Knowledge synthesis: Animal health and welfare in organic pig production

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This project is one of the eight research pilot projects selected in 2007 for transnational funding by the partners of the CORE Organic ERA-net project. The pilot projects, which are running in the period 2007 – 2010, are:

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Summary

This report reviews the available information on the welfare of pigs when maintained according to organic standards in Europe.

Across different European countries the proportion of pigs managed organically ranged in 2007 from 0.1 to 1.6% of the national pig production. Although all production is governed by *COUNCIL REGULATION (EC) No 1804/1999,* the typical housing and husbandry systems vary between countries as a result of differences in national legislation, certification body standards and climatic conditions. Thus some animals are kept in extensive, pasture based systems whilst others are housed with simple outdoor concrete runs.

There is very limited information on the health and welfare of sows in organic production systems. They have more behavioural freedom, but may be exposed to greater climatic challenges, parasite infestation and risk of body condition loss. General risk factors for health and welfare conditions can be extrapolated from knowledge gained in conventional systems. Issues with particular importance for organic production include outdoor access, roughage feeding, later weaning, less sophisticated diets and lack of good health management strategies.

Health, welfare and production problems of organic suckling piglets are also poorly known due to a lack of information in commercial farms. Organic farms are often characterized by a relatively low level of human intervention on animals around birth as well as by a low level of control of the environment of the animals, including microclimate, germs and parasites. It seems that piglet mortality is relatively high in organic farming but with a high variability between farms suggesting that improvement is easily feasible. Issues with particular importance for organic production are (a) control of the microclimate surrounding neonatal piglets, (b) management strategies to decrease the risks of germ and parasite infections, (c) selection of genotypes adapted to organic farming with special emphasis on robustness.

Diseases around weaning are multifactorial in nature. In general, not one but several factors are in place, simultaneously imposing stressors at weaning. The number of possible combinations of stressors, which additionally vary considerably in the possible extent and pathogenic capacity, are unlimited. The identification of main stressors supports the interpretation of the distress response of piglets in the specific farm conditions. However, trying to disentangle the various factors by a mono-causal approach can much diminish the combined response.

The use of antibiotics in herds with organic fattening pigs is lower compared to herds with conventional pigs. This is probably a result of the alternative system leading to a lower infection level, since no difference in mortality pigs could be discovered. The increased exposure to factors such as transporting and mixing pigs, especially in combination with a lack of age segregated housing, may increase the risk of respiratory diseases in organic pig farming. However, slaughter data indicate that organic pigs have fewer respiratory problems, skin lesions (including abscesses and hernias) and tail wounds compared to conventional pigs. On the other hand white spot livers and joint lesions are more common among organic pigs. The most important health concern among organic farmers seems to relate to endo- and ectoparasites.

In general there are many different methods, parameters and data to measure and to monitor animal health and welfare. The challege is for most countries to combine and link different

sources in order to make good use of available information. Abattoir data are very often not fed back to farmers and very few veterinarians review medicine records, which could be used for monitoring and improvement strategies. Also most veterinarians use an “emergency approach” mostly dealing with acute diseases rather than preventative strategies. There are many challenges related with monitoring systems, in order to reflect the “real” situation.

The information gathered in this review formed the basis for the subsequent development of tools for use in a HACCP based management and surveillance system for organic pig herds. These tools will assist the organic pig farmer to prevent selected pig diseases and welfare problems by monitoring and controlling the risk factors.

Introduction

This report reviews the available information on the welfare of pigs when maintained according to organic standards in Europe.

It begins by overviewing the populations of organic pigs in different countries at the time of writing (2007), the organic standards which govern their management and the systems in which they are typically kept.

It then reviews for each stage in the production cycle (sows, suckling piglets, weaned pigs and fattening pigs) the available literature on health and welfare problems which might be experienced by the animals and the hazards which might give rise to these problems. Hazards with the potential to give rise to sow health and welfare problems were initially identified by an expert group workshop within the COREPIG project. Where data gathered specifically on organic pigs relating to these hazards were found to be scarce or lacking in the available literature, relevant information has been identified by extrapolation of knowledge from conventional production systems. In this case, the extent to which these hazards differ between organic and conventional systems is considered, and the likely consequence for the animals highlighted.

Finally the report reviews the methods current available for the measurement of pig health and welfare and the extent to which monitoring systems currently exist in different countries, or might be developed.

The information gathered in this review formed the basis for the subsequent development of tools for use in a HACCP based management and surveillance system for organic pig herds. These tools will assist the organic pig farmer to prevent selected pig diseases and welfare problems by monitoring and controlling the risk factors. Further details can be found on the COREPIG project website http://www.icrofs.org/coreorganic/corepig.html

Chapter 1

Description of organic production systems in Europe in 2007

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1.1 Organic Farming in Europe

Since the beginning of the 1990s, organic farming has rapidly developed in almost all European countries. At the end of 2006, almost 7.5 million hectares were managed organically by more than 200,000 farms in Europe. In the European Union (EU-27), almost 6.9 million hectares were under organic management by the end of 2006 (180,000 organic farms), constituting 4 percent of the agricultural area. In many countries, higher shares are achieved (Austria 13%, Switzerland 12%, Latvia 10%). The European country with the highest number of farms and the largest organic area is Italy (more than one million hectares) (Willer et al., 2008).

In Europe, during 2006 organic land increased by almost 570,000 hectares (+8 percent), and in 2007 growth continued. The increase is due to high growth rates in the new EU member states (for instance Lithuania and Poland) as well as substantial increases in Italy and Spain. Support for organic farming in the European Union includes grants under the European Union's rural development programs, legal protection under the recently revised EU regulation on organic faming (since 1992) and the launch of the European Action Plan on Organic Food and Farming in June 2004. Many European countries that are not EU members have similar support.

The European market is estimated to have reached approximately 15 billion Euros in 2006, and it continued to grow in 2007. The largest market for organic products is Germany with an annual turnover of 5.3 billion Euros (2007), followed by the UK (2.8 billion Euros in 2006) and by France (2 billion Euros in 2007). The highest market share of organic products of the total market is in Austria with 5.4 percent (2007), and the highest per capita consumption is in Switzerland with 104 Euros (2007). Currently the European market grows by 15 % annually and some countries are experiencing shortages of supply (Willer et al., 2009).

1.2 Organic pig production in different European countries (Database 2006/2007)

The following section provides an overview about organic pig production in the countries participating in the COREPIG project.

1.2.1 Austria

Amount/Structure
There are still many small farms with up to 15 sows only (208 farms), although there is a steady increase of medium sized farms with up to 30 sows (33 farms) and even larger farms with more than 30 sows (30 farms). The total number of organic pigs is 49,627 on 5,101 farms. On average each pig farm has 9.7 pigs (BMLFUW, 2009).

Market
The market is approx. 50,000 finished pigs per year. There are two main marketing groups (EZG BioSchwein Austria, Pannonia BIOS). The proportion of organic pigs is 1.63 % of total pigs slaughtered.

Housing, management and systems description
Pigs are housed mainly indoors with a concrete outside run. Existing buildings without an outside run have derogation until the end of 2013. There are few outdoor farms. The majority of farms wean at 42 days of age.

Sows in gestation are kept in indoor group pens with a concrete outside run. There are mainly individual farrowing systems indoors (FAT2 pens). Half of the farms have group suckling systems after approx. 2 weeks in individual farrowing systems. Weaners are kept till a weight of 25 - 30kg in indoor pens with concrete outside runs, and fattening pigs are also indoors (various systems) with a concrete outside run.

Feeding
Mostly more than 50% home grown feed is used, in many cases protein (potato-protein) is purchased and limited to 10% conventional feed. No fishmeal is used.

Main health problems
One study (Leeb et al, 2001) on 30 organic breeding units and 30 finishing farms (Gruber, 2001) found in general comparable health and welfare of organic pigs with conventional pigs. Organic pigs had better lung scores compared to conventional pigs but more endo- and ectoparasites.

Relevant Differences to EU regulations
Number of treatments in finishing pigs: there are two "productive lifecycles" defined (from birth to 30kg and from 30kg to slaughter)- in each period animals can be treated once.
No fishmeal and no nose rings allowed for BioAustria farms.

1.2.2 Denmark

Amount/Structure
The Danish Advisory Service guesses that 90 % of all organic pigs farms have both sows and fattening pigs, while less than 5 % of herds have only sows and piglets, and less than 5 % of

herds have only fattening pigs. Over 90 % are integrated farms. In 2007 there were 68 organic pig farms with less than 40 sows (23 % of production); 11 farms with 40-69 sows (11% of production); 16 farms with 70-199 sows (21 % of production); 12 farms with 200-499 sows (40 % of production) and 2 farms with 500-799 sows (6 % of production) (Kledal, 2007)

In 2006 a total of 65,300 organic slaughter pigs and 20,950,000 conventional were produced, giving a production of 0.3 % organic pigs compared to conventional pigs. The organic pig production is increasing, with an expected production of 120,000 slaughter pigs in 2008 (Statistics, Denmark).

Market
About 60% percent of the Danish organic pig production is exported (Kledal, 2007). The market share of organic pigs is about 0.3 %.

Housing, management and systems description
All farrowing sows and piglets are outdoors on pasture all year in individual paddocks with huts. The pregnant sows have to be on pasture for a minimum of 150 days. Some farmers keep the pregnant sows on pasture all year, while others have deep litter systems with outdoor access during winter. Regarding weaning and fattening pigs, most are indoors with concrete outdoor runs, but some farmers keep the pigs on pasture for varying periods after weaning (to prevent diarrhoea) before taking them indoor at 30-85 kg for finishing. Fatteners are kept like weaners without kennelling till a weight of 90-100 kg. The earliest weaning age is 49 days

Feeding
The farmer can use 10 % approved non-organic feedstuffs and feed supplements (Plantedirektoratet, 2008). No GMO feeds are allowed.

Main health problems
Sow problems are poor body condition, reproductive problems and leg problems. For weaning pigs problems are diarrhoea, arthritis and parasites. For fattening pigs, the main problems are skin lesions, poor body condition, respiratory problems and parasites.

Relevant Differences to EU regulation
Sows in gestation must have access to pasture for 150 days a year. In the lactation period sows must have access to pasture. Weaning age must be greater than 7 weeks.

1.2.3 Finland

(Finland participated only in the initial stages of the project)

Amount/Structure
There are nine herds with organic sows, with an average of 37.3 sows per herd. Eleven herds have finishing pigs with an average of 170.2 pigs per herd. Conventional breeds are used mainly (Finnish Landrace and Yorkshire).

Market
The market is very small. The proportion of organic pigs is about 0.13 %.

Housing, management and systems description

Farrowing, weaning and fattening take place indoors with an outdoor run. An outdoor run is not necessary for finishing pigs in the last 1/5 of their lifetime or sick animals or lactating animals, or if weather is not convenient, but then the owner needs to record the time spent inside. A maximum of 75% of the outdoor run can have a roof. The pigs need to have daily access to outdoors during May to October.

Sows need to be kept in groups, except in late pregnancy or during lactation. Farrowing crates are not allowed. A certain area per pig is needed and at least 50% of the area needs to be solid floor. The minimum indoor and outdoor areas (m^2/pig) at different stages are: Sows 2.5 and 1.9, boars 6.0 and 8.0, pigs less than 30 kg 0.6 and 0.4, pigs less than 50 kg 0.6 and 0.6, pigs less than 85 kg 1.1 and 0.8, and pigs less than 110 kg 1.3 and 1.0, respectively. The earliest weaning age is 40 days.

Castration can be done without anaesthesia or analgesia up to 7 days of age.
Allowed identification methods are ear tagging, tattooing and microchipping. If the herd has problems with sow udder wounds, the teeth of piglets can be blunted by grinding when they are less than 8 days old. Artificial insemination is allowed, but other modern reproductive technologies not. A maximum of 10% of adult breeding animals can be brought into the herd from non-organic herds within a year.

There is a requirement to record all feedstuffs, fertilizers and disinfectants bought from outside the herd, information about the pigs (identification numbers of the pigs, dates of birth, bought animals, sold animals, dead animals, causes of death, medications, recording of keeping pigs outside).

Feeding

No GMO feeds are allowed. Only organic, approved feedstuffs, can be used which are mainly home grown.

Main Health problems

No research has been done, but most likely these are the same as in conventional herds. Finland is free from many infectious diseases, especially viral diseases (PRRS, TGE, SVD, PRCV, Aujeszky, swine influenza, swine fever). The country has also eradicated almost totally swine enzootic pneumoniae. For fattening pigs the main health problems are leg problems and tail biting, diarrhoea and pleuritis and for sows leg problems, fertility and PPDS.

Most farms vaccinate against parvovirus and erysipelas, some also against E. coli. Because of the freedom of many diseases, there is no need for other vaccinations. Only medicines accepted to market in Finland can be used, except homeopathic substances having less than 1/10000 active ingredient. No preventive medicines or growth promoters are allowed. Hormone treatments for regulation of reproduction are not allowed. Slaughter withdrawal time for all medications is double the time used in non-organic production. If sows are be treated more than three times a year and young pigs more than once a year, they are no longer organic pigs, but they have to start again transition to organic. Bookkeeping for medications is needed.

1.2.4 France

Amount/Structure

In 2007, the French Organic Agency (Agence Bio) showed a total number of sow herds of 250 with 4,900 sows. About 20 % of the farms have less than 10 sows, 20 % of the farms have10 – 20 sows, 60 % of the farms have more than 20 sows. 88 % of farms have more than 50 fattening pigs.

Market

The proportion of organic pigs is about 0.2 % of conventional production.

Housing, management and systems description

Pregnant sows are generally kept outdoors in huts. About 80 % of the farrowing is outdoors and 20 % indoors. Farrowing takes place in huts or stables. There can be single or group housing (about 20 %) of lactating sows. 70 % of the post weaning systems are outdoor-housing. Weaners are kept outdoors or in stables with concrete outrun till the weight of 20-25 kg. 95 % of fatteners are indoors and mostly without outdoor access till 110-120 kg liveweight. The earliest weaning age is 40 days (Repab F).

Feeding

40 % of the feed (DM) is produced on the farm. Since 2005, conventional feed is restricted to 10 %. No drugs to stimulate growth or production are allowed. No synthetic amino acids can be used, and there is a positive-list for feed additives.

Main Health problem

According to the organic advisory services of Chambers of Agriculture the main health problems are diarrhoea, injuries of the respiratory system in piglets and fattening pigs. In sows the major problems are fertility and leg problems.

Relevant Differences to EU regulations

In addition to the EC regulation, pig farming in France is under the regulation of national rules (REPAB-F from the 24 August 2000). These rules are stricter than the EC rules with the main differences as follows:

- Higher linkage between land and pig production: at least 40% (based on dry matter) of the feed provided to the pigs must be produced on the farm.
- A higher percentage of organic components in the diet: at least 90% of each diet must be from organic origin.
- Limited size of the pig farms: no more than 1500 fatteners produced/year, less than 200 sows present in the herd. (No longer a limit in size if feed is entirely produced on farm).
- More restrictive housing: slatted floors are fully banned except in mountain areas.
- Treatments against parasites are included in the number of allopathic treatments that are authorized.

1.2.5 Germany

Amount/Structure
The total number of sow herds amounted to approx. 450. 58 % of the herds keep about 10 sows, 17 % between 10 and 25 sows, 12 % between 25 and 50 sows, 8 % between 50 and 100 sows. Only 4 % of the farms own more than 100 sows.

Market
The total number of organic fattening pigs slaughtered in 2007 was approx. 200,000. The total number of pigs in Germany amounts to about 52 million, and thus organic production represents nearly 0.5 % (ZMP, 2008).

Housing, management and systems description
Pig production in Germany is mainly based on indoor housing systems, enriched with a concrete outdoor run. However, more than 50% of farms currently make use of derogation, allowing the farms to do without outdoor runs until 2013. Sows in gestation are mainly kept in groups with access to pasture or concrete outdoor run. Farrowing occurs in the stable either in pens for single sows or is implemented as group suckling. The majority of farms wean the piglets at the age of 42 days.

Allmost all weaners are kept indoors until they reach a liveweight of 20 – 25 kg. Fattening pigs are housed indoors often with outdoor runs until 115 kg liveweight.

Feeding
The feeding regime varies considerably between individual farms, ranging from purely bought-in-feedstuffs to purely home-grown feedstuffs. A remarkable variation in the composition of the single ingredients and in the portion of external supplements provides a large variation in diet composition.

Main health problems
Endoparasites, respiratory diseases, diarrhoea, and leg injuries are described as the main health problems in the case of fattening pigs. Sows are affected by MMA (Metritis, Mastitis, Agalactia), fertility disorders and leg problems. Fertility can also be a problem in terms of being too fertile (up to 18-20 live born piglets per farrowing); a high number of piglets often goes along with a high mortality rate of piglets in the first weeks. Piglet losses can be up to 25 % (Dietze et al., 2007). Both suckling and weaned piglets are suffering in the first place by diarrhoea.

Relevant Differences to EU regulation
No relevant differences.

1.2.6 Italy

Amount/Structure
In 2005 the number of herds was about 300. In 2006 the total number of organic pigs was 29,736. About 90 % of the farms have sows, piglets and fattening pigs. 10% of farms have

only fattening pigs.

Market
Organic pork is about 0.3 % of conventional pork; there are 9,205,000 conventional pigs.

Housing, management and systems description
In Italy there are different rearing systems according to geographical location. Most of the organic pig herds are outdoors and they are situated in fringe areas (hills and mountains). A small percentage of herds is situated in flat country.

Sows in gestation are kept in groups with litter and outrun. Farrowing and weaning are about 95% outdoors (in huts). Single farrowing takes place in a hut or stable (litter is recommended). Weaners are kept indoors (e.g. in a hut) with outrun, with the presence of a warm area recommended. Fattening is about 60% outdoors, with the rest indoors with an outrun. In Italy fattening pigs are slaughtered from 120 kg to 160 Kg live weight so legislation has added a minimum surface areas for fattening pigs over 110 Kg live weight which is indoor 1,6 m2/head and outdoor 2,0 m2/head. The earliest weaning age is 40 days but the mean is 45 days and often herds wean later (until 60 days).

Feeding
35% of feed must be produced on the farm or purchased in the farm district. There is a restriction to 10% conventional components until 31/12/2009 and 5% restricted conventional components after 01/01/2010.

Main health problems
The main problems for sows are mastitis, leg problems (injuries) and abscesses.
For piglets the problems are crushing and diarrhoea and for fattening pigs problems are leg problems, injuries and abscesses. Records are required on animal numbers and movements and veterinary treatments of each animal.

Relevant Differences to EU regulations
GaranziaAIAB: Farms must be totally organic and outdoors. No white pigs. Only one deworming per year is allowed. Only feeding of organic components is permitted, and 50% of feed must be produced on the farm or purchased in the farm district.

1.2.7 Sweden

Amount/Structure
The total number of herds in 2007 was 41 (from KRAV, The main Swedish organic standard, Internal statistics, 2007). 44 % of organic pig farmers have both sows and fattening pigs, and 17 % only have sows. 20 % of the sow farmers have less than 10 sows, 44 % of the farmers have 10 to 50 sows, 24 % have 51 to 100 sows and 12 % have more than 100 sows. About 37 % have only fattening pigs. Of these, 33 % have 1-100 pigs, 21 % 101-500, 24 % 501-100, and 21 % more than 1000.

Market
The Market is about 20,000 organic pigs every year. Conventional pigs are 3 million (Swedish board of Agriculture, 2006). This makes a proportion of 0.7 % organic pigs (numbers refer to slaughtered pigs).

Housing, management and systems description
The housing is mostly inside during winter with a concrete outrun. During summer the sows are outdoors in huts on pasture or in stables with access to pasture. Less than 10 % of piglets are born outside. The earliest weaning age is, according to the basic rules, 7 weeks. However, with farrowing in strict batches and the application of a health plan, the earliest weaning age is 40 days. When sows farrow they should have access to a secluded area e.g. a hut or a pen. Sows kept indoors must have material (straw etc) for nest building. The lactating sows with their piglets are usually kept in groups, at least when the piglets are older than 2 weeks. Also, dry sows, weaners and fatteners are kept in groups in stables or huts depending on the farm and the season. In general, two types of outdoor systems can be identified. One system is mobile, where the pigs and their huts are regularly moved to new areas, which can be fields included in the crop rotation or woodland. The other system consists of a permanent building, e.g. a barn, with concrete areas outdoors, which are often connected to two or three different summer pasture areas. A farm can also have the pigs in a stable during winter and in huts at the pasture during summer.

Feeding
At least 50% self sufficiency or a written agreement with neighbour farm is required.

Main health problems
For fattening pigs, the main problems are respiratory diseases, which are increasing but are still slightly less prevalent than in conventional production (~3.5%, slaughter data). Joint problems and liver white spots are about 4 times more common among organic pigs. For sows the main problems are MMA, leg problems and shoulder injuries, and the problems are of similar type to conventional systems but to a smaller extent.

Relevant Differences to EU regulations
According to the standards of the largest certifying body (KRAV) animals should have access to pasture most part of the day for at least a 4-month period during the warm season. During this period, pigs should have consistent access to grass/vegetation as feed and activation and two weeks after farrowing sows and piglets should have outdoor access with pasture. Until recently all herds were KRAV certified, but in year 2009 there were 7 herds out of a total of 29 that were certified according to EU regulations (without the demand for access to pasture).

1.2.8 Switzerland

Amount/Structure
About 70 % of all organic pig farmers have less than 10 sows, 20 % have between 10 and 20 sows and only 10 % of the farmers have over 20 sows per herd. About 50 % of the farms with fattening pigs have less than 10 pigs and nearly 20 % have more than 50 pigs (Herzog et al., 2006).

Market
The market is stagnant at 1 % organic pork.

Housing, management and systems description

Farrowing, weaning and fattening is indoors (about 95 %) with a concrete outrun. Sows in gestation are kept in groups with access to pasture or a concrete outrun with the possibility to dig, which is required by standards. There is usually single farrowing accommodation in a stable. After the 24th day of life sows and piglets have access to an outdoor run (always concrete floored). Some sows are kept in group housing during lactation (15 – 20 %). Weaning age is at 6 weeks; the earliest weaning age is 40 days. Weaners are kept till the weight of 20 – 25 kg indoors with an outrun. Fattening pigs are kept in stables with outruns till 105 kg liveweight.

Feeding

Fodder is mainly purchased with a maximum of 10 % conventional components and no fishmeal.

Main health problems

For fattening pigs the main health problems are diarrhoea, injuries of legs and problems of the respiratory system. For sows the main health problems are MMA (Metritis, Mastitis, Agalaktie), fertility and leg problems.

Relevant Differences to EU regulations

95 % of organic farmers are members of the private label Bio Suisse. Bio Suisse prohibits prophylactic iron injection and nose rings in pigs. Access to an outdoor run in winter time is mandatory. While Swiss Ordinance rules the minimal number of days per month of access to pasture or outdoor run in detail, the EU Regulation 2092/91 leaves it to a general principle, not fixing a minimal number of days for outdoor access and not requiring outdoor access during winter time (if pasture was used in summer). An outrun for breeding sows during the suckling period until day 24 after farrowing is facultative.
As in the European Union for 2009, a new regulation for organic farming in Switzerland has come into force. This new regulation followed in general the new EU Regulation.

1.2.9 United Kingdom

Amount/Structure

There are many small herds with less than 10 sows and a few rather big herds with more than 100 sows. These big herds probably supply ~80% of the total production, especially to supermarket chains. 88 producers have less than 11 pigs, 64 producers have 11 to 50 pigs, 13 producers have 51 to 100 pigs, 14 producers have 101 to 500 pigs and 13 producers have more than 500 pigs (source: Defra organic survey 2007).

Market

The market is approx. 51,000 finished pigs per year. Approx. 50% of organic pork is imported. The proportion of organic pigs is about 0.6 % of conventional slaughter numbers.

