

Herd health management in organic pig production using a quality assurance system based on Hazard Analysis and Critical Control Points

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Abstract

Health and welfare problems in organic pig production may differ from problems in conventional pig herds as a result of differences in management. Control of animal health problems in organic herds is affected by the restrictions in medicine use and prophylactic medication as well as by the risk of wildlife contact and difficulties in cleaning and disinfection imposed by the access to outdoor areas. To monitor risk factors for diseases and to control these risk factors as a means to prevent diseases, we suggest the implementation of health management based on Hazard Analysis Critical Control Point (the HACCP concept). The development of a HACCP system requires the quantification of risk factors by means of epidemiological studies or alternatively by an expert panel. This paper describes a procedure for developing a HACCP system for welfare problems in organic sow herds. A panel of farm advisers assessed the impact of different risk factors on problems in organic pig production and suggested possible control points. Further work concentrates on evaluating the control points and drawing up action plans to include in the system. The advantage of HACCP in herd health management is the preventative approach focusing on risk factors. Additionally, the continuous documentation of observations and corrective actions integrated in the concept is important when evaluating the herd health management.

Additional keywords: animal health, organic farming, HACCP, monitoring system

Introduction

The consumers of organic pork associate organic pig production with a high standard of animal health and welfare and with a high degree of food safety. The development

of organic pig production in the European Union is affected by EU-regulation 1804/1999 (Anon., 1999). This EU-regulation, which was implemented in 2000, provides a framework for animal health and welfare management in organic pig production.

Pigs in organic production systems benefit from a low animal density, and good possibilities for expressing normal behaviour such as locomotion, foraging, exploration and nest building. Organic pig production furthermore differs from conventional production in terms of e.g. feeding, access to outdoor areas, weaning age and use of preventive medication. It is therefore likely that the health and welfare problems in organic herds are different from those in conventional production systems. Improved management in the individual herd may reduce problems, and in order to ensure a high level of animal health and product safety it is necessary to be able to monitor and assess any risk factor present. This is relevant, especially to organic producers as the organic guidelines encourage control of disease and welfare problems by means of prophylactic measures.

In general the infection level of parasites and pathogenic bacteria, the severity of infections, and the effects of infections on production and animal welfare depend on management. The experiences with organic production systems are scarce, and management routines develop in a 'trial and error' manner on each farm. An international group of scientists in a EU-network for animal health and welfare in organic agriculture has evaluated the consequences of EU-regulation 1804/1999 on animal health and welfare in organic livestock production. When specifying further research required they give top priority to research that "maximizes the potential of management strategies for disease control" (Padel & Keatinge, 2000). So there is a need for developing effective management strategies to facilitate a high level of animal health and food safety in sustainable organic pig production and to develop tools for operational management. The purpose of this paper is to present the current status of animal health and welfare in organic pig production and furthermore to suggest a management system based on the quality assurance scheme Hazard Analysis Critical Control Points (HACCP).

Health and welfare in organic pig production

Organic pig production is a small-scale system compared with organic milk production. The system can vary from country to country. Yet, the knowledge of animal health and welfare in existing systems is scarce (Thamsborg *et al.*, 2004).

In a case study on four organic farms, Vaarst *et al.* (2000) observed that lameness was a common clinical disease in sows, and that respiratory diseases and parasites caused problems in some herds with fattening pigs. Hansson *et al.* (1999) found significantly less chronic pleuritis and more leg problems in organic pigs than in non-organic pigs. In a recent Danish case study by Bonde *et al.* (2004) that included four organic fattening herds, diarrhoea, lameness, respiratory disorders and skin lesions were the more frequent clinical problems. Besides, parasitic liver damage, abscesses and respiratory diseases were the predominant remarks from the abattoir. Health and

welfare problems in organic sow herds also have been the focus of a survey by Bonde & Sørensen (2003) using questionnaires. In this study, veterinarians and production advisers with experience in organic pig production reported that poor body condition and reproduction problems were frequently occurring in sows, and stone chewing in pregnant sows. The prevalence of leg disorders and other clinical diseases in outdoor herds might be under-estimated due to difficulties in diagnosing the problems in extensive production systems. Diarrhoea was the major health problem in weaned pigs. Crushing or trauma inflicted by the dam often caused injuries to suckling piglets, whereas insufficient supervision and disease treatment, disturbances and trauma from predators, and unsuccessful nursing were perceived as other causes of welfare problems.

