cub	s.y. [1]	cub	cub	cub	cub	s.y.	cub	Stan
Type of cows	HF	MRIJ	MRIJ/ MON	HF	HF	HF	HF	SIM/ FI	HF	HF
Number of cows	40	60	60	80	45	35	60	50	65	40
Average age (y.m)	5.03	5.04	5.10	5.10	5.00	4.04	5.00	5.04	4.06	4.06
Milk quotum (tons)	275	400	313	450	310	260	470	283	493	350
Milk quotum (kg/ ha)	11300	11100	5200	10000	8800	6300	9800	6000	9800	11300
Average milk yield	7800	6600	6000	6900	7900	7500	7500	5500	7800	10000
Ration in winter period										
Grass/clover silage,%	66	60[2]	75	69	65	72	54	85	51	37
Mais silage, %	7	14		10	8	7	4		21	16
Whole plant silage, %		8	5				15		4	
Potato / fodderbeet, %							6			17
Compound feed, %	27	18	20	21	27	21	21	15	24	30
Mean Energy (VEM)	890	860	860	870	910	870	860	840	920	960
Mean CP in diet (gr)	162	142	156	153	150	147	154	152	145	144
Intake as % of output										
Energy	116	112	101	117	106	104	110	110	111	102
Protein	123	105	117	133	113	109	112	112	115	87
N-efficiency, %	22	26	24	21	28	26	24	23	25	35
Urea (mg/100 gr)	30	23	32	26	23	28	26	31	24	
Mean cumulative incidence per year										
Fertility	11	5	1		13	12	26	5		14
Mastitis	25	31	15		18	10	16	3		17
Leg/claw problems	33	20	17		22	45	26	7		9
Metabolic disorders	7	5	3		20	4	3	13		4
Intestines problems	8	3	2		1	4	4	4		5
Udder/teats problems	4	7	6		4	1	1	0		3
Farm	1	3	4	5	6	7	8	9	10	11

[1]) cub = cubicle barn; stan = stanchion barn; s.y. = straw yard can be either a pit (farm 9) or a hill (farm 4)
[2]) Including alfalfa silage.

Relative importance of diseases and disorders

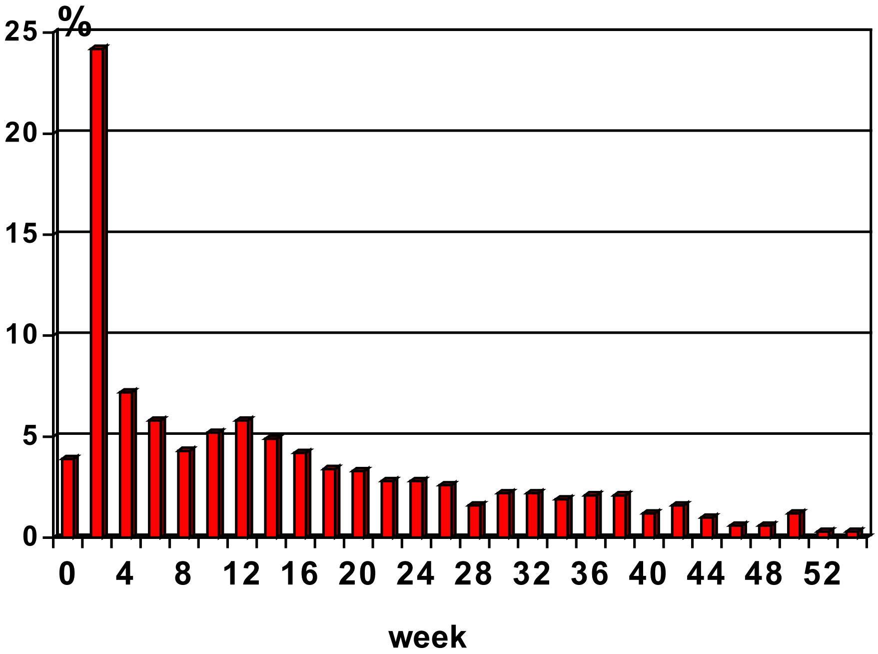
Fertility, mastitis and leg/claw problems were the main health disorders on the farms. These problems occurred on all farms, but in a different incidence rate. The relative importance of diseases on the farms is given in Figure 1. It shows the percentage of clinical diseases per group of diseases and disorders over the years. The most frequent problems were leg and claw problems, clinical mastitis and fertility problems. The impact on animal welfare, the difficulty of taking the necessary precautions and the effect on economics of these groups of diseases and disorders were large and will be discussed further on.

Figure 1. Percentage of clinical diseases per group of diseases and disorders over the years.



Metabolic problems amounted for 7% and intestinal problems made up for 11% of all diseases in dairy cows. Metabolic problems can be very fierce but mostly short (milk fever, acetonemy). Metabolic disorders were a major problem on two farms. Preventive measures consisted of adequate feeding in the dry period (feeding dry cows inside during the grazing period), reducing of stress pre and post calving and providing a ration that matches the demands of the cow after calving. Farms number 6 (most problems in autumn) and farm number 9 (most problems start at the housing period) did not succeed in the necessary measures. Measures preventing intestinal problems (diarrhoea, abomasal dislocation, off-feed, bloat) must be found in a combination of feeding and stress at calving and feeding healthy foodstuffs in the right proportions. Farms with a high amount of clover in the sward feed fibrous foods around milking to prevent bloat. In Figure 2 the course of diseases per week is given as a percentage of all diseases during the lactation. The period between 2 weeks pre-partum till 4 weeks post-partum counts for about 35% of the diseases in the entire lactation with a concentration in the first two weeks post-partum.

Figure 2. Percentage of diseases during the lactation (period 0 is 2 weeks pre-partum to calving)



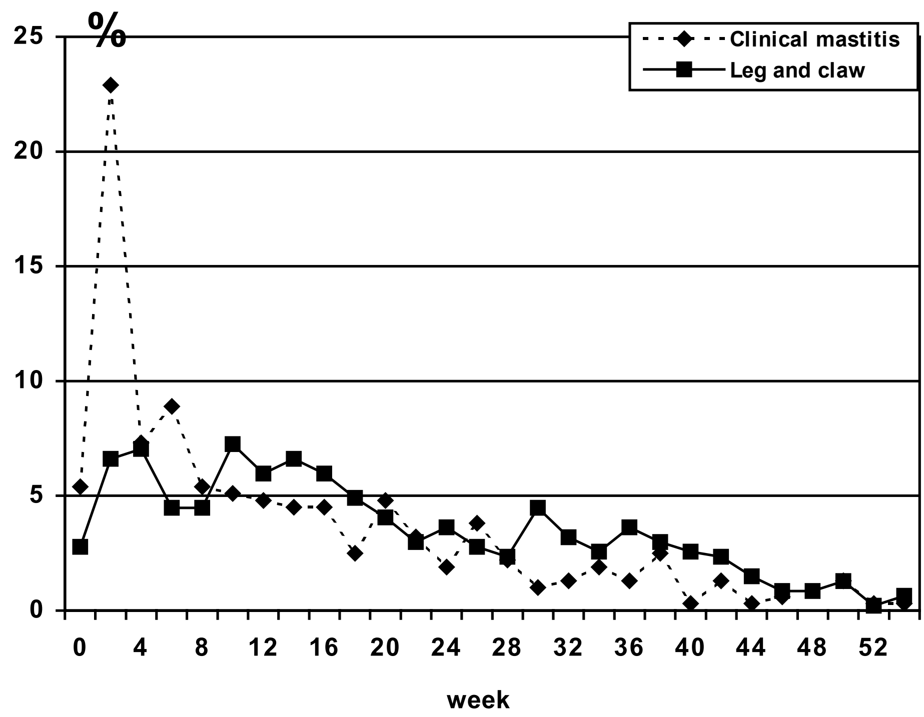
Claw and leg problems

Claw and leg problems counted for more than 30% of all diseases and disorders in dairy cows on the farms in this project (see Figure 1). In Figure 3 it is shown that, in contrast to clinical mastitis, claw and leg problems occur during the whole lactation. The 5 most frequent clinical claw problems on the farms are given in Table 2. Dermatitis digitalis (Mortellaro's disease) scores highest in all three years with pododermatitis as the second. The incidence of heel horn erosion is relatively low; it might be that more cows were affected but cows did not go lame (no clinical signs). Laminitis is relatively high on farm number 4 in autumn, possibly due to a very high protein content in the grass/clover diet. The farmer supplements the grass/clover diet now with feeds rich in energy and poor in protein.

Table 2. Percentage of cows with claw problems in the period 1998 - 2000

Disorder	*%*
Dermatitis digitalis	29.7
Pododermatitis	18.3
Laminitis	13.2
Phlegmona interdigitalis	9.2
Heel horn erosion	3.2

Figure 3. Percentage of claw/leg problems and clinical mastitis during 4 weeks periods in the lactation (period 0 is 2 weeks pre-partum to calving)



Claw and leg problems have great impact on animal welfare for they are mostly very painful (cows go lame) and some do have long recovery periods. As part of good preventive management it is necessary to diagnose the disease or disorder and record it together with the treatment used and the effect of treatment. Another less time-consuming measure is the locomotion score (see Table 3) where the cow is judged while walking. The score ranges from 1 to 5, going up by half a point, were 1 = perfect and 5 = crippled. The results of this score showed that a greater proportion of the cows housed in straw yards walked perfect or tender than those housed in cubicle housing. The incidence of claw problems in the two farms with a straw yard was relatively low (see Table 1).

Table 3. Locomotion scoring at 4 organic dairy farms shiwn in percentage (Manson & Leaver, 1988)

Farm	*Housing*	*Locomotion score*				
		1	*1.5*	*2*	*2.5*	*> 2.5*
4	Straw yard	40	44	12	4	0
9	Straw yard	46	46	5		2
8	Cubicles	30	51	11	3	5
6	Cubicles	16	42	26	7	9

The most effective prevention measures of claw problems are dry and clean housing conditions (Bagai, 1996; Webster, 2001), and if necessary, combined with routine pedicure at drying off and at 3 month in-lactation. Additional important factors are: elimination of obstacles and uneven slatted floors, provision of a regular footbath, taking care of feeding protein and healthy foodstuffs especially in the first month in lactation (Ward, 2001). Effective treatment of contagious claw problems (*heel horn erosion, dermatitis digitalis and phlegmona interdigitalis)* has also an effect in reducing spread of the infection. Especially *dermatitis digitalis,* a frequent disorder on farms number 5 and 8, treated with copper sulfate as spray and with lincomycine in the footbath (off label use), was hard to beat. Both farms sometimes purchased heifers or cows and stated they introduced the infection. Other farms used formaldehyde as a detergent in the footbath. Prevention by selection in cows and in breeding bulls is another starting point to reduce the incidence of claw and leg problems. Some farmers select breeding bulls in the first place on the figures for leg/claw conformation and in the second place on milk parameters.

Farmers hesitate to take measures if inadequate housing happens to be the main reason for problems even if they underline the importance of housing in this respect. Changing the housing system, replacing slippery floors, breaking complete walls away do have a great impact on the farm and economics plays an important role. Besides that, rules for animal welfare sometime conflict with rules for environment (prevention of nitrogen emission from stables) in the Netherlands. In the new system for judging sustainability of dairy farms, the demands for environment, animal health and welfare are combined (CLM, 1999).

Mastitis

Clinical mastitis counted for about 20% of all diseases. In Figure 3 it shows that in periods 0 to 4 (from 2 weeks pre-partum till 4 weeks post-partum) cows are very susceptible for clinical mastitis. Beside the age of the cows also the lactation curves of the cows differ between farms quite remarkably. In Figure 4 the lactation curves of 4 specific farms are given for the heifers, the second calvers and for the older cows. On farm 4 there is no curve but a nearly linear decline in milk production. Farm number 3 shows a smooth curve, mainly in the older cows. The curves on the farms 8 and 11 show curves for all parities with a very high peak at about 8 weeks and a steep decline on farm number 11.

In Figure 5 trends in BCS on three farms areshown (farm number 4 is very similar to the curve of farm number 8). It is shown that cows on farm 3 did not decline in body condition. They were able to meet the demands for milk production, or may be, protect themselves against a negative energy balance. The high mastitis rate on this farm must have had other reasons. The cows on farm 8 also appear to meet the requirements for production although the BCS at the end of the lactation could have been better. Cows at farm 11 could not meet the requirements and tended to loose body condition, especially in the first 2 month and also in the latest part of lactation. On farm 11 relatively large problems occur with mastitis (and fertility).