Housing, management and systems description

All production stages are outside in fields, except some farms which have deep straw yards for the last 2-4 weeks before slaughter for the finishing pigs. The earliest weaning age is 42 days, although some wait until 56 days as recommended by the main certification body. Sows in gestation are kept in groups in paddocks. Single or group farrowing and lactation takes place in paddocks with individual huts. Weaning age is 6-8 weeks. Weaners are kept till the weight of 20 – 25 kg either loose in paddocks or in outdoor huts with fenced runs on pasture. Fattening pigs are kept in paddocks for most of time, sometimes fatteners come into straw yards for the final 2-4 weeks before slaughter. Slaughter weight most typically 90-100kg liveweight, but some are sold lighter to specialist butchers/farm shops.

Feeding

Feeding is carried out according to EU regulations.

Main health problems

In a limited survey in 2002, observed health problems were few. The main health problems reported by the farmers themselves were ectoparasites, endoparasites, mastitis and uterine infections, lameness and arthritis and meningitis. Less frequently mentioned things were pneumonia, erysipelas, diarrhoea and fox predation (source: Day et al., 2003).

Relevant Differences to EU regulations

Soil Association standards demand free range conditions, with animals kept at pasture throughout the year. Pigs should be kept in rotational grazing systems.

1.2.10 Overview of European production

Table 1.1: Overview of Organic Pig Production Core Organic Countries 2006. (ha organic = totally converted land; fattening pigs = amount of slaughtered pigs in the year 2006; sows = amount of sow places; number of conventionally reared pigs = totally amount of slaughtered pigs in conventional production; % = calculated from fattening organic pigs and number of conventional pigs)

	ha organic	fattening pigs	sows	number of conv. pigs	%
Denmark	133046	65300	3333	20 950 000	0.30%
Finland	130940	1872	336	1 436 000	0.13%
France	557133	39600	4885	19 800 000	0.20%
Germany	825539	200000	12000	42 000 000	0.48%
Italy	801350	29736	-	9 205 000	0.32%
Sweden	303298	20000	1690	3 033 740	0.66%
Switzerland	117800	18000	950	2 200 000	0.81%
UK	498646	51000	4860	8 898 500	0.57%
Austria	361487	50000	3622	5 300 000	1.63 %

*data collection from the participants

1.3 Annex to the differences of countries to EU regulation

Until the 1st December 2009, in all countries belonging to the European Community, organic farming was under the control of two main regulations:

- *COUNCIL REGULATION (EEC) N° 2092/91 of 24 June 1991 on organic production of agricultural products and indications referring thereto on agricultural products and foodstuffs*

- COUNCIL REGULATION (EC) No 1804/1999 of 19 July 1999 supplementing Regulation (EEC) No 2092/91 on organic production of agricultural products and indications referring thereto on agricultural products and foodstuffs to include livestock production.
In addition to these EC regulations, individual Member States were allowed to have national production rules stricter than the Community organic rules. This was the case for France, Denmark and Belgium. In some countries (i.e. UK, Germany and Netherlands), private companies have developed schemes for organic farming that were stricter than the EC regulations.
From 1 January 2009, new regulations will be in force for EC Member States that will replace EC 2092/91 and EC1804/1999:
- Council Regulation (EC) No 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation (EEC) No 2092/91.
- Commission Regulation (EC) No 889/2008 of 5 September 2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007 on organic production and labelling of organic products with regard to organic production, labelling and control.
Both regulations shall apply as from 1 January 2009 with delay until 1 July 2010 for some articles (paragraph 2(a) of Article 27 and Article 58 of EC 889/2008).
In regulation EC 834/2007, it is stipulated: "*For the sake of consistency with Community legislation in other fields, in the case of plant and livestock production, Member States should be allowed to apply within their own territories, national production rules which are stricter than the Community organic production rules, provided that these national rules also apply to non-organic production and are otherwise in conformity with Community law*". Therefore, there will not be any more national regulations specific for organic farming. However, private schemes are still allowed and will probably continue in countries where they were implanted. As a consequence, in countries where there were no national rules for organic farming, regulation of organic pig farming will change marginally according to the new EC legislation whereas in other EC countries changes might be more important.

1.4 Data sources

Austria:
BioAustria, Produktionsrichtlinien, BIO AUSTRIA – Verein zur Förderung des Biologischen Landbaus, Linz, Austria http://www.bio-austria.at/biobauern/richtlinien/bio_austria_richtlinien/bio_austria_produktionsrichtlinien
BMLFUW – Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (several years): Grüner Bericht 200x. www.gruenerbericht.at.
Gruber, T.(2001) Aufstallung, Hygiene, Management und Gesundheit von Mastschweinen in biologisch bewirtschafteten Betrieben. Doctoral thesis, VMU Vienna , Austria
Leeb, T. (2001) Aufstallung, Hygiene, Management und Gesundheit von Zuchtsauen und Ferkeln in biologisch bewirtschafteten Betrieben., Doctoral thesis, VMU Vienna, Austria.
Denmark:
Statistics on organic farms 2006, authorizations and production, May 2007; Ministry of Forestry, Agriculture and Fishery.
***France*:**
Observatoire 2008 de l´Agence Bio, Chambre d´Agriculture des Pays de la Loire (Agricultural Technical Service)
***Germany*:**
Dietze, K., C. Werner, A. Sundrum (2007) Status quo of animal health of sows and piglets in organic farms. In: Niggli, U., C. Leifert, T. Alfoldi, L. Luck, H. Willer (eds.), Improving

sustainability in organic and low input food production systems. Proc. 3rd QLIF Congress, Hohenheim, Germany, March 20-23, 2007, p. 366-369.
ZMP (Zentrale Markt- und Preisberichtsstelle) (Hrsg.) (2008): ZMP-Marktbilanz Milch 2008. Deutschland, Europäische Union, Weltmarkt. Verlag. Zentrale Markt- und Preisberichtsstelle, Bonn.
***Italy*:**
SINAB National information system on organic agriculture, Ministry of Agriculture, Food and Forestry Policies (www.sinab.it)
***Sweden*:**
Organic: KRAV; conv: Swedish board of Agriculture, 2007, 2010
***Switzerland*:**
Bio Suisse Richtlinien und Weisungen, http://www.bio-suisse.ch/de/richtlinienweisungen3.php (2007)
Willer, Helga, Minou Yussefi and Neil Sorensen (Eds.) (2008): The World of Organic Agriculture. Statistics and Emerging Trends 2008. Earthscan, London.
Willer, Helga and Lukas Kilcher (Eds.) (2009): The World of Organic Agriculture. Statistics and Emerging Trends 2009. IFOAM, DE-Bonn and FiBL, Frick, Switzerland.
***UK*:**
Official Defra national survey, 2007

Table 1.2: Overview of regulations, housing systems and breeds of pig production in the participating countries in 2007

	Austria	Denmark	France	Germany	Italy	Sweden	CH	UK
Main regulation	Private Label: BioAustria, Demeter	Plantedirektoratet: Danish stat	CC REPAB-F Implementation in France since 28/08/00	Private labels: Bioland, Naturland, Biopark	private labels, e. g.: GaranziaAIAB	KRAV: incorporated Swedish organic association	Private label: Bio Suisse	Private labels: Soil Association is most common.
Housing	Mainly indoors with a concrete outside run	Farrowing is outdoor. Fattening pigs and weaners mainly indoor.	Farrowing is mainly outdoor. Fatteners are mainly indoor with outdoor access.	Mainly indoors with a concrete outdoor run.	Farrowing is mainly outdoor. Fattening is about 60% outdoor, as for the rest is indoor with outrun.	Winter: mainly indoors concrete outside run. Summer: the sows are outdoor on pasture or in stable with access to pasture. Less than 10 % of piglets are born outside.	Mainly indoors with a concrete outdoor run.	All production stages are outside in fields, except some farms which have deep straw yards for the last 2-4 weeks before slaughter for the finishing pigs.
Breeds	Conventional breeds: pure Large White or F1 (Large White X Landrace), Boar: NN Pietrain few exceptions: Duroc, Schwäbisch-Hällisch or crosses of those.	Conventional breeds are used mainly (Sow: Danish Landrace x Yorkshire x Boar: Duroc).	Conventional breeds are used mainly.	Conventional breeds are used mainly.	About half of the organic pigs originate from conventional breeds: Large White, Landrace and Duroc (and hybrids), the other pigs are local breeds like Mora Romagnola and Cinta Senese. Local breeds are darker and lighter than conventional breeds and more suitable for outdoor rearing.	Mainly conventional breeds are used.	Conventional breeds are used mainly: Large white and Landrace	Small farms often use traditional breeds. Large farms generally use specialist outdoor lines developed for the conventional outdoor sector.

Table 1.3 : Overview of the veterinary treatments and animal health aspects of pig production in the participating countries in 2007

	Austria	**Denmark**	**France**	**Germany**	**Italy**	**Sweden**	**Switzerland**	**UK**
Anthelminthics treatments	Mostly routine use of anthelm-inthics, in many cases Ivermectines	No routine treatments. A veterinarian diagnosis before use of avermectines	Vaccinations and treatments against parasites are registered as allopathic treatments in the French regulation.	Antiparasitic treatments do not occur sys-tematically; veterinary diagnosis is often insufficient .		Routine treatments are not permitted. Avermectines can only be used if other substances are not effective.	Not systematically; after analysis of faeces allowed.	No routine treatments. A veterinarian diagnosis is required before use
Castration	Castration is – with one exception- done without anaesthesia within the first week of life	Castration takes place without anaesthetics in the first week of life.	Castration takes place without anaesthetics in the first week of life.	Castration takes place without anaesthetics in the first week of life.		Castration should be done in the first week of life. Anaesthesia is recommended but is not used.	Castration without anaesthesia is allowed in the first two weeks of life.	Castration is rarely practiced. Entire males are commonly reared.
Vaccination	Sows are vaccinated against Erysipelas and Parvovirus, piglets against Mycoplasma and some against Circovirus.	Most common vaccination is against parvovirus and erysipelas	Apart compulsory vaccination in EU, vaccines are used in case of sanitary problems (e.g. Parvovirus and Erysipelas).	Standard is Erysipelas Parvovirus, SMEDI, Mycoplasma for piglet and some PRRS.	Aujeszkj's is compulsory. Standard vaccinations are Erysipelas, Parvovirus. Optional vaccinations are: leptospirosis and clostridia.	Standard is Erysipelas and Parvovirus, and some do also vaccinate against E. coli and Mycoplasma.	Standard is Erysipelas Parvovirus Some vaccinate against E. coli. No Clostridia and PRRS vaccination. No Mycoplasma vaccination for piglets.	Vaccination is only permitted in cases where this is a known disease risk on a farm or adjacent land that cannot be controlled by any other means. The most commonly used vaccines are against erysipelas and E. coli.

Duty for recording	Duty to record all treatments and animal movements and feeding rations.	Duty to record entry and leaving of animals, diets, feed account, registration of all major and minor actual incidence effecting groups or single animals, and medicine recordings.	A recording data book includes: entry of animals, leaving of animals, diets, pens access periods, disease prevention and veterinary treatments.	Recorded are number of animals and movements and veterinary treatments of each animal.		Records should be kept on number of animals and movements, diseases, treatments, additives to feed, animals kept inside during outdoor period, start and finish during outdoor period and slaughter remarks.	Recorded are number of animals and movements and veterinary treatments of each animal.	Recorded by law are number of animals and movements and veterinary treatments of each animal. Records of animal numbers and feeds required by certification body.
Differences to the EU regulation Veterinary prophylactic treatment	two “productive lifecycles” defined (from birth to 30kg and from 30kg to slaughter)- in each period animals can be treated once.	No relevant differences	Number of treatment limited (allopathic and against parasites) Fatteners: 1 + 1 = 2 during animal’s life Sows: 2 + 2 = 3 per year.	No relevant differences	GaranziaAIAB: Farm must be totally organic and outdoor. No white pigs. Only one deworming per year.	No relevant differences	Bio Suisse: prophylactic iron injections in pigs is prohibited.	Soil Association: prophylactic iron injections of pigs are prohibited

N.B. Data collection based on the year 2007. Since this time, several regulations, e.g. about the castration of male piglets and conventional feed allowances, have changed in different countries.

Chapter 2

Animal health, welfare and production problems in organic pregnant and lactating sows

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2.1 Background

The organic systems for keeping pregnant and lactating sows vary in different European countries (see Chapter 1). In some countries (such as the UK and Denmark) sows are at pasture throughout all stages of pregnancy and lactation. In other countries (eg Netherlands, Germany, Austria, Switzerland) most lactating sows are housed indoors, usually with a concrete outrun for all or part of lactation. This is likely to have a significant effect on many aspects of husbandry and disease risk, although no comparative data on this in an organic context have been found.

The health and welfare of sows in organic systems will depend on:

- The general level of endemic health challenge within a country or region;
- The extent to which organic standards influence health and welfare risks;
- Individual unit factors such as herd size, exact system of production, quality of the management and stockmanship.

This chapter will firstly review the available information on the prevalence of different sow health and welfare problems in organic units. It will then look at the available information on the hazards for such problems, focussing specifically on factors which may differ between organic and conventional production systems.

2.2 Problems

The basis for estimation of the nature and prevalence of sow health and welfare problems on organic units is extremely limited. Lund & Algers (2003), in their review of information on health and welfare in organic systems, reported almost no work on pigs. The exception was a small number of papers on endoparasites. The following sections summarise what little information is available regarding potential health and welfare problems identified by an expert group within the COREPIG project.

2.2.1 Health problems associated with farrowing and reproduction

The time of farrowing and the initiation of lactation is one of the highest risk periods for health problems in sows. Current and historic problems of vulval discharge, and mastitis were reported by about half the 7 UK herds surveyed by Day et al. (2003). In a survey of Swiss organic herds, MMA (mastitis-metritis-agalactia syndrome) was reported as a health problem in 50% of herds with >10 animals (Herzog et al., 2006). In 62% of farms in an Austrian survey, one or more sows suffered from Actinomycosis of the udder (Baumgartner et al., 2003).

Other reproductive problems include delayed return to oestrus, lack of oestrus synchronization, poor conception rate and abortion. These may relate to health or welfare conditions, but they can also be a result of poor management in relation to oestrus detection or insemination practice. Whilst reproductive performance is often reported to be poorer in organic herds than in conventional herds it is not possible to conclude that this is health-related, since many small organic herds have less professional management. Indeed, in the small German survey of Dietze et al. (2007), sows in organic herds showed a longer herd life than the norm for conventional herds, suggesting health to be not greatly impaired. Bonde and Sørensen (2003) reported frequent reproductive problems from a questionnaire survey of Danish veterinarians and production advisors working with organic herds. Fertility problems were reported with a prevalence of 18-31% of herds in a Swiss survey, increasing with size of herd (Herzog et al., 2006).

2.2.2 Parasites

Parasite species in pigs stimulate host immunity to a varying degree and only species against which the pig host does not acquire protective resistance are common in the adult animals (Nansen & Roepstorff, 1999). This counts for the nematodes Oesophagostomum spp. and Hyostrongylus rubidus, both of which may have very high prevalences in sows reared under conditions favourable to transmission (Connan, 1967; Rose & Small, 1980; Rose & Small, 1983), and the coccidians of the genus Eimeria, which seems most common under outdoor conditions (Roepstorff et al., 1992). In contrast, other common species such as Isospora suis, Ascaris suum, Trichuris suis, and Sarcoptes scabiei (mange) stimulate strong immune responses and these species are only relevant to consider in piglets and growing pigs (Nansen & Roepstorff, 1999).

In the most recent study of Danish organic herds, the prevalence of Oesophagostomum spp. in sows was moderately high (20% of the sows, 56% of the herds) while no Hyostrongylus were reported (Carstensen et al., 2002). The Oesophagostomum prevalence was higher than found in intensive systems (Thamsborg et al., 1999), while traditional indoor systems may have much higher prevalences (e.g. Roepstorff, 1991). The moderate Oesophagostomum infection level found by Carstensen et al. (2002) indicates a very positive development when compared to the pioneering Danish organic sow herds in which 50% of the sows (100% of the herds) were infected (Roepstorff et al., 1992). Similarly 51% of the sows in a study of Swedish outdoor herds were infected with Oesophagostomum spp. (Christensson, 1996). As none of the organic Danish herds used anthelmintics, this positive development is most likely due to more professional management, better indoor facilities, and more strict pasture rotation in the herds examined by Carstensen et al. (2002). It is interesting that Hyostrongylus, which together with Oesophagostomum spp. have been associated with the thin sow syndrome (Maclean, 1968), has not been recorded in any of the Danish organic herds. The latest recording of Hyostrongylus in Denmark was in an outdoor herd in 1967 (Jacobs & Andreassen, 1967), and as the transmission of this nematode seems to depend on outdoor conditions and/or use of deep litter (Connan, 1967; Connan, 1977) it may have been eradicated meanwhile due to the more intensively managed and exclusively indoor pig rearing in the 1970-80'ties and the fact that there in Denmark is no wild boars which may act as reservoir hosts. A survey of Austrian organic herds found Oesophagostumum spp. in 66% of the sow units of 48 herds (Baumgartner et al., 2003) whereas sows were positive for Oesophagostomum spp. in 30% of the organic herds in a Dutch survey (Eijck & Borgsteede, 2005). In contrast, a survey of 20 German herds found that 90% used deworming routines, even though only 40% applied regular parasitological diagnostics such as faecal egg counts Dietze et al. (2007).

Emeria spp. is not generally considered to be a health risk for sows (Stuart & Lindsay, 1986) although infection levels can be high (Roepstorff et al., 1992). The last Danish prevalence study recorded 42% of organic sows to be positive for up to 3-6 Eimeria species (Roepstorff et al., 1992). In Swedish outdoor herds 56% of the sows were shown to excrete coccidia whereas 21% and 80% of Austrian and Dutch organic herds were positive, respectively (Baumgartner et al., 2003; Eijck & Borgsteede, 2005).

A questionnaire survey of UK producers identified ectoparasites as the main health concern (Roderick & Hovi, 1999, cited in Hovi et al., 2003). A similar result was obtained in 4 out of 7 farms in a later UK survey by Day et al. (2003). A survey of Austrian herds detected Haematopinus suis and Sarcoptes in sow skin scrapings in 29% of 48 and 24 sow units, respectively (Baumgartner et al., 2003). In contrast, in a Danish survey (Carstensen et al., 2002), no clinical signs of ectoparasites were observed and in the early Danish study no Sarcoptes were detected on sows (Roepstorff et al., 1992). In the same study H. suis was detected sporadically.

2.2.3 Locomotory problems

Vaarst et al. (2000) reported that lameness, injuries and sunburn were the most common ailments in a Danish outdoor breeding herd. Current and historic problems of lameness and arthritis were reported by about half the 7 UK herds surveyed by Day et al. (2003), but observed levels of lameness at survey visits were negligible. In a Swiss survey, health problems with lameness were reported in 24% of small herds (<10 animals) and 9% of medium herds (10-20 animals), but not in larger herds (Herzog et al., 2006). In a postal survey of 60 organic producers in 5 different European countries, leg problems in sows were reported as being frequently observed in 21% of herds, with Dutch, German and Swedish farmers being more concerned about this problem that farmers in UK or Denmark (Bonde and Sørensen, 2005). In general, hoof injuries and abscesses were the most frequently observed leg problems, but leg and hoof disorders were culling reasons in only a few cases. A COREPIG project workshop identified osteoporosis, resulting from the high demands of a prolonged lactation, as being a potential cause of locomotory problems in organic sows, but no data on the extent of this condition in organic herds could be found in the literature.

2.2.4 Infectious diseases

The prevalence of infectious disease may be determined by the presence of clinical signs, or from serology. No published data on clinical disease prevalence have been found, but a survey of sow serology in 48 Austrian herds found the following prevalence of infectious disease: PRRS 36%, Parvovirus 26% and Leptospira 14% (Baumgartner et al., 2003).

2.2.5 Other health problems

Other possible problems identified during a COREPIG project workshop included infections (e.g. cystitis) and gastric ulcers. No data on prevalence of these conditions in organic sows could be found in the literature.

2.2.6 Welfare problems associated with nutrition

Possible welfare problems associated with nutrition include hunger and thirst, relating to the availability and quality of food and water, and excessive body condition loss due to the high demand for milk production in prolonged lactations. Current problems of loss of condition were reported by 2 of the 7 UK herds surveyed by Day et al. (2003). Bonde and Sørensen (2003) also reported frequent problems with poor body condition from a questionnaire survey of Danish veterinarians and production advisors working with organic herds.

2.2.7 Welfare problems associated with the physical environment

Such problems might relate to cold or heat stress as a result of inadequate management of the thermal environment, or to physical injury or discomfort resulting from poor quality of flooring or bedding. Of the 7 UK herds surveyed by Day et al. (2003), 57% had wet farrowing and dry sow paddocks in winter, but bedding dryness scores were all good. The main welfare issue reported by stockmen was keeping animals clean and dry in periods of wet weather.

The other type of welfare problem which can be included in this category is frustration of motivated behaviours by an environment which fails to provide the necessary degree of enrichment. This can result in increased aggression and the development of stereotyped behaviours or apathy. No specific studies of these issues in organic sows have been found.

2.2.8 Welfare problems associated with the social environment

These potential problems include aggression between sows (particularly at mixing) and social competition (for feed or lying space), which generally result in increased skin lesions and, in some circumstances, vulva lesions. Udder and teat lesions of lactating sows might also be caused by inadequate flooring, or by suckling of piglets with intact teeth during long lactations. In the 7 UK herds surveyed by Day et al. (2003), observed levels of skin lesions were negligible during pregnancy, at farrowing and at weaning. Current problems of vulva biting were reported by 2 of the 7 herds surveyed.

In the study of Day et al. (2003) 2 of the 7 herds also reported current and historic problems of pig-person aggression. The extent to which this reflects a welfare problem for the sows is debatable, since it may arise from maternal defensiveness rather than from fear of humans. However, it might also be taken to indicate a less good human-animal relationship.

A further problem of social behaviour which has welfare consequences, is the “doubling up” of young sows in farrowing huts, which frequently results in increased crushing of the piglets. This was reported as a current problem by 2 of the 7 UK herds surveyed by Day et al. (2003).

2.3 Hazards for health and welfare problems in organic sows

Hazards with the potential to give rise to sow health and welfare problems were identified by an expert group within the COREPIG project. Many hazards can be identified by extrapolation of knowledge from conventional production systems. In the following section, the extent to which these hazards differ between organic and conventional systems is considered, and the likely consequence for the animals highlighted.

2.3.1 Animal related hazards

A significant risk to animal health and welfare arises if animals are not genetically suited to the production systems in which they are placed. Sows in organic systems will often receive diets of poorer nutrient quality, with fewer high energy and high protein digestibility ingredients. At the same time they are expected to support a longer lactation, and may be subject to greater thermal challenge through living in outdoor or uninsulated indoor accommodation. Pig breeds in conventional systems have been selected for high prolificacy and leanness, which has often been associated with reduced appetite. These characteristics might make them unsuitable for organic systems. Furthermore, it is known that behavioural characteristics which might make sows well suited to more extensive production systems, such as reduced aggressive behaviour at mixing and better maternal behaviour, have a genetic basis (Løvendahl et al., 2005; Vangen et al., 2005).

Organic standards recommend the use of traditional breeds, adapted to the local environment. However, such breeds are often less productive and give progeny with poorer feed efficiency and carcass quality (Kelly et al., 2001). This gives an incentive to use more highly selected breeds from conventional systems. The extent to which this poses a welfare issue in practice is largely undocumented, since there have been few comparative studies of different breeds under organic conditions. In one study, a modern commercial sow line showed no welfare disadvantages in comparison with a traditional pure breed in a long term study (Kelly et al., 2005), but it must be borne in mind that the modern breed was one which had been specifically selected for outdoor production. Further studies of breed suitability are required.
The genetics of the sow is not the only inherent aspect which can affect her health and welfare in an organic production system. Developmental influences arising from her rearing experience may also be of importance in adaptation. It is often believed that animals which have grown up within a particular system are better adapted to thrive in that system than animals from a different background. Whilst replacement breeding animals are frequently sourced from specialist breeding herds in conventional production, the use of home bred gilts, which have therefore grown up on the same farm, is recommended in organic standards. There have been no specific studies on the importance of this in the organic context, but it has been shown that gilts introduced to a conventional farm at a younger age (30 kg) subsequently perform better than those introduced just before breeding (PIC, 1997). Experimental work has also demonstrated that the rearing environment can influence subsequent sexual behaviour (Soede and Schouten, 1991), aggressive behaviour and stress physiology (de Jonge et al., 1995), and farrowing behaviour (Schouten, 1986).

