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Är den moderna grisen anpassad for den ekologiska produktionens miljö?

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Sammanfattning

Utifrån KRAVs regelverk för ekologisk produktion behandlas i detta arbete bakgrunden till varför dessa regler är viktiga och hur egenskaper hos grisen påverkas av dessa. Denna studien går även igenom hur grisarna klarar den ekologiska miljön med tanke på deras genetiska bakgrund från den konventionella gris populationen. Slutsatsen är att grisarna överlag klarar sig sig bra i den ekologiska produktionen och de egenskaper som påverkar hur pass bra de fungerar i den ekologiska produktionsmiljön är följande; modersegenskaper, starka ben, bra köttkvalité, lång livslängd för suggor, mörk hudfärg, kapacitén att äta mycket grovfoder samt minskad produktion av galtlukt. Det finns dock fortfarande mycket man kan göra vad gäller egenskaper i avelsmålen, val av föräldradjur osv för att utveckla den ekologiska grispopulationen att bli mer anpassad till denna miljö.

Abstract

With a starting point in the legislation for organic production set up by the Swedish certification organization KRAV, the reasons to why these regulations are important is explained and how pigs are affected by these rules. The study also shows how well the pigs cope in the organic environment considering the origin of the genetic material; from the conventional pig population. The conclusion is that pigs do function fairly well in the organic production environment and the traits affecting their functionality involve: mothering abilities, strong legs, good meat quality, good sow durability and longevity, capacity to eat much roughage and dark skin color. There are however still many ways of improving the organic population of pigs to make them more adjusted to the organic environment; for example different traits brought into the breeding goals and the choice of good parent animals.

Introduction

Humans have a long history of keeping pigs, even since the stone ages. During the Middle Ages, Swedish families kept a few pigs roaming free in the forest during the summer. Today the pig production is centered on producers which specialize in pig production. It is an intense production which leaves little room for the animals to be kept outdoors.

Agriculture in Europe was industrialized during the first half of 20th century, thus food supply around post-war Europe was beginning to reach comfortable levels. Producers simultaneously tried alternative ways of managing their farms, new methods began to spread and the engagement for different ideologies came to grow. The values from ethics, environmental, food-health & animal rights movements etc. came to unite under one label: Organic farming. The first legislation from the Swedish organization for organic products (KRAV) was first published in 1985 and fitted within one A4 page covering rules for crop production (Wallenbeck, 2009a).

The pig breeds used in organic pig production are the same as pigs in conventional production, causing some problems due to the different living standards for the animals in the different production systems. These pig breeds have been selected for high production in the conventional environment. When put in another environment the pigs might not be as well suited to produce and cope with that environment. The objective in this literature study is to focus on the legislation from KRAV, see which qualities in the pig are affected and how future

breeding can solve the problems that arise.

Litterature survey

Pork consumption in Sweden

The consumption of pork in Sweden is approximately 35 kg per capita every year (Livsmedelssverige 2009b) and today, 1500 producers deliver roughly 3 million pigs for slaughter every year (Livsmedelssverige 2009a). The production of pork in Sweden does not cover the demands (Figure1.). The shortage is imported, mainly from other EU-countries.

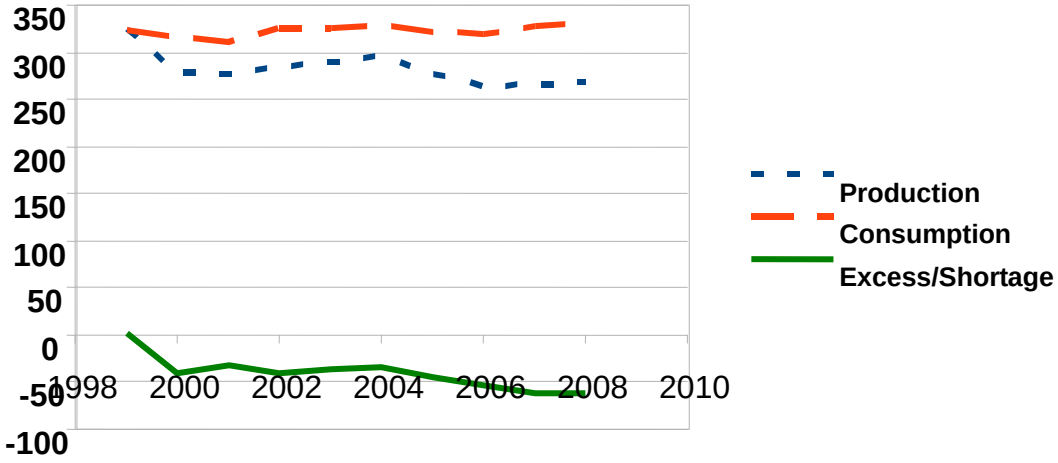

Figure 1. Production, consumption and import of pork in Sweden (million kilo with bones). (Jordbruksverket 2009b)

Pig production in Sweden

Pig production in Sweden is based on piglet producing herds and growing/finishing herds holding about 160000 sows and the offspring of these sows. The sow is gestational for 114 days and piglets in conventional production in Sweden will stay with the sow until weaning when they are five weeks old. At weaning the sow is removed from the farrowing pen and put in a breeding unit. After one week she will come into oestrus and be inseminated. Consequently it is possible for the producer to get more than 2 farrowings per sow every year (114 days + 5 weeks + 1 week = 156 x 2 farrowings = 312 days) (Figure 2). The pigs will be sent to slaughter when they are approximately 6 months old and weigh about 100-120 kg.