Figure 4. Mean lactation curves from cows in first lactation (lacnr1) and second lactation (lacnr2) parity and older cows (lacnr>2) on 4 farms, in two weeks periods.

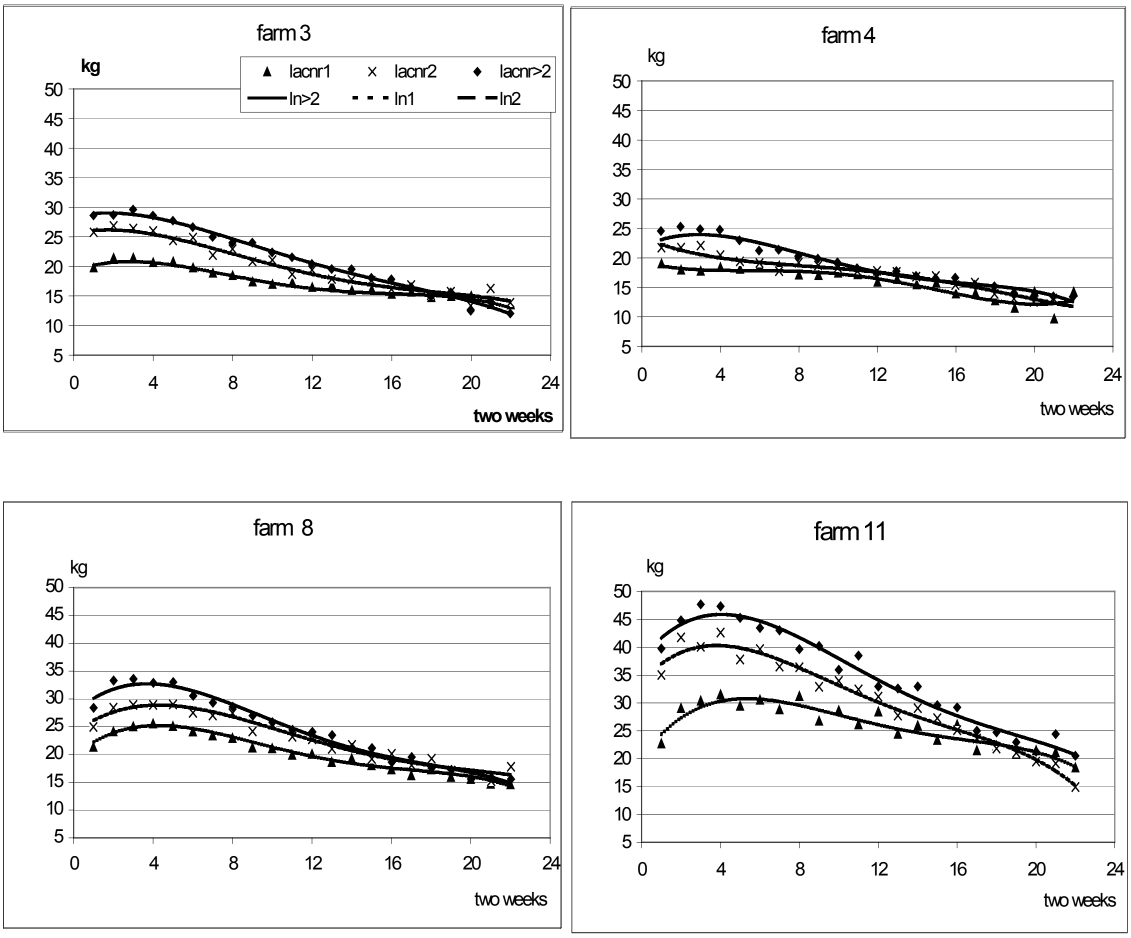
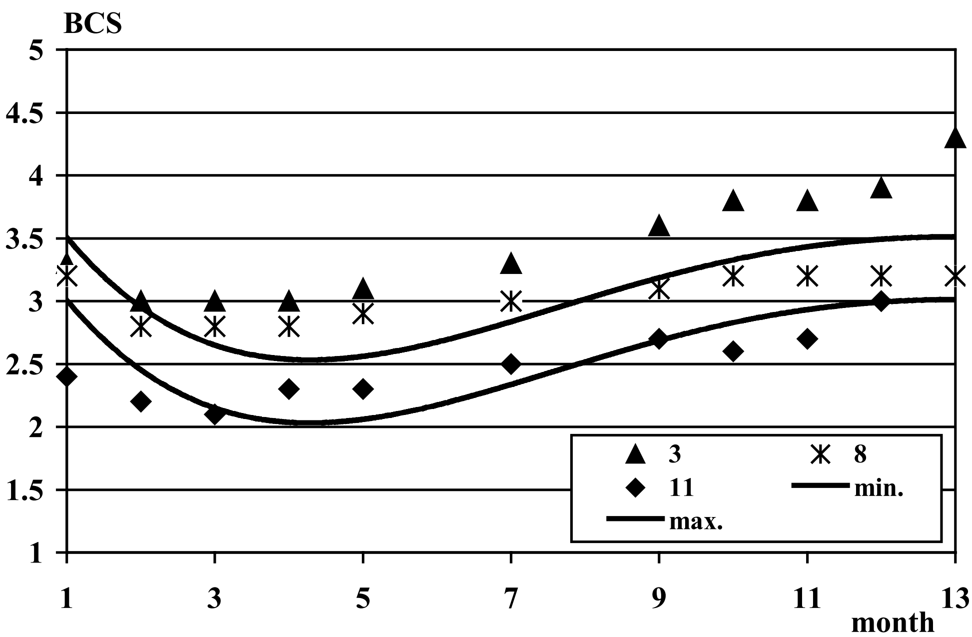


Figure 5. Course of body condition score (BCS) during lactation, related to the desired score (minimum and maximum)



The way clinical mastitis was treated differed among farms. For instance, farms 4 and 9 only as a last resort used antibiotics and treated cows by Ryki (farm 9) or massage with peppermint oil. Farms in conversion or recently converted and farm 11 used antibiotics as they were used to do, and farms 3, 5, 6 and 8 tried to limit the use of antibiotics and sometimes they used homeopathic or fythopatic means. Few farmers knew the kind of bacteria on their farms. Farm number 4 got five times a penalty for high SCCB, and two other farms received one penalty each during the entire project. Some farms used limestone or ground stonemeal in cubicles to get a dry surface and to limit the number of bacteria in case of lying out milk. Some farmers consequently milked infected cows last, used a new towel for every cow in the milking parlour and some used teat spray or dip after milking. On a number of farms cows were not allowed to lie down for one and a half hour post milking and were confined to the feeding passage.

Table 4 shows the SCCI in the last milk sample before drying off and the first sample post-partum as an average of all farms and of 4 individual farms. The total mean SCCI in the first sample after calving was 208,000 cells/ml. 32% of the cows had a SCCI less than 100,000 in the last sample before drying off, 40% of all cows had a SCCI between 100,000 and 250,000 and 28% of all cows had a SCCI over 250,000 cells/ml milk in the last sample before drying off.

Table 4. Mean SCCI in the first sample after calving per SCCI class before drying off (<100,000, 100,000-250,000 and >250,000 cells/ml) and per farm and the percentage of cows per class

Farm	***Class SCCI*1000 in last sample before drying off***						***Mean SCCI in first sample of subsequent lactation***
	<100		100-250		>250		
	%	cell	%	cell	%	cell	
All farms	32	128	40	212	28	318	208
3	50	107	32	191	18	240	153
4	24	260	47	336	29	670	402
8	28	208	41	301	31	362	292
11	31	128	39	151	30	98	126

The individual farms showed very different figures. 50% of the cows of farm 3 and only 24% of the cows of farm 4 had a SCCI below 100,000 before the dry off period. 18% and 29% of the cows respectively had a SCCI over 250,000 cells/ml. In the SCCI class over 250,000 cells/ml, after calving the SCCI on farm 3 was 240,000 and on farm 4 670,000 cells/ml. So the treatment of subclinical mastitis before the dry period (and limit in that way the number of bacteria) at farm 3 did have the intended effect, but on farm 4 it did not. In Table 5 the results of bacterial cultures are given. On farm number 4 milk samples were only taken because of serious problems with high SCCI. The farmer dislikes the use of antibiotics and was not convinced of the benefits of knowing bacteria cultures in case of alternative treatment. The knowledge about alternative strategies is still insufficient so perspectives are uncertain.

Table 5. Percentage of quarter milk samples per type of bacteria.

Farm	*N samples*	*Main reason*	*ECO*	*SUB*	*SAU*	*STC*	*SDY*	*HST*
3	385	Drying off	-	0.5	6.5	4.2	-	4.4
4	239	High SCCI	2.5	14.2	-	28.0	5.0	-
6	81	Mastitis	-	2.5	9.9	0.0	7.4	-
8	97	Mastitis	3.1	9.3	2.1	3.1	4.1	-

On farm 3, the incidence of clinical mastitis was high (30%) and the SCCB was increasing. Despite other preventive measures (check the milking machine and milking techniques, hygienic and fresh climate in stable, adequate feeding) too many cows had to be treated with antibiotics at drying off. During a one and a half-year period, all cows at drying off were sampled for bacterial determination. The results are given in Table 6. Antibiotics were restricted to cows with a SCCQ higher than 250,000 cells/ml and a positive bacterial determination. According to the figures shown in Table 4, it seems that the use of antibiotics lowered the SCCI in cows with high SCCI in the last milk sample before drying off.

Table 6. Number of milk samples at drying off and types of bacteria per cell count class (farm 3)

Cell count class	*Total*	*less than 100,000*	*100,001 t/m 250,000*	*more than 250,000*
Number of samples	74	35	23	16
Bacteria:				
Staphylococcus, not aureus	6	2	1	3
Staphylococcus aureus	5	-	2	3
Streptococcus (uberis/dysgalactiae	1	-	1	-
Staphylococcus Aureus/Agalactiae	2	2		
Total	14	4	4	6
Percent	19	11	17	37
No. cows with antibiotics at drying off	17	5	3	9

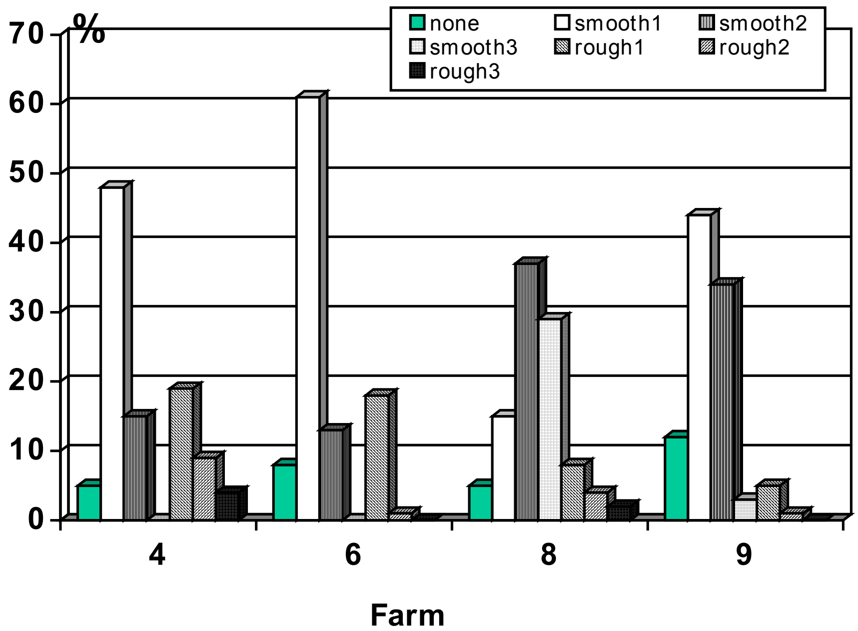
The latest ideas about SCCI of heifers is that it should be below 150,000 cells/ml in the first sample post-partum. Table 7 shows that none of the farms reaches an 80% score for that goal.

Table 7. Percentage of heifers with a SCCI < 150,000 cells/ml in the first sample post-partum (between 5 and 30 days) and average SCCB in 2000.