2.3.2 Factors related to the housing system

<u>Outdoor access</u>
Organic standards require animals to have access to outdoors, in contrast to conventional systems which in most cases maintain sows indoors throughout their life. In some countries

(such as the UK and Denmark) organic sows are at pasture throughout all stages of pregnancy and lactation. In other countries (eg. The Netherlands, Germany, Austria, Switzerland) some dry sows and most lactating sows are housed indoors, and may have access to an outdoor run or pasture. The keeping of sows at pasture potentially has both advantages and disadvantages for welfare (Edwards, 2005). Animals face greater challenges from climatic extremes and social competition, but greater space and environmental diversity permitting expression of a wider range of behaviours. Health challenges may be reduced by the lower animal density and better air quality, but there are also negative influences of reduced biosecurity, contact with wildlife disease reservoirs and increased numbers of endoparasites, some of which can only be transmitted outdoor. However, the picture is not always clear cut, as there were higher infection levels of Oesophagostomum spp. in those pioneering Danish organic herds, which had old-fashioned índoor facilities (poor hygiene) with access to outdoor runs/areas, compared to strictly outdoor reared herds of the same study (Roepstorff et al., 1992).

There have been no published comparisons of paddock or indoor systems for organic sows. However, large scale comparison of sows kept in indoor and outdoor systems is possible for conventional herds in the UK, where ~40% of conventional herds are kept in outdoor systems. Whilst these herds do not have many of the constraints on both indoor and outdoor systems imposed by organic standards (organic feeds, space and bedding, weaning age etc), it is of interest to note the contrasts (Table 2.1).

Table 2.1. The performance of ***conventional*** *indoor and outdoor breeding herds in the UK (BPEX, 2008)*

	Outdoor	**Indoor**
Sow mortality (%)	3.1	3.9
Replacement rate (%)	45.8	47.7
Conception rate (%)	82.2	81.6
Litters/sow/year	2.19	2.25
Liveborn piglets/litter	10.9	11.4
Stillborn piglets/litter	0.5	0.6
Mortality of piglets born alive (%)	12.3	13.0
Pigs weaned/sow/year	20.9	22.4

These data indicate that outdoor management may result in slightly better health, as reflected by mortality and replacement rates, but poorer reproductive performance, as reflected by litters/sow/year and litter size, but not conception rate. Farrowing problems and post farrowing disorders might be slightly reduced, as reflected by stillborn piglets and piglet survival to weaning, although this might also reflect the difference in initial litter size. Economic data, last published in 1997 for a limited number of herds (MLC 1997), indicated a much lower cost of veterinary services and medicines for outdoor herds (£15.90 v £26.59). This trend was consistent over previous years and suggests that fewer health problems might be experienced under outdoor conditions. However, it may also reflect the greater difficulty in identifying and treating animals under these conditions.

The effect of outdoor housing on sow health and welfare will be dependent on the condition of the ground. This will depend on soil type, rainfall, stocking density and paddock rotation management. The rooting activities of sows make it difficult to maintain vegetation cover, and mean that wet and muddy ground can predominate in winter conditions. This is particularly the case if organic sows are stocked at higher densities in rotational grazing systems, when the level of pasture damage may be so severe as to prevent subsequent recovery (Kelly et al., 2001). Set stocking of sows at lower density, with less frequent moving avoided this problem, but might have adverse implications for parasite build-up. Vegetation cover, and hence ground conditions, can be preserved by nose-ringing of sows (Edwards et al., 1998), but this mutilation raises welfare issues for the sow (Horrell et al., 2001) and is not permitted by some organic standards. The effect on parasites of pasture management is, however, complex because of micro-environmental factors. Thus, high herbage, which may only be found at very low stocking densities strongly favours the survival of infective larvae of Oesophagostomum spp. (Rose & Small, 1981; Kraglund et al., 2001). Nose-ringing may theoretically reduce parasite transmission by keepig the grass at a low height, although one pasture study was not able to demonstrate any significant effect (Mejer et al., 2000).

The nature of the sow housing system will affect the extent of climatic challenge as a hazard to sow health and welfare. The majority of organic sows are kept in naturally ventilated housing, in contrast to conventional sows which are often kept in insulated, controlled-ventilation buildings. Depending on the geographical location, sows may experience both heat stress and cold stress at different times of the year. Heat stress is more likely to be a problem for lactating sows, with high feed intake and metabolic activity for milk production, while dry sows will be more susceptible to cold stress because of their restricted feed level. The lower and upper critical temperatures under conditions of housing on straw in extensive conditions with typical feed intakes are approximately 12 and 31 ^{o}C for dry sows, and 7 and 26 ^{o}C degrees for lactating sows. These temperature ranges can often be exceeded by ambient conditions, although no data have been found regarding physiological consequences of this in organic sows. Heat stress can be alleviated by the provision of shades, wallows or water sprinkling systems, whilst cold stress can be alleviated by provision of huts or covered kennels and plentiful dry bedding. The requirement for organic sows to have straw bedding will therefore benefit thermoregulation in cold conditions, but might increase heat stress under hot conditions.

Exposure to outdoor conditions will also give sows access to natural light, whereas many conventional sows will be kept in conditions of artificial light and controlled fixed photoperiod. The importance of natural light (in terms of intensity and spectrum) for sow health and welfare has not been determined. Sows do show some response to photoperiod, having evolved as seasonal breeders, and it is possible that poorer fertility sometimes reported in organic sows may be partly influenced by seasonal endocrine changed induced by changes in photoperiod (Love et al., 1993).

Space allowance

Organic sows are not allowed to be kept in individual confinement housing, and have a defined minimum space allowance which is greater than that for sows in conventional systems. The welfare aspects which have raised concerns about the close confinement of sows can be divided into physical and behavioural issues. Physical concerns arise from the consequences of lack of exercise for cardiovascular fitness (Marchant et al., 1997) and for bone strength and muscle mass (Marchant and Broom, 1996), giving rise to leg weakness and lameness (Barnett et al., 2001). Lack of activity, in combination with inability to separate the lying and excretory areas, has also been blamed for a higher prevalence of cystitis in confined sows (Madec, 1985). The major behavioural issue is the high level of stereotyped behaviours seen in confined dry sows. Whilst initially attributed to the stress of close confinement and the boredom engendered by barren environments, subsequent work clearly demonstrated that the occurrence of these abnormal oral behaviours was much more closely linked to feeding level than to housing system (Terlouw et al., 1991). Subsequent studies demonstrated that pregnant sows experience chronic hunger because the level of concentrated feed necessary for maintenance of good health and performance does not induce feelings of satiety. Expression of the resultant feeding motivation is frustrated in the absence of a foraging substrate, giving rise to channeling of behaviour into stereotype development in restrictive housing conditions. Thus, whilst the housing system is not, in itself, the cause of the abnormal behaviour it is a significant contributory factor to its expression. Organic sows therefore have a lower level of hazard as a result of lack of confinement.

However, loose-housing systems also present some challenges to dry sow health and welfare. These relate to social aggression and ability to access a fair share of feed resources. Because of the restricted feed level and chronic hunger, competition for feed can be a major source of aggression in dry sows unless feeding animals are fully segregated. With floor feeding systems, aggression at feeding time can be severe (Brouns and Edwards, 1994; Whittaker et al., 1999) and large variation in body condition can result (Edwards, 1992). For this reason, careful matching of age and body condition in grouping strategies is important. The other source of aggression in group housing systems comes from social instability, since unfamiliar sows will fight when mixed to establish relative social rank. To minimise the problems with social aggression, a number of recommendations for system design and management based on scientific understanding of social behaviour can be made (Edwards, 1992, 2000). Allowing adequate space for social signalling of submissive behaviour, with a minimum of 2.4 m^2 per sow in stable groups (Weng et al., 1998), and providing increased area and visual barriers at the time of mixing (Edwards et al., 1993), can reduce the level and severity of injurious behaviour. This means that systems where space is limited to save cost, such as cubicle and free access stall systems, can give serious problems of aggression during regrouping of sows and this procedure is best done in other accommodation prior to introduction. The higher space allowances for organic sows will therefore also constitute a reduction in welfare hazard.

Confinement of sows during the farrowing period is generally not practiced in organic herds. However, in Austria, a survey of 48 organic sow herds indicated that 60% of herds confined sows from seven days before farrowing to 10 days after, as permitted under national regulations (Baumgartner et al., 2003). For the farrowing sow, the welfare issues associated with confinement again result from the frustration of strongly motivated behaviours by a restrictive environment. The hormonal state shortly prior to farrowing will induce nest building motivation, even when it is unnecessary because of human provision of an optimal piglet environment. Prevention of the expression of nest building behaviour by physical space restriction at this time results in a measurable stress hormone response, in addition to abnormal behaviours, indicating impaired welfare state (Jarvis et al., 2002). The farrowing crate may also impose other welfare challenges for the sow in later lactation, when she would normally begin the process of gradual weaning by withdrawing from the piglets for increasing periods of time. Enforced proximity and being subject to the demands of increasingly persistent piglets has been associated with elevated levels of cortisol in crated gilts in later lactation (Cronin et al, 1991). Loose farrowing systems also pose welfare hazards, but these are principally for the piglets rather than the sow (see chapter 3).

Where sows are farrowed in individual pens, but subsequently grouped during lactation, this allows greater space and complexity of the lactation environment which will enhance sow welfare. Aggression at grouping is generally less than observed in sows regrouped at other stages of the reproductive cycle (Olsson and Samuelsson, 1993). However, the disruption in suckling patterns which occurs immediately post grouping (Wattanakul et al., 1997), the variable suckling numbers resulting from cross-suckling activities (Wattanakul et al., 1997) and the stimulation of a new environment can combine to induce lactational oestrus in many of the animals (Rowlinson and Bryant, 1982; Hulten et al., 1995). Whilst not necessarily a sow welfare issue in itself, it may give rise to problems if riding behaviour is shown in unsuitable accommodation or involves other sows in the group who are weakened by the demands of a long lactation. It will also disrupt the synchrony of the batch, thus making subsequent all-in all-out management for disease control more difficult.

Flooring and provision of bedding

Another important component of the physical environment which can be a hazard for sow health and welfare is the type of flooring. Sows in organic systems will either be at pasture or on straw bedding, whereas sows in conventional systems are frequently housed in unbedded systems with partly or fully slatted floors. There have been relatively few studies of the effect of different floor types for sows, except for endoparasites in conventional herds, in which the prevalence of Oesophagostomum is almost totally controlled by slatted floors without straw bedding, while increased use of straw is a significant risk factor (Roepstorff et al. 1991; Nansen & Roepstorff, 1999). Especially sows on deep litter have been shown to be heavily infected (Holmgren & Nilsson, 1998; Haugegaard, 2010) although recent observations indicate that deep litter mats may be less favourable to parasite transmission than hithero believed (Andersen, 2009). Examination of the feet of cull sows at an abattoir showed that sows from outdoor units had more corns, whereas from indoor units had more heel and toe erosions and white line lesions (Davies et al., 1998). Outdoor sows also had more condemnations for arthritis (Davies, 1998). A Dutch survey in conventional herds showed that herds with loose housing of dry sows on slatted floors had sows with higher forelimb lesion scores than herds with loose housing on solid floors, although hindlimb lesion scores didn't differ (de Koning, 1985). Sows kept in deep litter pens had lower 'leg weakness' scores, defined by abnormality of gait, and lower limb lesion scores than those in unbedded or minimally bedded systems (de Koning, 1985) and a similar result was found for sows housed in large dynamic groups on part slatted or bedded floors (van der Meulen et al., 1990). Lactating sows in farrowing crates have also been shown to have more leg and teat injuries on slatted floors than on solid floors with bedding (Edwards and Lightfoot, 1986).

It has been shown that sows in late pregnancy show a preference for lying on solid, rather than slatted floors (Phillips et al., 1986) and for a bedded rather than unbedded area (Arey et al., 1992). Data on the effect of flooring on lying comfort, bursae and decubital ulcers in sows are lacking, although slatted and hard, unbedded floors have detrimental effects on these parameters in growing pigs. In a Dutch survey in conventional herds, group-housed dry sows on deep litter had lower numbers of body lesions than those with minimal bedding, or on unbedded solid floors, which in turn had fewer lesions than those on part slatted floors (de Koning, 1985). It is unclear to what extent this resulted from direct physical characteristics of the floor surface, or increased aggression between sows in the absence of a foraging substrate.

In addition to its role as a cushioned physical surface, the provision of straw, which is a requirement for all organic systems, also reduces health and welfare hazards through its role as a behavioural substrate. In the case of dry sows, it can be eaten to provide gut fill, and rooted to permit appropriate expression of foraging behaviour. This prevents the development of stereotyped bar biting behaviours, and reduces social aggression (Edwards, 1992; Meunier-

Salaün et al., 2000). In the case of the farrowing sow, straw bedding provides a substrate for the expression of nesting behaviour and alleviates stress responses at this time (Thodberg et al., 1992).

Slatted flooring can give improved hygiene conditions, especially if management of bedded systems is poor. It is also known that poor quality straw bedding can contain high levels of mycotoxins, which cause health and reproductive disorders (Moore, 2005). The extent to which these factors give rise to differences in sow health has not been adequately studied in the absence of other confounding factors. In a study of conventional sows farrowing in crates, a lower incidence of sow veterinary treatments over an 18-month period was recorded in a solid-floored straw-bedded system than in a part-slatted or fully slatted system (Edwards et al., 1987). However, the same may not be the case for piglet health (see chapter 3).

2.3.3 Factors related to nutrition/feeding

Organic production systems differ from conventional systems in the restriction on types of feed ingredients, which must be produced under organic conditions, and in the requirement that pigs have inclusion of roughage in the diet.

The restriction in ingredients should not give rise to specific nutrient deficiencies in sows, provided that careful ingredient control, ration formulation and mixing of feed are carried out. Animals at pasture can obtain significant quantities of vitamins and minerals from vegetation and soil, although the availability of these may be seasonally affected (Rivera Ferre et al., 2001; Edwards, 2003). The restricted sources of dietary protein, and the inability to use synthetic amino acids in organic diets, is less of an issue for the adult sow than for the young growing pig, although inadequate or poor quality protein in gilts can cause impaired reproductive performance (Edwards, 1998).

Inadequate feed intake in lactation, when nutrient demand for milk production is high, can result in substantial loss in body condition, especially in young sows and with the prolonged lactations required by organic standards. This may increase the risk of shoulder sores, lameness and inability to compete for resources, and can also result in impaired reproductive performance. Inadequate provision of feed can also give rise to behavioural problems in pregnant sows. Animals which have serious chronic hunger are more irritable, and maintaining animals in better body condition can reduce levels of aggression (Edwards, 1992).

The requirement to provide roughage can also confer significant health and welfare benefits (reviewed by Meunier-Salaün et al., 2000). Roughage can reduce risk of constipation and gastric ulcers, and increase satiety from increased feeding time and greater physical bulk in the gut. However, it has also been shown that increased intake of insoluble dietary carbohydrates (i.e. dietary fibres as found in roughage) resistant to digestion and fermentation, may increase severity of infection with gastrointestinal nematodes, especially *Oesophagostomum*, whereas easily fermentable carbohydrates, e.g. inulin, may have the opposite effect (Petkeviçius et al., 1997; Petkeviçius et al., 1999; Petkeviçius et al., 2001; Petkeviçius et al., 2003).

The presence of detrimental levels of anti-nutritive factors and toxins in feed can arise through inappropriate selection of ingredients, or poor storage of feed. Growth or storage of raw materials in warm moist conditions can promote fungal growth and production of mycotoxins, which impair health and reproductive performance (Osweiler, 2006).

The provision of adequate water supply is necessary to prevent thirst and, in the case of lactating sows, to ensure maximum intake of dry feed. Restriction of intake, such as can result from low water flow rates from drinkers, results in reduced feed intake, increased weight loss of sows (Leibbrandt et al., 2001). Water quality, in terms of microbiological standard and dissolved salts has also been shown to be of importance for health in growing pigs, but has been inadequately studied in sows (NRC, 1974).

2.3.4 Factors related to management

A number of factors relating to management were identified as potential hazards to health and welfare by the COREPIG expert group. These included:

Lactation length
Organic standards dictate longer lactation lengths (6-8 weeks) than are normally used in conventional production systems (3-5 weeks). It has been suggested that this might impose extra metabolic stress on the sow and result in excessive loss of body condition and associated health and fertility problems. However, a recent long term comparison of conventional sows weaned over 4 parities after either 4, 6 or 8 weeks of lactation showed no adverse effects of later weaning (Edge et al., 2007). Longer lactations, of more than 40 days, do increase the risk of lactational oestrus as suckling intensity declines, especially in group housing, with multiparous sows being more likely to show this phenomenon (Hulten et al., 2006).

Quality of human carers
An element of the greatest importance in sow health and welfare is the quality of the stockman-sow interaction. It has been repeatedly demonstrated that poor handling of pigs gives rise to a chronic physiological stress response, and that this has detrimental effects on other aspects of performance including growth, mating behaviour and conception (Hemsworth et al, 1991). A beneficial effect of regular positive contact has been suggested (Dryden & Seabrook, 1986), but their conclusion was based on inadequate data. The extent of training, and the use of advice from veterinarians and other qualified professionals, are important aspects of development of improved quality of care. These assist the correct diagnosis of problems, treatment of sick animals and prompt euthanasia when appropriate. However, there is little information on the extent to which such supporting mechanisms are exploited in organic herds.

Health management strategies
A key aspect of health management is the practice of good biosecurity. Because organic units are generally more extensive and have outdoor access, it is more difficult to control ingress of pathogens from wildlife and visitors. Since the principle risk of disease transmission comes through contact with infected pigs, a thorough knowledge of unit health status, the matching of this with any purchased stock and appropriate quarantine facilities and procedures are of great importance. Although organic units generally import fewer animals than conventional units, they may also be less likely to have rigorous quarantine facilities.

In general, organic herds are smaller in size with less ability to operate batch systems with all-in, all-out (AIAO) use of housing. A survey of Austrian herds indicated that all used a continuous flow production system (Baumgartner et al., 2003), whilst a survey of German herds indicated that only 25% operated and AIAO system (Dietze et al., 2007). This means that vertical transmission of infections from older to younger pigs can occur unchecked, which is a significant disease risk (Kingston, 1999). Without AIAO, accommodation cannot be readily cleaned and disinfected between batches of pigs. Cleaning and disinfection is regarded as one of the most important disease control strategies, and this is also true for the most frequently occurring helminths of sows, *Oesophagostomum* and *Hyostrongylus*. In contrast, such disinfectants have very little effect on infective helminth larvae (e.g. *Ascaris*), which are protected by egg shells (see Chapters 4-5). Contaminated buildings can harbour infectious agents over long periods of time, continuing to spread infection to new animals in a disease cycle. Effective disinfection breaks this cycle, removing, or at the very least, reducing the exposure of new batches of pigs to the pathogens of their predecessors (Bowman et al., 1996). However, Dietze et al. (2007) reported that whilst all the organic herds in their German survey performed cleaning of housing, only 25% of herds used disinfection. Disinfection is only effective if a full and correct procedure is followed (WHO, 1994):

i) The removal of solid muck and dry matter
ii) The application of a pre-cleanser (de-greaser)
iii) Powerwashing the pen clean
iv) Application of disinfection
v) Drying the building before re-stocking.

The failure to remove all organic matter prior to application of the disinfection has a major effect of reducing the efficiency of the disinfection (Thompson, 2007). Foot dips have also been found to be ineffective at disinfecting boots, unless scrubbing of the boots prior to, or whilst, standing in the disinfectant to remove all organic matter (Amass et al., 2001). Similarly, failure to completely dry a building prior to placing in pigs is equally detrimental, the wet surfaces providing an ideal environment for bacteria to proliferate.

Where endemic disease is known to be present, it can be controlled by a sound vaccination strategy. However, this is often not adopted in organic herds. A survey of Austrian herds indicated that only a few farms vaccinated sows against erysipelas and parvovirus infection (Baumgartner et al., 2003). In a German survey, 85% of the organic herds used vaccination protocols (Dietze et al., 2007).

2.4 Conclusions

There is very limited information on the health and welfare of sows in organic production systems. They have more behavioural freedom, but may be exposed to greater climatic challenges, parasite infestation and risk of body condition loss. General risk factors for health and welfare conditions can be extrapolated from knowledge gained in conventional systems. Issues with particular importance for organic production include outdoor access, roughage feeding, later weaning, less sophisticated diets and lack of good health management strategies.

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Chapter 3

Animal health, welfare and production problems in organic suckling piglets

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3.1. Background

The organic systems for keeping lactating sows and their litters vary between European countries (see Chapter 1 and Table 3.1). Their specificities compared to conventional farms concern the housing, the management, the diet, the treatments and the breeds that are used. Taking into account the accumulated knowledge, it is likely that genotype is a key factor for determining litter size at birth, that housing and management are of main importance for piglet survival and health and that diet is very important for controlling growth of piglets during lactation. This chapter will review the available information on the prevalence of different health and welfare problems in suckling piglets. Thereafter, it will look at the available information on the hazards for such problems. Data will be focused on organic pig farms but results from conventional pig farms will be included when characteristics are close to those of organic farms, especially regarding housing and management. This will be the case for outdoor farrowing systems or for data collected in conventional farms in the "past" during the sixties/seventies when farming conditions where less intensive (for example with lack of heating in farrowing pens, lactations longer than 4 weeks...).

In some countries, most of the organic sows are at pasture whereas in others, most lactating sows are indoors throughout the year (Table 3.1). In some cases (e.g. in Sweden), lactating sows are indoors during winter and outdoors during summer. According to the EU regulation (Council Directives 1999/1804/EC and 2008/889/EC), the area per lactating sow with her litter should be at least 10 m^2, with at least 2.5 m^2 outdoors. Lactating sows should be free in organic farms. However, in some indoor systems, movements of sows may be restricted in crates around farrowing. In outdoor systems, sows are usually penned in individual paddocks but suckling piglets can circulate between pens. In some systems (indoor and outdoor) lactating sows may be kept in groups, a few days or weeks after parturition. In addition to these specificities of the housing, organic pig farming is usually characterized by a low level of management intervention around parturition, with nearly no assistance of the animals by the farmer during farrowing, and by difficulties to formulate diets balanced for amino acids due to the low availability of organic feedstuffs with high quality proteins (Sundrum et al., 2007) and to the ban of synthetic amino acids in organic diets (Council Directives 1999/1804/EC and 2008/889/EC). Finally, allopathic treatments are highly restricted in both sows and piglets from organic herds due to the regulations.

3.2. Problems

3.2.1. Congenital defects

There are almost no specific data for organic herds but it can be assumed that the occurrence of congenital defects is similar in organic and conventional pig farms when breeds are similar. A questionnaire survey from Netherlands has shown that umbilical hernia is regarded in organic farms as an important problem (van der Meulen et al., 2006). In conventional farms, congenital defects leading to piglet death (e.g. atresia ani) have a frequency between 0.5 and 3% in total (review: Ollivier and Denis 1985) and hence account for a minor part of neonatal mortality. Heritable anomalies with low viability have a slightly higher frequency ranging between 1.2 and 5% of the pigs (review: Ollivier and Denis 1985). Splay leg belongs to this category since affected animals have difficulties to reach the mammary glands. Similarly, a hernia decreases the chance to survive since it may strangle or rupture. In some conventional farms, splay leg, scrotal and umbilical hernia are very common and may affect more than 5% of the pigs (Andersson and Rydhmer 1991, Sellier et al., 1999, Prunier et al., 2006a).

3.2.2. Mortality

Very few data are available regarding mortality of piglets in organic pig farms. Available data come from a small number of farms that are probably not representative of all organic farms (Table 3.2). Overall, results show relatively high levels of piglet mortality.