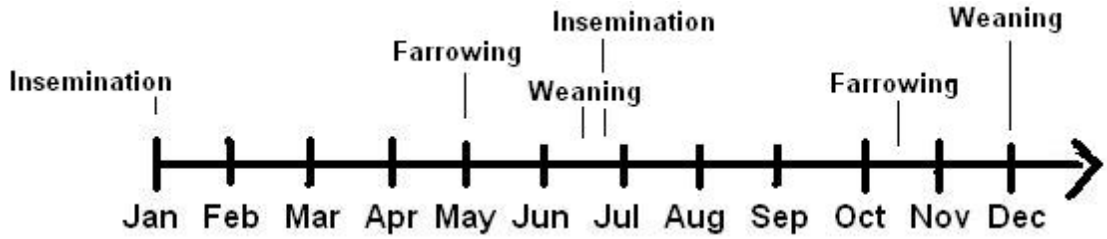

Figure 2. The production year of a sow

There are many different ways of housing pigs, depending on animal category and the type of production (piglets, sows, dry sows etc.) Both insulated and uninsulated buildings are used and a common house type is a simple stall with concrete and/or slatted floor and a varying

amount of straw (Andersson et al., 1996). According to the Swedish animal protection law, all animals should be able to lay down at the same time on surfaces not made of slatted floors (Djurskyddsmyndigheten, 2007). The Swedish law requires higher minimum space allowance (Table 1) for the pigs than most other countries. This is included in "The Swedish concept" involving banning of growth promoters in feeds, restraining of pigs and tail docking etc. (LRF, 2005).

Table 1. Minimum space requirement for pigs in conventional pig production (Djurskyddsmyndigheten, 2007)

	Resting area in a resting pen with straw (m^2)	Total area in a resting pen with straw (m^2)	Total area in litter bed pen (m^2)	Minimum length of wall of the pen (m)
Boar	6	7	7	
Lactating sow with litter younger than two weeks	4	5		
Lactating sow	4	6	7	
Dry sow <6 animals/group	1.1	2.48	2.5	2.4
Dry sow more than 6 animals/group	1.1	2.25	2.5	2.8
Gestational young sow <6 animals/group	0.9	1.81	*	2.4
Gestational young sow more than 6 animals/group	0.9	1.64	*	2.8

* 0.20 m^2 /animal + weight in kg/84

Straw is a major determinant to behavioral patterns for pigs and the availability of straw from an early age plays an important role in the behavioral development of the pig. For example, a study by Bolhuis et al. (2006) showed that when pigs reared in a enriched environment with straw were moved into a barren environment without straw their inactivity level was higher than pigs primarily reared in a barren environment (Bolhuis et al., 2006). Bedding material also provides physical comfort on the floor, aid the pig in temperature regulation and provides bedding material for the preparturient sow (Tuyttens, 2005).

Breeding

Pig breeding is divided into three levels where the purebred animals (breeding herd) are on top of the hierarchy (Figure 2). This is where the selection is made on each breed separately and where the genetic gain is achieved. The next level is the multiplying herd where the mothers to the growing pigs are produced when the purebred animals are crossed with each other (normally Landrace x Yorkshire in Sweden). The next level is the commercial piglet and growing producing herd where the crossbred sows are inseminated with sperm from purebred Duroc or Hampshire boars (in Sweden). These piglets will be brought up to slaughter. This kind of breeding is practiced to make use of advantages

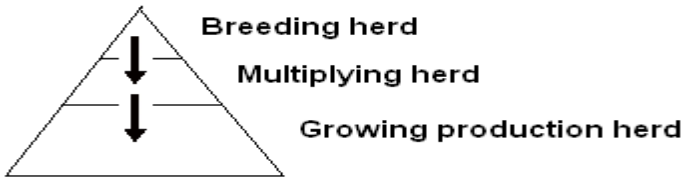

Figure 3. Breeding hierarchy.

from the different breeds. Concurrently we can make use of the heterosis effect, a term describing the superiority of the crossbreed over the mid-parent mean of the original breeds (Simm, 1998).

Breeding programs are set up separately for the different breeds. Breeds used as dams (ex. Yorkshire) have target qualities concerning production, carcass quality, litter size, reproductivity, mothering abilities, durability and for the Norwegian Landrace meat quality is also included. The target qualities for sire breeds (ex. Hampshire) involve solely the production traits: production, carcass quality, meat quality, durability and for Norwegian Duroc litter size is also included.

Organic pig production

Organic production in Sweden involves two types of farming: EU-organic and KRAV-production. The two are rather similar but there are some differences. EU-organic producers follow the rules set up by the legislation from EU (Johansson, 2008). However the requirements for KRAV-certified production stretch beyond the regulations from EU. The rules for KRAV include rules from EU, the Swedish law, the IFOAM Basic Standards (International Federation of Organic Agriculture Movement) and regulations set up by KRAV themselves (KRAV, 2010). The major differences concern the requirement for grazing (Johansson, 2008). Organic pig production is still a relatively small production but the interest for organic produced products is growing (Alarik et al., 2002). The proportion organically produced organic pork is less than 1% of the total Swedish pork production (Jordbruksverket, 2009b)

Outdoor housing

According to the regulation of KRAV pigs should be kept in groups (KRAV, 2010)(5.6.8). The animals have to be kept outdoors with the opportunity to graze for a minimum of 4 continuous months but preferably as much as possible without damaging the animals or the land. The remaining parts of the year the pigs should have the opportunity to visit an outside paddock located in connection to the stationary housing (KRAV, 2010)(5.4.7). The area should be of that kind providing ability to rout (KRAV, 2010)(5.4.9). Housing of organic pigs mainly involves two types of systems, mobile outdoor systems or stationary system with an attached pen for grazing (Salomon et al., 2006). The investment for a stationary system is higher than for mobile huts due to the larger surface requirements/animal in the organic pig production (table 3) plus the higher costs for to the increased levels of straw, though this accord with better hygiene (Svensson & Alarik, 2005). Moreover the pigs in organic production should have access to roughage. Research on the behavioural differences due to this expansion shows that pigs spend less time resting or showing aggressive behavior towards other animals and more time exploring the surroundings when they are provided roughage (Beattie et al., 1999; Presto, 2008). Outdoor pigs also seem to rest less when they grow older than pigs kept indoors (Presto, 2008). Wild boars and feral pigs are searching for food almost all their awake time. Thus pigs have a need for such explorative behavior (Jensen, 1995).