Farm	*1*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
% heifers	58	64	76	79	66	67	70	76	75	67
Average SCCB (2000)	119	169	597	105	329	202	345	198	99	220

A good instrument to judge the milking technique is a system developed by Nijenhuis *et al.* (2001) judging the callosity of teat ends. The teat ends are scored after milking for two types of abnormalities (a smooth callosity ring and a rough callosity ring, both varying from thin to thick or extreme). In Figure 6 an example of the results is given. As a result of these observations, at farms 4 and 8, with a high percentage in class smooth2 and smooth3 and rough2 and rough3, milking equipment and milk technique have been changed and resulted in a lower SCCB.

Figure 6. Callosity of teat ends on 4 farms



The reasons to take preventive measures to keep clinical mastitis rate low in most farms are economical reasons. If SCCB is too high, there will be a cut in milk price or a complete refusal of milk. Clinical mastitis also causes pain, but the recovery period is shorter than that with leg and claw problems. In some cases clinical mastitis has the threat of killing cows. One of the most obvious preventive measures is an annual check of the milking equipment and the milk technique. In addition, housing must be adequate so that other cows don't harm herdmates (on farm 3 sometimes herdmates injure other cows by stepping on teats and on farm 4 injuries at the udders occurred from horned cows, see Table 1, category udder/teats). Cubicles and straw yards must be clean. Keep the resistance of the cow at a proper level by minimising the negative energy balance around calving and stress and keep an eye on minerals, especially in the dry period and just after calving.

To limit the number of intra-mammary infections (clinical and subclinical mastitis) one should treat clinical mastitis, cull incurable cows and, if necessary, dip or spray. The ways in which preventive measures are taken depend on cause of the mastitis (bacteria species) and farm management concerning udder health. Each type of bacteria requires a different type of preventive management. Bacteria from the environment of the cow (stable, litter) as

Streptococcus uberis (SUB) and *Escherichia coli* (ECO) could be limited by taking hygienic measures. Bacteria which need the cow to survive as *Streptococcus agalactiae* (SAG), *Staphylococcus areus* (SAU) and *coagulase negative Staphylococcus* (STC) needs treatment of the cow. In the latest ideas, this division in two types of bacteria seems to fade away. Besides that there is a group of bacteria in between, they can survive in the cow as well as outside the udder (*Streptococcus dysgalactiae* (SDY) and *Arcanobaterium pyogenes* (APY). If no or limited amounts of antibiotics are used in dry cows, farmers should take other precautions to prevent cows from having mastitis.

Some tools to assist the farmer in optimising udder health are: recording of the clinical cases, the monthly SCC in bulk milk, individual SCC during milk production, recording and bacterial determination in milk from clinical and subclinical mastitis cows and judging callosity of teat ends. Measuring conductivity is not completely ready for practical use.

Fertility

Fertility problems count for 15% of all diseases. They mainly occur around calving (calving abnormalities, retained placenta, and endometritis) and in the second month after calving (onset to oestrus). As shown in Table 1, fertility problems were relatively high on farm 8, moderate on farm 11 and low on farms number 3, 4 and 5. Table 8 shows that metritis and retained placenta were the main fertility disorders. On farm 8 feeding met demands and BCS stayed at the same level during the entire lactation. In 1998, about 19% of the cows on this farm had endometritis. Another problem with fertility on this farm was that a large percentage of heats were missed. Question was whether the cow or the alertness or inspection of the farmer happened to be the problem. On farms 3, 4 and 9 feeding was in accordance with production and farmers were able to inseminate with more normal intervals between subsequent inseminations. on farm 11 demands for production were far greater than the nutrients offered (see Table 1). Delaying the time of the first insemination solved part of this problem. The experience was that most farmers were not so keen on a short calving interval.

Table 8. Percentage of cows with fertility disorders in the period 1998 - 2000.

Disorder	*%*
Metritis	5.1
Retained placenta	4.1
Not or not in time in heat	2.6
Endometritis	1.9

Preventive measures do have economic reasons. Most fertility problems (not or to late onset to oestrus after calving) are not painful and do not affect animal welfare. Prevention starts with the choice of bull, especially for heifers it is advise to use a bull that proved to "deliver easy". Prevention has also to do with the resistance of the cow, feeding management in the dry period and at calving (retained placenta) and matching the energy and protein demands after calving with an adequate food supply (onset to oestrus). Part of the prevention has to do with the alertness of the farmer (does he look for cows in heat) and with the floor condition (dare cows to show they are in heat). Measuring the activity of the cow, combined with temperature and milk yield, could be a helpful device in detecting heat. Most organic farmers, however, like it more the natural way.

Conclusions

The main diseases and disorders on organic farms are clinical mastitis, claw/leg problems and fertility. Awareness can be achieved by keeping records of problems and using the devices for management developed. Not all farmers do. Balance between the demands for production and the feeds offered is profitable for all three categories of disorders. So do measures for optimal housing conditions. The effects of preventive measures on animal health, welfare and economics are not always clear. Implementation of preventive measures depends on the attitude and knowledge of the farmer, the devices for management and the costs and labour to apply them.

Acknowledgements

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Pig health and health planning in organic herds in Austria

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Introduction

In Austria, out of 19,031 organic farms (9.4% of all Austrian farms) 7,147 (38%) keep pigs (BMLFUW, 2001). The average herd size is 4.9 pigs per farm. A total of 68% of the farmers have 1-2 pigs, only 6% have 10 or more pigs. These results indicate, that in Austria most of the pig producing organic farms keep pigs in small herds, mainly for private consumption and for on-farm-sales. Only 75 farms in total keep more than 50 pigs (Schneeberger *et al.,* 1997). A total of 7% of the organic pig producing farms produce half of the total number of organic pigs (Eder *et al.,* 2000). In the year 2000, about 13,000 slaughter pigs were sold from dealer organisations.

At the same time, there is a growing demand for organic pork by the Austrian consumers and for export. In this area, expectations of dealer organisations and consumers regarding husbandry, animal health and carcass quality are especially high. Therefore, it seemed appropriate for the association "Ernte für das Leben" to conduct a survey on the most important pig producing organic farms. The aim of this study was to collect data about *status quo* as a basis for hazard analysis and quality improvement programmes.

Materials and methods

Our field study included 84 organic farms, 48 with piglet production (20,1 sows/farm) and 51 with pig fattening (84 fatteners/farm), while 15 farms had both pig production and pig fattening. All farms were members of the association "Ernte für das Leben". Between 1999 and 2000 each farm was visited twice by a veterinarian. The farmers were interviewed by means of a questionnaire, which covered data about farm organisation, husbandry, feeding, management, hygiene and animal health. During clinical examination samples of faeces, skin scrapings and blood samples were taken. Faeces and skin scrapings were inspected for parasites, and blood (serum) was examined for Parvovirosis, Leptospirosis and PRRS (Porcine Reproductive and Respiratory Syndrome). Furthermore, a total of 1497 slaughter pigs from the study farms were monitored for the prevalence of organ lesions.

Results

Husbandry

All farms kept their pigs in adapted old buildings without air-conditioning and with continuous solid floors or partitially slatted floors. All farms provided straw for bedding and as manuable material. There was no farm with outdoor pig production. If existing (see Table 1), the outdoor runs had concrete floors and no roof.

Twenty-six out of 48 farms used crates in the period from 7 days before to 10 days after farrowing, which is permitted by the Austrian regulations. Well tried farrowing systems without confinement of the sow as the FAT pen or the Schmid pen were not common. Five piglet producing farms (10%) kept lactating sows and their litters in a multiple suckling system. On 29 out of 48 farms piglets were weaned at an age higher than 40 days. All pregnant sows were kept in group housing systems, mainly in 2-area pens with straw bedding and outdoor runs. Pens for rearing piglets and fattening pigs had continuous solid or partitially slatted floors; and in many pens lying area was inadequate compared to temperature demands of pigs.

Table 1. Percentage of farms with or without an outdoor run

	Outdoor run for all pigs	**Outdoor run not for all pigs**	**No outdoor run**
For pregnant sows *	69	29	2
For lactating sows *	-	15	85
For rearing piglets *	-	11	79
For fattening pigs **	82	12	6

* n=48 farms; ** n=51 farms

Feeding

On most farms. sows were fed twice a day. On more than 60% of the farms the animals were fed roughage, fresh or dry fodder or silage daily. Sixty % of the farms had only one diet for pregnant and lactating sows and no specific diet for weaning piglets (Zollitsch *et al.,* 2000). Therefore, diets for lactating sows and rearing piglets often were too low in energy, protein and lysine. Calcium (Ca) and phosphorus (P) levels were low in both the rearing pigs and lactating sow diets (Wagner *et al.,* 2001). Seventy-eight % of farms with fattening pigs had only one diet for the whole fattening period, 40% of the diets were too low in protein and lysine and more than 70% had insufficient Ca- and P-levels (Wagner *et al.,* 2000).

Management and hygiene

Fifteen out of 84 farms (18%) had both piglet production and pig fattening. All farms produced in a continuous-flow-system (no all-in-all-out production). Only few farmers had evaluable performance data about piglets weaned per year per sow, daily liveweight gain, feed consumption and nutritian efficiency (Table 2).

Table 2. Percentage of farms with specific measures for disease prevention and veterinary treatment

Treatment	**piglet production (n=48 farms)**	**pig fattening (n=51 farms)**
Evaluable performance data	15	6
Periodical samples of faeces	8	10
Periodical antiparasitic treatment	37	22
Periodical treatment against mange	15	8
Vaccination of sows	27	-
Vaccination against Mycoplasma	46	30
Homeopathy by farm veterinarian	31	18
Homeopathy by farmer	27	20
Member of an animal health service	65	47

On most of the farms investigated, pens were cleaned dry before next replacement, washing was done only in warm saisons, pressure washing was not common. Only few farms disinfected pens in regular intervals. Eleven farms fattened only piglets from the own unit, 12 finisher farms got piglets from one breeding farm but 28 finisher farms got piglets from 2 or more breeding farms. Unit clothes for visitors and staff were found only in 25% of the farms. Many farms had no adequate hospital pen and/or quarantine station.

About 50% of the farms were member of an animal health service. Homeopathy does not play an important role in veterinary treatment on organic farms with pig production. Only in few farms sows had been vaccinated (mainly against Erysipelothrix and Parvovirosis). Vaccination of piglets and fatteners against Mycoplasma was more common. Only few farms took samples of faeces in regular intervals for controlling the endoparasitic situation, but most of them treated pigs with chemically-synthesised antiparasitics in regular intervals (Table 2).

Animal health

More than 75% of the farms had pig herds with endoparasites in samples of faeces, taken during the farm visits (Table 3). In 2/3 of the farms with sows *Oesophagostumum spp.* were detected, *Ascaris suum* was the most common endoparasite in farms with fattening pigs. *Coccidia* and *Trichuris suis* also could be found.

In approximately 30% of the farms lice (*Haematopinus suis*) were found and mange (*Sarcoptes suis*) was detected in the skin scrapings.

Table 3. Percentage of farms with specific endoparasites detected in sampes of faeces and ectoparasites detected in skin scrapings

Parasites	piglet production (n=48 farms)	pig fattening (n=51 farms)
Endoparasites	**79**	**78**
Oesophagostumum spp.	66	43
Ascaris suum	30	59
Coccidia	21	31
Trichuris suis	11	27
Ectoparasites		
Haematopinus suis	29	-
Sarcoptes suis	29*	59**

* detection of *Sarcoptes suis* in skin scrapings (n=24 farms); ** mange suspected in clinical examination

Beside parasites PRRS (Porcine Reproductive and Respiratory Syndrome), Parvovirosis and Leptospira could be detected in some farms (Table 4). In more than 60% of the farms one or more sows suffered from Actinomycosis of the udder. Every third farmer with piglet production declared that there is a problem with Diarrhoea of piglets.

Table 4. Number and percentage of farms with bacterial and viral infections or diseases

Infection / Disease		Farms (no.)	Farms (%)
PRRS* farms)	(n=45	16	36
Parvovirosis* farms)	(n=45	11	26
Leptospira** farms)	(n=44	6	14
Actinomycosis** farms)	(n=32	20	62
Diarrhea of piglets*** farms)	(n=32	11	34

* blood samples; ** clincal examination; *** answer of the farmer.