In conventional pig farms, crushing accounts for a high percentage of mortality (about one third) and is lower indoors than out outdoors (review: Edwards 2002) where it may account for more than 50% of total deaths (Edwards et al., 1994). In outdoor conventional farms, crushing occurs mainly at farrowing and at night during the first 12 hours after farrowing, and involves changes of position of the sow (Vieuille et al., 2003). Similarly, in outdoor organic farms, the majority of piglet mortality occurs within 3 days of age (about 75%) and is also related mainly to crushing by the mother (about 65%) and to weakness/starvation of the piglets (about 25%) (Feenstra, 1999). Numerous factors are associated with crushing (Weary et al., 1996, 1998):
- high proximity of the piglets with the dam due to a cold environment or to insufficient colostrum or milk production or to a large litter size;
- lack of protection of the piglets against sow crushing (lack of piglets' nest, lack of anti-crushing systems);
- lack of a farrowing crate that slows down movements of the sow and reduces the amount of rolling from ventral to lateral position;
- heavy and clumsy sows.

3.2.3. Hunger and thirst

There are almost no specific data regarding colostrum and milk intake in organic pig production. To our knowledge, the only information comes from Feenstra (1999) showing that some piglets suffer from low colostrum and milk intake in the first days after birth. Since low levels of proteins and of essential amino acids in the diet of lactating sows have negative effects on milk production (Mahan et al., 1971, Lewis and Speer, 1973, review: Etienne et al., 2000) and since balanced diets are difficult to formulate in organic pig farming (see above), it is likely that piglets may suffer from insufficient milk intake and hence from hunger and thirst in some farms.

In organic production, piglets must be suckled until at least 40 days of age but many producers wean the piglets later (Table 3.1). Milk production varies during lactation with maximum level that is reached around the 3rd-4th weeks of lactation (Salmon-Legagneur, 1958, Noblet and Etienne, 1986, review: Etienne et al., 2000). Thereafter, milk production is probably not sufficient to cover the nutrient needs for maintenance and growth. Therefore, suckling piglets should have access to creep feeding adapted to their nutritional needs and digestive abilities from at least 4 weeks of age. Indeed, in conventional production, when lactating piglets have free access to creep feeding, their intake increases gradually from 25 to 1350 g/day between 21 and 70 days of age (Boe, 1991). From these data and data regarding milk production (Salmon-Legagneur, 1958; Noblet and Etienne, 1986, 1989), it can be calculated that creep feeding should supply between less than 1% to more than 50% of the metabolic energy intake of piglets between 21 and 40 days of age. In practice, it is common that piglets on organic farms do not receive specific creep feed but have access to their mothers' diet. Such a diet is probably not adapted to their digestive abilities and to their nutritional needs. Indeed, the digestive enzymes necessary for the digestion of complex carbohydrates and non-milk proteins are present at very low levels until 3 weeks of age and increase progressively thereafter (Corring et al., 1978, Pierzynowski et al., 1993, review: Aumaître et al., 1995). Moreover, protein and amino acid requirements are high in 2-6 week piglets with recommendations of about 230 g crude proteins and 15 g lysine per kg of dry matter (King and Pluske, 2003) that are probably higher than in the dam's diet.

Under most circumstances, the amount of water consumed via sows' milk is largely sufficient to satisfy piglets' requirements. However, under warm environmental conditions, episodes of diarrhoea and at the end of lactation (> 4 weeks) when milk production starts to decrease whereas piglet needs increase, water from milk is probably not sufficient and water supply becomes necessary. In practice, it is common that piglets do not have their own adapted access to water and must use the same watering system as their dam.

3.2.4. Cold stress

At birth, body reserves are necessary to provide energy for thermoregulation. Moreover, subcutaneous fat contributes to isolate animals from a cold environment. Unfortunately, body reserves and subcutaneous fat thickness are low in piglets at birth (Review: Herpin and Le Dividich, 1995) making them highly sensitive to cold. In organic production, outdoor farrowing is common (Table 3.1) and piglets that are born outside may be more at risk due to the lack of control of the environmental temperature. Indeed, when piglets are born outdoors, their rectal temperature at 30 min after birth is lower during winter than during summer by about 1°C (Gueguen et al., 2000).

3.2.5. Health disorders

The most common health disorders in piglets that have been identified by an expert group within the COREPIG project are: diarrhoea, arthritis, skin, joint and claw lesions, anaemia and parasites. All these disorders have negative consequences on the welfare, growth and even on survival of the piglets. There are only few data regarding the occurrence of these problems in organic farms. Data from conventional farms, when they are collected in similar environmental conditions, may give some indication on the incidence and gravity of these problems.

In a questionnaire survey in organic farms from Austria (mainly indoor), one third of the farmers reported diarrhoea in lactating piglets as a problem (Baumgartner et al., 2003). When piglets are reared outdoors, anaemia is unlikely since piglets can find enough iron from the soil (Brown and al., 1996). When piglets are reared indoors, iron treatment shortly after birth is necessary to prevent anaemia and seems to be a common practice in organic farming (Van der Meulen et al., 2006). It can be given by intramuscular injection or oral ingestion.

There are few data regarding parasite prevalence in suckling piglets from organic production. Only the coccidia *Isospora suis* and the nematode *Strongyloides ransomi* are predominantly found in piglets, as older pigs usually have acquired resistance (reviews: Nansen and Roepstorff, 1999 ; Thamsborg and Roepstorff, 2003). A limited number of piglet samples in pioneering organic herds in Denmark revealed that *Isospora* was most frequently found in piglets born in indoor farrowing crates and in stationary outdoor huts, while this diarrhoea causing parasite was almost absent, when outdoor farrowing huts were moved between farrowings (Roepstorff et al., 1992). This is most likely because transmission takes place between consecutive litters, whereby the transmission route is broken by moving the huts. *Isospora* is very common in 2-4 weeks old piglets in industrialised conventional herds (e.g. Roepstorff et al., 1998), and the low prevalence in organic piglets within a pasture rotation management system is to our knowledge the only example of a gastrointestinal parasite, which is of lesser importance in organic herds compared to conventional herds. *Strongyloides* has neither been commonly found in indoor piglets (eg. Roepstorff et al., 1998) nor in organic piglets (Roepstorff et al., 1992), and outbreaks in piglets may most likely be associated with very poor hygiene in the sow unit (e.g. Roepstorff, 1991), whereafter arrested larvae within the sows are transferred lactogenically to the piglets immediately after birth. Though not considered a major heath problem in young animals, 4-week old piglets can harbour *Oesophagostomum* and excrete eggs as shown in organic farms from Netherlands (Eijck and Borgsteede, 2005). Other helminths like *Ascaris* and *Trichuris* may also infect piglets, however, true egg-positive infections cannot be diagnosed by faecal sampling of piglets because of the 6 to 7-weeks long prepatent periods of these species. Nevertheless, the commencement of egg excretion shortly after 7-8 weeks of age demonstrates that the piglets may become infected shortly after birth, when the piglets are born in farrowing pens with poor hygiene (Raynaud et al., 1975; Roepstorff, 1991). By *post mortem* examination of piglets born on contaminated pastures it has been unequivocally demonstrated that the piglets were already exposed to intestinal worms within their first 2 weeks of life i.e. before they left the farrowing huts (Roepstorff and Mejer, unpublished). Furthermore, a second study using controlled experimental infections showed that infections with nematode larvae significantly reduced the growth rate and weight gain just as the body composition was altered in 7 weeks old piglets (Mejer et al., 1999).

3.2.6. Low growth rate

There are almost no specific data regarding piglet growth in organic pig production. However, data from conventional production clearly indicate that growth rate varies greatly both within and between litters. Since milk is the main source of nutrients in lactating pigs until about 4 weeks of age (see above), insufficient milk production will have negative consequences on growth rate. Thereafter, the intake of creep feed is likely to influence greatly their growth until weaning. Regarding organic pig production, in the favourable conditions of an experimental herd with creep feeding adapted to the piglet nutritional needs and digestive abilities, growth of suckling piglets until 7 weeks of age was satisfactory (340 g/day in Andersen et al., 1999).

3.2.7. Predation

Young piglets that are reared outside may be submitted to predation by corvids, foxes or even badgers. Indeed, losses due to predation have been reported in studies in UK (Edwards et al., 1994; Kelly et al., 2001) and in Denmark (Lodal et al., 2003).

3.2.8. Pain and health consequences of castration

In most European countries, piglets are castrated primarily to avoid boar taint and secondly to avoid undesired behaviours such as mounting. Pigs are usually castrated by surgical means involving the cutting of the scrotum and of the spermatic cords (Fredriksen et al., 2009). This is a painful procedure (Prunier et al., 2006b). In addition to pain, castration induces an acute stimulation of the adrenal axis (Prunier et al., 2005) and the open wound may be a source of infection especially when hygiene is poor. Indeed, castration is believed to favour arthritis in conventional pig production (Strom, 1996). There is no reason that such phenomenon does not exist in organic production. In a recent questionnaire survey at the European level, it was shown that a majority of male pigs are castrated with a similar frequency in conventional and non-conventional systems including organic farming (Fredriksen et al., 2009). Castrating piglets above 7 days is common in non-conventional systems such as organic herds (Fredriksen et al., 2009). In many cases, these animals are castrated above 2 weeks of age. At such ages, castration may have more negative effects on behaviour especially on feeding behaviour (McGlone and Hellman, 1988). The consequences on health may also be more severe since the passive immunity from colostrum is decreasing with age whereas the acquired immunity as measured by circulating immunoglobulins takes several weeks to reach a level similar to 1-week piglets (review: Rooke and Bland, 2002). Above 7 days of age, animals should be castrated under anaesthesia by a veterinarian according the general EC regulation for pig farming (Council Directive 2001/93/EC, amending Council Directive 1991/630/EEC) but, in practice, it does not seem to be the case (Fredriksen et al., 2009). New regulations for organic farming (Council Directive 2008/889/EC) will impose pain reduction at castration by "applying adequate anaesthesia and/or analgesia and by carrying out the operation only at the most appropriate age by qualified personnel" in organic farming regardless the age of the piglets, with a transition period expiring on 31 December 2011.

3.3. Hazards for health and welfare problems in organic piglets

Mortality, hunger, thirst, low growth rate, coldness, health disorders have been grouped together since they are highly interrelated and since all hazards for insufficient colostrum and milk intake by the piglets are hazards for mortality, hunger, thirst, low growth rate, coldness and health disorders. In order to facilitate the writing of the text, we will use the expression "welfare disorders" to designate all problems except mortality.

3.3.1. Animal related hazards

<u>Congenital defects</u>
Genetic as well as environmental, nutritional and management factors play a role in the appearance and severity of hernia and splay leg defects even though exact contributions and underlying mechanisms are not known. Differences between breeds have been described regarding splay leg occurrence (e.g. splay leg is more frequent in Pietrain than Large White

pigs, Sellier et al., 1999) and inguinal hernia (e.g. inguinal hernia are more frequent in Duroc than in Large White males, Vogt and Ellersieck, 1990). Relatively high heritabilities have been described for genetic defects, around 0.5 for splay leg (Sellier and Ollivier, 1982) and 0.3 for inguinal/scrotal hernia (Vogt and Ellersieck, 1990). Among other maternal related hazards, prolificacy and parity seem to play a role. Indeed, the incidence of splay leg increases with litter size (Sellier et al., 1999) and is higher in litters from higher parity sows (Spicer et al., 1986). Finally, sex of the animal is a hazard since the occurrence of both splay leg and hernia is higher in males than in females (splay leg: Sellier et al., 1999, hernia: Hayes, 1974).

Mortality, hunger, thirst, low growth rate, coldness, health disorders

High litter size at birth is a hazard for piglet mortality as demonstrated in conventional farms from the "past" (Legault, 1977) or more recently indoors (Review: Herpin and Le Dividich, 1998) as well as outdoors (Edwards et al., 1994; Baxter et al., 2009). For example, mortality of piglets during a 4-week lactation in conventional indoor farms was respectively 12.5%, 16.5% and 24.7% for litter size at birth of 8, 12 and 15 piglets (Review: Herpin and Le Dividich, 1998). Numerous factors that are interrelated can explain this phenomenon (Reviews: Herpin and Le Dividich, 1998; Edwards, 2002): longer farrowing duration, lower birth weight of piglets (Gardner et al., 1989), reduced colostrum/milk intake per piglet, piglets remaining closer to the sow etc.

High litter size is also a hazard for thirst, low growth rate and coldness since all these problems are increased when individual colostrum and milk intake decreases, which happens when litter size increases. Indeed, pigs from a given litter have to share the colostrum and milk that are produced by the dam. Therefore, individual intake depends on the overall production by the dam and on the litter size. It is known that milk production increases with litter size but the increase is not fully proportional and individual piglet's intake decreases with litter size (Auldist et al., 1998, review: Etienne et al., 2000).

Genotype explains large differences in piglet mortality and welfare disorders between herds. Some of the differences are related to the litter size and higher problems are expected in breeds selected for prolificacy. However, for a given litter size at birth, differences still exist between breeds. For example, total mortality between birth and weaning in conventional farms from the "past" was similar in Large White and French Landrace breeds but lower than in Belgian Landrace that was itself lower than in Pietrain breed (Legault, 1977). Genetic effects on piglet survival include direct effects on piglet’s potential (genes related to vitality, growth, resistance to disease...) and maternal effects on dam’s potential (genes related to uterine development, milk production, maternal behaviour...). Estimates of direct and maternal heritability of survival at birth (0.21 and 0.15, respectively) and during the nursing period (0.24 and 0.14, respectively) for outdoor conventional production are larger than those reported for indoor production suggesting a higher importance of the genetic potential when the environment is less controlled (Roehe et al., 2010). Use of pure bred animals is a hazard for mortality and "welfare disorders" since heterosis effects can be observed on litter size at birth and at weaning, on individual weight at weaning and on pre-weaning survival (Legault, 1977, Bidanel et al., 1989, Cassady et al., 2002, review: Sellier, 1976). These heterosis effects can be from maternal origin (sows are crossbred) or from direct origin (piglets are cross breed) as shown in conventional herds. Heterosis from paternal origin is very low on litter characteristics (Bidanel et al., 1989). Therefore, both the lack of crossing of the mother and of the offspring must be considered. Finally, it should be observed that overall production of milk by the dam depends on genetic factors. Differences between breeds have been described (e.g. German Large White sows export more nutrients in milk than Pietrain sows, Grun et al.,

1993) and the heritability for milk production has been estimated around 0.17 in pigs (York and Robinson 1985, review: Etienne et al., 2000). Therefore, genotype may influence mortality and "welfare disorders" through its effect on milk production.

Lower number of functional teats than litter size is a strong hazard for insufficient milk intake and hence for mortality of piglets and "welfare disorders". Number of functional teats has a strong genetic component: differences have been described between breeds (e.g. sows with genes from the Chinese Meishan breed have more functional teats than sows from only European pig breeds, Haley et al., 1995) and the heritability is higher than 0.1 (Hanset and Camerlynck, 1974, Clayton et al., 1981). Moreover, direct heterosis effect has been described for the number of nipples (Cassady et al., 2002).

Parity is also a hazard for mortality of piglets since overall mortality of piglets (stillborn + pre-weaning death) increases with parity of sows above 2, as shown in conventional sows farrowing outdoors (Berger et al., 1997) as well as in indoor conventional farms from the "past" (Legault et al., 1975) and from today (Koketsu et al., 2005). Concerning stillbirth, it seems that their number and percentage increase only above parity 3 (Legault et al., 1975). The influence of parity on mortality can be explained, at least in part, by the fact that older sows have higher rates of crushing (Weary et al., 1998). Numerous factors that are interrelated can explain this phenomenon: older sows have larger litter size, lower birth weight piglets and lower colostrum/milk available per piglet (Weary et al., 1998). In addition, older sows are heavier and probably more clumsy (Weary et al., 1998). Parity regardless its effect on litter size is also a hazard for hunger, thirst and coldness since milk production varies with parity and seems highest between the 2nd and 4th litter (Salmon-Legagneur 1958, review: Etienne et al., 2000).

3.3.2. Factors related to the housing system

<u>Mortality, hunger, thirst, low growth rate, coldness, health disorders</u>
Inadequate housing conditions may also account for a high part of piglet mortality, especially when it is related to a lack of thermoregulation control. Indeed, lowering of body temperature induces lethargy of piglets that may lead to death through crushing and starvation (review: Edwards, 2002). In conventional farms from the "past", it was shown that the mortality of the lactating piglets was increased from October to March (Legault, 1977). More recently, in outdoor farrowing systems, it was shown that piglet losses during lactation are greater during the colder months, from November to February (Berger et al., 1997). These losses are due to a higher mortality on the first days after of birth (outdoors: Gueguen et al., 2000). Again reasons for these losses are interrelated and imply probably crushing of the piglets that are closer to the sow when it is colder. Insufficient amounts of dry straw to build the nest and insulate the piglets from a cold environment, as well as lack of protection of the piglet area against wind or draught, will contribute to accentuate the influence of coldness. Contrarily, providing insulation in farrowing huts had no significant effect on piglet mortality (Edwards et al., 1995), although several studies and practical experience suggest the possibility of benefits in some situations.

High ambient temperature (milk production decreases above 25°C, Quiniou and Noblet, 1999) and noise (milk production decreases with noise, review: Algers, 1993) have powerful negative effects on milk production and hence on piglet survival and welfare. The influence of high ambient temperature on milk production is explained only marginally by its inhibitory effect on sow appetite (Messias de Bragança et al., 1998). The influence of lighting is controversial: lower milk production has been observed when light duration was shorter (8 vs. 16 hours) by Mabry et al. (1983) whereas a lack of effect was observed by Prunier et al. (1994).

In outdoor systems, group penning of the sows seems to be a hazard for piglet mortality as shown by a tendency for higher mortality of live born piglets in conventional sows that were moved to paddocks of four with individual huts at about one week before the expected farrowing date compared to sows moved to individual paddocks (Higgins and Edwards, 1996). This higher mortality was associated with changes in the behaviour of the sows that spent less time within their own huts both before and after farrowing but more time foraging outside. However, growth of the piglets was similar in both systems. No data are available for outdoor sows grouped during lactation, but an increase of piglet mortality is expected since higher mortality of piglets older than 14 days was observed in the study from Higgins and Edwards (1996).

In indoor systems, group penning of sows is probably a hazard for hunger, thirst and low growth rate of piglets as shown by reduced growth rate in piglets when conventional sows kept in crates at farrowing and early lactation were grouped at 3 weeks post partum (Bryant et al., 1983; Wattanakul et al., 1998). This reduced growth rate was associated to disturbance in the nursing and suckling behaviour. However, piglet mortality was not modified. The negative influence of group suckling on nursing behaviour and milk production was less marked when conventional sows were not relocated at grouping (Wattanakul et al., 1998). When grouping occurred before farrowing with the possibility for the sows to isolate correctly as described in a family pen system by Arey and Sancha (1996), neither mortality nor growth of the piglets were deteriorated. Therefore, group penning is a hazard for piglets depending on its timing and on the housing system.

Lack of protection of the piglets against sow crushing (lack of piglets' nest or of anti-crushing systems) will favour crushing.

In outdoor production, poor "drainage" of soil may favour health disorders and mortality since animals are more likely to be wet and dirty. Moreover, germs and parasites are more likely to survive and/or develop in wet environments. In outdoor production, insufficient grass cover is also a hazard for piglet mortality since higher mortality has been observed in farms where the grass cover is poorly established (Berger et al., 1997). The reasons for this are probably complex. For instance, in degraded paddocks, mud can be brought into the huts by the sows, increasing humidity and bacterial pollution (Berger et al., 1997). In addition, grass constitutes a supply of nutrients (Edwards, 2003) that can be transferred to the offspring via the uterus or the mammary glands and contribute to keeping the sows in a better health and body condition to support gestation and lactation. Both phenomena will benefit piglet survival and welfare. However, lush pasture vegetation creates a humid microclimate close to the ground that favours the survival of eggs and larvae of common parasites such as *Ascaris*, *Trichuris* and *Oesophagosotmum* (Rose and Small, 1981; Kraglund et al., 2001) thereby potentially increasing transmission levels.

In outdoor production, it is common not to treat piglets with exogenous iron. When soils are low in iron content, piglets may suffer from iron deficit and develop anaemia if they are not treated with iron (Szabo and Bilkei, 2002). In indoor production, lack of iron treatment is always a hazard for the piglets that will be anaemic otherwise (Ulrey et al., 1959).

Lack of a specific watering system is a hazard for thirst of the piglets since they may have difficulties to reach water from their mothers' water supply.

Hard and/or abrasive flooring is supposed to be a hazard for limb and foot lesions (abrasion lesions) in piglets. Indeed, it was observed in conventional farms that foot and limb lesion scores were higher in piglets raised on slatted steel in both the sow and piglet areas than in other treatments where plastic-coated expanded metal was present (Lewis et al., 2005). Slippery floor is also a hazard for mortality and welfare of piglets especially since it will favour the development of splay leg symptoms and increase the difficulties for piglets to reach the mammary glands or the piglet nest.

Predation

Lack of fencing and proximity to woods will favour predation by foxes or even badgers.

3.3.2. Factors related to the management

Congenital defects

Environmental, nutritional and management factors play a role in the appearance and severity of hernia and splay leg defects in addition to genetic factors even though exact contributions and underlying mechanisms are not known. Among management factors, lack of farmer's intervention on splay leg piglets is important. Indeed, taping together the affected legs of splay-legged piglets favour locomotion and recovery and hence increase their survival rate. Lack of intervention is more likely to occur when lactating sows are outdoors since it is more difficult to detect the problem, catch the affected piglets and give them the adequate treatment.

Splay leg defects may be favoured by the ingestion of mycotoxins by the sows during pregnancy (Alexopoulos, 2001). These mycotoxins may come from contaminated cereals in the diet or from contaminated straw used as bedding but ingested by pregnant sows.

Mortality, hunger, thirst, low growth rate, health disorders

Both farmer supervision around farrowing and lack of farmer supervision can be considered as hazards depending on the context. For instance, intervention around farrowing allows:
- removal of placental envelops around pig snout to prevent suffocation,
- drying and positioning pigs under heater lamps to avoid coldness,
- extracting pigs from the uterus to avoid prolonged farrowing,
- external feeding of low-viability pigs with colostrum to avoid coldness and immune deficiency...

Shortly after farrowing, supervision of the litters and of the sows allows a more rapid treatment of sows displaying MMA (mastitis-metritis-agalactia syndrome). It also allows taping together the affected legs of splay-legged piglets to favour their locomotion and recovery. All these interventions have positive effects on piglet survival and welfare but they can also induce disturbance of the sows and hence have negative effects on the process of farrowing as well as on the maternal behaviour and finally on piglet survival and welfare. In indoor systems, it seems that the positive effects of supervision during farrowing are higher than the negative ones leading to lower perinatal mortality (Holyoake et al., 1995). However, in outdoor systems, data from commercial herds have shown increased losses from birth to 4 weeks of age when parturition is supervised by the farmer suggesting high disturbance of sows (Berger et al., 1997). However, it can be argued that when farmers have high piglet losses they want to reduce them and use supervision as a method to reduce mortality. In that situation, supervision of parturition could be a consequence rather than a cause of the increased mortality. Overall, it can be concluded that both excessive supervision and lack of supervision are hazards for piglets.

Lack of fostering of piglets increases the risk for low colostrum/milk intake per piglet and hence for mortality and "welfare disorders" in case of large litter size or low colostrum/milk production due to MMA or any other reason. These situations are more likely to occur when lactating sows are outdoors since it is more difficult to control litter size as well as the occurrence of MMA. Delayed fostering is also a hazard for mortality and "welfare disorders". Indeed, the risk of rejection of the piglet by the dam increases with time after farrowing as shown by Price et al. (1994). It was concluded by these authors that *“fostering pigs older than 1-2 days of age will slow the rate at which they integrate into the new sow-litter environment and engage in suckling behaviours".*

High levels of essential amino acids in the diets of lactating sows are necessary to insure high production level of milk (e.g. at least 0.6% of lysine according to Dourmad et al., 1998) and these levels may be too low due to the difficulty to formulate balanced diets in organic production (see above). Therefore, amino acids deficiency, especially lysine deficiency is a hazard for piglets.