Table 2. Minimum space requirement for pigs in organic pig production (KRAV, 2010)

	Live weight	Minimum space indoors m^2/animal	Minimum space outdoors (not grazing space) m^2 /animal
Sow, gestational young sow		2.5	1.9
Boar		7	8
Sow with piglets up to 40 days old		7.5	2.5
Growing pigs	<30	0.6	0.4
	<50	0.9	0.6
	<85	1.2	0.8
	<110	1.5	1

When animals are kept outdoors it is more difficult for the farmer to prevent nutrient leaching and preventative measures against it are necessary for the farmer (Alarik et al., 2002). In organic pig production the housing is to be divided so that the animals have separate places to eat, rest and excrete (KRAV, 2010)(5.6.9). If pigs have the opportunity they tend to excrete away from their feeding stuff and resting areas (Olsen et al., 2001; Salomon et al., 2006). However, when kept on grazing areas the tendency to defecate and urinate in specific areas result in uneven distribution of nutrients which conflict with recommendations for maximum waste of plant nutrients (Salomon et al., 2006). When pigs are given the opportunity to move around more they also use more energy on movement and consequently they require a higher feed intake. For every kilometer walked, they use 1.67 kcal ME/kg body weight extra which need to be added to their feed allowance. The decrease in temperature for outdoor pigs also increase the need for higher energy provision (Millet et al., 2006). In a study by Beattie et al. (1999), daily food intake and growth rate was showed to be higher in the organic environment but the ability to convert food was lower compared to pigs in conventional production. The pigs were heavier and had higher back-fat levels compared to the pigs in a typical conventional production (Beattie et al., 1999).

According to KRAV pigs need to be able to cool themselves in mud baths during the summer (KRAV, 2010)(5.4.9). Due to their inability to sweat, pigs are dependent on the surroundings for keeping their temperature optimal (Olsen et al., 2001). When the weather is hot pigs tend to keep themselves in areas of shade or in mud pools (Heitman et al., 1962). When the skin is damp from the mud and the surroundings are hot, the water will evaporate and thereby cool the skin (Olsen et al., 2001). The mud also protects the pig from the sun especially pigs with lighter skin (SAFO, 2004) and when the dried mud falls of the pig possible parasites will fall off at the same time. Therefore the availability of a mud bath is important for the wellbeing of the outdoor pig (Jensen, 1995).

Sows and piglets

One of the most important parts of having an established production is finding good sows to produce viable piglets. A good producer knows the behavior of the sow and applies that knowledge to the ways of keeping pigs. One important behavior is the nest building which gestational sows is practicing just before parturition (Jensen, 1995). Therefore a KRAV certified sow need to be given proper amounts of straw and space allowance to be able to make a nest. The pigs also need to be kept separated from other pigs to ease the bond formation between sow and the young (KRAV, 2010) (5.6.12 & 5.5.4). Under feral conditions

the sow will walk away from the group of pregnant sows and start searching for a good place to build her nest. When the proper spot is found she digs and scratches in the ground and gather material from the surroundings and puts it on top of the soil. The sow will finish the nest building when the nest is sufficient in magnitude and security. When the parturition is due, she will lie down in the nest and deliver her offspring. The sow will then stay in the nest with the piglets for up to two weeks forming bonds with the young (Jensen, 1995). Sows have on average shorter farrowing durations with a lower number of stillborn piglets when kept outdoors in individual huts compared to indoors in farrowing pens. However it has also been showed that piglet mortality is higher in organic production compared to conventional production (Wallenbeck et al., 2009). One reason for piglet mortality is the occurrence of large litters with low birth weight that are exposed to more extreme climates. However the majority of piglet mortality is caused by the sow crushing piglets (Vermeer & Houwers, 2008). Sows with many piglets also use more of the energy stored in the body to produce milk for her young when kept outside thus leading to a thinner, lighter sow at weaning (Wallenbeck & Rydhmer, 2008). Furthermore, organically farmed sows are kept in groups during lactation and have a higher tendency to go into oestrus during the lactation period compared to single housed sows during lactation (Wallenbeck, 2009) which results in the sow not showing heat after weaning. This hinders the producer's way of grouping sows and having them farrow in batches which is favorable for health and production efficiency. Another result is the higher need for recruitment and the costs that involves (Svensson & Alarik, 2005).

In organic piglet production according to KRAV, piglets stay with the sow until they are 7 weeks old (KRAV, 2010) (5.9.6). The weaning involves massive change for the piglets. From birth, the piglets are totally dependant on milk from their mother and at weaning they abruptly loose their mother and are forced to eat solely solid food (Damm et al., 2003). These changes can cause problems for the piglets such as intestinal disturbances, reduced growth and showing signs of stress (Pluske et al., 1997). Piglets weaned at 5 weeks of age show more fearful behaviour towards humans whereas piglets weaned at 7 week were more uniform in their behaviour and growth (Andersen et al., 1999). In their natural environment piglets are weaned gradually until they are 9-17 weeks old. During the weaning process the sow makes it more and more difficult for the piglets to nurse thus stimulating the young to search for solid foodstuff (Newberry & Wood-Gush, 1985). Therefore, weaning at 7 week is a somewhat more natural method for the piglets compared to weaning at 5 weeks as in Swedish conventional pig production. When sows were kept in groups of three during lactation, studied by Andersen et al. (1999), there were no records of damaging effects on the sow whether in weight loss or signs of aggression towards her young during this extension in time with the piglets (Andersen et al., 1999). However if kept in a farrowing pen until weaning where the sow can not escape from the piglets, problems can develop (Wallenbeck, 2010). However the longer period spent nursing conflict with the aim of the producer to get as many litters from the sow as possible every year (Hermansen et al., 2004) affecting the profitability of the enterprise.