The examination for prevalence of organ lesions of 1497 slaughter pigs originating from the farms involved in this study gave the following results: about 50% of slaughter pigs displayed milk spots in the liver caused by *Ascaris suum*, 18% had mange caused by *Sarcoptes suis* and 24% had pneumonic lesions. These results give rise to considerable concern. Nevertheless, compared with the results from a study carried out using the same method on slaughter pigs from conventional Austrian farms (Wiskott, 1998), organic slaughter pigs had less pneumonic lesions, nearly the the same percentage of milk spots but more cases of mange (Figure 1).

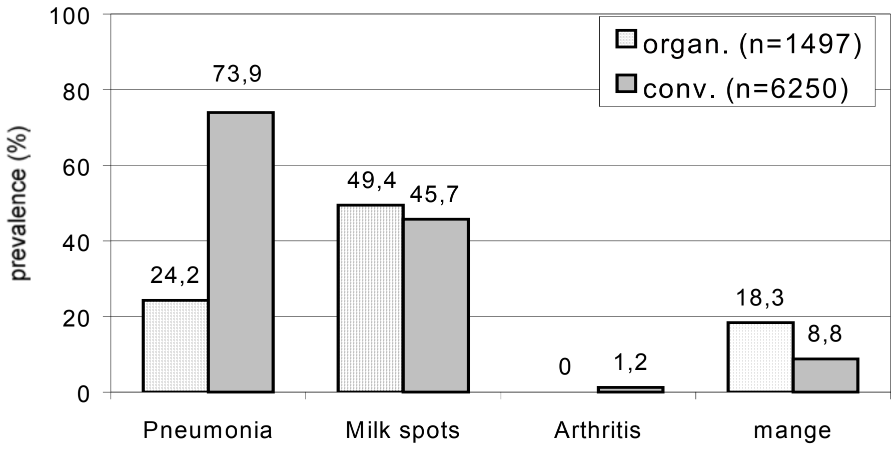

Figure 1. Prevalence of organ lesions in slaughter pigs (%). Comparison between organically and conventionally kept pigs (conv.: Wiskott, 1998).

Summary and Conclusion

Main health problems in organic pig herds are endo- and ectoparasites, actinomycosis and diarrhea of piglets. The results indicate that many organic pig farmers are not aware of the health problems in their herds. On most farms the housing situation does not allow an adequate hygiene management. The structure and the geographical deployment of the organic pig producing farms complicate a well managed animal transfer.

There are also big deficiencies in advising concerning husbandry, feeding and veterinary care. Homeopathy still does not play the important role in veterinary treatment that is described in the EC regulation No. 1804/99. In order to improve animal health in organic pig production farms in Austria, preventive measures in husbandry, feeding and hygiene management must be intensified.

The farmers should be motivated to collect evaluable performance data. If holdings have to be newly built or rebuilt the possibility of "all-in-all-out" production should be planned. Cooperation between piglet production farms and finisher farms concerning health planning should also be intensified. Improved advising of the farmers with special regard to composition of feedstuffs is necessary.

The health status of the pig herds should be examined (samples of faeces, blood samples, skin scrapings) in regular intervals and a reporting back system from slaughter houses should also be installed. Pig herds with health problems should be treated consequently. For the Austrian situation the organic farmers association "Ernte für das Leben" should establish an animal health advicory service. This could be the missing link between farmers and farm veterinarians.

In general, we need more further education and training of farmers, advisors and veterinians in organic livestock production, homeopathy an phytotherapy. But also further scientific studies especially on prevention of endoparasitosis are necessary. Maybe the newly established interdisciplinary working group "OEKO-TIER" at the University of Veterinary Medicine Vienna can help to solve the problems.

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Animal health plans for organic farms: the UK experience

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Introduction

The development of animal health plans specific to individual organic livestock enterprises has become a feature of the organic certification process in recent years. This is particularly true in the United Kingdom since the implementation of the EU livestock Regulation 1804/99 in August 2000. The new national livestock standards retain a requirement for a health plan as an integral part of the approach to positive animal health and welfare (UKROFS, 2001). Specifically, the standards state that positive animal health

> "must be provided for by a plan drawn up by the farmer, preferably working in partnership with a veterinary surgeon and agreed between them during and after conversion, to develop and operate an organic livestock system, which conforms to these Standards. The plan must ensure the development of a pattern of health building and disease control measures appropriate to the particular circumstances of the individual farm and allow for the evolution of a farming system progressively less dependant on allopathic veterinary medicinal products."

The organic standards included in the EU Regulation are designed to achieve positive health and welfare. However, there is a need to interpret and apply the standards within a context applicable at the level of the individual organic unit. The animal health plan provides such a context.

The UKROFS standards provide the baseline requirements, which must be satisfied by all organic certification bodies operating in the UK. As such, the requirement for animal health plans has provided a challenge to these bodies, to which they have responded in different ways. The development and implementation of the plans is a continuing process, and this paper seeks to describe the current situation, detail the advantages of health plans and suggest ways in which some of the current difficulties may be addressed and overcome.

Features and components of animal health plans

The following definition of an animal health plan as envisaged by the UKROFS requirement is proposed by the authors; "a live document which describes the current animal health status of an individual organic farm and outlines the methods to be used to achieve enhanced status within the whole farm context". However, the document should not be simply a statement of intent and aspirations; it should be based on facts and the application of sound science. The involvement of a veterinary surgeon in the development of such plans is seen as crucial to this evidence-based and quantitative approach. The production of the plan remains the responsibility of the farmer, but the veterinary input in terms of disease epidemiology and preventive strategies is vital.

A crucial feature of the plan is that it is an evolutionary process, starting during the conversion phase and continuing to develop and be refined after conversion. Although it is thus an ongoing process, for practical purposes, it can be divided into two stages (Gray and Hovi, 2001). The first stage is an assessment of current status and projected status. At this stage, the health plan should detail livestock numbers, existing husbandry systems and methods, including routine medications and procedures such as vaccination. Where possible this information should be based on quantifiable evidence. In other words, the incidence of clinical or sub-clinical disease should be recorded and the frequency of veterinary medicine and vaccine use detailed. The current situation should then be assessed in terms of compliance with the organic standards, with a view to ensuring compliance at the end of the conversion period. Areas where changes are required should be identified and strategies to achieve those changes detailed. The strategies will need to take into account circumstances particular to that farm in terms of biosecurity, preventive husbandry options and the level of management expertise available. In relation to medicine and vaccine use, proposed changes should be based on a risk assessment, which takes into account alternative strategies as well as the consequences for animal health and welfare, if those strategies fail.

Most plans will detail the animal health strategies to be used on a yearly basis, starting at the beginning of conversion and extending into the post conversion period. This ideally will require targets to be set for disease incidence and medicine usage. The plans, including strategies and targets, are subject to on-going review during the second phase, which is a continuous monitoring phase. This will be carried out mainly by the farmer, but ideally should include at least annual or twice-yearly visits by the veterinary adviser. During these visits, agreed monitoring and evaluation procedures are carried out and the plan modified for the next year as a result of this assessment and the progress achieved.

Sources of evidence

Verifiable and, if possible, quantifiable evidence is required for three aspects of health plan use; to satisfy the certification body, to allow progress to be assessed and to support reliable animal welfare assessment on organic livestock farms. The quality of available information will vary with the type of enterprise and the level of previous management expertise. It can be expected that a conventional dairy farm is likely to have, at the very least, historical information on milk quality, including bulk tank somatic cell counts. In addition, there should be some records relating to breeding and treatments for clinical mastitis. There may well be individual cow somatic cell count records and health and fertility records in electronic format. At the other extreme, extensive hill or upland farms may have very little in the way of health records, although it is a legal requirement that the use of conventional veterinary medicines should be recorded. The quantity and type of medicines and vaccines used may be verified by veterinary or merchants' invoices.

In relation to disease incidence, confirmation of the presence of disease on the basis of clinical examination and veterinary certification will be sufficient for some diseases such as paravaccinia infection in sheep. For other diseases, laboratory confirmation with associated reports may be required. Other sources of evidence include soil and feed analysis, which may give information on likely mineral or trace element deficiencies on the farm (SAC, 2000).

Independent of the quality of evidence available for the initial assessment, it is likely that additional methods of obtaining quantifiable evidence will have to be built into the animal health plan. Organic farmers will thus need to be more active in their disease surveillance with the aim of arriving at a definitive diagnosis of disease problems. This may be as a result of clinical examinations by a veterinarian or by the use of an analytical or pathology laboratory. The results of active surveillance can be used to confirm the need to vaccinate or not to vaccinate against a specific disease, to justify treatments where necessary or to assess the efficacy of a control strategy. For example, organic farmers in many parts of the UK are now carrying out targeted faecal worm egg counts on cattle and sheep to assess the efficiency of their clean grazing systems.

Objectives of animal health plans on organic farms

In introducing compulsory animal health planning into the current national organic livestock production standard in the UK, UKROFS, the certification bodies and the organic advisory sector recognised the following objectives:

- To ensure that organic livestock farmers are compliant with organic standards;
- To ensure compliance with best practice and promote positive health and welfare;
- To allow rational interpretation of the standards by certifying bodies and farmers;
- To provide a tool for the implementation of standards by the certifying bodies (in addition to initial registration assessments, the plans provide an inspection tool for continuing certification needs);
- To monitor animal health and welfare status and the use of medicines on organic livestock farms;
- To provide a management tool for farmers, stockpersons and advisers in their efforts to improve animal health and welfare on the farm; and
- To promote team building in relation to the organic enterprise between the farmer, workers, advisers and certifying body.

Organic health plans - the UK experience

Health plans have been developed and implemented by a number of certifying and advisory bodies in the UK since August 2000. Certifying bodies are using them as part of the initial registration process, when farmers wish to convert. The health plan forms part of the organic conversion plan, which must be approved before registration. Similarly, advisers and consultants include a health plan in the conversion planning for organic farmer clients in support of registration or grant applications.

The detail of the way information in health plans is presented varies between organisations. Some advisory bodies use a standard format with a proforma for data recording supported by explanatory notes. For example, the Organic Advisory Service (OAS, 2001) details the objectives and procedures as well as the means of recording the necessary information (Figure 1). The Scottish Agricultural College (SAC, 2001) includes a basic risk assessment approach to vaccine choice (Figure 2). In both cases, the format is flexible, with the opportunity to use an electronic spreadsheet format or hard copy. Some veterinary bodies, like the British Cattle Veterinary Association, have offered their Herd Health Plan for Farm Assurance (BCVA, 2001) as suitable for organic certification purposes.

The certification bodies have used a less structured approach to animal health plans. The Soil Association, in particular, has wanted to encourage a “creative” approach by farmers and give only guidance on what the aims of the plans should be. The Organic Farmers and Growers also give guidance only, but list in detail which issues should be addressed. The Scottish Organic Producers Association (SOPA, 2001) provides explanatory notes on the evidence-based approach it takes to organic certification and also provides a weighting system for medicine choice (Figure 3). Interestingly, some of the certification bodies have taken a proactive approach to health plans, whilst others have expressed a concern that the plans only add to the substantial paper work required from organic farmers, and have taken a less active approach.

A small pilot survey of organic livestock producers (120) was carried out in February 2001, six months after the introduction of the requirement to produce written health plans in the UK (Jenkinson and Hovi, unpublished). A total of 74 returns (62%) were received from a mixture of enterprises (20% dairy, 30% sheep, 20% beef, 30% mixed – 20% of mixed farms had poultry or pigs). Only 13% of the respondents had not completed a health plan at the time of the survey. Veterinary involvement in the development of plans was reported only on half of the farms (54%). Over half of the respondents felt that making the plan was easy or relatively easy, and 65% felt that having to make animal health plans was necessary to control disease and to improve animal welfare standards on organic farms.

A total of 50% of respondents thought that the plan had helped them to identify an existing animal health problem on the farm, and another 65% agreed that the plan had helped them to identify shortcomings in their existing livestock management techniques. A majority of the farmers (78%) felt that suggestions made in the plan would help to reduce a specific problem on the farm, and only 13% of respondents felt that the plan had irrelevant and unnecessary parts to it. Almost half of the farmers (47%) felt that they would use the plan in the day-today management of the farm. In contrast to these positive comments, 75% of the respondents felt, in contradiction to their own earlier comments, that the plan would not act as a useful management tool on the farm.