Lack of creep feeding is a hazard for piglet hunger. The availability of the diet that is offered to the sow does not solve the problem since it is not adapted to the specific needs of piglets in amino acids and to their digestive abilities (see above part 3.2.3)

Lack of advisory expertise as well as lack of diagnosis by a veterinarian are general hazards for piglet mortality and "welfare disorders". Indeed, in many situations, the farmer has probably not enough expertise to take the appropriate measures against health disorders.
Other important hazards are those related to the control of germs, pests and parasites in the farm (see chapter 2). Lack of hygiene (lack of cleaning and disinfection, lack of batch system with all-in, all-out use of housing when indoors, too short rotation of pastures when outdoors), lack of vaccination protocol and lack of protection measures against the entrance of pathogens from wildlife and visitors belong to this category of hazards.

<u>Pain at castration</u>
Lack of anaesthesia and antalgic treatments are hazards for pain at castration. Lack of hygiene (animals and housing are not clean, instruments are not disinfected between animals) is a hazard for the health of the animals. Age of the animals above one week is also a hazard for recovery since the passive immune protection received by the colostrum decreases with age (Rooke and Bland, 2002) whereas it takes several weeks for the piglets to develop their own active immunity (Gaskins, 1998). Moreover, it seems that surgical castration has stronger inhibitory influence on appetite in older animals (McGlone and Hellman, 1988).

3.4. Conclusions

Health, welfare and production problems of organic suckling piglets are poorly known due to a lack of information regarding performance, management and housing conditions in commercial farms. In addition, there is a lack of experiments run under organic standards.

Low economic importance of organic pig production compared to that of conventional production explains probably this poverty of information. However, some general characteristics of pig organic farming can be described from the present synthesis of knowledge. Organic farms are often characterized by a relatively low level of human intervention on animals around birth as well as by a low level of control of the environment of the animals, including microclimate, germs and parasites. In such situation where animals are exposed to the fluctuations of the environment and where the use of allopathic treatments is highly restricted, the skill of the farmer in observing his animals to adapt his management according to their needs and problems is extremely important. It seems that piglet mortality is relatively high in organic farming but with a high variability between farms suggesting that improvement is easily feasible. Similarly, management and housing conditions seem to differ greatly between farms and a better knowledge of the relationships between farm characteristics and piglet mortality should help to reduce the problems. Issues with particular importance for organic production are (a) control of the microclimate surrounding neonatal piglets, (b) management strategies to decrease the risks of germ and parasite infections, (c) selection of genotypes adapted to organic farming with special emphasis on robustness.

Table 3.1 Short description of the more common system for sucking piglets in each country.

In each country other systems exist in addition to the main one

	DK	UK	Germany	France	Sweden	Italy	Austria	Switzerland
Housing								
Out/in	Outdoor	Outdoor	Indoor with access to concrete outdoor run	Outdoor	Winter: indoor with concrete run Summer: outdoor	Outdoor	Indoor with concrete outside run	Indoor (after 24 days of life access to outdoor run) concrete floor
Penning	Individual or group housing	Single and group	Group penning of sows	Indivi-dual	Individual at farrowing and until ~14 days, Group suckling thereafter	Individual	Individual, in almost 50% group suckling after 1-2 weeks	Single and Group Housing (15 – 20 %)
Farrowing crate	No	No	Yes	No	No	No	No	No
Bedding	Straw	Straw	Straw	Straw	Straw	Straw or nothing	Straw	Straw
Type of breed	Conventional	Large herds conventional, small herds local	Convention al	Conventi onal	Conventional	50% Local	Conventional	Conventional
Weaning age	49-56 days, some farms up to 80 days	42-56 days	42-49	42-56 days	40-50 days	40-60 days	42 days	42 – 56 days
Management								
Monitoring of parturition	No	No	Some	No	No	No	Some	Some
Fostering of piglets	Some	In larger herds	Some	No	Yes	No	Some	No information
Castration	Yes	No (except in small herds for specialist butcher)	yes	Yes	Yes	Yes	Yes	Yes
Age at castration	2-7 days	n/a	7-10 days	10-56 days	Within 1st week of life	7-21 days	Within first week of life	By 14 days
Anaesthesia at castration	No	n/a	No	No	No	No	No	by law from 2010

Table 3.2. Reproductive performance of sows in organic farming (1: Kelly et al., 2005, 2: Vaarst &Thamsborg 2001, 3: Dietze et al., 2007, 4: Kiljtra & Eijck 2006, 5: Früh et al., 2008, 6: Leeb, 2001, 7: Maupertuis & Bordes 2007)

Publication	1	2	3	4	5	6	7
Housing	Outdoor	Outdoor	Indoor	-	Indoor	Indoor	
	Both						
Total born, n/litter	10.9	-	-	-	-	-	13.5
Born alive, n/litter	10.3	10.7	11.4	-	-	11.7	12.0
Weaned, n/litter	8.5	9.3	9.3	-	9.1	9.3	9.0
Stillborn, %	5.2		-	-	-	-	11
Live losses							
birth-weaning, %	17.5	13.0	18.0	21.0	19.5	20.5	25
Total losses, %	21.7	-	-	-	-	-	34
N sows	119	-	-	-	-	-	-
N farms	2	1	20	-	25	13	9

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Chapter 4

Animal health, welfare and production problems in organic weaner pigs

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4.1 Background

In semi-natural conditions, weaning of piglets is a gradual process involving a reduction in suckling frequency, a concomitant increase in foraging activity and the ingestion of solid feed (Jensen and Recén, 1989). This contrasts with the situation in commercial pig production, where weaning is a particular critical period in the life of a piglet, implying an exposure to numerous stressors at the same time. Among others, separation of piglets and sows provides a change in the piglets' diet not only in relation to the nutritional composition but also a change from fluid to solid feed. The piglets are no longer protected by the sow's milk with respect to passive immunity or in terms of the sows' body heat when resting. Further stressors include challenges through changes in the microbial flora in the environment, changes in climatic conditions, challenges by new physical and social environments associated with possible moving and mixing.

There are significant differences in the management of weaning between organic and conventional pig production. The biggest of these is the age at weaning, but there are also differences in the lactation environment and the housing conditions for the newly weaned piglet. Table 4.1 illustrates the large diversity of weaning procedures which is applied in organic pig production throughout Europe. In most organic systems weaning is performed by physically separating the sow and piglets, when the piglets are 40 days old, which is the minimum weaning age according to EU regulation (EC Regulation 1804/1999). In some countries, piglets' are weaned at an older age dictated by national certifications bodies (see Chapter 1). In addition, many organic farmers move their piglets to a different location when weaning, thereby further subjecting the piglets to potential stressors as handling, transportation and a different bacterial load. In many contries, weaners, growers and fatteners in organic systems are kept in indoor systems with access to concrete outdoor runs. Consequently, the change in environment can be rather dramatic in the systems practising outdoor farrowing and indoor weaning. Finally weaning often involves regrouping the piglets by mixing different litters, giving social instability as new group hierarchies has to be formed.

This chapter will review the available information on the different health and animal welfare information in organic pigs regarding weaning. It will addess the prevalence of most relvant health problems and will review their potential hazards and associated risk factors.

Table 4.1 General weaning procedure in European organic pig production

	DK	UK	D	F	S	IT	AU	CH
Weaning age (days)	49	42-56	42	42	42	40-60	42	42 – 56
Farrowing	Mostly outside	Always outside	Mostly indoors	Mostly outside	Mostly indoor with concrete outrun	Mostly outside	Indoor with access to outdoor concrete run from birth or after 3-7 days	Indoor (after 24 days of life access to outdoor run – always concrete floor)
Weaning place	Mostly inside	Outdoor	Mostly indoor with outdoor run	Mostly outdoor but some with concrete outrun	Mostly indoor with outdoor run. Some on pasture in summer	Mostly indoor with outdoor run	Mostly indoor with outdoor run	Mostly indoor with outdoor run
Are weaners or sows moved ?	Mostly weaners	Mostly weaners	50:50	?	?	Mostly weaners	both in most cases	50:50
Are litters mixed	yes	yes	yes	yes	yes	yes	most	most

DK: as practiced in the largest herds (>20 sows)
CH: practiced in herds from 5 to >20 sows

4.2 Health problems

The various weaning procedures applied across European organic pig farms predispose the weaners for different health and welfare problems. In combination with the occurrence of epidemic diseases, the prevalence of diseases related to the weaning process is expected to differ considerably within and between countries. So far, only a few studies have dealt with the prevalence of disease or welfare problems in organic weaners. In a survey including farmers from Denmark, Sweden, the Netherlands, Germany and England, the predominant health problems around weaning were respiratory diseases (NL, D, DK), diarrhoea (D, DK, NL), arthritis (NL, D) and endoparasites (DK), while English farmers reported that insufficient feed intake is a bigger problem than infectious diseases (Bonde and Sørensen, 2005). Porcine dermatitis and nephropathy syndrome (PDNS), post weaning multisystemic wasting syndrome (PMWS) and keeping the stock dry during periods of heavy rainfall are mentioned as primary concerns in another survey conducted in England (Day et al., 2003). Nordic veterinarians and advisors points to poor quality of feed (>50%), lack of wallowing facilities (25-50%), diarrhoea (25-50%), joint infections (<25%), meningitis (<25%), respiratory problems (<25%), and tail biting (<25%) as main health and welfare problems (Bonde and Sørensen, 2004).

4.2.1. Post weaning diarrhoea (PWD)

Diarrhoea is a multifactorial disease, coming into existence by a combination of a challenged digestive system, a challenged immune system and various stressors during the weaning process. While in the past scientists primarily focussed on specific pathogens found in place in the case of diarrhoea (Carpenter and Burlatschenko, 2005; Jacobson et al., 2003; Wieler et al., 2001), there is increasing evidence that the presence of pathogens is only one out of a long list of factors involved (Lallès et al., 2007a,b).

Most studies concerning postweaning diarrhoea have been performed in conventional systems, characterised by an early weaning age and by housing conditions with a high stocking density and without litter. In these studies numerous risk factors for post-weaning diarrhoea (PWD) are identified: 'pre-weaning diarrhoea', 'larger litters', 'low weaning weight', 'low weaning age', 'low creep feed intake', 'cleanliness of the weaning pen', 'temperature of the weaning pen', 'air quality', group size', 'stocking procedure', 'feed intake of the piglets during the first week post weaning' (Svensmark et al., 1989; Madec et al., 1998; Skirrow et al., 1997). In conventional systems, weaning diarrhoea is seen 3-10 days after weaning, typically involving proliferation of haemolytic E.coli (Carstensen et al., 2005). Often multiple concurrent pathogens are involved. Differential diagnoses for diarrhea in weaned pigs include salmonellosis, swine dysentery, procine proliferative eneropathy (PPE) caused by *Lawsonia intracellularis*, rotavirus and coronavirus enteritis, postweaning colibacillosis, trichuriasis, coccidiosis and procine colonic spirochetosis (PCS) caused by *Brachyspira pilosicoli* (Carpenter and Burlatschenko, 2005). The symptoms are not confined to the gut but can overlap with disturbances of other organs and tissues. According to Svensmark et al. (1989), diarrhoea is often associated with an increased incidence of diseases of the skin and respiratoy tract.

On 6 organic farms affected with PWD problems, laboratory analyses provided proof for the presence of different strains of haemolytic *E. coli*, *Brachyspira pilosicoli* and *Lawsonia intracellularis*, however, independent of the health status of the piglets (Sundrum et al., 2010). The examination of critical control points revealed that all affected farms showed more or less severe deficits in the hygiene management and in the nutrient regime.

In the study of Bussemas and Weissmann (2008), an extended suckling period of 63 days resulted in an improved growth rate and in a reduced number of medically treated piglets while the prolongation did not negatively affect the body condition and the teats of the sow.
Under semi-natural conditions, weaning is a gradual process where the piglets suckling frequency decreases as milk is substituted with solid food. This process is completed when the piglets are 10-19 weeks old (Jensen and Recén, 1989). As the intake of solid feed increases the piglets' intestinal system is matured with regards to the microbial colonisation and the gastrointestinal physiology and morphology (as reviewed by Lalles et al., 2007).
A well documented consequence of an early and abrupt weaning is a temporarily reduced intestinal digestion and absorption which increases the risk of post-weaning diarrhoea (Pluske et al., 1997). The piglets immune system is developed in successive stages, and among the later components are IgA+ (Lallés et al., 2007) which acts to protect against E. coli. These developmental issues, which can cause problem with early weaning, are amply documented in conventional systems, where the weaning age is 21-28 days. Although post weaning diarrhoea has been shown to decrease with increasing weaning weight and age (Madec et al., 1998), the minimum weaning age of 40+ days in organic systems is still considerable earlier than under

semi-natural conditions and thus at least some of the developmental/maturity problems are likely to be still relevant.

4.2.2. Cold stress

Another potential welfare implication of weaning during cold seasons is thermal discomfort when the piglets cannot benefit from the sow's heating capacity/body heat. This is a likely reason for the regional differences seen in weaning systems with respect to whether weaners are kept inside or outside. In general the southern European countries wean outdoors, while northern European countries, except England, wean in indoor systems with outdoor runs. A problem keeping the stock dry during periods of heavy rainfall are mentioned as primary concerns in a survey conducted in England (Day et al., 2003). The reduced feed intake which occurs when the piglet is forced to make a transition from milk to a diet with only solid feed results in an increase in the Lower Critical Temperature and hence greater susceptibility to cold stress. Whilst a later weaning age reduces the extent of this deficit in energy intake, it has still been shown to occur when piglets are weaned at 6 weeks of age (Wellock et al, 2007) and may be more marked if the feed is of lower nutrient density and palatability as can be the case in some organic systems because of limitations on permitted ingredients.

4.2.3. Skin lesions

Skin lesions are generally indicative of social disruption within the group (see section 4.2.7). Comparing skin lesions on body, ear and tail on day 5 and 28 after weaning shows significantly more skin lesions on the body in mixed groups compared to groups consisting of littermates (Baumgartner, 2007).

4.2.4. Respiratory diseases

No data have been found on the prevalence of respiratory diseases in organic weaned piglets.

4.2.5. Arthritis

No data have been found on the prevalence of arthritis in organic weaned piglets.

4.2.6. Endoparasites

Parasites of importance for weaners are primarily *Ascaris* and *Trichuris*. Piglets born in farrowing crates with solid flooring and straw bedding may have been exposed to many *Ascaris* eggs, while piglets born on pastures may have been exposed to both helminths. As mentioned in Chapter 3, the piglets may have many immature worms already from the first few weeks of life (Roepstorff & Mejer, unpublished). These worms may reach adulthood during the first 2-4 weeks after weaning at 7 weeks of age, whereafter worm eggs in faeces can be demonstrated using standard diagnostic techniques. In traditionally managed indoor herds, weaners have been shown to have 54% *Ascaris* and 3% *Trichuris* in Denmark (Roepstorff, 1991), 12% and 0% in France (Raynaud et al., 1975), 16% and 24% in UK (Pattison et al., 1980).

In intensive indoor herds, there is almost no helminth transmission in the farrowing pens, irrespective of whether the sows excrete eggs or not, which has been attributed to a very dry microclimate (Roepstorff, 1997). The prevalences of *Ascaris* in 10-12 week old weaners in Denmark have thus been found to vary with the production system, being 1% in intensive indoor herds (conventional), 10% in traditional indoor herds (conventional), 50% in pioneering organic herds, and 28% in second generation organic herds, respectively (Roepstorff et al., 1998; Roepstorff et al., 1992; Carstensen et al., 2002). In comparison, 67% of 8-12 week old pigs were positive for *Ascaris* in Swedish outdoor herds (Christensson, 1996) whereas organic weaners in a Dutch study were borderline too young to have detectable patent infections (Eijck & Borgsteede, 2005). Even though the more professional management within Danish organic herds thus seems to have reduced the prevalence of *Ascaris* in weaners from 1991-1992 to 2000, this age group is still heavily infected. This may in part reflect that some *Ascaris* eggs may survive for 9 years on pastures (Krasnonos, 1978) and exposure is thus impossible to avoid if pigs are born outside and permanent pastures are used or pasture rotation schemes are too short.

Trichuris is primarily found in weaners born on pastures, as transmission with this parasite is very poor indoors, whereas its eggs may survive for up to 11 years in soil (Burden et al., 1987). As pigs do acquire a very strong resistance, *Trichuris* usually only have a restricted period of egg excretion, varying from 5-8 weeks, before the worms are completely expelled (Roepstorff & Murrel, 1997; Pedersen & Saeed, 2001; Kringel & Roepstorff, 2006). In pioneering organic herds in Denmark, only one herd out of 12 was heavily infected (weaner prevalence 79%, Roepstorff et al., 1992), while 2 out of 9 of the second generation organic herds had highly infected weaners (10-50%, Carstensen et al., 2003). Similarly, weaners from 1 of 10 Swedish outdoor farms were positive for *Trichuris* (Christensson, 1996). It is remarkable that all heavily infected Danish herds were established ≥5 years before the study, which means that *Trichuris* eggs have had time to accumulate in the soil and that the pigs may have had the opportunity to return to previously contaminated areas.

Werner et al. (2009) conducted a study to assess the hygienic measures used on organic pig farms and to evaluate their effectiveness in reducing endoparasite infections on 20 organic pig-breeding farms in Germany. Management factors related to helminth infections of the herds were recorded in personal interviews. The majority of the farrowing units (n = 15) were cleaned wet, whereas most of the farmers did not clean the gestation pens at all and if so only mechanically by removing dung. Chemical disinfection was only performed in at most 20% of the farms in farrowing units. Strongylid, Trichuris suis and Ascaris suum eggs were detected in 78.5%, 2.8% and 1.3%, respectively. Regarding the worm control and hygiene management, there were no differences between strongylid free or infected farms. Thus, those farms who used comprehensive hygiene measures were not necessarily gaining the best results with respect to endoparasite infection. The authors concluded that without the implementation of strategic control and feedback mechanism within the production process, effectiveness of hygiene measures related to worm burden can not be assessed sufficiently.

4.2.6. Post weaning multisystemic wasting syndrome (PMWS)

PMWS is a disease that affects weaned pigs, mainly between 6 and 14 weeks of age. It has variable clinical signs including loss of condition, pallor, depression, laboured breathing, fever, inappetance and enlarged peripheral lymph nodes. Mortality rates of up to 20% are common during the early stages of the disease. The cause has not been completely defined, but there is an association with the Porcine Circovirus-2 (PCV-2). Although it has been suggested that later weaning may reduce the prevalence of clinical problems, PMWS has been reported as a significant problem on a number of organic units (Day et al., 2003; SAC Veterinary Services, 2006).

4.2.7. Distress and frustration

Separation from mother

Andersen et al., 1999 reported that belly nosing was initiated a short period after weaning and that the frequency increased during the following weeks. Additionally these authors found that aggression increases after weaning (Andersen et al., 1999; Fraser 1978). These behavioural changes indicate that weaning piglet experiences distress or frustration due to an unsatisfied need to suckle (van Putten and Dammers, 1976; Fraser, 1978), social factors (van Putten 1980; Petersen et al., 1995) or a restrictive environment (Dybkjær, 1992). As mentioned above piglets may experience a range of stressors when weaned. Compared to natural conditions, weaning is an abrubt and premature terminating of the mother-offspring-relationship. Typically weaners are additionally moved to other housing systems – some from outdoor to indoor systems - increasing the risk of experiencing distress due to handling, transport and a new environment, and finally mixing of litters is a frequently used procedure increasing the risk of social competition. Depending on the exact weaning procedure the welfare implications of weaning can be increased distress-responsiveness, frustration, aggression or development of stereotypic behaviour (as discussed by Latham and Mason, 2008; Weary et al., 2008). The rearing environment in it self can further influence the welfare implications of weaning, as animals reared in more enriched environments tends to be better capable of coping with weaning (Hötzel et al., 2004; O'Connel et al., 2005).

New environment

The transport and new housing facilities that many piglets experiences when weaned is an additional stressor. Studies have shown that newly weaned piglets (42 days) have more problems coping with unfamiliar housing than coping with unfamiliar piglets (Puppe et al., 1997). Donaldson et al. (2002) reported depression in play during the first days after weaning (in pigs weaned at 24 d). Organic standards require that weaned piglets have bedding and an outside area, providing a greater degree of enrichment than experienced by many conventional weaners. Millet et al, 2005 pointed in a review out that in general alternative housing has several advantages due to such access to straw and a generally higher enrichment level.

Mixing

Often weaning involves regrouping the piglets by mixing different litters, and this can temporarily affect the piglet welfare as the level of aggression is increased when unfamiliar piglets are mixed (Puppeet al., 1997; Friend et al., 1983). The aggressions and associated injuries can be reduced if piglets are mixed in the suckling period (Pitts et al., 2000 – cited in Weary et al., 2008; Weary et al., 2002) when they more easily form social hierarchies (D'Eath, 2005). Also the physical environment at rearing affects the behaviour of piglets when mixed, as several studies point to a lower level of aggression when mixing piglets reared outside or in enriched pens (Cox and Cooper, 2001; Weary et al., 2008). This can be a consequence of specific social skills learned by the piglets when intermingling with other older and younger litters, or due improved capacity to cope with novel challenges in animals exposed to complex social and physical environment (as discussed by Cox and Copper, 2001). In many outside farrowing systems, the piglets benefit from an enriched environment and they are capable of moving between pens thereby and getting familiarized with other litters before weaning.

4.2.10. Fear of humans

Fear of humans, as measured by a human approach test, is significantly smaller in piglets weaned at seven weeks compared to piglets weaned at 5 weeks (Andersen et al., 1999). The later weaning age in organic systems might therefore be beneficial.

4.3 Hazards and risk factors for health and welfare in organic weaners

Weaning exposes the piglets to numerous, presumably interacting, stressors at the same time potentially resulting in one or more of the above mentioned problems. In the following section, the potential hazards of the different problems are therefore addressed in a summarised way, in as much as potential animal, housing, nutritional and management related risk factors are discussed.

4.3.1 Animal

The major animal related risk factor for health and welfare problems in organic weaners would appear to be weaning age. This affects many different hazards, as described in section 4.2. Information on the effect of other animal characteristics, such as breed, is lacking.

4.3.2 Housing System

Organic weaners must be housed with bedding and with outdoor access. The benefits of outdoor access for weaners, either to fresh air in concrete outruns or full access to soil at pasture, have not been well studied. Data from UK conventional herds suggest that outdoor rearing, in huts with runs, gives better health and performance but these data may be confounded by the origin of the pigs (BPEX 2005).

The provision of bedding provides benefits for foot and leg health, through cushioning properties, for thermal comfort, through insulation properties, and for environmental enrichment. Kelly et al. (2000) compared three types of flooring for weaners: galvanised expanded metal floors, a system with solid concrete floor and minimal straw cover and deep straw. It was found that weaned piglets, with existing foot injuries from the farrowing house floor, recovered quickly in deep bedded pens. The authors concluded from the experiments that solid floors, particularly with bedding, benefit welfare since fewer foot injuries were recorded. With weaners, appetitive behaviour directed at the belly of other piglets, known as belly-nosing, as well as other oral behaviour directed at penmates are also reduced if they are offered straw (McKinnon et al., 1989; Kelly et al., 2000). Furthermore, Zonderland et al (2004) demonstrated a reduced prevalence of tail biting in weaners when straw was present.

However, the use of bedded systems may also pose an increased risk for development and spread of enteric disease. Experiments on conventional pigs conducted in Sweden (Holmgren and Lundeheim, 1994, Rantzer and Svendsen 2001) showed that pigs housed in pens on solid floors lived in dirtier pens with much higher bacterial counts, and had greater prevalence of diarrhoea. Postweaning Multisystemic Wasting Syndrome (PMWS) was found to have more severe expression in a straw-based housing system with solid floors compared to those with conventional fully slatted floors (BPEX 2005). Parasite persistence and transmission is also greater in bedded systems (see section 4.2.6). The hygiene management in bedded systems is therefore of critical importance.

In addition, provision of straw induces the risk of exposure to mycotoxins, those produced by *Fusarium* mould in particular (Moore 2005).