Feed stuff

Feeding pigs in organic production slightly differs from the ways of conventional methods. For example: the feed stuff provided to the animals need to be approved by KRAV, with a few exceptions (KRAV, 2010) (5.7.5). Furthermore, 50% of the feed stuff has to be self-sufficiently produced on the farm (KRAV, 2010) (5.7.1). Organically produced feed stuff is not always an optimal protein source for growing pigs (Kijlstra & Eijck, 2006), in

conventional production artificial amino acids are used to adjust the amino acid levels in diets where requirements are not fulfilled (Presto, 2008) however in organic production artificial amino acids are not allowed and cannot be provided (KRAV, 2010) (5.7.1). An uneven amino acid balance can cause decreased growth and make the animal more susceptible to disease (Kijlstra & Eijck, 2006). Consequently, organic producers often overfeed protein to settle the needs of the pig. The amino acids not used by the pig are excreted and can cause pollution problems to the environment (Kijlstra & Eijck, 2006). Overfeeding with protein is questionable for more reasons; studies made by Presto (2008) showed that the higher daily food intake existing in organically produced pigs actually can compensate for a diet with lower amino acid content. Furthermore, the microorganisms in the intestines of the pig produce essential amino acids which are not accounted for when the requirements are estimated. The study concurrently found no affect on carcass qualities of the pig, contradictory to other studies and to those mentioned above. Presto (2008) thus suggests a lowering of amino acid levels in the diet for pigs in organic production when fed ad libitum. This can ease optimizing diets and minimize the excretion of nutrients to the environment (Presto, 2008). High feed consumption concurrent with low feed conversion, large waste of feed when housing pigs outside and high costs for organically produced feed stuff makes feed stuff the most expensive factor in the economy of organic pig production (Svensson & Alarik, 2005; Kijlstra & Eijck, 2006).

Health

A successful production relies on healthy animals that can produce optimally and provide economy for the farmer. Sick animals do not produce as well as healthy, well nourished animals. Keeping a well-adjusted environment for the animals is therefore favorable for the producer. Health maintenance is important and preventive treatments are not allowed according to the legislation of KRAV (KRAV, 2010)(5.11.4). Sick animals are to be given proper healthcare immediately according to the Swedish law (KRAV, 2010)(5.11.2). The time of withdrawal before the animal can be sent to slaughter is twice as long as the time established by the food and drug administration (KRAV, 2010)(5.11.7). The withdrawal time is also applied for newly purchased animals to keep possible infections from spreading in the farm (KRAV, 2010)(5.3.3). Castration of male piglets under the age of 7 days is allowed, however from 1/1-2012 the procedure needs to be performed on anesthetized animals (KRAV, 2010) (5.11.11). The problem with boar taint could be reduced using gender pre-selection of sperm. The method has proven fairly successful with a prediction of sex of pig offspring to about 85%. It will decrease the portion of male piglets thus minimizing the need for castration. IVF is however a time consuming method which make it impractical to use for common artificial insemination (Johnson, 1996). The method is accepted in the EU-organic ways of production, though not by KRAV (Jordbruksverket, 2009a).

Pigs raised in organic production have a higher proportion of leg rejections at slaughter due to observations of joint health remarks resulting in deductions on the slaughter value with 40 SEK + the value of the discarded part of the carcass (Heldmer et al. 2006). Damaging of the joint is thought to be caused by the increased ability to move in this production method. In a Swedish study 70% of the joint problems among organic pigs caught at the slaughter plant were caused by osteochronditis dissecans (OCD) in the hock- and/or elbow joint. It was also shown that pigs that were kept outdoors all year had the most joint problems (Gångare, 2009). The structure of the joint is thought to influence the oncoming of the disease (Heldmer, 2007).

Problems with parasites occur more often in organic farming compared to conventional pig production (Kijlstra & Eijck, 2006). A study made by Lindgren (2005) show the round worm (*Ascaris sum)* to be the most common parasite in pigs in Sweden. The study also showed that pigs were often infected at an early age, even before the weaning. This is an indication of poor hygiene in the farrowing pens. This fact also made it difficult for the researchers to see variation in parasitic attack in pigs grazed in pens with variation in parasitic pressure. If the animals suffer from parasites they must be medically treated. If the whole farm is treated proper ways to prevent the problem in the future need to be made by the producer (KRAV, 2010) (5.11.5), for example keeping a pasture rotation to keep pigs from being re-infected from the soil or avoiding to spread liquid manure on leys meant to be grazed by pigs (Alarik et al., 2000). Livers that have been damaged by round worms result in a deduction of 20 SEK on the price at slaughter (Heldmer et al., 2006).

Straw and roughage should be given *ad libitum* (KRAV, 2010) (5.5.6) to keep the pigs occupied during the day. The dispensation of straw material can however cause dust to fill the stable. Dust is filled with endotoxines produced by bacteria from the species *Enterobacter Agglomerans* which occur on many different plants. When handled the endotoxins are thought to be detached into the airborne state (Zucker et al., 2000). The endotoxin concentration is significantly correlated with dust concentration and is primarily influenced by choice of forage and bedding material to some extent (Whittaker et al., 2009). A pig's lung is very sensitive to endotoxines which may cause pulmonary problems. Pigs in organic production have the ability to be outside and limit their time spent in dusty environment thus the pulmonary health of organic pigs is mainly good (Kijlstra & Eijck, 2006). Åkerfeldt et al. (2007) also emphasize the positive in outdoor housing for the pulmonary health of the animal keeper (Åkerfeldt et al., 2007). However pneumonia is rather common for pigs and studies in the Netherlands have showed that a higher proportion of pigs in organic production were affected by pneumonia than pigs in conventional production (Kijlstra & Eijck, 2006). A possible reason can be the differing in temperature and humidity in the two production methods. Both frequency and extent of the disease is lowered in warm and humid environments (Gordon, 1963). Pneumonia can be causes by bacteria (ex. Mycoplasma hyopneumoniae) or virus (ex. influenza, Porcine Respiratory Corona Virus) and the herd is usually treated with antibiotics (SVA, 2009).