When asked, if the animal health plan would force any changes on the farm, 38% of respondents felt that they would have to make significant changes in the farms' veterinary practices, 20% felt that they would have to make significant changes in farm buildings, and 22% felt that they would have to make significant changes in livestock diets. Whilst most respondents identified several benefits to the farm, staff and livestock from the introduction of health plans, very few thought that inspection (7%), consumers (16%) or vets (4%) would benefit. A small percentage of respondents (7%) felt that no one would benefit from the health plans or that only "bad farmers" would benefit.

Constraints and problems

In spite of the apparent advantages and the positive response by farmers described above, the introduction of health planning on organic livestock farms in the UK has not been problem-free. Firstly, the plans have clear constraints that may add to the feeling expressed by some farmers and certification bodies in regard to the plans being just another set of paperwork to produce. Secondly, as the plans have not been wholeheartedly endorsed by all certification bodies, and guidance between the bodies has varied substantially, the plans do not provide a homogeneous approach that could be developed and improved easily or used as evidence of good welfare on organic livestock farms. Thirdly, the existence of quantifiable data on disease incidence and prevalence on organic farms will inevitably raise the question of target levels of disease on these farms.

In regard to the inherent constraints of animal health plans, it has been recognised that they are only a tool and do not in themselves guarantee any of the advantages or objectives listed above. If the plans are to be more than a paper exercise, the reasons for having them must be accepted by all the parties involved. In particular, their success will depend on the effort and expertise invested in their development and implementation. The expertise and commitment of the farmer is crucial to the success of the plan. The responsibility to produce the plan is his but if he sees it only as a means to satisfy the requirements of organic certification, it is unlikely to be successful. The results of the pilot study above, suggest that farmer commitment is there and needs to be harnessed by the certification bodies. Similarly, commitment on the part of the veterinary adviser is essential. The fact that only half of the organic farmers who had developed an animal health plan had used veterinary advice should be of concern. An understanding of the philosophy of organic principles as well as a detailed knowledge of the standards is required. In some cases, veterinary expertise is lacking on both counts. It is crucial that the farmer and veterinary adviser develop a good working relationship. Not insignificant in this relationship is the recognition by the farmer that the veterinary adviser has much to contribute and that he must be paid for that contribution.

Another inherent constraint to the development of evidence-based and quantitative rather than descriptive health plans is the absence of necessary information, both on farm and locally or nationally. The data may not be available on some farms and the risk assessment approach requires knowledge and expertise to apply. In some cases, the information on local disease prevalence and risk factors may not be available to make rational choices in relation to vaccine use, for instance (see Box 1).

The arguments put forward by some certification bodies in regard to the health plans adding to the existing paper work on farms and needing to be a "creative" rather than a bureaucratic process may be valid to some extent. However, animal health plans are more likely to fulfil their objectives if a structured and quantifiable approach is taken. The authors have considerable experience in assessing a variety of animal health plans produced by farmers, and feel that descriptive plans, requiring considerable effort on the part of the farmer, serve little purpose as tools or working documents and provide virtually no evidence of the current health situation on the farm.

Even if the above mentioned constraints to an evidence-based and quantifiable approach to health planning on farms were to be solved, the approach will create a need to set targets in regard to disease and treatment levels, medicine use and quantity and quality of prophylactic approaches on organic farms. Whilst it is important that target setting in practice remains specific to the individual farm, there will be pressures to set overall targets, for instance, on what level of mortality or morbidity is acceptable on an organic farm. Otherwise the system may be open to accusations of inconsistency of approach if different targets are set for individual farms. The quantifiable approach will also lead to direct comparisons between conventional and organic systems, with no real benefit to either side. Furthermore, the question of who sets these targets needs to be addressed.

Potential solutions and opportunities

The attitude of farmers, their advisors (including veterinarians) and certification bodies towards health planning on organic farms is a key to the success and usefulness of the plans. The results of the small survey quoted above appear to suggest that, whilst most farmers found the exercise of health planning useful and recognised the advantages that planning brought, very few of them considered the plan as a management tool. The discrepancy in farmer attitudes needs to be further explored to establish the reasons behind farmers' reluctance to consider health planning as a useful management aid. Participatory research into farmer attitudes concerning recording, information gathering and information based decision support at farm level is needed to identify approaches that would be acceptable to farmers.

Similarly there is a need to explore the veterinary profession's reluctance to embrace organic livestock farming as part of serious farm assurance and to be willing to offer it support. Since the introduction of a requirement for written health plans on organic livestock farms, the veterinary profession has shown increasing interest in organic farming, and some of the Continued Professional Development courses offered in this area have been very popular among practising veterinarians, who are obviously missing an opportunity by not being involved in health planning on many farms, as the survey results indicate.

Box 1. Vaccines: a special case?

The application of an evidence-based/quantitative approach to health planning has thrown up some contentious issues in relation to vaccine use in organic livestock. The EU Regulation is rather obscure in terms of the classification of vaccines. The use of chemically synthesised allopathic veterinary medicinal products for preventive treatments is prohibited. In the UK, vaccines are classified as immunological preparations and since, by their very nature, vaccines are used for prevention, *vaccination* is permitted but should be restricted to situations where there is a known disease or risk of disease present. In addition, univalent, rather than multivalent vaccines should be used. Vaccines are designed to improve the immune status of animals and since immune function is one of the main methods of achieving positive health in organic livestock, it can be argued that vaccination should be encouraged.

However, the counter-argument is that vaccines are a conventional approach to disease and may permit unsustainable systems to survive and discourage the development of organic solutions to the problems faced. Specific areas of concern relate to protection of sheep and cattle against clostridial infections, where often the diseases are endemic and the organisms ubiquitous, surviving in the environment for many years. In addition, multivalent vaccines are normally used since the risk factors associated with the different clostridial organisms are common.

A detailed risk assessment approach to vaccine selection and use is required to allow advisers and certification bodies to make rational decisions. In addition, the organic standards need to take into account the welfare implications of the failure to use vaccines in situations where disease cannot be prevented by management means only. This risk assessment approach is considered to be an urgent research need and a proposal is currently with a UK funding body.

One way of encouraging farmers to see the value in the exercise of health planning based on quantifiable disease data could be the utilisation of data generated by health plans in benchmarking. Quantifiable health plans could become a basis of mutual, farmers' co-operative benchmarking systems, that have been recognised as popular and useful among farmers. Electronic benchmarking systems that allow farmers to submit data directly to a database connected to benchmarking software, have been developed recently (InterLeague™, Agrisoft Ltd, UK). These systems allow farmers to compare their own data with those of other farms anonymously. A system that would allow organic farmers to compare their own performance with that of other organic farmers would eventually produce a "voluntary" set of targets among farmers rather than at certification level.

Conclusions

Evidence-based/quantitative organic animal health plans have a fundamental part to play in the approach to positive animal health and welfare in organic systems. As such, they fulfil multiple functions. The plans form an integral part of the quality audit process where they can be used to support compliance with standards and as an inspection and certification tool. In addition, they provide a management tool for organic farmers to allow them to improve the health status of their livestock in a progressive manner. Animal health plans should be integrated into the overall management strategy for the farm and, as such, are consistent with an organic holistic approach. However, they are a means to an end and not a substitute for the further development of preventive animal health strategies on organic farms. Current constraints will require further promotion of the advantages of such plans and further research and technology transfer, particularly in relation to a risk assessment approach to animal health management.

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Figure 1. Example: Organic Advisory Service Animal Health Plan

<u>7. Assessment of animal health situation on the farm:</u> (page 3 of 6)

Condition	Current situation			12-month objective		*Notes*
	Disease level	**Estimate based on**	**Current control**	**Disease level**	**New measures**	
Foot rot/lameness in sheep	No records kept. "Normal" incidence. Scald.	Farm manager's estimate	Pairing when lameness observed. Terramycin spray used to treat lame individuals.	Recording system established. See Part 5	Will be decided in 6 month's time if recording suggests problems.	Use of Terramycin spray on individuals acceptable but 48 hour withdrawal for slaughter needs to be observed. – Zinc sulphate for footbaths. (See attached notes on control and treatment)
Sheep scab	None	Farm manager's observation	None	None	Isolate	
Scrapie	No clinical disease observed.	Farm manager's estimate	None	Minimisation of risk of introduction	All rams scrapie-tested	
Minerals deficiency in sheep and cattle	Not known. No testing.		Se and Cu included in current wormer, Se in concentrates.	Monitoring system established.	No supplementation, better monitoring.	A sample of lambs will be tested in September for plasma Se/Cu levels and further measures will be decided according to results and possible clinical observations.

Figure 2. Example: Scottish Agricultural College Livestock Conversion Plan

1 List the diseases/parasites which are known to be present on farm

	Name of disease/parasite	**How recently has the disease *occurred*?**			***Incidence* in last 12 months**
		Within last 12 months	12-24 months ago	More than 2 years ago	Number of animals affected
1					
2					
3					
4					
5					

2 Evidence of disease/parasite occurrence for those problems which have occurred *within the last five years*

	Name of disease/parasite	**What was the evidence for the problem? (Tick appropriate box)**		
		Clinical diagnosis by		Was there a Vet Lab diagnosis
		Self	Vet.	
1				
2				
3				
4				
5				

				Vaccines					Antelmintics (wormers)								Ectoparasiticides					
Category	Best/Worse Case Scenario	Rating for Best/Worst Case Scenario (out of 7)	Weight of Importance (out of 5)	Intranasal	Injectable Multivalent	Injectable Monovalent	Oral	Dermal	Injectable Avermectins	Oral Avermectins	Injectable Levamisole	Oral Benzimidasoles	Boluses (excluding Avermectins)	Pour On Avermectin	Pour On Levamisoles	Oral Levamisoles	OP Dips	Non-OP Dips	Pour On Cypermethrins	Injectable Avermectins	Pour On Avermectins	Powders
Mode of Action	Non-Systemic	7	4	4	4	4	4	4	4	28	4	28	28	4	4	4	4	8	24	4	4	28
	Systemic	1																				
Breadth of Spectrum (1 product = 1 problem/many problems)	Narrow/Single Spectrum	7	5	35	5	35	35	35	5	30	35	35	30	5	35	35	5	10	30	5	5	30
	Broad Spectrum	1																				
Mode of Application	Ingestion/In Feed (non invasive)	6																				
	Pour On	5																				
	Drench/Bolus	4	2	12	6	6	12	6	6	8	6	8	8	10	10	8	4	4	10	6	10	10
	Inject	3																				
	Dip	2																				
Toxicity – Animals	Zero	7	4	24	12	12	24	12	16	12	8	24	16	16	8	12	12	20	20	16	16	24
	High	1																				
Toxicity – Humans	Zero	7	4	24	12	16	24	12	12	12	12	24	28	12	8	12	4	20	12	12	12	16
	High	1																				
Toxicity – Wildlife	Zero	7	4	24	24	24	24	24	4	4	24	24	24	4	24	24	4	4	8	4	4	4
	High	1																				
Withdrawal Period	Zero Days (e.g. water/homeopathy)	7	4	28	28	28	28	28	4	12	8	12	4	8	8	8	12	24	12	4	8	28
	Long e.g. 80 days	1																				
			TOTAL *	**151**	**91**	**125**	**151**	**121**	**51**	**106**	**97**	**155**	**#138**	**59**	**97**	**103**	**45**	**90**	**116**	**51**	**59**	**140**

* HIGHER SCORING PRODUCTS ARE PREFERRED IN AN ORGANIC PROGRAMME

Figure 3. Example: Scottish Organic Producers Association Guidance on Health Plans

Development of health advisory service in Danish organic dairy herds - presentation of an action research project

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Introduction

In Denmark, veterinarians and farmers can enter a health advisory service framework defined by the public veterinary authorities. Farmers, who have monthly veterinary Health Advisory Service (HAS) visits in their herds, are allowed to receive antibiotics for post-treatments. Organic farmers are not allowed to enter this HAS contract with their veterinarians, since they are not allowed to use antibiotics for post-treatment of cows in their herds. A paradox appears: in organic herds, where there should be an explicit focus on prevention of disease and on health promotion, farmers cannot sign the only formalised Danish HAS contract with their local veterinarians.