4.3.3 Nutrition / Feeding

Thirst and hunger

Suckling piglets rely primarily on milk as a source of nutrients, energy and water. In farm practice, the feeding regime and nutrient supply before and after weaning varies to a high degree between farms. While in many farm systems piglets go through a period of anorexia immediately after weaning, other farms provide a restricted ration or feed the piglets ad lib. Also the diet composition can vary across a wide range from low quality feed with respect to the digestibility, to special diets exclusively composed to help the piglets through this critical life stage. Thus, change of the diet from milk to solid feed can be associated with more or less weaning distress. Beside the intake of solid feed, the piglets must learn to recognise and drink water when weaned. A change in type of water dispenser at weaning to a nipple or bite drinker can result in a temporary decrease in water consumption but also unhygienic troughs are avoided (Phillips and Phillips, 1999; Sørensen et al., 1994). Furthermore, the drinking behaviour is influenced when piglets are mixed with unfamiliar litters (Dybkjaer et al., 2006).

Feed consumption

Early food consumption after weaning is generally considered essential for maintaining gut function in early weaned piglets (Hedemann et al., 2007; Kuller et al., 2007). Several studies show that a high post-weaning feed intake lowers the risk of PWD (Callesen et al., 2007; Madec et al., 1998; Skirrow et al., 1997). An experimental study of piglets inoculated with E.coli O149 and weaned at 7 weeks showed that a feed intake of less than 200g at day one after weaning was associated with a high incidence of post-weaning diarrhoea-like condition (Sørensen et al., 2007).

However, beside the variation in feeding regime and diet composition, a group of piglets is not homogenous. Correspondingly, feed intake behaviour varies considerably between piglets. Sub-optimal conditions are more likely to result in a depressed feed intake in piglets than in older pigs and sub-optimal feed intake of the group will result in under-nutrition for a number of piglets within the group (Hees et al., 2004).

Whether or not an irregular feed intake will cause diarrhoea is determined by a large number of feed and environmental factors. Overfeeding and irregular feed intake may lead to a diminished digestibility and may result in intestinal disorder and diarrhoea. On the other hand, a low feed intake immediately after weaning can also provide beneficial effects when trying to prevent PWD (Carstensen et al., 2005). In studies of Taina et al. (2008), an increased risk of PWD was associated with the regimen of twice a day feeding and feed restriction after weaning compared to feeding three or more meals a day or the use of *ad libitum* feeding. The post-weaning consumption is influenced by age (as reviewed by Weary et al., 2008), pre-weaning creep feed intake (Bruininx et al., 2002; Kuller et al., 2004, 2007; Carstensen et al., 2005), and housing condition of the suckling piglets. Avoidance of mixing and undisturbed, easy access to food and water is beneficial to both health and welfare of piglets as well as their productivity (Horvath et al., 2000).

Studies with early weaned piglets have shown that creep feed intake during the suckling period stimulates early postweaning intake (Bruininx et al., 2002). Also the quality of the diet (Pajor et al., 2002 – cited in Weary et al., 2008), taste/flavour (Langendijk et al., 2007) and design of the feeder (Appelby et al., 1992) is important for enhancing food consumption after weaning. Piglets eat more creep feed from a tray feeder than a hopper feeder, while no significant effect of sow feeding method on piglet creep feed intake was demonstrated (Wattanakul et al., 2005). The authors conclude that the method of presentation is less relevant for the total feed intake but very important in the initiation of feeding behaviour.
Achieving high intakes before weaning to the extent that the piglets are partially or fully established on solid feed, can reduce distress responses to separation from the sow. Creep feed intake during the suckling period enhances net absorption in the small intestine after weaning which provide as such a useful tool in the prevention of post-weaning diarrhoea (Kuller et al., 2007).

Diet composition

As reviewed by Lallès et al. (2007b), the diet composition is one of the key factors in controlling weaning diarrhoea. Many studies performed under conventional conditions point to the importance of amino acids, dietary fibres, fermentable carbohydrates, lactobacilli, bifidobacilli, yeasts and plant/herb extracts for either prevention or cure. On the other hand, in the numerous investigations that have been conducted with varying diet composition or supplementing with different substances of animal or plant origin, positive effects on the gut have often been more variable and sometimes inconsistent (Lallès et al., 2007a).

Organic pig production has to face severe restrictions in the availability of feedstuffs of high quality protein. Organic farmers often make use of home-grown cereals and grain legumes to formulate farm specific diets (Dietze et al., 2007). There is, however, a huge variation between farms on the local, regional or national level in their ability to provide organic diets (Sundrum et al., 2005). Different legume protein sources vary considerably in weaned piglets in relation to their impacts on nutrient digestibility, intestinal morphology and digestive enzymes (Salgado et al., 2002).The protein profile of legume seeds is characterised by a relative deficiency in sulphur amino acids and tryptophan and by the presence of antinutritional factors (ANF; e.g. protease inhibitors, lectins, tannins or alkaloids) (Gatel, 1994). ANF's can be responsible for a lower feed intake and a lower digestibility, which can partly be explained by reduced accessibility of legume seed protein to digestive enzymes (Godfrey et al., 1985; Gatel, 1994). Due to the restricted availability of feedstuffs with a high content of limited amino acids and a high digestibility, growth rates and protein accretion are clearly lower in organic compared to conventional production (Sundrum et al., 2005). Within the organic framework conditions different measures are at the farmer's disposal to optimise the use of limited resources and to adapt the supply of limited amino acids to the growth process.

In an experimental study of piglets inoculated with E.coli O149 and weaned at 7 weeks, 'feed restriction' and 'diet including lupine as a protein source' had no effect on faecal consistency while 'protein restriction' increased faeces dry matter (Sørensen et al., 2007). While case studies have shown a positive effect of vitamin E in terms of reducing weaning diarrhoea (Lamberts, 1997), studies in organic systems supply no evidence that providing extra E-vitamin in the diet reduces incidence of post-weaning diarrhoea in piglets weaned in organic systems (Sørensen et al., 2007; Sørensen et al., 2005).

A high portion of home-grown feedstuffs possibly implies a higher risk for the presence of mycotoxins in the diet. Low doses of mycotoxins are able to depress growth and alter many aspects of humoral and cellular immunity in weanling piglets (Marin et al., 2002).

4.3.4 Management

In a questionnaire survey to advisors and veterinarians in Nordic organic systems 'insufficient cleaning of outdoor run' was suggested as the main cause of diarrhoea, while 'insufficient daily cleaning', 'insufficient cleaning between groups', 'common sharing cleaning path between pens', 'possibility for contact between pens', 'poor hygiene of sølebad', 'insufficient nutrient composistion of feed' and 'no opportunity for restrictive feeding' were other important causes. Additionally 'poor hygienic quality of feed and water' and 'too few drinking places' were contributory causes (Bonde and Sørensen, 2005). In various studies, the occurrence of post weaning diarrhoea has been associated with poor pen hygiene (Rantzer and Svendsen, 2001; Madec et al., 1998). On farm assessments on organic pig farms revealed suboptimal hygiene conditions and deficits in the hygiene management and in the nutrient regime, although varying in their details considerably between the farms (Dietze et al., 2007). Thus, effective clinical management includes the identification of risk factors and the implementation of changes aimed at reducing the incidence of PWD. The development of diagnostic tools to be used on the farm level should be enforced to enable appropriate and promptly counteractive measures.

4.4 Conclusions

When a problem is recognised, the first step in controlling it is to make an accurate diagnosis. Diseases around weaning are multifactorial in nature. In general, not one but several factors are in place, simultaneously imposing stressors at weaning. The number of possible combinations of stressors, which additionally vary considerably in the possible extent and pathogenic capacity, are unlimited. The identification of main stressors supports the interpretation of the distress response of piglets in the specific farm conditions. However, trying to disentangle the various factors by a mono-causal approach can much diminish the combined response.

There is a need for improved diagnostic measures on a farm level and for preventive and curative measures that are closely related to the farm specific situation. The complexity and the individuality of farm systems need to be taken into account. Within a system approach, animal health precaution plans can be developed as a suitable frame for feedback mechanisms. The use of feedback mechanisms, however, requires a clear guideline concerning the expected output of the system. Consequently, there is a need for a change in the paradigm from a standard-oriented to an output-oriented approach.

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Chapter 5

Animal health, welfare and production problems in organic fattening pigs

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5.1 Background

Although the EU Regulation (EC 834/2007) on organic agriculture provides a clear framework for the housing of fattening pigs, the practical implementation varies to a high degree between countries. The pigs may be housed indoors with access to a concrete outrun or in an outdoor system with access to areas with soil/grass. In general, two types of outdoor systems can be identified. One system consists of a permanent building, e.g. a barn, with permanent outdoor areas and sometimes connected to two or three rotated pasture areas. The other system is more mobile; the pigs and their huts are more or less regularly moved to new areas, which can be fields included in the crop rotation or woodland. In some countries (e.g. Sweden) the fattening pigs are often housed indoors with concrete outrun during winter and outdoors on pasture during summer. The design of the free range systems depends on the extent to which the farmer utilises the pigs for stubble cultivation, incorporation of leys, loosening of the soil and depressing weeds, and also on site specific possibilities and limits (Andresen, 2000).

This chapter summarises information regarding potential health and welfare problems (section 5.2) and hazards (section 5.3) in organic systems for fattening pigs. The results are primarily from studies of organic production or comparisons between organic and conventional production. When results from conventional studies have been considered relevant to throw light upon certain problems or hazards such data has also been included.

5.2 Health and Welfare Problems

The following sections summarises information regarding potential health and welfare problems identified by an expert group within the COREPIG project.

5.2.1 Medication and infection level

When comparing animal health status and husbandry practises between countries it is necessary to consider both the differences between production systems and the national disease situation (Hovi et al. 2003) as well as national regulations for organic production.

An investigation of the use of antibiotics to fattening pigs in Denmark showed that the conventional herds consumed three times as much as the organic herds (Hegelund et al., 2006). There was no significant difference in mortality rate between conventional and organic herds and clinical examinations in the herds did not reveal more pigs in need of treatment in the organic herds. Hence, the conclusion was that there was a difference in the level of infections among conventional and organic herds. The use of anthelmintics against parasites was not included in this investigation.

In a study of organic farms in Austria, 22 farmers out of a sample of 51 used chemically synthesised antiparasitica for regular treatment, but only 10 farmers used regular faecal sampling to monitor the parasitological status in the herd (Baumgartner et al. 2003).

In Sweden the vaccination against erysipelas is recommended for organic pigs, which according to Kugelberg and co-workers (2001) reduced joint lesions in outdoor pigs. However, in a recent study by Heldmer & Ekman (2009) only 11% of joint lesions in organic pigs were infectious, while the rest were related to osteochondrosis.

5.2.2 Endoparasites and ectoparasites

Hovi and co-workers (2003) have reviewed data from surveys of organic production in the UK, Denmark, Austria and The Netherlands. Among organic pig producers, the main health concern appears to be endo- and ectoparasites (Hovi et al. 2003; Day et al., 2003). Lund & Algers (2003) further concluded from a literature review that parasitic diseases could be a problem in organic production and the risk of endoparasitic infections has been confirmed in Denmark (Roepstorff et al. 1992; Carstensen et al. 2002). The endoparasites with the highest impact on fatteners are *Ascaris* (from weaning to slaughter) and *Trichuris suis* (primarily weaners and young fatteners), whereas *Oesophagostomum* spp. and Coccidia, though common, are of less importance. *Sarcoptes scabiei* (mange) is the most important ectoparasite.

Piglets born in farrowing pens with solid floor and straw bedding may have been exposed to many *Ascaris* eggs. In contrast, there is almost no helminth transmission in the farrowing pens of intensive indoor systems, even if sows excrete eggs, which has been attributed to a very dry microclimate (Roepstorff, 1997). *Trichuris* is primarily found in pigs with access to outdoor areas (Roepstorff et al. 1992). It is often impossible to avoid exposure to both parasites if pigs are born or at some point raised on pastures, if permanent pastures are used or pastures rotation schemes are too short (see below).

Pigs may become infected with *Ascaris* and *Trichuris* within the first weeks of life (Mejer & Roepstorff, 2006), but it takes the worms 6-8 weeks to reach adulthood and start producing eggs (Roepstorff et al. 1997; Kringel & Roepstorff, 2006). The infections may thus not be detectable until 2-4 weeks after weaning or when the pigs are young fatteners. *Trichuris* usually only have a restricted period of egg excretion at higher infection levels, varying from 5-8 weeks, before the worms are completely expelled (Roepstorff & Murrel, 1997; Pedersen & Saeed, 2001; Kringel & Roepstorff, 2006). Acquired resistance against *Ascaris* can also be very strong and result in an aggregated distribution within a host population (Roepstorff et al. 1997) and thus a variable impact of the parasite on individual pigs.

In Denmark, the prevalence of *Ascaris* in large fatteners was generally lower (33%) in the 1999 survey conducted by Carstensen et al. (2002) than in the 1990-1991 survey (57%) by Roepstorff et al. (1992). Carstensen et al. (2002) interpreted this as due to better pasture rotation, and improved hygiene and buildings, as the eggs are hardy and some may survive for several years (Krasnonos, 1978). The decline in the prevalence of *Ascaris* may be of economic significance because the growth rate of fatteners has been shown to be associated to their 'life-time worm burden' (Bernardo et al., 1990). Better management may also explain the reduction in *Oesophagostomum* spp. prevalence from 44% to 14% (Roepstorff et al. 1992; Carstensen et al. 2002). Contrastingly, the prevalence of *Trichuris* increased from 7% to 13% (Roepstorff et al., 1992; Carstensen et al., 2002). Carstensen et al. (2002) attributed this to the ecology of *Trichuris* eggs, which often need >1 year to become infective on pastures (Roepstorff & Murrell, 1997; Kraglund, 1999), but may then survive for 11 years (Burden et al., 1987). This slow development and long survival of *Trichuris* eggs means that pasture rotation on a yearly basis, or shorter, may be highly efficient in newly established herds, while it might be have little or no effect when pigs start to return to previously grazed pastures. Actually, the 3 most heavily *Trichuris* infected herds had all had outdoor pigs for >5 years (Carstensen et al. 2003). In a Danish case study, an outdoor area highly contaminated with *Trichuris* was the cause of unthriftiness and even death of young fatteners (Jensen & Svensmark, 1996). In case studies from Sweden the prevalence of *Ascaris* among organic fattening pigs was more than 50%, *Oesophagostomum* spp was very common (Christensson, 1996; Beskow et al. 2003; Lindgren, 2008) and also *Trichuris* was found (Lindgren, 2008). In a survey of organic finishing units in Austria the most common endoparasite was *Ascaris* but also Coccidia and *Trichuris* were found (Baumgartner et al. 2003). In The Netherlands, on approximately half of the examined organic farms young fatteners were positive for *Ascaris* and Coccidia while approximately 20% were positive for *Trichuris* and *Oesophagostomum* (Eijck & Borgsteede, 2005).

Danish organic pigs had more liver condemnations (8%) due to migrating *Ascaris* than conventional (1%) (Bonde et al. 2006). Slaughter statistics from 1997 – 2005 revealed that Swedish organic pigs had about 4 times more white spots compared to conventional pigs (Heldmer et al. 2006). At the examination of slaughter pigs from Austrian farms about 50 % of the organic pigs had milk spots on the liver (Baumgartner et al. 2003). In Germany only 36% of the livers from organic pigs were free from milk spots, while 57% of the conventional livers were not affected (Sundrum & Ebke, 2004). It is very difficult to interpret frequencies of white spots and liver condemnation (Roepstorff, 2003), however, the general finding of more white spots in organic fatteners nevertheless indicates a higher exposure to *Ascaris* and surely reflects a higher economic loss due to condemned livers.

Mange was identified for 18% of pigs inspected at slaughter in Austria (Baumgartner et al. 2003). Mange was a severe problem in some of the pioneering organic herds in Denmark (Roepstorff et al., 1992; Jørgensen & Roepstorff, 1991), however, ectoparasites may be controllable in organic herds in Denmark, as there are no wild boars to infect/reinfect outdoor herds, which are ectoparasite-free from establishment or in which ectoparasites have been eradicated.

5.2.3 Respiratory problems

Hovi and co-workers (2003) suggest that differences in the general national disease situation in pig production affect the organic pig production. In a study from Austria (Leeb & Baumgartner 2000) the prevalence of pneumonic lesions at slaughter was 74% in conventional pigs and about 25% in organic pigs. A comparison at a German abattoir showed that a larger proportion of the organic pigs were without findings in the lungs, 47% versus 41.4% among conventional pigs (Sundrum & Ebke, 2004). In Switzerland, Herzog and co-workers (2006) investigated health problems through a questionnaire and about 7-17% of the organic fatteners had experienced respiratory problems. In Denmark 17 organic and 53 conventional indoor herds were investigated through visits to the herds and analysis of slaughter data (Bonde et al. 2006). At the clinical examinations respiratory problems were similar in organic and conventional herds. However, at slaughter the conventional pigs had more respiratory remarks (27.9%) compared to the organic (11.6%).

When compared to other national populations, the pig population in Sweden, Norway and Finland has a good health status (Wallgren et al. 2004). In Sweden, the prevalence of lesions notified at the abattoir decreased between 1996 and 2001 due to the introduction of age-segregated production and networking operations (Holmgren & Lundeheim 2002). Swine Enzootic Pneumonia (SEP) decreased most significantly of all diseases during the study period; from a prevalence of 17-18% to 2%.

Statistics from slaughter-condemnations in the years 1997-1999 indicated that Swedish organic outdoor pigs had significantly reduced respiratory disorders compared to conventional pigs (Lindsjö, 1997; Kugelberg et al. 2001). However, in a more recent study by Heldmer and co-workers (2006), slaughter statistics from 1997 – 2005 revealed that the health advantages with organic production were diminishing; respiratory disorders (SEP) at slaughter were almost the same in Swedish organic and conventional pigs, about 3.5 %. When analyzing slaughter data from 2002-2004, Lindgren & Lindahl (2005) found that two organic farms with farrowing to finish production had a significantly lower number of Pneumonia SEP compared to four organic specialized fattening herds. Both Heldmer and co-workers (2006) and Lindgren & Lindahl (2005) suggested a connection between an increase in respiratory problems and the more common transferring of organic piglets from several producers to specialized fattening units and also the increased use of indoor housing in stables/barns.

5.2.4 Joint lesions and other leg disorders

Bonde and co-workers (2006) found a similar prevalence of leg disorders, about 2 %, during the clinical examinations in organic and conventional herds. In Switzerland about 10-15% of the organic fatteners had experienced lameness according to a questionnaire (Herzog et al. 2006).

Statistics of Swedish slaughter data from 1997 – 2005 showed that remarks about joint lesions in organic fattening pigs were about 5-6 % or 4 times more common compared to conventional pigs (Heldmer et al. 2006). Heldmer et al (2009) investigated 71 joints from 49 pigs with remarks at slaughter, in year 2007. The pigs represented 12 herds or about 40% of the Swedish organic herds. It was revealed that 89% of the joint lesions were related to ostechondrosis and only 11% were infectious lesions. The authors concluded that since osteochondrosis is also found in conventional pigs, probably the combination of osteochondrosis together with increased exercise was the cause of more frequent joint lesions among organic pigs. One suggestion is to avoid features in the design of the pig environment that may provoke microfractures and increase articular cartilage i.e. differences in floor surface where the pig must jump up and down. (Heldmer et al. 2009) also suggest using pigs with different genetics, such as boars with fewer remarks of joints or other breeds.

5.2.5 Skin problems, abscess, diarrhoea, general health problems

In Switzerland, Herzog and co-workers (2006) used a questionnaire, which was answered by 264 organic pig producers (44% returns). The most common health problem among fattening pigs was diarrhoea, which had affected 25-30% of the pigs, except in the herds with less than 10 fatteners. Generally, health problems among fatteners were less common in the smallest herds than in herds with more than 10 fatteners. Oedema had affected about 1-10% and skin lesions up to a few percent. Haemophilus parasuis bacteria (HPS) were most common in the largest herds (>49 fatteners), with about 13% prevalence, while herds with 10-19 animals had no HPS problems.

In Denmark 17 organic and 53 conventional indoor herds were investigated through visits to the herds and analysis of slaughter data (Bonde et al. 2006). The clinical examinations at the visits showed that in both systems 3.6 % pigs had serious health problems, often requiring treatment. Skin lesions (including abscesses, hernia etc) were more common (8.9%) among conventional pigs than among organic pigs (5.6%). On the other hand, more unthrifty pigs were found in organic herds (4.75%) than in conventional herds (2.9%). The incidence of general health, diarrhoea or CNS-disturbances at the visits was similar in organic and conventional herds. However, at slaughter the conventional pigs had more intestinal remarks; conventional (1.4%) and organic (0.82%), Moreover, organic pigs (74.5%) had no remarks at slaughter than conventional pigs (64.9%). The difference in skin lesions (abscesses etc) found at the visits did not show up in the slaughter remarks, probably because some of those pigs never were sent to the slaughterhouse (Bonde et al. 2006).

In data from slaughter in the years 1997-1999 Swedish organic pigs had significantly reduced condemnations due to abscesses compared to conventional pigs (Kugelberg et al. 2001).

5.2.6 Welfare problems associated with cannibalism and tail biting

Edwards (2006) emphasizes that tail biting has serious animal welfare implications and that, in pig production in general, better environmental design must be a priority until the causal mechanisms of tail biting are fully understood and can be directly controlled. Edwards (2006) also points out that large conventional enterprises throughout the world find it necessary to dock the tails, which makes it difficult to assess the development of the problem. Swedish pigs have a relatively good health status and tail docking is banned in Sweden in both organic and conventional systems. Tail manipulation was more frequent in pigs housed in a conventional Swedish indoor system compared to pigs raised in huts on a pasture (Høøk Presto et al. 2007). However, the statistics for conventional indoor production of pigs in Sweden slaughtered in 2004 displayed a low (1.2%) occurrence of tail-biting (Lindgren & Lindahl, 2005). The percentage was remarkably lower compared to conventional outdoor pigs in a Croatian study, where the prevalence of bitten tails at slaughter was between 14.1 and 20.1% (Walker & Bilkei, 2006). There are different definitions of tail injuries and Walker & Bilkei (2006) scored the grade of lesion from 1 to 4. In their study the moderately (3) and severely (4) bitten pigs represented about 60 % of all the bitten pigs. The authors studied 5 production units with 150 sows each. Groups of 25-30 pigs were kept in paddocks (200 m^2)

and once a week 40-50 kg straw was added to the huts. The conclusion was that outdoor rearing does not prevent tail biting. This indicates that it could be important to monitor tail biting in organic production.

Lindgren & Lindahl (2005) examined six Swedish organic herds in 2004. No abnormal behaviours were recorded during the farm visits, accordingly, the number of slaughter condemnations due to tail biting was generally very low (0.3%). This was also the case in the study by Kugelberg and co-workers (2001) who analyzed slaughter data from 1997-1999 of all organic pigs in Sweden and found a prevalence rate of 0.7%. At the time of slaughter of pigs from four Danish herds tail wounds appeared in 0.1-0.5% of the animals (Bonde et al. 2005).

In Switzerland a questionnaire study indicated that tail-biting had affected about 3-14% of the organic fattening pigs (Herzog et al. 2006).

The feed and feeding system can also affect the risk of abnormal behaviour. Grass and roots in the pasture and also roughage provides oral activity to the pigs. Roughage can contribute to reduce pen mate-directed oral activities (Olsen, 2001) and to decrease the level of aggression (Persson et al. 2004; Høøk Presto et al. 2007).

5.2.7 Welfare problems associated with cold, heat stress and sun burn

Pigs cannot cool themselves by sweating therefore they need moisture from the environment to regulate their body temperature in a warm environment. Weissmann and co-workers (2005) did not observe pigs that had problems with sunburnt skin, not even in genotypes without pigmentation, although the study period covered an extremely sunny and warm summer. The reason was first of all the functional wallows, which were well used by the animals (Weissman et al. 2005; Laister, 2002). In another study, in six organic farms in Sweden, it was found that with either mobile huts or the stationary system with stables, the wallowing facilities were usually well managed (Lindgren & Lindahl, 2005).