Summary of desirable traits for pigs in organic production - and possible breeding solutions to acquire them.

The qualities which help pigs cope in the organic environment involve mothering ability, strong legs, good meat quality, durability and longevity, dark skin color and the capacity to eat much roughage. The pig breeds used in organic production are the same as used in conventional production and it is possible that the pigs will produce differently in the two environments. These differences in expression of genetic potential are called genotype-environment interaction which implies that a trait is controlled by different genes in different environments (Nauta & Roep, 2008). This phenomenon can cause one animal to perform well and get high ranking in one environment but bad in another leading to different choice of breeding animals in the two environments. Thus Nauta & Roep (2008) have been studying the possibilities for future breeding strategies to benefit the organic production method. These include: adaptation of conventional breeding programs, having a specific breeding program

for organic production and the strategy involving natural breeding (Table 3).

Table 3. Possible breeding solutions for organic pig production (Nauta & Roep, 2008; Wallenbeck & Sundberg, 2009)

Adaptation of conventional breeding program		**Specific breeding program for organic production**		**Improved natural breeding**	
+	-	+	-	+	-
Simple if breeding goals for organic production is included in conventional program.	Require knowledge about GxE interaction	High influence for organic farmers	Require much time, for example to calculate new heritabilities etc.	Practice natural mating involving animals form the local area. Produce animals well suited for the specific area	Require wide breeding knowledge and time to reach advancement in these small populations
	The genetic advancement is made in the conventional production	Genetic advancement in organic pig population.		Natural mating will allow the sows to perform their natural behaviour not present when insemination is excercised *	

* When natural mating occurs, different stimuli from the boar affect the sow and her bodily functions around mating and gestation for example the release of oxytocin. It is thought to play a major role in sperm transport and stimulate the ovulation process in the sow. Stimuli presented by the boar evoke much higher response in the sows than on stimuli presented by humans. All of the mechanisms concerning mating response are not yet clarified. Studies haven't showed big variance in production results between natural breeding and insemination (Soede, 1992).

On the other hand, statistical studies made by Werner et al. (2007) show that even with genotype and environment interaction, no important change in ranking between breeds can be found. Consequently, the best suited breed in the conventional production will also produce best in the organic production. This study thus claims that no specific breeding programs for the organic pig population are needed (Werner et al., 2007).

Discussion

Organic production methods were formed from different ideologies: ethics, environmental, food-health & animal rights movements etc (Wallenbeck, 2009 a). The legislation is thus a mixture of different ideologies, however when applied in practice I have found that they sometimes contradict eachother.

In conventional pig production, the environment is rather barren and makes little room for the animal to perform their natural behaviour such as rooting and chewing (Table 2) (Djurskyddsmyndigheten, 2007). The lack of behavioural expression can cause stereotypic behaviour, for instance tail biting and chewing bars (Jensen, 1995). So the enlargement of space and outdoor housing for pigs in organic production methods is very positive concerning the well-being of the pigs. The outdoor housing and the availability of more space and straw influence the pigs to spend less time resting, show less aggressive behaviour towards other animals, spend more time exploring the surroundings and to perform their natural behaviour to larger extent (Beattie et al., 1999; Presto, 2008). The ability to be outside also limit the pig's time spent in dusty environment thus the pulmonary health of organic pigs is mainly

good. However some studies show that pneumonia is more frequent among pigs in organic production than pigs in conventional production (Kijlstra & Eijck, 2006). Furthermore, pigs raised in organic production have a higher amount of carcass discards at slaughter due to joint inflammation as a result of the higher potential of movement (Gångare, 2009). There are also problems with parasites which occur more frequent in organic farming (Kijlstra & Eijck, 2006). Outdoor pigs are also exposed to a higher amount of sunlight causing sunburn (SAFO, 2004). Theoretically I find it difficult to decide which system is best for the animals. It is a matter of choosing between either physical or mental health. On the other hand when practically comparing to human standards I find mental health to outweigh the physical health issues. A child is not locked up to protect it from danger, it is to explore the world and perform its natural behaviour even if it carries a few bumps and bruises. However I strongly feel that further studies should be made to improve the parts of the production method where it falls short and also apply research results to practice. For example, joint problems are often caused by Osteochronditis which was though to be partly heritable thus it was included in the breeding goal for animals in organic pig production. Breeding towards stronger legs on the animals can prevent small damages on joints to evolve to bigger problems causing Osteochronditis (Heldmer, 2007). Including skin colour in the breeding program could also prevent problems with sunburn. The parasite problem could perhaps be somewhat solved when selecting animals which show signs of resistance to parasites. The higher opportunity for movement and the lower temperature outside also cause pigs to waste more energy instead of growing, consequently requiring higher food intake (Millet et al., 2006). Roughage is given *ad libitum* (KRAV, 2010) (5.5.6) thus making it positive if the animals have the capacity to eat a higher amount of roughage to use it as an energy source and help fulfil the energy requirement of the pig.