Endoparasites are considered as one of the major constraints on welfare in organic pig production (Nansen & Roepstorff, 1999). Normally, the infections are subclinical, primarily reducing the feed conversion rate and causing poor growth rates (e.g. Hale *et al.*, 1981). *Ascaris suum* causes condemnation of the liver due to migrating larvae. The development and survival of infective parasite stages and thus the helminth transmission rates are markedly increased when the pigs have access to outdoor areas or when they are housed on deep litter, especially because routine medical prophylaxis is prohibited. Furthermore, organic diets with high levels of insoluble dietary fibre and a relatively low digestibility may favour establishment and fecundity of worms (Petkevicius *et al.*, 1996; 1999). Two Danish surveys showed high prevalences of helminth infestations in organic outdoor pig production systems (Roepstorff *et al.*, 1992; Carstensen *et al.*, 2002). Also Leeb & Baumgartner (2000) reported that endo- and ectoparasites were the main problem in organic herds, whereas Vermeer *et al.* (2000) found that endoparasites and post-weaning problems were health problems of concern. Roderick & Hovi (1999) conducted a questionnaire survey reporting a low level of diseases in organic pig production in general. Parasites were the biggest problem according to the survey, whereas diarrhoea and respiratory diseases were seen as minor problems.

Outdoor pig production units may attract rodents such as rats and mice (Leirs *et al.*, 2004; Pelz & Klemann, 2004). Rodents may serve as an important reservoir of pathogens such as different species or strains of *Salmonella*, *Leptospira*, *Yersinia*, *Brucella suis*, *Erysipelothrix rhusiopathiae*, and *Brachyspira hyodysenteriae* (see e.g. Feenstra *et al.*, 2000). Arthropod pests, particularly ectoparasites, may cause similar problems. Hald *et al.* (1999) compared intensive indoor systems, conventional outdoor systems, and organic pig farms in relation to the level of *Salmonella* infections. Based on serology of meat juice they found no differences between organic and conventional production. However, the number of organic farms in the study was very small.

Compared with traditional indoor pig production, the different disease and zoonoses pattern in organic pig production calls for different priorities in the prevention and treatment of health problems. It is difficult to clean outdoor areas for pathogens, and options such as the use of organic acids in the feed to prevent *Salmonella* are not possible. Prophylactic treatment with anthelmintics and antibiotics is forbidden, and there are limitations on the number of times an organic animal can be treated with allopathic medicine and still preserve its organic status. Alternative treat-

ments of the animals should be considered as first choice in case of disease, and the withdrawal period for antibiotics or anthelmintics is considerably longer than in non-organic production. So the conditions for managing health and food safety risks in organic pig production are different from other pig production systems.

Herd health management by means of a HACCP-compatible system

The development of strategies for preventing diseases and zoonoses needs taking into account the complex interaction between diseases, production systems, and management that prevail in organic pig production.

In veterinary epidemiology, methods have been developed for risk management on a livestock farm. Hazard Analysis Critical Control Points (HACCP) is a risk analysis concept that was originally developed in the 1970s by the food industry to ensure product safety. The National Advisory Committee on Microbiological Criteria for Foods (NACMCF) of the U.S. Department of Agriculture has described the standard for the HACCP concept (Anon., 1997). The HACCP system integrates epidemiological risk assessment and qualitative control procedures. Intervention is directed towards the risk factors rather than focusing on the problem, and its potential value for health management in various livestock production systems has been extensively discussed (Pierson, 1995; Noordhuizen & Welpelo, 1996; Cullor, 1997; Noordhuizen & Frankena, 1999; Mousing, 2000).

The major elements in a HACCP are listed in Table 1: identification of the hazard, identification of risk factors associated with the hazard, identification of critical control points (CCPs), and a description of an on-farm monitoring network for CCPs. Besides, the HACCP system must include action plans in case the critical limit for a CCP is exceeded. Critical control points indicate the presence of a risk factor, and identification and quantification of risk factors and description of CCPs are important elements of the HACCP system. The CCPs must be measurable on-farm; they form the core of the monitoring system. A CCP monitoring programme can be used in the day-to-day farm management and may also produce documentation on disease and food safety risks on a certain farm.