5.2 8 Welfare problems associated with fear of humans

Hemsworth and co-workers (1987) examined the influence of different handling treatments on the behaviour, growth and corticosteroids of young pigs. Thirty-two 7-week-old gilts were exposed to one of four different treatments; Unpleasant, where the gilts were briefly shocked with a battery-operated prodder whenever they approached the experimenter during a 3-minute handling bout; Pleasant, where the gilts were gently stroked whenever they approached the experimenter; Inconsistent, where the gilts were randomly exposed to unpleasant or pleasant handling bouts at a ratio of 1:5 and Minimal, where the gilts received no human contact apart from that received during routine husbandry practices. The results showed that gilts in the minimal and pleasant treatments approached and interacted with the experimenter significantly quicker, that they interacted more with the experimenter and that they spent more time close to the experimenter than gilts in the unpleasant and inconsistent treatments. Also, the gilts treated pleasantly showed more approach behaviour than those with minimal treatment. Furthermore, gilts in the minimal and pleasant treatments had better growth rates and feed conversion efficiencies during the initial two weeks of the experiment than gilts in the unpleasant and inconsistent treatments. The unpleasant and inconsistent treatments showed similar levels of daytime mean free corticosteroid concentrations, and they were both significantly higher than in the pleasant and minimal treatments.

Fear of humans through an animal- approach test was measured in six organic pig farms in Sweden (Lindgren & Lindahl, 2005). A test person entered an enclosure, approached the herd and stopped at a distance of seven meters from the herd. The time for the first pig to make physical contact with the test person was only 1-2 minutes in both the stationary (0.98 minutes) and the mobile system (1.5 minutes), which indicated that the pigs did not expect an unpleasant treatment.

5.3 Hazards for health and welfare in organic finishing pigs

The following sections summarises information regarding the hazards, with the potential to give health and welfare problems, that were identified by an expert group within the COREPIG project.

5.3.1 Animal related hazards

Selection lines

Kelly and co-workers (2007) compared Duroc-sired progeny from three maternal breed types housed with an outdoor run or at pasture. The genotypes did not differ in live weight gain, feed intake or the proportion of forages consumed. However, carcass fatness was lowest for the modern genotype (Camborough 12), highest for the traditional purebred Saddleback and intermediate for the crossbred Saddleback x Duroc.

In Italy the organic pig herds are often situated on fringe areas, hills and mountains, where conventional farming is economically less interesting. In a review, Saltalamacchia and co-workers (2004) described the situation for Italian organic pig herds and in particular they considered the use of different breeds such as conventional LW, Landrace, Duroc and the typical local black pigs. The conclusion was that breeds suitable for organic farming included Siena Belted, Casertana, Romagnola, Calabrian, Black Madonie, Duroc, Large White × Duroc, and Large White × Siena Belted pigs.

The behaviour of Large White (LW), Large White × Landrace × NN Pietrain (AH) and Landrace × Duroc was compared in a study in Austria (Laister & Konrad, 2005). The pigs used the various habitat features differently and there were also differences in locomotion. The authors concluded that further research is needed to draw conclusions about the most suitable genotype for organic production and that especially the rearing conditions must be considered in this matter.

5.3.2 Factors related to the housing system

Outdoor systems, environmental impact and rotation

Problems that can be associated with management of outdoor fattening pigs are infections from the roundworm in pigs, Ascaris suum, and risk of plant nutrient losses (Lund, 1998; Quintern, 2005). An excessive stocking density (15 sows ha^{-1} y^{-1}) on outdoor areas resulted in a large net input of nutrients and an increased risk of nitrogen leaching (Eriksen and Kristensen, 2001). Often strategies to minimise negative environmental impact interact with animal welfare. Nose-rings on sows or raising the pigs indoors may reduce the risk of environmental impact but it also reduces the pigs' activity options.

In Denmark different strategies have been investigated to allow growing pigs plenty of space when they are young and most active (Hermansen, 2005). Different combinations of grazing and rearing in barns were used. However, the vegetation was destroyed and the author concluded that either the choice is to take advantage of the effect of the rooting or to use a considerably lower stocking rate, than 100m^2/pig (Hermansen, 2005). One way of integrating the pigs into land use is to include them in the crop rotation, which leads to a rotation of the animals between different areas (Quintern, 2005). Rotation of outdoor areas is also recommended in order to control the infestation of endoparasites (Carstensen et al. 2002).

So far only few studies have been conducted on defecation and urinating behaviour of pigs in free range areas. From the previous studies, it can be concluded that pigs excrete to a high frequency in the dwelling area (Stolba & Wood-Gush, 1989; Andresen, 2000). Andresen (2000) showed that it is possible to influence the urination and defecation pattern by daily allocation of new land.

Outdoor/indoor

Organic pigs should have access to grazing at least for some part of the year according to the EU requirements. For finishers it is, however, allowed to house them in barns if they have access to an outdoor run at least 80% of their lifetime. Some countries can have stricter rules and for Swedish farms approved by the major organic certifier, KRAV, also fattening pigs should have access to pasture during summertime. Benfalk and co-workers (2005) found that organic fattening pigs housed in barns with access to pasture spent more time in the barn compared to the time spent in the hut for pigs in huts on pasture. This was partly due to the provision of feed and water in the barn, whereas the food and water were outside the huts.

Hermansen (2005) summarizes that in Danish housing systems, where most of the manure was placed on the outdoor runs, aggression among pigs was low and the indoor climate was good. On the other hand, a survey of 21 farms in Germany revealed that 13 farms had no outdoor pens at all and only 3 farms had pens dimensioned according to the EEC-regulation (Sundrum & Ebke, 2004).

Less body and lung damage was found in conventional growing-finishing pigs housed outdoors compared to indoor pigs (Guy et al. 2002). Also, Lindsjö (1997) found that pigs kept outdoors showed fewer lesions related to pneumonia, pleuritis and abscesses than conventionally indoor reared pigs. Pigs housed in a conventional Swedish indoor system were less active compared to pigs raised in huts on a pasture. However, social behaviours such as sniffing, nibbling, pushing and tail biting were more frequent in indoor pigs than in outdoor pigs. More pigs were seropositive to erysipelas when they were housed outdoors compared to indoors. (Høøk Presto et al. 2007). When comparing research of indoor versus outdoor housing systems, Millet and co-workers (2005) found that some authors report the incidence/occurrence of health problems in certain systems, while other authors do not confirm this, indicating that good management might counter such problems. However, the authors (2005) also concluded that it is easier to deal with health problems in alternative systems through good management than to change conventional housing systems to meet the pigs' behavioural needs.

Lying area and flooring

The EU requirements stipulate that organic pigs shall not have slatted floors as a lying area. Conventional growing-finishing pigs housed outdoor in huts or in buildings with straw yards had a better welfare compared to pigs in fully-slatted pens (Guy et al. 2002). Danish pig houses naturally ventilated and with different type of indoor floor (deep-bedded and partly slatted) in combination with outdoor runs were investigated. The overall results were that the aggression among pigs was low and that the indoor climate was good. Part of the good results was because most of the manure was placed on the outdoor runs (Hermansen, 2005).

Mobile or stationary housing system

Nematode prevention routines on organic pig farms with two different housing and management systems were compared (Lindgren et al. 2008). Three herds had a mobile system with huts, where the pig pasture was included in a crop rotation during the summer, while the pigs were stabled with access to an outdoor concrete yard during winter; Three other herds had a stationary system in which the pigs were housed all year round in a barn with access to outdoor pastures in summer time and a concrete yard during the winter. The organic pig pastures in the stationary system were much more intensely used compared to those in the mobile system. The use of a stationary system did not fulfil the actual recommendations for rotation of pasture areas in order to prevent parasite infections (Lindgren et al. 2008).

Social competition

Lindgren & Lindahl (2005) found that in some groups in the mobile system with huts, the number of water and feeding places were not appropriate according to Swedish regulations. Also, simultaneous feeding of fatteners during the restricted period could not be conducted at the pasture because the feeding places were fewer than the number of animals.

5.3.3 Factors related to nutrition/feeding

Organic feed, pasture, amino acids

In organic production, self-sufficiency and the use of locally produced feed are factors, which may influence the choice of feedstuffs. The intention with the choice of feed is to ensure quality production rather than maximizing production. The feedstuffs should be organically produced and not all raw materials are permitted in the feed mixture. Also, all pigs must have access to pasture or roughage (Edwards, 2007). The results from several studies indicate that good production results could be obtained with outdoor finishers (Farke & Sundrum, 2005; Hermansen, 2005; Kelly et al. 2007). Housing with an outdoor run or keeping the animals at pasture did not result in different growth rates but the daily feed intake was higher at pasture. Less additional forage was consumed at pasture and the killing-out % was higher while carcass fatness was similar to indoor pigs (Kelly et al. 2007).

One of the limitations connected to the use of 100% organic feed is the feedstuffs available for supply of amino acids. Indoor and outdoor growing-finishing pigs were fed ad libitum diets with amino acid levels that were 7% and 14% lower than recommended Swedish standards for conventional pigs (Høøk Presto et al. 2007). The influence on performance and carcass quality was measured and the outdoor pigs grew faster during the finishing phase than the indoor pigs and their dressing percentage was higher. However, neither the feed conversion ratio nor the lean meat content was different. The authors concluded that a reduction, below Swedish standards, of the amino acid level in diets could be used for organic growing/finishing pigs fed ad libitum without any negative effects on the production results. In the same study Folestam (2005) found that when the outdoor pigs were fed the lowest level of amino acids (-14%) they increased their rooting activity compared to the pigs fed only a 7% lower level than the standard.

A German survey of 21 organic farms revealed substantial deficits in the feeding management and the composition of diets, particularly concerning the content of crude protein. The daily weight gain was 657 g (Sundrum & Ebke, 2004).

From a welfare point of view outdoor housing does not seem to pose nutritional problems and the supply of roughage or pasture can reduce aggressions and abnormal behaviour (Olsen, 2001; Persson et al. 2004). However in some countries poisonous plants could be a hazard. In Italy pasture lands are often woods or grazing lands, so a special attention is needed concerning the presence of poisonous plants such as Conium maculatum, Crotalaria spectabilis, Agrostemma githago and Helleborus spp, which can contain toxic alkaloids (Parisini & Martelli, 2003).

5.3.4 Factors related to management

Specialized production, age segregation or batch production, hygiene

It has become more common for organic pig farmers to specialize in one phase of the production and buy or sell young pigs. When piglets are transferred from several producers to fattening units, there is a rapid spread of infection among the animals (Wallgren et al. 1994). One week after allocation signs of reduced immune function can be seen (Wallgren et al. 1993), probably caused by the stress that the animals experience when they are transported, mixed and establishing new ranking orders. This immuno-suppression together with exposure to new microorganisms would be expected to increase the pigs' susceptibility to infections (Wallgren et al. 1994). Age segregated production and networking operations is recommended in specialized fattening pig production also for organic farmers (Leeb & Baumgartner, 2000; Holmgren & Lundeheim, 2002). In a survey of 51 farms in Austria, piglets from their own unit were fattened on 11 farms, while 12 finisher farms bought piglets from only one sow unit and 28 finisher farms received piglets from two or more farms (Baumgartner et al. 2003). In Sweden, a finisher farm should only buy piglets from a maximum of three different farms, according to the certifying regulations (KRAV 2007).

In Sweden, the mobile system, with huts and long rotation intervals of pig pasture areas, was originally the most common system for organic pig production. There was also an intention to keep the animals in one farm during the whole lifetime, i.e. farrowing to finish production. At that time, the prevalence of respiratory diseases was reduced in organic compared to conventional herds (Kugelberg et al. 2001). However, during the cold and wet seasons many farmers found the mobile system to be too labour intensive. Fattening pig production changed towards a more conventional approach with stationary barns, and a pig pasture restricted to the area that can be connected to the barn. Lately, some producers have invested in new buildings, but it has also been common with old buildings without age segregation. This was also the case in surveys of organic farms in Germany (Sundrum & Ebke, 2004) and Austria

(Baumgartner et al. 2003). Experience from conventional pig production reveals that when younger animals are housed in the same section as older ones and simultaneous cleaning of the whole section cannot be performed the development of respiratory diseases increases (Done, 2000).

In a study by Lindgren & Lindahl (2005), none of four Swedish specialized fattening herds had separated sections between older and younger pigs. However, one farm had batch rearing and on another farm the pigs were in huts during the summertime so that it was possible to empty and clean the whole stable during the summer.

5.4 Conclusions

The use of antibiotics in herds with organic fattening pigs was lower compared to herds with conventional pigs. This was probably a result of the alternative system leading to a lower infection level, since no difference in mortality or untreated pigs could be discovered.

The increased exposure to factors such as transporting and mixing pigs especially in combination with a lack of age segregated housing may however increase the level of respiratory diseases in organic pig farming.

Slaughter data indicated that organic pigs had fewer respiratory problems, skin lesions (including abscesses and hernias) and tail wounds compared to conventional pigs. On the other hand remarks because of white spots and joint lesions were more common among organic pigs.

The most important health concern among organic farmers seemed to relate to endo- and ectoparasites. The best strategy known so far is good hygiene and to rotate the animals' outdoor areas with as long intervals as possible. This is also favourable from an environmental point of view. However, we still lack enough knowledge on how long time the endoparasites survive in the environment under different climatic conditions.

Millet and co-workers (2005) concluded that it is easier to deal with health problems in alternative systems through good management than to change conventional housing systems to meet the pigs' behavioural needs.

A conflict of goal could, for example, appear when pigs are given access to outdoor areas to promote animal welfare and this causes plant nutrient losses or an increased workload.

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Chapter 6

Methods of Monitoring and Managing Pig Health and Welfare

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6.1. Background

There is still no general agreement on the definition of the terms "health and welfare", even when most authors agree to include the concept of physical welfare (e.g. Fraser and Broom, [i]1990 "attempt to cope") and feelings (e.g. Duncan, 1993). The situation is getting more complex, when the concept of "naturalness" is included (Rollin, 1993, Lund, 2006). The four principles of Organic agiculture (IFOAM, 2010) include the principle of health, which is defined as "the wholeness and integrity of living systems, the maintainance of physical, mental, social and ecological wellbeing".

Whatever the definition of animal welfare is, an even more important question is how to measure and to monitor it. This is relevant not only to consumers, who want to be informed about the origin and the welfare of the animals producing meat, milk and eggs, but also as a marketing claim for farmers investing in higher welfare systems. Recently WelfareQuality®, a large scale project aimed at the development of such a system, which could be applied across Europe (WelfareQuality®, 2009).

Once health and welfare is measured, strategies can be found for how to improve it, and how to manage potential problems. This can be done by various aproaches, such as HACCP, herd health planning or self evaluation. Most of those strategies include identification of potential problem areas, risk factors related to them and potential solutions or codes of (best) practise. The final goal is to be able to improve health, welfare and productivity continously.

6.2 Definitions

In order to describe methods of monitoring and managing pig health and welfare, definitions of those terms are needed.

Within the COST Action 846 "Measuring and Monitoring Farm Animal Welfare" the **location of collecting data** was used as the distinction between measuring and monitoring.

- *Measuring* was described as recording data such as behaviour, physiology, immunology and pathology within controlled laboratory experiments (Geers 2007).
- The term *monitoring* was defined by assessment of welfare on farm, during transport and at abattoirs.

However, other definitions use **number of recordings** as the differentiation between measuring and monitoring:

- *Measuring* is defined as recording, in order to gain baseline information, to provide information on status of diseases and welfare issues and to enable monitoring to occur.
- *Monitoring* is seen as the process of reviewing, a repeated measuring over a timescale, allowing evaluation of chronological changes, which maybe a result of season, weather, interventions, emergence of new diseases etc (Neale and Leeb 2008).

The following definition of monitoring goes even further, it includes the **use of those data**, including the process of comparing with expectations (targets, intervention levels):

- "*Monitoring* is checking an expectation (or assumption) by comparing it to observations" (Ministry of Forests and Range 2008)
- The following definition goes along the same lines: "Monitoring is an intermittent (regular or irregular) series of observations in time, carried out to show the extent of compliance with a formulated standard or degree of deviation from an expected norm. The state desired in terms of objectives or targets needs to be defined, and then monitoring is undertaken to assess whether these objectives are being met." (Hellawell 1991).

In general, quite commonly, the process of measuring and monitoring is described as a continuous circle, a "spiral of never ending improvement" (Main, 2000).

E - Evaluate	- the situation and define objectives	= **MEASURE**
P - Plan	- to fully achieve those objectives	= MANAGE
D - Do	- implement the plans	= MANAGE
C - Check	- that the objectives are being achieved	= **MONITOR**
A - Amend	- take corrective action if they are not.	= MANAGE

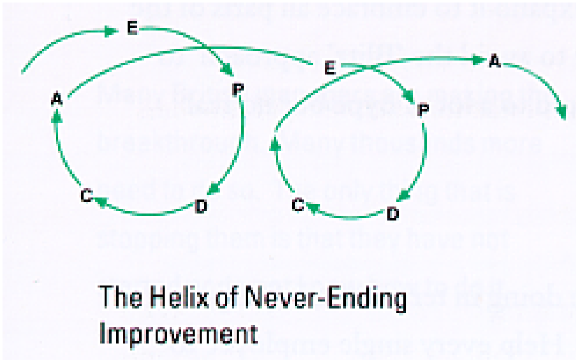

Figure 6.1: The Helix of never – ending improvement

6.2.1 Definition of management

It is even more difficult to define management, as Dillon (1965) states: "Farm management means different things to different people". One definition is the one used by FAO (1997):

- ".. the science (and art) of optimising the use of resources in the farm and of achieving the optimal functioning of these systems in relation to specific objectives." (FAO, 1997)

It is a combination of the traditional tasks of a farm manager, such as planning strategies, recording and reviewing data, but includes also the application of those strategies by the stockman, the "muddy boot part".

6.3. Applications of Measuring and Monitoring

There are many different potential application for welfare assessment described (Main *et al.* 2003), which are more or less the same for measuring and monitoring organic pig welfare. Across Core Organic countries they are also summarised in Table 6.1 and 6.2.

- Research:

Recently there were several projects carried out in order to measure and to monitor pig health and welfare, however, most of them did not specifically look at organic pigs.

  - WelfareQuality®: a large European project with the aim to develop on farm assessment protocols for pigs, cattle and laying hens (2009)
  - COST864- On farm monitoring of pig welfare (Velarde & Geers 2007): The goals were to discuss currently available technology to measure and monitor farm animal welfare and to create a "knowledge base".
  - Freedom Foods Study (Whay *et al.* 2007): A range of animal based parameters suggested by experts (Whay *et al.* 2003) were used.
  - QUASI ((Leeb 2000, Leeb & Baumgartner 2000, Baumgartner *et al.* 2003) and BEP Bioschwein (Leeb et al, 2009): These studies were looking at organic pig farms in Austria, suggesting measures to improve the situation and evaluating the effect of that after one year.

- Assurance schemes: Increasingly Quality Assurance schemes are using animal welfare claims for marketing their products, which was reviewed by Edwards (2008). From measuring mainly resource based parameters, such as the Austrian ANI/TGI (Bartussek 1999) or ABM (Assured British Meat) are using, recently there is a tendency to use animal based outcome measures, such as BWAP (Leeb *et al.* 2004) or WelfareQuality® (Blokhuis *et al.* 2003). For organic farms there are various certification bodies across Europe (Table 6.1), auditing farms according to their (national) organic regulations.

- Legislation: A main application of measuring and monitoring systems are legal requirements, documenting movements of animals and disease incidences. There are various examples across countries such as AUSL (Italy), VIS (Austria) or a sanitary check (France), which is required for medicine delivery.
- Animal and human health monitoring systems are often related or connected to legal requirements, but sometimes voluntary or reated to specific diseases. General animal health service systems are for example TGD (Austria), SGD (Switzerland), Tiergesundheitsdienst (Germany) or Svdhv (Sweden), including voluntary monitoring systems for certain diseases e.g. Salmonella, PRRS or mange.
- Farm management (Farmer, advisor): A number of different records (medicine records) could be important tools to analyse and improve the situation. Animal health service systems are in some countries combining legal requirements with advisory action, they are inspecting issues such as medicine storage, stocking densities. Only in the UK is there a requirement for a written health plan, which is a tool to strategically plan farm management.

6.4 Methods of Measuring and Monitoring

Pig Welfare can be measured and monitored in various locations. Depending on place and aim of the recording, the person responsible varies. Very often there is no systematic feedback mechanism between locations, e.g. results of meat inspections are in few cases available for farm management (National data bank in Sweden).

- On Farm: Farmer/stockman/vet/researcher/advisor/assurance schemes
- Transport: local authorities, vets
- Abattoir: meat inspection, vets, researcher, assurance schemes

Methods can vary from visual inspection of animals or housing equipment, clinical examination using various technical equipment, taking samples (e.g. blood) or analysing existing records.

6.5 Challenges for Measuring and Monitoring pig welfare

6.5.1 Variation within groups of animals on farm

Pigs are kept mostly in various groups, which can be very heteroeneous due to housing, age, group size and many other factors. The challenge for measuring and monitoring is to reflect the “real” situation, without missing potential welfare problems of individual animals or groups. On the other hand the situation of the whole farm should be recorded without getting too detailed information and within a realistic time frame (Mullan, 2009).

6.5.2 Difference from normal/healthy

One challenge is to define the term “normal”.This is not very clearly answered for many parameters, even if some validation of animal based parameters has been carried out. The reference, the “gold standard”, might be animals on the same farm or in similar systems, or even animals in a semi/natural environment. Even very "objective" parameters such as serology results are sometimes difficult to interprete, depending on the laboratory involved, their methods, thresholds and interpretations. Also, there is the possibility that ethical values or points of references can change over time. The definition of normal depends also on the sensitivity of farmers or researcher. The recognition of a problem or a sick animal and the time, until some action follows can vary a lot. A higher treatment incidence is therefore not necessarily an indicator for poor health, but it can be.

6.5.3 General problems with measuring and monitoring

The advantage of an on farm situation is the reflection of the "real world", a combination of multidimensional influencing factors and many different combinations of breeds, housing systems and feeding regimes. There are also various people involved in recording, measuring and managing. This is very different to an experimental situation and the quality of data can be affected by no recording happening, different people measuring and misdiagnosis. Also very practical problems can arise- on farm measuring can be very time consuming, safety aspects need to be respected and invasive methods are mostly too expensive (Lund 2006).

6.5.4 Can improvements be achieved by measuring and monitoring?

There are many people involved in the stages along the long journey towards welfare improvement (Whay, 2007) and not all of them are able to influence animal welfare. There are also different ways for communicating with each other, such as classical advisory situations (between vets/advisor and farmers), changes after failure to meet certain legal/certification requirements or new concepts such as stable schools (Vaarst et al, 2007). Not all of them are effective. It is also unclear, if the possibility to gain more money by improvements might be encouraging changes.

6.6 Which parameters are measured and monitored?

Common concepts of measuring welfare are to assess inputs/resources and outcomes, based on assessment of the animals. The parameters and methods used are decribesd in various papers and books, such as Verlarde and Geers (2007).

The "Inputs" (Resources) include all housing details (measurements, amount of bedding, drinkers, air quality, temperature, soil quality), feeding (quality and quantity of food,..), caretaking of animals (training of staff, number of pigs per stockmen) and breed used. Also animal welfare at transport can be evaluated using parameters, such as transport time and design of loading ramps.

For the outcome parameters all age groups need to be included and it can be differenciated into assessment of dead and live animals and records.

- **Dead animals:** can be inspected on farm using records (mortality, post-mortem results, culling rate, euthanasia rate,..) or at incineration plants or abattoirs (dead on arrival, condemnations, lung scores/snout scores, pleurisy, liver: milk spots, absesses/ pyemia, skin: mange, lesions/damage scores, tail). Also measurement of meat quality parameters (PSE/DFD, PH, weight, lean meat percentage,..) and monitoring of bacterial infections (Salmonella/Listeria/E. coli) happen on dead animals. For research purposes even more detailed parameters can be measured on dead animals such as serology, acute phase protein, gastric ulcers, cardiac lesions, adrenal hypertrophy, osteochondrosis, feet/claw/bursa, gut parasites, etc.

- **Live animals:** Clinical assessment includes body condition scores, lameness, cleanliness, injuries of ears, tails, body, .. For more detailed investigation samples can be taken from faeces, blood, colostrum, saliva,.. Also the evaluation of sick animals can give valuable information, such as treatment records, vaccinations, number of sick pigs. To evaluate behaviour, both quantitative and qualitative methods (Wemelsfelder, 2000) are used, looking at parameters such as lying positions, approach tests, abnormal behaviours,..
- **Productivity records:** combine data of live and dead animals, they include information such as piglets/sow/year, growth rate/number of days until slaughter, feed efficiency

6.7 Monitoring quality and effectiveness of management

In order to assess "good management" a list of key management questions to investigate was suggested by Leeb et al. (2004).