This anomaly, in combination with the fact that a number of organic dairy farmers wanted to take a more multi-faceted and inter-disciplinary approach to health management in their herds, initiated a combined development and research project. The main objective of this project was to develop a formalised framework for a HAS, particularly suited to the needs of organic farmers.

Materials and methods

Twenty herds and their advisory partners (the local veterinarian and the local cattle health advisor) were included in the project. They were encouraged to find a way of building up a health advisory system that would be appropriate to each farm. The project was carried through from February 1999 to March 2001, and herds were included in a step-wise learning process in the following way in order to develop the HAS:

- February 1999: Eight farmers started in February 1999. They were asked to formulate a HAS service contract from scratch, supported by project researchers.
- October 1999: Based on their experiences, 12 additional farmers entered the project and were asked to formulate a more structured HAS contract.
- During the project period, plenum meetings of various kinds were arranged, and 5 to 6 herd visits in each herd took place, where project researchers, farmers and their sparring partners discussed the project in context of each farm and the progress made there. The process of HAS and the dialogue between partners is the main focus of these meetings and this part of the project.
- Data collection took place during the whole project period. In addition to the 20 farmers included in the development of the HAS contract, 20 control herds were included in the project in order to describe the 'background' of organic dairy production in herds, which are not directly influenced by HAS. Health status is measured by means of readily available production and milk quality data and one visit from a project veterinarian. Epidemiological studies were carried out during the study period, and development of health status over time is described in the Ph.D. study of Torben Bennedsgaard.

Results of the development of HAS: three different models of health advisory service, based on explicit formulation of expectations

The core of the development of HAS was reached through discussions on each farm about expectations to the HAS. It became clear that the farmers' motivations to change things and to go into a dialogue was absolutely essential for a succesful health advisroy agreement. This motivation could only be seen through each farmer's formulation of how he/she viewed the problems at the farm, what he/she expected could be changed, and what he/she expected the advisors to do – including the methods of giving advice.

Expectations were expressed through interviews and 'exercises' for farmers and their advisors, where they should agree on which roles each of them played in the work for health support and disease prevention in the herd. (The results of these interviews, exercises and how it led to the final HAS 'contract' is presented in manuscripts which will be submitted to publication during winter 2001-2002).

Based on these expectations, three different models for HAS were formulated. This is partly expressed in the 'agreement and foundations', presented below, where the background for each of the three models is briefly described. It must be underlined, that the discussion about expectations to each other, to the effort in the farm and to the health advisory work is the central element of framing the health advisory contract. Additionally to this, the practical arrangements should be made, and the content and goals of the whole effort is of course to make things happen in the herd: that the whole herd situation is improved.

Health advisory service in the 'daily life' of the herd: making the practical arrangements

A number of choices are given for the 'practical life' of the HAS contract, such as how often/under which conditions follow-up should be made, which kind of data background is expected to be included as a part of the collaboration and dialogue about the health status in the herd, and who takes care of making the agenda for the meetings and writing the summary after the meeting, for example.

The following elements were described as crucial for the success of the HAS:

- Writing an agenda: In order to make the dialogue focused and goal directed it was found essential to write an agenda – everybody had the possibility to be prepared. Everybody in the collaboration around the farm can add to the agenda.
- Making a summary, which is agreed upon among all partners in the team around each herd. Some of these health advisory visits took place four times per year, for example. If a summary is not made, it is impossible to remember what happened during a meeting 3-4 months earlier. By making a summary, a common memory of the meeting is created. A summary also creates the foundation for a proper follow-up on each effort which is made.
- Follow-up on all agreements. A procedure of follow-up must be made explicit for each topic, which is taken up in the team with regard to future efforts. It was an experience throughout the project that many agreements 'crumbled away' because no proper follow-up process had taken place.
- Making as much explicit as possible. Another experience made many times in the course of the project was the creation of opinions about expectations – without sharing it with the rest of the team. In order to make the best environment for collaboration and action, the dialogue should bot be blocked by un-expressed expectations.
- Plenum meetings – for farmers, advisors, or both. In the project, the plenum meetings were a very positive experience, and we had much positive feed-back from the farmers and advisors. It gave inspiration to the advisory process, and inspiration about solution of the problems. Creation of a network can be highly beneficial especially in situations of acute crisis, where both farmers' and advisors' networks can offer advice, own experience and background for solutions.
- The presence of a 'process maker' was vital for the advisory service in some cases, according to the involved participants. Discussions about expectations and roles

were very usual for most partners, and difficult to handle. Involving such 'dialogue partners' must be recommended, also for future formulations of contracts, especially in cases where farmers find it difficult to formulate the goals for the herd, or where these goals seem difficult to implement in the concrete work in the herd.

Comments on the research methodology

Action research involves various research approaches in practice environments. The method will always be adjusted to the area in focus. These projects were carried out as action research projects, and have – as such – been very interactive in their approach. As project researchers, we have learned very much from this, and we are aware that we – through our presence in the centre of our own research area – have influenced the 'object of research'. This must of course be handled when reporting the results. It may seem chaotic at times – but it would never have been possible to reach these results in any other way than through this approach. One example is the fact that the farmers had to pay all advisory service by themselves – which gave a very realistic relationship to the financial aspects of any advisory service, and what farmers could be expected willing to pay. The project paid plenary meeting – which was a precondition for collecting data about the process. However, this also influenced the whole process on each farm!

The structure of this project also implies that we – as researchers – do not 'own the conclusion'. There are at least 70 carriers of the results and conclusion, and each of these has the right to contribute with their version of the common story about development of HAS. We have collected as much data and experience as possible, and analyse it in a way, which we judge as a responsible, loyal, critical and systematic way of reaching the results we have reached. We are grateful to and aware about the effort put into this project and the results by this huge number of competent and experienced partners. And we acknowledge their daily practice and inspiration, and their right – at any time – to question our version of the conclusion!

Animal health advisory service in organic farming

(Agreement and foundation)

The agreement applies to the following partners:

Farmer:______________________________

Vet:- ______________________________

Cattle herd advisor:______________________________

(Others) who: ______________________________

Preliminary conditions for health advising in this herd

1. The needs of the herd decide the level of health advising. These needs are discussed openly among the partners. The advice seeks to fulfil the goals of the herd and implicates actively the organic basic idea of good animal welfare into the work.
2. All partners are actively co-operation concerning this herd. Health advising is a joint learning process. All partners participate and gain new experience and everybody makes an effort to fulfil the goals of the herd, and to understand the goals agreed upon for the advising and for the herd.
3. It is presumed that the farmer raises the alarm, if a problem arises in the herd. It is likewise presumed that the consultants report, should they estimate a problem arising.
4. The health advisory service will - as a minimum - cover:
   - an annual consultancy meeting with vet and cattle herd advisor; and
   - an annual consultancy meeting with each of the above (together or individually)

   Additionally the timing and frequency of visits is scheduled optionally.
5. After each visit a summary report is made. Decisions and the need for follow-up are noted in these summary reports, which are carried out by the consultants.
6. Every year the agreement is discussed at the collective meeting and altered if the partners find it relevant. The following items are on the agenda for this meeting:
   a. Is the health advisory service working satisfactorily?
   b. Do the partners keep time for the agreements made?
   c. Which projects are activated at present and what have the results been up until now?
   d. Are the summary reports from the meetings sufficient and useful?
   e. Do we follow-up on our initiatives in a satisfying manner?
   f. What could be better or what could be an advantage to alter?
   g. Items are added by farmers and consultants and a new agreement is made.
7. The farmer, the vet and the cattle herd advisor are attached to a network, where relevant topics are discussed and inspiration concerning health control is exchanged. The centre for organic agriculture in Denmark has initiated formation of regional networks.
8. The farmer will have participated in a start-course and the vet & cattle herd advisor will have participated in a course concerning health advisory service in organic herds, within a year of entering the agreement in this herd.

__________ __________ __________ __________

(farmer) (vet) (cattle herd advisor) (others)

B. Advisory model

The model for advisory service in this herd is chosen on the basis of the expectations of the farmer and the role he wishes for his consultants to fulfil, as well as the opinion of the consultants, as to whether this model fits the conditions of the herd. The practical agreements of the consultancy are adjusted and altered according to wishes and demands. (See enclosure 1 for description of the individual models)

Mark with a cross	**Model 1** **Subject:**	**Model 2** **Monitoring:**	**Model 3** **Process and analysis:**
The role of the consultant	Show options and inspire in areas pointed out by the farmer as subjects or problem areas. Create a foundation for the decisions of the farmer.	Monitoring the herd closely. Sparring partner for the farmer in the daily running of the farm. Frequent visits.	Follow the herd regularly and generally examine the herd regularly. Focus on selected problems defined by both parts.
Data/foundational knowledge	Data are extracted from the herd when necessary and with focus on current problem areas/subjects. A high degree of communication, based on how the farmer experiences the situation.	Data supply the examinations and registrations carried out by consultants (vet and cattle herd advisor).	Data are continuously extracted in the chosen focus areas. All data are extracted on a regular basis once or several times a year.
Shape of meetings	Collective meetings as required, defined by the farmer. The farmer comes up with agenda, which is distributed at least one week in advance.	The consultants visit the herds. Collective meetings typically 1-2 times a year.	Usually 2-4 collective meetings. The entire herd is examined and problem areas are pointed out. Initiatives and achieved results are presented.
Agreements on meetings	The farmer summons	Often within fixed limits.	Meetings are always ended with an agreement on a new date.
Follow-up	Course of follow-up is agreed upon for each subject.	Continuously at individual visits and presentation at collective meetings.	Close follow-up of initiatives with feedback to all parts.

C. Goals for health advisory service

The health advisory service is meant to result in actual improvements in the herd. The goals can be within production, disease problems, welfare and regarding various groups of animals (calves, young animals, and cows). The following goals are applicable for co-operation with the health advisory service in this herd:

Purpose of the health advisory service:

____

____

______________________________.

Long-term goals:

____

____

____

Short-term concrete goals:

____

____

____

D. Structure of meetings

The shape and contents of the meetings is continuously developed throughout the first year. The following is agreed in advance:

1. Summoning for consultancy meetings with agenda:
   a. The agenda is agreed upon verbally, ______________________ takes the initiative and ensures that all partners are updated concerning the items going on the agenda.
   b. An agenda is always prepared at least _______ days before the meeting with the health advisory service.
   c. All partners can obtain items from the agenda, which are written and dispatched by__________________________.

2. Summary report after collective meetings on the farm:
   At collective meetings in this herd ____________________ writes the summary report.

3. In this herd the partners are attached to the following network:
   ____
   with expectations of at least one annual public meeting, where the farmer, the cattle herd adviser and the vet participate.

4. Special wishes for regular agreements on frequency of visits:
   a. Collective visits __________ times a year, when:_______________________
   b. Collective meetings start: ☐ in the stables ☐ at the kitchen table
   c. In addition to this, the following fixed visits are requested in this agreement
      Visit at_________________________, how often: __________________

Visit at_____________________________, how often: _____________________.

G. *Follow-up*

Follow-up on initiatives in the herd are agreed upon in connection with each individual initiative. This will always appear in the report.

F. *Basis for consultant and decisions in the herd*

1. Expectations to the knowledge and data, forming the basis of the consultancy
   a. Data material in the herd is chosen from the list on page 7
   b. A thorough analysis of the results of the herd with focus on the goals of the herd is requested ________ times a year (describe):___________________________________
   c. An evaluation of animal welfare is requested how often: ________________ carried out at _______________________________ as basis for goals and discussion in the consultancy.

2. Expectations of extra monitoring in specific areas
   Should extra monitoring be expected from any of the consultants, it must be defined. The timing for carrying out this extra monitoring is managed by the consultant, based on an arrangement of intervals agreed upon with the farmer.

   It is expected that_______________________continiously monitors___________________.
   It is expected that_______________________continiously monitors___________________.
   It is expected that_______________________continiously monitors___________________.