Piglets in conventional production in Sweden are weaned when they are five weeks old. This is not a natural time for piglets to be separated from their mother and be forced to eat solid food. This early separation can cause intestinal disturbances, reduced growth and stress (Pluske et al., 1997). In organic pig production piglets are weaned at 7 weeks and at this age piglets are found to be more uniform in their behaviour and growth compared to earlier weaning ages (Andersen et al., 1999). This prolonged time until piglets are weaned compared to conventional production methods resemble a more natural gradual weaning process making the piglets search for solid food and naturally be separated from their mother. However, the increased weaning age cause reduced productivity of sows in the organic pig production. The sows are grouped together during lactation making the occurrence of oestrus during lactation more frequent in organically produced pigs (Wallenbeck & Sundberg, 2009). This is also costly for the producer because its affect on labour cost and structure in the production which are depending on the sows farrowing during the same time period. Organically farmed sows thus need good reproduction ability and excellent mothering abilities. For example, being of low age when farrowing for the first time, showing heat distinctively, getting gestational at first oestrus cycle concurrently with having many functional teats, producing large amounts of milk and provide it to the piglets. Studies show that piglet mortality is high in organic farming compared to conventional production methods. One reason is the higher exposure to weather conditions but mainly piglet deaths are caused by trampling and crushing by the sow (Kijlstra & Eijck, 2006). Attempts have been made to find a way to modify farrowing huts to decrease piglet mortality. However no big improvements were found. Further studies have been

suggested to focus on maternal behaviour, milk production, managing of animals and selection of mothers who are careful with their young (Vermeer & Houwers, 2009).

One purpose of the organic production legislation and regulation is to give animals the opportunity to perform their natural behaviour. However organic production still involves insemination which leaves less room for the pigs to perform their natural sexual behaviour. A study made by Soede (1992) show that stimuli presented by a boar evoke much higher response in sows than stimuli presented by humans. One possible interpretation of these results can imply that the sow shows less sexual behaviour when inseminated in contrast to natural mating. This fact makes me interested in the breeding method involving natural mating where the pigs are given the opportunity to perform their sexual behaviour. However the complexity of the mechanisms concerning mating response is not yet clarified and I find this to be a very interesting field to conduct research on in the future. Moreover, the acceptance or exclusion of different reproduction techniques within organic production, such as insemination, have a large impact on the level of genetic progress that can be achieved. I am also surprised concerning the acceptance of castration within organic pig production. Male pigs produce a pheromone, androstenone which certain people can sense resulting in hesitation against eating pork. This is a big problem for pig producers causing them to castrate all male piglets. Castration brings suffering to the piglets and costs for the producer. Gender selected sperm is a possibility for EU-organic farms however not by KRAV (Jordbruksverket, 2009a) but one can question the profitability of this strategy due to the time consumption of sorting the spermatozoa. However it would keep the castration to its minimum and easy suffering for both the animals and the producer and I feel that this method has good potential to be used in the future when further work has been done to improve the method.

One aspect also with contradictory ideologies is the usage of synthetic amino acids. Another aim of organic farming is to naturally and locally produce feedstuff to animals. Thus artificially produced amino acids are not allowed to be used as feedstuff. Therefore the amino acid composition is more limiting in organically produced pigs compared to conventional pig production where artificial amino acids are allowed. Shortage of amino acids can cause decreased growth leading to producers over feeding protein, which consequently cause environmental problems. The ban of artificial amino acids thus conflict with the will to reduce the contribution to environmental problems. One can question whether the banning of artificial amino acids is really acceptable considering the animal material used in organic pig production (Presto, 2008). The doctoral thesis by Presto (2008) also suggests a lowering of amino acid requirements in the diet for organically produced pigs (Presto, 2008). Perhaps the ability to utilize more of the amino acids formed by micro organisms in the intestinal-canal could be a future trait to breed on, forming pigs with tolerance for low protein quality in the diet. It could result in easing diet composition concurrently reduce the contribution to the environmental problems.

In summary of what traits I consider to be positive to include into breeding goals for organic pigs are: being able to use amino acids produced by the micro organisms in the intestinal-canal concurrently with the ability to grow adequately on feed stuff containing low quality of protein. Also showing resistance against parasites and other diseases, having dark skin, good maternal ability and vital, healthy piglets, minimizing piglet mortality. A few of these traits are more positive for pigs in organic compared to conventional production. Pigs that are kept

indoors, as for conventionally produced pigs, do for example not need dark skin since they do not suffer from sunburn. So, the separate demands put on the organically produced pigs compared to conventionally produced pigs raise questions concerning the need to breed differently in the two production methods. Nauta & Roep (2008) claim that different breeding programs are needed for the organic pig production also due to the genotype and environment interaction. This can cause one animals to get high ranking in one production environment but bad in the other (Nauta & Roep, 2008) making it hard for the producer to choose the most suited animals for the production method. However the results from a study made by Werner et al. (2007) show that no important difference in ranking was found between the different breeds in the two environments thus no specific breeding program is needed. I find this very interesting and propose further studies concerning this subject. If the claims from Werner et al. (2007) are true the breeding for organic pig production will be simplified. The pig producers in Sweden, both conventional and organic, can work together and get greater genetic improvement in the pig population.

Conclusions

There are many advantages and also many disadvantages concerning the organic production of pigs. It provides a somewhat more natural environment for the pigs and give them a greater possibility to perform their natural behaviour compared to pigs in conventional production. However this brings extra burdens for the pigs in the shape of leg problems, parasitic strike, respiratory diseases etc. Since the environment brings these burdens is it positive if the producer can adapt the pigs and their features through breeding to help them cope better in this environment. Examples of such features which are good for the animals are: strong legs and resistance against parasites and other diseases. Furthermore, is it positive for the economy and animal welfare to select pigs that have good mothering abilities, involving sows getting gestational by the first oestrus cycle after weaning, being of low age when farrowing for the first time, showing heat distinctively, concurrently with having many functional teats, producing large amounts of milk and provide it to the piglets. Also pigs with strong legs, good meat quality, good sow durability and longevity, capacity to eat much roughage, dark skin color and reduced oestrus during lactation ease the work made by the producer. Since the features preferred in pigs somewhat differ between conventional and organic pig production the breeding goals and strategies in the two production methods might differ. Opinions are divided concerning the importance of separate breeding programs. If no re-ranking is present when selecting breeding animals then logically no separate program is necessary which carries a simpler way of managing the breeding for the individual producer. Furthermore, for the most parts the use of conventional pigs work fairly well in organic pig production. However thoroughly choosing breeding animals and selecting well suited breeding goals concurrent with more studies on the subject will improve the organic pig production. Preferably can the different goals in KRAVs regulation work simultaneously without contradictory results and hopefully produce healthy animals both mentally and physically.