The management strategies need to be based on relevant knowledge and experiences. The relative risk or odds ratio for every risk factor should be quantified.

Table 1. Elements of a HACCP system.

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- Identification and quantification of risk factors for the problem.
 - Identification of critical control points (CCP) for the risk factors.
 - Establishing alarm values for the individual CCPs.
 - Description of monitoring systems for CCPs applicable in the individual herd.
 - Preparation of action plans in case of exceeded alarm values.
 - Preparation of an efficient and user-friendly documentation system for the HACCP programme.
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A source of information is the scientific literature on risk factors and effects of the disease in question and on effects of specific options for prevention and treatment. A major problem with this source in relation to organic pig production is that published research results based on relevant organic conditions are scarce. Field studies or surveys based on cross-sectional data (often questionnaires) are a typical source of information in veterinary epidemiology. Almost all information on health and welfare problems in organic pig production is derived from field studies. A problem in relation to organic pig production is that there are so few organic pig producers that it is difficult to do a survey with a satisfactory number of observations (farms). For some management aspects it may be possible also to include conventional outdoor sow production systems to obtain a sufficient number of farms.

In situations with little published information it is often valuable to consider expert opinion studies (Noordhuizen & Welpelo, 1996). There is an increasing interest among epidemiologists in using expert opinions in a systematic manner for quantification of parameters that are difficult to estimate directly from empirical data. Expert panels have been used for quantifying risk factors for contagious diseases such as swine fever and foot and mouth disease (Horst, 1998) as well as for bovine respiratory disease (Van Der Fels-Klerx *et al.*, 2000) and *Salmonella* infections in pigs (Stärk *et al.*, 2002). Besides, a possible application for expert opinion studies is the evaluation of the relevance of various alternative control options and control strategies applied in a livestock herd (Sørensen *et al.*, 2002).

Questions relevant to management strategies can be studied in classical experiments, which can be conducted on private farms, on research stations or in laboratories. For clarification of many questions related to management it is important to do on-farm experiments in order to obtain relevant management conditions (Sørensen & Hindhede, 1997).

How to develop a CCP protocol for organic sow herds? An example

Poor body condition and leg disorders have been identified by farm advisers as important welfare problems of organic sows, whereas crushing/trauma and diarrhoea were identified as the most common welfare problems of suckling and weaned pigs, respectively (Bonde & Sørensen, 2003). In a follow-up series of questionnaires the farm advisers identified the risk factors for these health and welfare problems, scored the factors on a 5-point scale for relevance and then suggested possible Control Points. Relevant risk factors in a HACCP system should be important for the occurrence of the problem, and the factor should be sensitive to changes in operational farm management routines.

Risk factors for poor body condition in sows were identified as mainly feeding-related (Table 2). Possible control points measurable on-farm concerned the feed, feeding system and grouping of sows.

Important risk factors for leg problems in sows were related to the animal (leg strength and activity) and conditions of the surface area (Table 3). Potential control

Table 2. Important (relevance 3–5) risk factors and potential control points for poor body condition in sows. The relevance of risk factors is scored by experienced farm advisers on a 5-point scale¹ and presented as the median score.

Risk factor	Relevance ¹	Potential control points
Competitive feeding systems or restricted access to feed	4	Feeding space per sow Feeding-related aggression Group composition Actual amount of feed provided
Poor feed quality	3	Energy, protein and vitamin/mineral content in feed Control of feed mixing equipment Percentage returns-to-oestrus

¹ 1 = not relevant; 2 = aggravates problem; 3 = contributory cause; 4 = considerable cause; 5 = main cause.

Table 3. Important (relevance 3–5) risk factors and potential control points for leg problems in sows. The relevance of risk factors is scored by experienced farm advisers on a 5-point scale¹ and presented as the median score.

Risk factor	Relevance ¹	Potential control points
Genetic factors affecting leg strength	4	Assessment of leg conformation in replacement gilts Control of sow breeds employed
Diseases in legs and hooves	4	Hoof examination focusing on lesions Lameness Disease treatments Reports from the abattoir Regular control of hoof length
Ground condition in outdoor areas	3	Assessment of the outdoor area Strategy for moving feeding area
Aggression and mounting in mating area	3	Skin lesions Area per sow Group size Flooring

¹ 1 = not relevant; 2 = aggravates problem; 3 = contributory cause; 4 = considerable cause; 5 = main cause.

points suggested were leg conformation in replacement gilts, hoof examination, assessment of the outdoor area and sow conditions in the mating area.