3. Specific examinations of the herd, as supplement to consultancy

(See the idea catalogue for suggestions, or schedule relevant examinations yourself)

Request for special examinations:	How often

4. The veterinary consultant is required in situations with acute disease to the furthest extent possible. .

Yes ☐ No ☐

G. *Special agreements apart from the above mentioned*

Discussion report:

Health planning and management in organic livestock systems

Hovi, M.[1] and Sundrum, A.[2]

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The discussion on health planning and management in organic livestock systems was divided into three different topics:

1) How to plan and incorporate parasite control into health planning?
2) How to justify health planning and motivate certification bodies and farmers to implement health planning?
3) What should health plans contain?

1) Parasite control

How to incorporate parasite control into health planning?

It was proposed that there was a need to utilise good decision support tools on organic farms, particularly during and immediately after conversion, when the use of routine anthelmintic prophylaxis has to be discontinued and stockpeople are under pressure to learn new modalities of control. The following support tools were discussed:

1) Flow charts

It was agreed that flow-charts, as presented by Eysker (2002) in these Proceedings would be helpful as a decision support and management tool. However, the following points were made:

- Flow charts should be adapted to local conditions.
- Flow charts can be a practical aid to parasite management but do not include factors like breeding, feeding, stocking rates, pasture biodiversity etc.
- Flow charts are only helpful if the user knows the farm and the above mentioned factors well (farmer, local vet).
- Surveillance by a veterinarian and by routine faecal egg counting would still be necessary.
- As the flow charts rely on conventional anthelmintics as the main strategic and therapeutic inputs, there is still a need to look for alternatives to these, as the constraints to anthelmintic availability are likely to increase.

2) Faecal egg counting (FEC)

The usefulness of routine FECs was discussed. It was pointed out that there is still too little expertise in Europe in interpreting the results of routine faecal egg counting at farm level. Again, good understanding of individual farm situation is important in the interpretation of FEC results. It was also pointed out that there are no clear guidelines on interference levels of FECs, and that each farm has to develop their own baseline for this.

3) Pepsinogen testing

Measuring pepsinogen levels in the serum of youngstock at housing after first grazing season as an indicator of level of exposure to parasites was considered useful, as long as right interpretation of the results was made. The following interpretation was proposed:

- Low pepsinogen levels indicate that there is inadequate protective immunity for the second grazing season.
- Intermediate pepsinogen levels indicate that the animals have adequate immunity for the second grazing season.
- If the levels are high, there is a need to reconsider grazing management for first season youngstock in order to avoid parasite damage.

4) Routine therapy at housing for inhibited *Ostertagia* larvae (type II ostertagiasis)

It was felt that applications for derogations to use routine therapy for type II ostertagiasis in cattle at housing was often misused and counterproductive. The infection with type II ostertagiasis is rare and routine therapy at this point will prevent the development of immunity promoted by low level infection with parasites.

The following research needs in the field of parasite control were identified:

- It was suggested that there is little need for more knowledge on the general epidemiology of endoparasites in ruminants. However, understanding of local situation at farm level in regard to parasite dynamics is vital for effective control.

- There is a need to establish a better understanding of internal parasite epidemiology in monogastric animals under free-range conditions.
- There is still a great need to research and identify alternative therapies and systems level strategies for parasite control in all species.
- It was suggested that collaborative European projects on parasite epidemiology and control in pigs and poultry were needed to ensure adequate and representative data.
- It was also suggested that there is a need for controlled field trials to produce data for simulation models that could eventually be used as decision support tools.

2) How to motivate farmers and certification bodies to carry out health planning

The working group felt that there was an urgent need to motivate organic and converting farmers to implement formal health management planning. It was felt that there was very little evidence to suggest that the health status of organic livestock was any better than that of conventional livestock. In order to maintain consumer confidence in organic food and to guarantee high health and welfare standards on organic farms, health promotion and disease control needs to receive more attention. Statutory health planning, which is incorporated in the United Kingdom Register of Organic Food Standards (UKROFS), should be introduced into the EU Regulation 1804/99.

How?

By increasing the pressure to comply with standards at several levels:

- Farm level: threat of loss of consumer confidence should be made more real and explicit. It was pointed out that if organic farmers perceive animal health and welfare situation good or, indeed, very good on their farms, it will be difficult to convince them that health management planning is necessary. Assessments have to be carried out by independent certifying bodies with adequate skills.
- Legislative level: EU regulation should include a requirement for written health/welfare plans. It was suggested that NAHWOA should make an official statement supporting this and to point out that health and welfare issues did not have sufficient emphasis in the current EU regulation on organic livestock production.
- National level: certification bodies should be more positive about health planning and take a more formal approach to them: clear guidelines on how to make the plans, training of inspectors on the assessment of the plans and using expert advice (veterinary) on scrutinising and approving of the plans.
- Subsidy/grant level: some of the grant money could be ring-fenced for the development of health plans.
- Retail level: by educating supermarket on the real cost of animal welfare and health.
- Consumer level: same as retailers.

3) Technical aspects of health management planning

The working group suggested that it would be more appropriate to call health plans 'health/welfare management plans'. In order to decide on any of the technical aspects of health management planning, it would be important to decide which purpose the plans were aimed at: certification or on-farm management. The working group felt that it would be important for the plans to be designed as management and communication tools. If they turned out to be useful as inspection/certification tools, that would add to their value. Certification purposes should, however, not be the primary aim of the plans.

The following technical aspects of health management plans (HMP) were discussed:

1) Target setting

Target setting should be farm-specific and should be based on both short- and long-term targets. It was suggested that setting of "national" or "organic" target levels (e.g. for disease levels) would be counterproductive. – Setting of farm-specific target levels should be combined with an assessment of existing diagnostic and recording systems and treatment thresholds to ensure that recordings between different observation periods are comparable.

2) Step-wise establishment

It was suggested that a step-wise establishment of health plans would be needed, particularly on converting farms. Existing data may not always be adequate to assess the existing disease situation on the farm and to allow target setting and targeted planning (e.g. some diagnostic work may have to be carried out in the first 12 months to establish whether a dairy herd is infected with BVD, IBR, Leptospirosis etc.). In this context, the need to ensure the dynamic nature of health management plans was emphasised. Regular updating and reviewing of the plans should be compulsory.

3) Incorporation of alternative/complementary therapies

The health management plan should be utilised to help to introduce alternative/complementary therapies on a farm in a way that allows feed-back and assessment of the impact of these therapies. This may help to avoid some of the pitfalls discussed by Hovi (2002) in these proceedings and to ensure that a shift to alternative therapy use on organic farms does not lead to animal health and welfare problems.

4) Constraints

The following issues were seen as the main technical constraints to the adoptaiton of health management planning in the organic sector:

- Cost may discourage farmers from involving veterinary advice or other advisory support. Ring-fencing of conversion grants for this purpose may be a solution.
- Quality of available advice may discourage farmers. Veterinary profession lacks knowledge of a holistic approach to preventive measures. Veterinarians may be reluctant to get involved in advice on alternative/complementary therapies. Training of veterinarians and attitude change among veterinarians is urgently needed.
- Target setting may appear threatening to farmers who may fear penalties if targets are not met. Farm-specific nature of targets and evidence-based nature of

management plans should provide information and justification on why targets have not been met.

- Lack of interest in health management plans by certification bodies may ultimately be a greater constraint than any of the technical problems, as Gray and Hovi point out in these proceedings that farmers, who have experience of setting up health management plans, find them both useful and meaningful and technically feasible to implement.

The following research needs were identified:

- There is a need to further develop health and welfare indices and to assess their usefulness to all stakeholders.
- Research should be innovative and participative: demonstration farms, study groups, socio-psychological studies (e.g. to establish what makes farmer willing to accept and adopt advice). Action research, as described by Vaarst *et al.* in these proceedings, was recognised as a useful research approach to health planning.

Part C: Farm Visits

Farm visits: Danish organic dairy and pig herds – brief introduction to the farms and the background for farm visits

Vaarst, M. and Thamsborg, S.M.

Background for choosing the farms

The purpose of these farm visits was to present the current situation for organic farming in Denmark:

- the situation of many newly converted farms,
- the situation of decreasing demand for organic food and decreasing prices, followed by a discussion about the future development of organic farming. The choice in practice can be to make some compromises and work in a certain direction on a more long-term basis or leave the farm, or the organic production method.
- Implementation and adjustment to EU-regulations, of which some are found very illogical in the context of organic thinking – partly also followed by discussions about interpretation and control of the rules under Danish circumstances. The level of details and the changes compared to former Danish rules leave many farmers frustrated and focused on the rules instead of the ideas of organic farming.

The two dairy herds represent the two most common housing systems of Danish organic dairy production: deep litter loose housing and beds + slatted floor. The pig herd is to some extent NOT typical – first, the small amount of organic pig herds makes it rather difficult to talk about ’typical pig herds’ – and secondly, the owner is a relatively ’old’ organic farmer, who continuously tries off new solutions and ways of doing things, participating in farmer-based so-called ’grassroot-research’ and being organisatorically involved.

Presentation of the three farms in words and figures

The key figures which will represent the two dairy herds, are made by a colleague, Carsten Enevoldsen, who has his own private health advisory company, offering data analyses to dairy farmers – with particular interest in the farmers who involve their veterinarians in a so-called 'Israelian health advisory service model' with weekly or fortnightly visits by the vet, who examines certain cows in the herd. These cows represent certain risk groups around drying-off and calving. Clinical examinations are carried through, and the body condition score is a central tool to 'adjust' the feed and milk yield level. Based on the results from these examinations plus central data in the Danish cow data base, Carsten Enevoldsen calculates a huge number of figures which describe the status in the herd with regard to disease and production levels. One major challenge when using these figures – besides learning to use 23 pages of figures! – is the thought of 'health' being expressed by homogenity among animals of the same herd. An example can be that a very different milk yield within one herd expresses that food intake is unequally distributed – which again can indicate that 'weak cows' are kept down and 'leader cows' are too dominating, which can fall back on the housing system etc. In this way, good discussions can be taken with the farmer, who may explain the picture from his/her point of view. Identification of groups which somehow seem to fail (from a herd point of view) can help in finding the weak points for the whole herd.

In Tables 1 and 2, the two herds from this herd visit are described through some of these key figures. Table 3 shows the overall level from a huge number of Danish dairy herds. In Table 4, some summaries describing clinical observations in the visited organic pig herd are given. The organic pig herds are described in words, summarising the clinical recordings/observations in the herd, which were systematically carried through by the local vet every 6 weeks during the 1½ years project period, supplemented by recordings made by two project veterinarians.

Short presentations of the three farms

Farmer 1 – Olaf Hansen, a dairy farmer. Olaf Hansen and his wife Doris bought the farm from his parents in 1977. They had four children, who help on the farm. There is 72 ha owned + 36 leased land; 8 ha of these are wood. The farm is placed in one end of the area – which is also quite spread. It was converted to organic farming in 1996, and a new housing system with deep litter and a 2 x 7 milking parlour was built. Cows are 'Danish black and white' (Holstein Friesian). Calves and young stock are kept in single boxes and groups in the old buildings. They feed with total mixed ration. Olaf is member of 2 erfa-groups, and has participated in health advisory service. He has a part-time assistant, and his 4 children also help. The cows are still grazing 6 hours per day (until the weather becomes bad), and heifers are still out in mid-November. Olaf Hansen has participated in a project about development of health advisory service from 1999 till June this year (see more about this project elsewhere in these proceedings). The visit to his place gave us an opportunity to present and discuss aspects of this project as well – and also relate his herd and the need of his herd for health advisory service to the results of the project. He was one of the farmers who impressed the group working with the process of advisory service by being very explicit and well-argued about his own situation and what he expected from the advisors. His farm situation has been quite problematic during a period (which can be seen from the figures), mainly explained by change of system and adjustment of the now 2 year new deep litter system.

Farmer 2 – Torkild Gjaldbæk is also an organic dairy producer. Torkild and his family is a young farming family - having bought the farm in 1998 with 48 cows and converted in 1999 (started to deliver organic milk in January 2000), and they have 70 cows now. They feed total mixed ration to all cows and heifers, and feed concentrate in the milking parlour (a 50^{o} hering bone parlour), and the calves are raised with 'suckler aunts' and access to an outdoor area all year round. One reason for choosing him for farm visits was that he involves his veterinarian in regular health advisory visits (weekly-fortnightly), and his veterinarian is Jes Nissen, who is treating cows using homoeoapthy. He – Jes Nissen – prefers to involve certain herds, where he communicates well with the farmer, and where the majority of treatments can be homeopathic. This is – seen from our point of view – very interesting, and furthermore, we are very involved in a discussion going on among cattle-practicing veteriarians in Denmark about the future collaboration with farmers around homoeopathic treatments. Visiting this farmer and his interesting farm – among others with suckler cows or nurse cows for the milk-fed calves (we call them suckler aunts), also gave us an opportunity to discuss the collaboration with his innovative and interesting veterinarian and together with both of them to discuss the theme of this workshop – alternative treatment based on an example from 'real life'.