References

Alarik, M., Pettersson, T., Roempke, G., Sällvik, A., Åkerfeldt, Y. 2000. Ekogris - En handledning i ekologisk grisuppfödning. Ekokött; Ekologiska lantbrukarna (ISBN, ISSN): 91-973377-1-4.

Alarik, M., Henriksson, J., Mattsson, P.A. 2002. Byggnader för ekologiska slaktsvin. Jordbruksinformation 2, Jordbruksverket & Hushållningssällskapet, Uppsala, Sweden

Andersen, L., Jensen, K.K., Jensen, K.H., Dybkjaer, L., Andersen, B.H.1999. Weaning age in organic pig production. Ecological Animal Husbandry in the Nordic Countries, Proceedings from NJF-seminar No. 303

Andersson, M.A., Olsson, A-C., Botermans, J. 1996. Otraditionella stallar till slaktsvin. Stiftelsen Sydsvensk Jordbruksforskning, Info nr 3.

Bauer, S. March 2007. Sow with piglet. http://sv.wikipedia.org/wiki/Fil:Sow_with_piglet.jpg

Beattie, V.E., O'Connel, N.E., Moss, B.W. 1999. Influence of environmental enrichment on the behaviour, performance and meat quality of domestic pigs. Livestock Production Science 65, 71–79

Bolhuis, J.E., Schouten, W.G.P, Schrama, J.W., Wiegant, V.M. 2006. Effects of rearing and housing environment on behaviour and performance of pigs with different coping characteristics. Applied Animal Behaviour Science 101, 68–85

Damm, B.I., Pedersen, L.J., Jessen, L.B., Thamsborg, S.M., Mejer, H., Ersböll, A.K. 2003. The gradual weaning process in outdoor sows and piglets in relation to nematode infections. Applied Animal Behaviour Science 82, 101–120

Djurskyddsmyndigheten. April 2007. Utrymmeskrav & Djurskyddsregler. http://dsmweb.sjv.se/Steria/templates/Page.aspx?id=387

Ellström, S.W. December 2009. Ett riktigt grisliv. http://www.krav.se/Konsument/Om-KRAV-markningen/Fordjupande-lasning-/Djur/Sa-har-blir-grisen-KRAV-godkand/

Geng, Q., Toren, A., Salomon, E. 2009. Screening the working environment in outdoor pig systems. Journal of Agricultural Safety and Health 15:3, 283-297

Gordon, W.A.M. 1963. Environmental studies in pig housing, The effect of housing on the degree and incidence of pneumonia in bacon pigs. In: British Veterinary Journal, Volume 119, Pages 307-314.

Gångare, A. 2009. KRAV-grisar har fler ledanmärkningar än konventionellt uppfödda grisar. Sveriges lantbruksuniversitet, veterinärmedicinska fakulteten. Examensarbete.

Heitman, H. Jr., Hahn, LeR., Bond T.E., Kelly, C.F. 1962. The effects of modified summer environment on swine behaviour. Animal Behaviour 10, 15-19

Heldmer, E. 2007. Varför har ekologiska grisar mer ledanmärkningar vid slakt än konventionellt uppfödda grisar? In: Rapport: Statens Jordbruksverk Projekt nr 25-1135/07.

Heldmer, E., Lundeheim, N., Robertsson, J.Å. 2006. Sjukdomsfynd hos ekologiskt uppfödda grisar. Svensk veterinärtidning 13, 13-19

Hermansen, J.E., Strudsholm, K., Horsted, K. 2004. Integration of organic animal production into land use with special reference to swine and poultry. Livestock Production Science 90, 11–26

Jensen, P. 1995. Djurens beteende och orsakerna till det. LTs förlag, Falköping, Sweden.

Johansson, M. 2008. Ekologisk grisproduktion - något att satsa på? Skånska lantbruk 4, 19-20

Johnson, L.A. 1999. Gender preselection in mammals: an overview. Deutsche Tierarztliche Wochenschrift 103, 8/9, 288-291

Jordbruksverket. Februari 2009a. Får man använda könsseparerad sperma i ekologisk produktion? http://www.sjv.se/amnesomraden/miljoochklimat/ekologiskproduktion/reglerochcertifiering/fragorochsvar/faqekologiskodling/farmananvandakonsspereradspermaiekologiskproduktion.5.2a19d05112133800c8b8000494.html

Jordbruksverket. December 2009b. Eu's marknadsreglering för griskött. http://www.sjv.se/amnesomraden/handel/politikochframtid/eusjordbrukspolitik/griskott.4.67e843d911ff9f551db80008884.html

Kijlstra, A., Eijck, I.A.J.M. 2006. Animal health in organic livestock production systems: a review. NJAS-Wageningen Journal of Life Sciences 54:1, 77-94

KRAV 2010. Regler för KRAV-certifierad produktion 2010, kap 5: Djurhållning

Lindgren, K., Lindahl, C., Roepstorff, A. 2005. Parasiter hos ekologiska slaktsvin och i jord på grisbeten och stallgödslad åkermark. JTI-rapport Lantbruk & Industri 340, ISSN 1401-4963

Livsmedelssverige. October 2009a. Uppfödning och specialicering. http://www.livsmedelssverige.se/hem/fakta-om-mat/117-uppfoedning-och-specialisering/37-uppfoedning-och-specialisering.html

Livsmedelssverige. October 2009b. Gris. http://www.livsmedelssverige.se/hem/fakta-om-mat/8-gris.html

LRF & Swedish University of Agricultural Sciences 2005. Swedish pig production.