The expert panel suggested risk factors for the crushing of piglets (Table 4). Possible control points are focusing on aspects of the bedding material, indications of environmental disturbance and sow condition.

The risk factors suggested for diarrhoea in weaned pigs were related to feed quality

Table 4. Important (relevance 3–5) risk factors and potential control points for crushing of piglets. The relevance of risk factors is scored by experienced farm advisers on a 5-point scale[†] and presented as the median score.

Risk factor	Relevance [†]	Potential control points
Several gilts per hut	4	Several animals per farrowing pen
Disturbance from predators	3.5	Insufficient fencing
Type of bedding	3	Type, amount and quality of the straw bedding
Restless sow	3	Straw bedding messed up The sows being nervous at inspections Location of hut in pen Timing of introducing the sow in the farrowing pen
Poor milk production – mothering ability	3	Thriving of the piglets Crushed piglets in previous litters Disease treatment of the sow
Litter size	3	Litter size

[†] 1 = not relevant; 2 = aggravates problem; 3 = contributory cause; 4 = considerable cause; 5 = main cause.

Table 5. Important (relevance 4–5) risk factors and potential control points for diarrhoea in weaned pigs. The relevance of risk factors is scored by experienced farm advisers on a 5-point scale[†] and presented as the median score.

Risk factor	Relevance [†]	Potential control points
Filthy outdoor area	5	Assessment of outdoor area Cleanliness of the pigs
Filthy indoor area	4.5	Condition of resting area – dry bedding Cleanliness of pigs
Insufficient cleaning between batches of pigs	4.5	Cleanliness of empty pens between batches of pigs
Filthy wallowing holes	4	Strategy for moving wallowing holes Use of wallowing holes
Poor feed quality	4	Control of feed mixture – proteins and amino acids Control of mixing equipment Daily gain, meat percentage, leg problems

[†] 1 = not relevant; 2 = aggravates problem; 3 = contributory cause; 4 = considerable cause; 5 = main cause.

and hygiene (Table 5). So control points are related to the feed mixture and to the cleanliness of animal facilities.

The selection of CCPs relevant to the welfare problems must rely on an evaluation of risk factors present in the individual herd. The selected welfare problems – poor

body condition and leg problems in sows, crushing of piglets and diarrhoea in weaned pigs – are all multifactorial in nature, so that their complete eradication is not likely to happen by controlling some of the risk factors by for instance a HACCP programme. But a reduction in the incidence of problems should be achievable.

The HACCP system is currently being adapted as a possible management tool in organic sow herds. The suggested control points are being evaluated, critical limits are estimated and action plans are drawn up in case of problems. The applicability of the system and its potential as an on-farm decision support tool will be evaluated through an international questionnaire targeting organic farmers.

Discussion

Disease prevention is a key point in organic livestock production. Health management by identifying and controlling the level of risk factors may therefore be particularly relevant to organic farmers (see also Arsenos *et al.*, 2004). HACCP systems are characterized by continuous monitoring of the risk factor level in the operational health management on-farm. Instead of such monitoring the routine control of risk factors like hoof trimming at regular intervals to prevent hoof disorders causing lameness may be an option. Other options could be to breed for disease resistance or, in general, choosing more robust breeds in the production system. The general health status in the herd might also be improved by implementing Good Farming Practice codes emphasizing e.g. sanitary measures, quarantine facilities for recently purchased animals as well as good rodent management measures (see Meerburg *et al.*, 2004). Disease monitoring by means of abattoir recordings or regular blood or faeces sampling, followed by standard corrective actions in case of problems may be another way of health management. However, in this case problems have already developed possibly resulting in noticeable consequences for animal health and welfare, food safety or production.

Health advisory agreement plans involving the veterinarian or other farm advisers could also be part of the herd health management system, and could be constructed as a HACCP programme as well. The adviser may focus on general risk factors such as feed quality, for example by analysing feed samples. Problems are dealt with by context-specific advice on corrective actions, preferably before the onset of disease outbreaks in the herd. However, the adviser must regularly monitor the level of disease in the herd to evaluate the efficiency of the health management programme.

Health plans describing and documenting the course of action in case of problems are important in herd health management. The HACCP concept is suitable for this purpose as well.

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