- The health protocols (plans) are used to look at the farm specific strategies, their completeness and effectiveness. They need to include treatment and prevention plans for the most relevant diseases; plans need to be implemented and effective. They need to be specific for the circumstances on each farm, external advice should be included and the farmer needs to agree with the content. Most importantly, these plans need to be updated at least once a year. For organic systems these strategies should also allow continous reduction of medicine use.
- The quality of records can be evaluated looking at their completeness, readability, inclusion of reason for treatment, presence of review, target/intervention levels

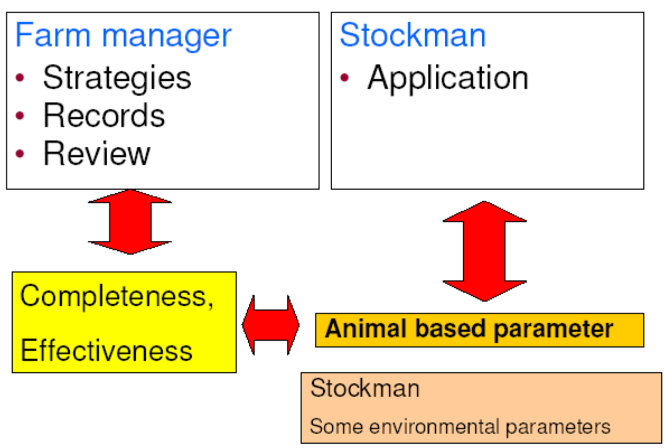

Figure 6.2: Assessment of Farm management

In order to assess the application of these strategies and the quality of the stockman, various parameters have been suggested, such as training records, skills (basic husbandry skills, observation of animals – see above: Action taken?), attitude (response to/of animals) and knowledge about e.g. technical equipment, legal requirements and diseases. These parameters are often difficult to assess objectively and some (e.g. amount of training received) are not necessarily a direct measure of animal welfare. In general the actual situation (i.e. the animal) should be assessed to evaluate the quality of stockmanship.

6.8 Conclusions

In general there are many different methods, parameters and data to measure and to monitor. The challege is for most countries to combine and link different sources in order to make good use of available information. Abattoir data are very often not fed back to farmers and very few veterinarians review medicine records, which could be used for monitoring and improvement strategies. This is the case not only for organic pig farms, but for livestock farming in general, with exceptions for some countries. This can potentially be explained with missing infrastructure for such systems (recording systems at abattoirs). Also most veterinarians use an “emergency approach” mostly dealing with acute diseases rather than preventative strategies. Also there are many challenges related with monitoring systems, in order to reflect the “real” situation.

Table 6.1 Systems to Measure and Monitor Pig Health and Welfare within CorePIG Countries – application

Country	Name of System	Why? (e.g. Advisory Action, Assurance scheme, legislation, farm management,..)	Since?	How often are data collected?	Are data in any form fed back to farmers? If so, give some details!	Is it compulsory for all organic pig farms to take part?	How many of organic pig farmers take part (approx. %)?	How well does the system work/is it accepted by farmers? (your opinion)	References (e.g. Homepage, literature,..)
Austria	Animal health service - TGD (Tiergesundheitsdienst)	legislative requirement (if use of antibiotics by farmer), includes voluntary monitoring systems for PRA; PRRS and Mange	2002	depends on herd size: 1-3/year	yes, one sheet of paper with boxes to tick and few lines of written action plan	No	90%	Depends a lot on veterinarian, who does it; mostly perceived as "have to be a member in order to apply antibiotics, but see no/littel benefit otherwise"	http://www.tgd.at/
Austria	Schirnhofer Qualitätssicherungssystem	Assurance Scheme	around 2000	all batches at abattoir	yes, results from abattoir avialable online	No	just started for about 10000 organic pigs/year	works ok in conventional systems,	http://www.feinkost-schirnhofer.at/cms/index.php?v9b8aflr-kpna-fkli-crpr-ui0kfwmmjj
Austria	AMA	Assurance Scheme	?	every 1-2 years		more or less for marketing	?	certification only, no benefit other than necessary for selling the product	http://www.ama-marketing.at/index.php?id=amabiozeichen0
Austria	organic certification bodies: ABG, SLK, ..	Independent certification bodies	?	once a year	non compliences are fed back	yes, but farmers can choose which certification body	all organic farmers are part of one of them	certification only, no benefit other than necessary for selling the product	http://www.at.sgs.com/de_at/food__process_assessments.htm?serviceId=31730&lobId=41165, www.abg.at http://www.lacon-institut.at/
Austria	Monitoring of health data of slaughter pigs BIOAustria/Vetcontrol	Advisory	2003-2006	every batch in main organic abattoirs	yes, sent by post, own results compared to others (benchmarked) and over time	no	?	farmers interseted in results, but no real willingness to improve? perceived as too expensive, organisatory difficulties	http://www.bioland.de/fileadmin/bioland/file/aktuelles/fachtagung/tagungsbericht_schweinetagung%202007/Readerbeitrag_Wlcek.pdf
Austria	VIS (Veterinär Informations System)	Legislative requirement (Movement records, notifiable disease surveillance)	2002	immidiately after changes	available online	yes	100%	working well	http://www.statistik.at/vis/start.shtml

Germany	Animalhealthservice of the countys (Tiergesundheitsdienste)	advisory action,	before 2000	on request,for sampling, after changes	laboratory data from sampling	No - available for all farmers with animal health problems	?		http://www.hmulv.hessen.de/verbraucherschutz_veterinaerwesen/untersuchung/amt_hessen/aufgaben/abt2/fg4/
Germany	QS - Qualitätssicherungssystem, (also: BQM Basis-Qualitätsmanagement-Programm)	Assurance scheme	2001	every year - every 3 years; depends on inspection-status the farm will reach on previous checks	salmonellenmonitoring results available online	No	?	works good, well accepted	www.q-s.info
Germany	Kontrollstellen der BLE: AGRECO, ABCERT AG,IMO, BCS GmbH…usw	independent certification bodies	2002	once a year		yes, if EG Öko certificate		certification only	www.bundesprogramm-oekolandbau.de
Germany	CCP Konzept für die Schweinehaltung der DGfZ	advisory action,	2001	depends on CCP analyse	No, farmers self monitoring	no	?	?	Borell,E., et al. (2001):Critical control points for on-farm assesment of pig housing. Livest.Prod. Sci. 72, 177-184
Germany	ITB (integrierte Tierärztliche Bestandsbetreuung)	Advisor	1998	?	?	no	?	?	Blaha u Blaha, 1998 - Qualitätssicherung in der Schweinefleischerzeugung
Italy	ICEA, Ecocert, Q.C.and I., …	Independent certification bodies	1996	once a year (often twice)	yes, reports must filled in and signed with farmers	yes, but farmers can choose which certification body	all organic farmers are part of one of them	certification only, no benefit other than necessary for selling the product	http://www.icea.info/Default.aspx?language=en-US
Italy	AUSL	Legislative requirement (Movement records, notifiable disease surveillance)		once a year to control the farm, all batches at abattoir	yes	yes	1	accepted	http://www.ausl.mo.it/flex/FixedPages/IT/CartaDeiServizi.php/L/IT/DISTRETTO/036023/M/3/C/036023/ID0/2975/SL/0
Sweden	Svdhv (Svenska djurhälsovården, The Swedish animal health service)	Farm management, surveillance of health	1950's	ongoing	Breeding farms and producers of breeding animals several times a year, others at least once a year	no	well	90% totally (conv+organic), organic ??	http://www.svdhv.org/dhvhome.html
Sweden	National data bank on lesions recorded at slaughter	Official meat inspection	1994	ongoing	Every carcass	yes	Well. Important information back to farmer.	100%	Lundeheim, N. et al. 1998

Sweden	RASP (Result analysis in pig production)	see Pigwin	end 1970's	mid 1990's	see Pigwin	see Pigwin	see Pigwin	see Pigwin	see Pigwin
Sweden	Pigwin	Farm management	mid 1990's	ongoing	Every day	no	well for those who use it	?	http://www.svenskapig.se/?id=324
Sweden	Official Salmonella control program	Legislation/prevention of Salmonella in any part of the production chain from feed to food (program approved by the EC)	1960's	ongoing	daily at abattoir, a certain % randomly selected	yes	do not know	100%	http://www.riksdagen.se/webbnav/index.aspx?nid=3911&bet=1999:658
Sweden	Volontary Salmonella program	Preventative measure to get full insurance compensation	1999	ongoing	twice a year	no	do not know	?	www.sjv.se
Sweden	Surveillance of PRRS	Legislation/document freedom from PRRS	1998	ongoing	Twice a year at nucleus farms + 3 times/farm/year at abattoir	yes	do not know	100%	http://www.sjv.se/download/18.1b8099a1098b506c728000104/2006-010.pdf, http://www.sva.se/upload/pdf/Tjänster%20och%20produkter/Trycksaker/surveillance_2007_web.pdf
Sweden	Surveillance of AD	Legislation/document freedom from AD	1991	ongoing (earlier: control program for a few years until declared free by the EU in 1996)	do not knkow	yes	do not know	100%	http://www.sjv.se/download/18.1b8099a1098b506c728000104/2006-010.pdf, http://www.sva.se/upload/pdf/Tjänster%20och%20produkter/Trycksaker/surveillance_2007_web.pdf
Sweden	Surveillance of Progressive atrophic rhinitis	To declare selling herds as free - health declaration	1995	ongoing	Nucleus and multiplying herds once a year	no	do not know	100% of breeding farms, gilt producing farms and sow pools	http://www.sva.se/upload/pdf/Tjänster%20och%20produkter/Trycksaker/surveillance_2007_web.pdf
Sweden	Surveillance of dysenteria	general health management	?	ongoing	Twice a year	no	do not know	100% of breeding farms, gilt producing farms and sow pools	
Sweden	Surveillance of mange	To declare selling farms as free, health declaration	?	ongoing	when suspicion of disease	no	do not know	100% of breeding farms, gilt producing farms and sow pools	

Sweden	Aranea Certifiering AB (subsidiary company to KRAV since 2007), HS Certifiering AB, SMAK	Independent certification bodies, which can certify according to the national KRAV rules that has existed since 1985 and according to the EU regulations since 2001. According to the law/regulations if you claim your products are organic you must be certified.	KRAV/Aranea 1985, HS certifiering 2008, SMAK 2007	Once a year	The farmer receives a certificate/ approbation and information if there are deviations. The farmer can request to see the revisionreport.	If you want to claim your products are organic	Aranea approx 90%, HS certifiering AB approx 10%, SMAK 0%?	Since it is voluntary probably those who can handle it find it acceptable, however from time to time some details in the rules are questioned	www.KRAV.se and www.sjv.se and www.hscertifiering.se with links to regulations
Switzerland	certification body								
Switzerland	Schlachthofkontrolle								
Switzerland	SGD (Schweinegesundheitsdienst)	Voluntary	1965	1 - 2 per year	Yes, sheet of paper / copy of journal and if necessary intervention plan	No	?	Working quite well/accepted	http://www.suisag.ch/DesktopDefault.aspx?tabid=556&tabindex=3&langid=1
UK	British Pig Health Scheme (voluntary, mainly conventional farms)	advisory action,	2005	~quarterly	yes, own results, time trends and benchmarks	no	very few	Working quite well/accepted	http://www.bpex.org/PracticalAdvice/ProducerKt/Bphs/default.aspx
UK	ZNCP scheme - Salmonella control	legislation	2008	?	yes	?	do not know	Working quite well/accepted	http://www.bpex-zncp.org.uk/zncp/
UK	Farm veterinarian (voluntary, not all farms)	farm management	?	typically quarterly	yes, usually written report	no	do not know		
UK	Certification body eg Soil Association	Assurance scheme	?	annually	yes	yes	100%	certification only, no benefit other than necessary for selling the product	http://www.soilassociation.org/Certification/Guidetocertification/tabid/351/Default.aspx
UK	Meat Hygiene Service	legislation	?	all pigs slaughtered	yes, with abattoir payments	yes	100%	Working quite well/accepted	http://www.food.gov.uk/foodindustry/meat/mhservice/
France	Sanitory check	Legislative requirement for medecine delivery	2007	at least 2 visits per year	One hard copy is given to the pig's owner	when allopathic drugs are used without clinical examination of the animals by a vet	100%	working well	

Denmark	sundhedsrådgivning	Legislative requirement (if use of Antibiotics by farmer)		12 times a year	report	no	?	well accepted	
Denmark	meat inspection system	legislation	2004	all pigs at abattoir	yes, sent by post or on-line at least from the large abattoirs	yes	100%	well accepted	http://www.danishmeat.dk/Veterinaerfagligt/Service/Virksomhedsraadgivning/Koedkontrol_svin.aspx#Det levende syn
Denmark	økologisk certifikation	Certification	2005 Videnssyntese	Once a year, random check	Report	yes	100%	Well accepted	http://pdir.fvm.dk/
Denmark	Det Centrale HusdyrbrugsRegistrerin	legislation		once a year +		yes	100%	Well accepted	http://www.glr-chr.dk/pls/glrchr/chrmenu$.menu
Denmark	Salmonella	legislation/clasification				yes	100%	Well accepted	
Denmark	Dyrenes Beskyttelse	Assurance Scheme	1992/2004	checklist	report	yes	100%	Well accepted	www.dyrenesbeskyttelse.dk
Denmark	Danish Crown - Friland	Assurance Scheme				yes	100%	Well accepted	www.friland.dk

Table 6.2 Systems to Measure and Monitor Pig Health and Welfare within CorePIG Countries – data

Country	Name of System	Where are data collected?	Who collects the data?	How are data recorded/ analysed?	Are input parameters measured? (e.g. Food, Housing, Breed,)	Which animal related parameters on live animal are recorded?	What is measured on dead animals?	What is measured using records	Are targets/ intervention levels/ benchmarking integrated in the system?	What happens, if parameters are above/below those levels?
Austria	Animal health service - TGD (Tiergesundheitsdienst)	Farm	Vet	Computer based system, filled in checklists on farm	yes (all areas but in little detail)	clinical parameters (diarrhoea, lameness, lesions,..)	only if available, no general system	mortality, some treatment figures, but depends on vet and availability	yes (intervention levels)	plan should be made, deadline given to solve the problem
Austria	Schirnhofer Qualitätssicherungssystem	Farm, Abattoir	Certification body, trained vet at abattoir	Computer based system	yes in detail	none	milk spots, pneumonia, mange,..	treatment records	yes (benchmarking to other farms within system)	do not know
Austria	AMA	Farm	Certification body	checklists on farm	basic inputs	none	none	none	no	na
Austria	organic certification bodies: ABG, SLK, ..	Farm	Certification body		yes in detail (EU Reg), use of TGI for farms existing before 1999	few within the TGI	none	none	no	another inspection, farmer has to pay for that
Austria	Monitoring of health data of slaughter pigs BIOAustria/Vetcontrol	abattoir	vets	?	no	none	milk spots, pneumonia, mange,..	nothing	yes	nothing
Austria	VIS (Veterinär Informations System)	Farm	Farmer	web based	no	none	none	movements, identification of animals, notifiable diseases	no	na
Germany	Animal health service of the countys (Tiergesundheitsdienste)	farm	Vet,Advisor	checklists on farm	all areas in detail	animal health status (diarrhoea, respiratory disease…)		productivity, treatment, mortality		

Germany	QS - Qualitätssicherungssystem, (also: BQM Basis-Qualitätsmanagement-Programm)	farm, abattoir	farmer, certificated auditor, Vet	checklists on farm, handwritten records and computer based system	yes in detail	none	salmonellenmonitoring,lung,pericardium,pleura,liver	treatment, productivity, mortality	yes, intervention levels	inspection interval, warnings, system-exclusion
Germany	Kontrollstellen der BLE: AGRECO, ABCERT AG,IMO, BCS GmbH…usw	farm	certification body	handwritten records,	yes, EU regulation, feeding, housing (outdoor run), animal id, antibiotic treats	none	none		intervention levels	warning, instruction, system-exclusion
Germany	CCP Konzept für die Schweinehaltung der DGfZ	farm	farmer	handwritten	yes	clinical parameters	none	treatment, productivity, mortality, housing, conditions	no	nothing
Germany	ITB (integrierte Tierärztliche Bestandsbetreuung)	farm	Vet	checklists on farm	yes	clinical parameters, laboratory analysis	?	checking of indicators for problems on farm, productivity, mortality	yes, intervention levels	?
Italy	ICEA, Ecocert, Q.C.and I., …	Farm	Certification body	checklist on farm	Yes in detail		none	none	no	problems with organic certification: from another inspection to exclusion
Italy	AUSL	Farm and abattoir	Vet	checklist on farm	Yes	clinical parameters	milk spots, pneumonia, mange,..	movements, identification of animals, notifiable diseases	no	
Sweden	Svdhv (Svenska djurhälsovården, The Swedish animal health service)	Farm	vet/advisor	Computer based system	yes	clinical parameters	only if available, no general system	use of all available information	yes	further investigation
Sweden	National data bank on lesions recorded at slaughter	Abattoir	Official meat inspector/ vet	Computer based system	no	none	abscesses, arthritis, arthrosis, tail biting, enzootic pneumonia, pleuropneumonia, pleuritis and white spots	none	yes	further inspection of the 10% farms with most findings
Sweden	RASP (Result analysis in pig production)	see Pigwin	see Pigwin	see Pigwin	see Pigwin	see Pigwin	see Pigwin	see Pigwin	see Pigwin	see Pigwin

Sweden	Pigwin	farm	Farmer	Computer based system	yes	clinical parameters, medication, reproductive data	only if available, no general system	treatment records, productivity records, mortality, movements	yes	Data is (apart from being handled by the farmer) handled by The Swedish animal health service and it can be used to detect if something unusual appears on national basis
Sweden	Official Salmonella control program	abattoir	meat inspector/ vet	Computer based system	no	none	lymph nodes	none	no	Notifiable on suspicion; restrictions on farm, investigation, decontamination
Sweden	Voluntary Salmonella program	farm	vet/adviso r	Computer based system	yes	fecal samples	none	hygiene level, control program agains rodents and other animals, etc.	no	mandatory to be connected to a preventive control program to receive the highest level of compensation from the insurance in case of disease
Sweden	Surveillance of PRRS	farm + abattoir	vet/adviso r/meat inspector	Computer based system	no	clinical parameters (serology)	clinical parameters (serology)	none	no	stamping out (notifiable; epizootic disease with the same measures taken as for e.g. Swine fever in other countries)
Sweden	Surveillance of AD	abattoir	meat inspector/ vet	Computer based system	no	none	clinical parameters (serology)	none	no	stamping out (notifiable disease)
Sweden	Surveillance of Progressive atrophic rhinitis	farm	vet/adviso r	Computer based system	no	nose swab	none	none	no	notifiable disease; decontamination or treatment and vaccination program, withdrawal of health declaration
Sweden	Surveillance of dysenteria	farm	vet/adviso r	Computer based system	no	fecal samples	none	none	no	decontamination
Sweden	Surveillance of mange	farm	vet/adviso r	Computer based system	no	skin scrapings if suspicion of disease	none	none	no	decontamination

Sweden	Aranea Certifiering AB (subsidiary company to KRAV since 2007), HS Certifiering AB, SMAK	All data comes from the farmer and the farm. If a problem exists other sources can be used	The farmer delivers the data and the certifying body/auditor verifys the data	Electronic reports and scanning programs and also manually (KRAV rules). If it is according to EU regulation the stipulated methods are used.	Yes according to the KRAV rules (more detailed on outdoor requirements) or the EU regulation respectively	Nothing is systematically registered only a general overview is done and if a problem seems to exist eg dirty animals a follow up or reported deviation could be made.	When considered relevant which has been on at least 25% of farms the reports (ante- and postmortem) from the abattoirs are examined	treatment records of all treatments	yes, intervention levels	plan should be made, deadline given to solve the problem and a new inspection
Switz-erland	certification body	farm	certification body	handwritten records, computer based system	feeding, housing (outdoor run),animal identification, antibiotic treatment	none	none		intervention levels	warning, instruction, system-exclusion
Switz-erland	Schlachthofkontrolle	abattoir	meat inspector/ vet	Computer based system	no	condition	milk spots, pneumonia, mange,..		intervention levels	less money for the product
Switz-erland	SGD (Schweinegesundheitsdienst)	on farm	Vet	Hand written on farm, transferred to computer using a specific software	Yes (all areas eg. Size of farm, amount of animals, feeding, all in - all out, etc)	No single Parameters. A general score from 0 -2 is estimated. Score 0 is good. Score 2 is bad.	No. But there is a project to test if it would be useful to do so.	health status, notifiable diseases	Yes, if score is above 2.	If score is above 2 the farmer gets a short time limit to get things right, combined with a recommendation how to do so. If no reaction a report is written.
UK	British Pig Health Scheme (voluntary, mainly conventional farms)	abattoir	vet	Computer based system	no	none	clinical parameters (lungs, livers)	none	benchmarking of all herds	nothing - own vet may advise
UK	ZNCP scheme - Salmonella control	abattoir	vet	Computer based system	no	none	Salmonella monitoring from Meat juice	none	yes	measures for improvement required
UK	Farm veterinarian (voluntary, not all farms)	on farm	vet	hand written records during the visit	sometimes	diseases that are observed during the visit for each age group	none	mortality, performance (sometimes)	no	nothing
UK	Certification body eg Soil Association	on farm	Certification inspector	Assessment written checklist	yes	none except in research projects	none	animal numbers, feeding, treatments	no	n/a

UK	Meat Hygiene Service	abattoir	meat inspector/ vet	computer based system (usually)	no	none	fitness for human consumption	none	intervention levels for condemnation	carcass removed from food chain (all or part)
France	Sanitory check	farm	vets	hand written records during the visit	mortality and encountered diseases for all age groups	diseases that are observed during the visit for each age group	none	mortality for all age groups, reproductive disorders	no	nothing
Denmark	sundhedsrådgivnin g	farm	farmer and vet	computer software, written records	everything	clinical herd inspection	diagnosis/autopsy	production data, health data,	no	na
Denmark	meat inspection system	abattoir	vet or veterinary technician at the abattoir	Computer based system	no	Clinical inspection on animal level (live and carcass	milk spots, pneumonia, mange,…	none	no	na
Denmark	økologisk certifikation	farm	farmer and Vet		organic legistration in general	Feeding and system parameters	nothing	everything	yes	sanction
Denmark	Det Centrale HusdyrbrugsRegis trerin	Farm, Abattoir	farmer and abattoir	Handwritten records/Com puter written	no	Animal flow on farm level	na	animal status and infection control	no	na
Denmark	Salmonella	farm, abattoir	technician	computer system	no	salmonella antibodies in serum	salmonella antibodies in meat juice	none	yes	obligatory advice, price deduction
Denmark	Dyrenes Beskyttelse	farm, transport, abattoir	technician	hand written	yes	welfare	na	none	no	follow up visit
Denmark	Danish Crown - Friland	farm, transport, abattoir	technician	hand written	yes	welfare	na	none	no	follow up visit

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"COREPIG A tool to prevent diseases and parasites in organic pig herds"

Abstract

This report reviews the available information on the welfare of pigs when maintained according to organic standards in Europe.

It begins by overviewing the populations of organic pigs in different countries at the time of writing (2007), the organic standards which govern their management and the systems in which they are typically kept. It then reviews for each stage in the production cycle (sows, suckling piglets, weaned pigs and fattening pigs) the available literature on health and welfare problems which might be experienced by the animals and the hazards which might give rise to these problems. Finally the report reviews the methods current available for the measurement of pig health and welfare and the extent to which monitoring systems currently exist in different countries, or might be developed.

The information gathered in this review formed the basis for the subsequent development of tools for use in a HACCP based management and surveillance system for organic pig herds. These tools will assist the organic pig farmer to prevent selected pig diseases and welfare problems by monitoring and controlling the risk factors. Further details can be found on the COREPIG project website http://www.icrofs.org/coreorganic/corepig.html

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