Millet, S., Hesta, M., Seynaeve, M., Ongenae, E., De Smet, S., Debraekleer, J., Janssens, G.P.J. 2003. Performance, meat and carcass traits of fattening pigs with organic versus conventional housing and nutrition. Livestock Production Science 87, 109–119

Millet, S., Ongenae, E., Hesta, M., Seynaeve, M., De Smet, S., Janssens, G.P.J. 2006. The feeding of ad libitum dietary protein to organic growing-finishing pigs. The Veterinary Journal 171, 483–490

Nauta, W.J. & Roep, D. 2008. Principles and practicality of organic dairy cattle breeding: different options and implications. Cultivating the future based on science. Proceedings of the Second Scientific Conference of the International Society of Organic Reserch, held at the 16th IFOAM Organic World Congress

Newberry, R.C., Wood-Gush, D.G.M., 1985. The suckling behaviour of pigs in a semi-natural environment. Behaviour 95, 11–25.

Nilzen,V., Babol. J., Dutta, P.C., Lundeheim, N., Enfält, A.C., Lundström, K.1977. Free range rearing of pigs with access to pasture grazing - effect on fatty acid composition and lipid oxidation products. Meat Science 58: 3, 267-275

Norsvin, October 2009. Avelsmålene for landsvin og duroc. http://www.norsvin.no/index.php/avl/mal

Olsen, A., Dybkjær, L., Simonsen, H. 2001. Behaviour of growing pigs kept in pens with outdoor runs II. Temperature regulatory behaviour, comfort behaviour and dunging preferences. Livestock production science 69, 265–278.

Pluske, J.R., Hampson, D.J. and Williams, I. H. 1997. Factors influencing the structure and function of the small intestine in the weaned pig: a review. Livestock Production Science. 51, 215-236.

Presto, M.H. 2008. Organic Pig Meat Production - Nutrient Supply, Behaviour and Health. Swedish University of Agricultural Sciences. Doctoral Thesis 2008:97

Quality Genetics. Nordic Genetics, Avelsprogram. http://www.qgenetics.com/

SAFO Workshop. 2004. Organic livestock farming: potential and limitations of husbandry practice to secure animal health and welfare and food quality.

Salomon, E., Åkerhielm, H., Lindahl, C., Lindgren, K. 2006. Outdoor pig fattening at two Swedish organic farms—Spatial and temporal load of nutrients and potential environmental impact. Agriculture, Ecosystems and Environment 121, 407–418.

Simm, G. 1998. Strategies for genetic improvement. In: Genetic improvement of cattle and sheep, 86-87. Farming press, Tonbridge, United Kingdom.

SVA, Enhet för djurhälsa och antibiotikafrågor. April 2009. Luftvägsinfektioner hos grisar. http://www.sva.se/sv/navigera/Djurhalsa/Gris/Sjukdomar-hos grisar/ Luftvagsinfektioner-hos-grisar/

Svensson, C., Alarik, M. 2005. Resultat och kostnader i ekologisk grisproduktion

Tuyttens, F.A.M. 2005. The importance of straw for pig and cattle welfare: A review. Applied Animal Behaviour Science 92 (2005) 261–282

Vermeer, H.M., Houwers, H.W.J. 2008. Effect of additional heating, floor length, straw quantity and piglet nest accessibility on piglet losses in organic farrowingpens. Cultivating the future based on science. Volume 2: Livestock, socio-economy and cross disciplinary research in organic agriculture. Proceedings of the Second Scientific Conference of ISOFAR, held at the 16th IFOAM Organic World Conference. p.118-121

Wallenbeck, A. 2009. Pigs for organic production, Sweden university of agriculture, Faculty of veterinary medicine and animal science. Doctoral Thesis No. 2009:37

Wallenbeck, A., Gustafson, G., Rydhmer, L. 2009. Sow performance and maternal behaviour in organic and conventional herds. Acta Agriculturae Scand Section A 59, 181-191

Wallenbeck, A., Rydhmer, L. 2008. Relationships between sow and piglet traits in organic production outdoors and indoors. Cultivating the future based on science. Volume 2: Livestock, socio-economy and cross disciplinary research in organic agriculture. Proceedings of the Second Scientific Conference of ISOFAR, held at the 16th IFOAM Organic World Conference. p. 134-137

Wallenbeck, A., Sundberg,T. 2009. Avel för ekologisk anpassning, Ekologiskt lantbruk 4,10-11

Wallenbeck, A. April 2010. Personal message. Scientist, Swedish University of Agricultural Sciences. Box 7023, Uppsala

Werner, D., Brade, W., Weismann, F., Brandt, H., 2007. Performance and carcass quality of genetically different pigs under conventional and organic conditions, Van der Honing, Y. (Ed.), Annual Meeting of the European Association for Animal Production. Wageningen Academic Publishers, Dublin, Ireland, p. 277

Whittaker, A.G., Hughes, K.J., Parkin, T.D.H., Love, S. 2009. Concentrations of dust and endotoxin in equine stabling. In: The Veterinary Record 165:293-295

Zucker, B.A., Trojan, S., Müller, W.M. 2000. Airborne Gram-Negative Bacterial Flora in Animal Houses, J. Vet. Med. B 47, 37–46

Åkerfeldt, Y., Alarik, M., Stabo, S. 2007. Hur mår de ekologiska djuren? Ekologiskt Lantbruk 1, 8.