Table 1. First dairy farm: Olaf Hansen - Presentation of some key figures on production, disease and culling.

Parametre	**1st lactating cows**		**2nd lactating cows**		**3rd lactating cows**	
	No.	**Median**	**No.**	**Median**	**No.**	**Median**
Milk yield, kg 4%; top yield	50	20	41	23	44	27
Top milk yield, relative	50	74	41	85* (93)	44	100
Milk yield, kg 4%; 305 days pp	41	16	25	15	29	14
Milk yield, 305 days, less than 16 kg, % animals	41	39* (9)	25	56* (16)	29	48* (23)
Dry cow period shorter than 50 days	35	57**	20	55**	25	36**
Dry cow period longer than 70 days	35	17**	20	40**	25	40**
SCC, early lactation	49	335* (50)	39	347* (100)	44	385* (150)
SCC, late lactation	29	307* (100)	8	304* (150)	11	392* (200)
% Milk fever treatment	60	0	41	2* (1)	57	5* (1)
% Ketosis treatment	57	0	41	0	56	0
% disease treatments earlier than 50 days pp	57	18	41	17	56	41
% disease treatments later than 49 days pp	46	15	27	7	41	20
% complicated calvings	62	8	42	17* (5)	57	19* (5)
% stillborn calves	62	5	42	17* (5)	57	18* (5)
Age in months, 1st calving (variation)	62	28 (8)	42	28 (5)	57	27 (6)
% culled 0-50 days pp	57	5* (2)	41	0	56	9* (2)
% culled 51-150 days pp	49	8* (2)	31	3* (2)	45	9* (2)
% culled >150 days pp	41	20	18	39	31	39

*) = different from standard recommendation according to Enevoldsen, which is shown
**) = standard recommendation according to Enevoldsen is 15% less than 50 days and 15 % longer than 70 days.

Table 2. Second dairy farm: Torkild Gjaldbæk - Presentation of some key figures on production, disease and culling.

Parametre	1st lactating cows		2nd lactating cows		3rd lactating cows	
	No.	Median	No.	Median	No.	Median
Milk yield, kg 4%; top yield	61	25	51	29	28	29
Top milk yield, relative	61	86* (75)	51	100* (93)	28	100
Milk yield, kg 4%; 305 days pp	46	23	36	21	10	23
Milk yield, 305 days, less than 16 kg, % animals	46	7	36	19* (16)	10	0
Dry cow period shorter than 50 days	63	3	27	4	10	0
Dry cow period longer than 70 days	63	17**	27	48**	10	0
SCC, early lactation	58	135* (50)	51	305* (100)	28	568* (150)
SCC, late lactation	14	150* (100)	11	377* (150)	3	433* (200)
% Milk fever treatment	69	0	63	0	35	6* (1)
% Ketosis treatment	66	11	62	13	31	6
% disease treatments earlier than 50 days pp	66	14	62	8	31	10
% disease treatments later than 49 days pp	51	16	42	5	20	0
% complicated calvings	71	25* (10)	64	6* (5)	37	11* (5)
% stillborn calves	71	25* (7)	64	5 (5)	37	5 (5)
Age in months, 1st calving (variation)	71	26 (5)	64	27 (7)	37	28 (6)
% culled 0-50 days pp	66	6* (2)	62	13* (2)	31	3* (2)
% culled 51-150 days pp	52	4* (2)	48	4* (2)	22	32* (2)
% culled >150 days pp	41	27	32	25	6	33

*) = different from standard recommendation according to Enevoldsen, which is shown
**) = standard recommendation according to Enevoldsen is 15% less than 50 days and 15 % longer than 70 days.

Table 3. For information, the levels from a huge number of Danish farms participating in this kind of health advisory service is given.

Parametre	Level of parametres from conventional and organic Danish dairy herds participating in this kind of advisory service (October 2001)		
	(25-75)% percentiles, 1st lact.	(25-75)% percentiles, 2nd lact.	(25-75)% percentiles, 3rd lact.
Milk yield, kg 4%; top yield	23-27	29-33	31-35
Top milk yield, relative	73-79	91-97	100
Milk yield, kg4%; 305 days pp	19-23	18-22	17-22
Milk yield, 305 days, % cows with less than 16 kg	4-17	11-33	13-35
Dry cow period shorter than 50 days	23-56	19-49	19-48
Dry cow period longer than 70 days	7-27	11-35	12-36
SCC, early lactation	112-193	164-303	267-450
SCC, late lactation	131-218	193-327	271-439
% Milk fever treatment	0	0-2	4-14
% Ketosis treatment	0-1	0-2	0-4
% disease treatments earlier than 50 days pp	17-35	17-34	29-49
% disease treatments later than 49 days pp	14-31	16-35	18-37
% complicated calvings	10-18	6-13	8-14
% stillborn calves	9-16	4-10	5-10
Age in months, 1st calving	27-29	27-28	26-28
% culled 0-50 days pp	2-7	1-6	3-8
% culled 51-150 days pp	3-8	3-10	5-13
% culled >150 days pp	11-21	17-30	24-38

Farmer 3 – Søren Bak, is an organic pig producer. He has – together with his veterinarian – participated in a study from 1997-1999, where DIAS was involved in making health recordings through clinical evaluations of groups of pigs in his herd. Even though these recordings are relatively old, some of them will be presented to give food for discussion and thoughts about the development in the herd. Søren Bak started his experience with organic pigs in a large co-operative organic farm with 9 owners and a wide spectrum of production activities. In 1997, he bought a farm in West Justland, where he keeps 60 sows with fattening pigs – where it can actually be relatively difficult to keep animals because of large wet areas. In a Danish context, where organic pig production has been difficult to start and organise, Søren Bak has been one of the very innovative farmers in organic pig production, building up his farm using experience from all sources and his own ideas – trying to use different possibilities, such as having a local company to stir boil potatoes for the pigs. Sows are kept in separate farrowing pens (in nature they would also withdraw themselves from the flock), and fattening pigs are raised in deep litter under roof (which has been very much under debate previously, whether it could be defined as 'outdoor' – it must be changed during the following year, even though this system seems much more attractive than the system, he has in older buildings, which are accepted according to the organic standards, but where space, air and light are much more sparse). During the visit to his farm, discussions came up about the feeding system in his herd, and what to define as 'roughage' – the general conclusion between the participants having insight into feeding agreed that there was basis for improvement of his feeding systems.

Providing some background information about Danish organic dairy and pig production

Organic dairy production

In Denmark, we had governmental legislation from 1987, and EU-legislation since August 2000. Organic dairy production has increased rapidly over the past few years. During a 5 year period, the number of organic dairy herds increased from 132 to 722 in December 2000 (almost stagnating from 1999 till now). Now, organic milk comprises approximately a fourth part of the Danish milk for consume, and approximately 7% of the total amount of milk received at the dairies from farms. Organic dairy herds are in generally relatively big; in average 87.3 cows per year in herds with dual purpose breeds, and 74.9 in Jersey herds, where it was (on average) 65.7 cows per year in 2000 in Danish dairy herds in general. The milk production per cow is in average approximately 7500 kg milk on average (4% fat content) for dual purpose breeds, and around 6500 kg milk (4% fat content) for Jersey cows. The total amount of organic milk was 333 million kg in 1998 (in Denmark), where it was 39 million kg in 1993! In the dairy herd, mastitis is definitely the most dominating disease problem. Risk factors connected to the environment, the organic rules and the structure of organic milking herds can be mentioned – and in each case, more of these will most likely be involved, since the causal background for mastitis and udder health problems definitely is very complex.

Table 4. Some 'summaries' describing clinical observations in the herd of Søren Bak during the period from 1997-1998. Tables (in Danish) can be presented if more interested. The results come from clinical observations and examinations in the herd every 6th week by either Mette Vaarst and Peter Høgedal (a Danish pig production second opinion vet, who acted as a 'teacher' during this period), or Randi Worm, who is the practicing vet in the herd.

Pregnant sows	Body condition score varies over time, but in general are 2/3 described as being 'appropriate' (BSC=3) or more. In general, a negative effect of 7 weeks with piglets could not be found in these herds. Very few with leg disorders, 0-5% per observation – except from one time in May 1998, where 22% were lame and the claws were found in bad condition. 0-41% had skin traumas, depending on how long they had been together. The boar made some of them, and the hierachy making also caused some wounds – they were normally relatively harmless and small.
Sows with piglets	43-100% in BCS=3 or more, except from February 1998, where they were very slim (90% less than BCS=3); the art of feeding in cold weather! Very few with leg problems. From 8.5-12.8 piglets were observed per sow (the figures from the herd in this period were 10.7 live-born pigs and 9.3 weaned pig per sow). Some diarrhoea cases and relatively many skin traumas were observed among piglets --- skin traumas were of mild character and a result of play between play mates. Piglets were often observed in flocks running around on a big area outside the pen, but very little cross suckling was suspected – seemed as piglets returned to each their 'home'.
Fattening pigs, newly weaned	From 0-9% with remarks, mostly 'depressed' (which meant that they were slow, preferred to lay down and kept away from the flock). Few (1-3%) observed with diarrhoea, and 0 with signs of respiratory disease except from one time, where 11% showed signs (cough, dyspnoe).
Fattening pigs, approx. 50 kg	0-12 % with signs on diarrhoea. Up to 12% with 'other remarks' than diarrhoea or respiratory signs --- most of them were remarked because of 'saddle back'.
Fattening pigs, close to slaughter	Up to 11% with remark 'depressed', no respiratory signs, or signs of diarrhoea.

Danish organic pig production: aspects and development over the past years

Organic pig production is a growing field, but not rapidly. Where it has been relatively easy to create a market for milk and other kinds of food – such as vegetables and bread – the meat distribution and sale has had hard times, and there still seems to be 'bottle necks' in more places in the system. In 1997-1998, a small project was carried out regarding health and disease problems in organic pig herds. We had decided that it should take place in pig herds with at least one full time job, which we estimated to 60 sows. We intended to find 8 to10 herds - but could only find 4 herds, one of which was only at 40 sows at the time, we started the project. This examples may give an idea about the current status: organic pig production is still collecting experience and gaining land. Quite a lot of the pork is distributed via the company 'Free Land Food', which sells from both non-organic and organic herds keeping the sows outdoor. In Denmark, organic sows can be nose-ringed, which is seen – from many points of view – as a necessary step in order to protect the environment and the ground water, via protection of the grass cover in the fields. Most pigs are vaccinated – which may not be necessary in most of the time, but WHEN a disease outbreak is seen, it may have huge consequences. Weaning is normally taking place in 7 to 8 weeks of age, and some herds have the routine to move the sows and let the piglets stay at the area for another 1 to 2 weeks, before they are moved to indoor pens with outdoor areas (normally relatively little runs). There are lots of challenges in the organic pig production – given that there is a market.

In summary about the disease situation, experiences from the relatively few projects in Danish organic pig production has shown a very good health in the outdoor sow herds, with very few infectious diseases. Reproduction problems have been observed in some herds – at times suspected to be a management problem, where it is difficult to observe the sows and make them come in heat after the 7 to 8 weeks with the piglets. Leg disorders are the most prominent 'failure', and it is most prominent at the times of the year where it is raining and freezing with short intervals – because the outdoor areas are difficult to keep under those conditions, especially around feeding and water troughs. There are generally too many stillborn and/or dead piglets – not more than in non-organic herds, but still too many – especially under those 'good production conditions' for sows and piglets.

Health condition among piglets in the projects so far shown to be very varying! It depends on the buildings and the management – a lot of piglets are grown in old buildings, and it is not optimal to the relatively large groups of growing animals. One problem is the access to the outdoor little yards – which the buildings were definitely not designed for. The climate in the indoor pens can be of varying quality because of 'strange wind conditions'.

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