First draft of an information resource

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Practical strategies for improving farm animal welfare: an information resource

The present information resource is one of the outcomes of the Welfare Quality® research project. This project was co-financed by the European Commission within the 6th Framework Programme, (contract No. FOOD-CT-2004-506508), and it focussed on the integration of animal welfare in the food quality chain. It is the largest piece of integrated research work yet carried out on farm animal welfare in Europe. Forty four institutes and universities, representing thirteen European countries and four Latin American countries participate in this integrated research project. In a 'fork to farm' approach the project recognizes that consumers' perception of food quality is not only determined by its overall nature and safety but also by the welfare status of the animal from which it was produced. Thus, animal welfare is viewed as an integral part of an overall 'food quality concept'. Welfare Quality® focussed on the three main species (cattle, pigs and chickens) and consisted of a number of Sub Projects (SPs). For example, SP 1 was designed to identify, analyse and acknowledge consumer concerns and market demands while Sub Projects 2 and 3 respectively aimed to develop and validate: i) reliable on-farm welfare assessment systems and ii) practical species-specific strategies to improve farm animal welfare. The work in SP3 addressed key welfare problems that are perceived as important by European stakeholders, including producers, retailers, academics, government and the public. The problem areas include handling stress, harmful traits, injurious behaviours, lameness, neonatal mortality, and social stress. Their alleviation could greatly improve the quality of life for farm animals.

This technical information resource builds on the results of Sub Project 3. It is also closely linked to the principles and criteria of good welfare developed by Welfare Quality® (see Chapter 1). The web-based resource is freely available and it is intended to enable farmers, advisors, researchers and policy groups to easily identify practical strategies that can help to solve specific welfare problems or at least to minimize their occurrence. The resource is subdivided into two chapters. The first chapter provides the background, rationale and brief descriptions of each of the above-mentioned principles and criteria which form the basis of the Welfare Quality assessment systems developed in Sub Project 2. It also very briefly summarises the welfare implications of failures to satisfy the criteria as well as the general causes of such failures and potential remedial measures. The second chapter covers the scientific background and benefits of all the viable welfare improvement strategies identified in Sub Project 3 together with additional relevant information on the many remedial methods generated outside the Welfare Quality® project. Instructions for their implementation are also provided.

Thus, the resource offers different levels of information for different degrees of interest, with clear links to other more detailed sources of information such as the scientific papers cited, regulatory documents, websites etc.

Chapter 1

Welfare Quality® researchers drew together the views of consumers, industry representatives, biologists, social scientists and legislators to establish the following four principles which are considered essential to safeguard and improve farm animal welfare: good feeding, good housing, good health and appropriate behaviour. Twelve clear criteria were also defined within the 4 principles (see below; Botreau et al., 2007). The original principles and criteria have been slightly updated recently as shown below. Collectively, they complement and extend the ´Five Freedoms` published by the Farm Animal Welfare Council in 1992. GET REFERENCE. We describe each of the above criteria in terms of why they are problematic, what causes them and what might be done to prevent or alleviate them.

Welfare Quality® Principles and Criteria of good farm animal welfare

Good feeding

- Absence of prolonged hunger. Animals should not suffer prolonged hunger, i.e. they should have a sufficient and appropriate diet

- Absence of prolonged thirst. Animals should not suffer prolonged hunger, i.e. they should have a sufficient and accessible water supply.

Good housing

- Comfort around resting (assessment of behaviour rather than injuries): Animals should have comfort around resting

- Thermal comfort. Animals should have thermal comfort, i.e. they should not be too hot or too cold.

- Ease of movement (other than health or resting-related issues). Animals should have enough space to move around freely.

Good health

- Absence of injuries (except those due to disease or voluntary interventions; neonatal mortality in piglets included here). Animals should be free of physical injuries.

- Absence of disease (as well as neonatal and transport-related mortality). Animals should be free of disease, i.e. farmers should maintain high standards of hygiene and care.

- Absence of pain induced by management procedures (including stunning). Animals should not suffer pain induced by inappropriate management, handling, slaughter, or surgical procedures (e.g. castration, dehorning).

Appropriate behaviour

- Expression of social behaviours (balance between negative, e.g. aggression, and positive aspects, e.g. social licking). Animals should be able to express normal, non-harmful social behaviours, e.g. grooming.

- Expression of other welfare-related behaviours (balance between negative, e.g. stereotypies, and positive behaviours, e.g. exploration). Animals should be able to express other normal non-harmful behaviours, i.e. species-specific natural behaviours such as foraging

- Good human-animal relationship (reduced fear of humans). Animals should be handled well in all situations, i.e. handlers should promote good human-animal relationships.

- Positive emotional state. Negative emotions such as fear, distress, frustration and apathy should be avoided and positive emotions such as security or contentment should be promoted.

References

Botreau R, Veissier I, Butterworth A, Bracke MBM and Keeling L J 2007 Definition of criteria for overall assessment of animal welfare *Animal Welfare* 16: 225-228.

<u>The 12 criteria, the causes of associated welfare problems and potential remedies</u>

Criterion 1: Absence of prolonged hunger

<u>Introduction</u>

- Hunger may result from malnutrition, undernutrition or both. Malnutrition occurs when nutritients are not balanced, whereas undernutrition reflects insufficient supply.

<u>Why is prolonged hunger a welfare problem?</u>

- Both malnutrition and undernutrition cause the animal stress and, if sufficiently prolonged or severe, this can lead to debilitation, loss of body condition, immunosuppression, disease and death.

- Prolonged hunger plays a key role in the development of stereotypies in farm animals. Stereotypies (repetitive performance of apparently functionless behaviour) are widely considered an indicator of poor welfare and, in general, farming systems associated with a high prevalence of stereotypies are consistently regarded as "welfare unfriendly" when they are ranked using other indicators. Stereotypies will be dealt with under "Expression of other behaviours" (see below).

- Hunger may also increase aggression between animals, which in itself is a welfare problem (see section on "Expression of social behaviour").

What are the causes of prolonged hunger?

- Malnutrition may sometimes be deliberately caused, for example, when veal calves are fed a diet deficient in iron in order to produce "pale meat". More often, however, it may simply result from a mismatch between an individual animal's nutritional requirements, (which are a consequence of its sex, age, stage of growth or reproduction, and previous nutritional history), and the common farming practice of providing a single diet designed to satisfy the needs of the "average" animal.

- Undernutrition may be a consequence of neglect or poor husbandry. In extensive conditions, grazing ruminants may also suffer undernutrition when forage conditions are very poor.

- Competition with conspecifics may also lead to undernutrition, particularly when access to food is limited due, for example, to insufficient feeding space.

- Undernutrition is intentionally imposed in some production systems, usually to prevent reproductive and health problems and/or to reduce food costs. Firstly for example, broiler breeders are offered 25 to 50% of what they would eat if fed ad libitum in order to ensure that reproductive activity is maintained. This is probably the highest level of quantitative food restriction imposed on any farm animal. Secondly, pregnant sows are usually food restricted to prevent them becoming too fat and to maintain milk yield at farrowing. However, they are known to experience prolonged hunger as a result. Thirdly, forced moulting in laying hens is often induced by withholding food temporarily, sometimes for several days, in order to \`rejuvenate the reproductive tract´ and thereby increase production, egg quality and profitability of flocks in their second and third laying seasons. Feeding recommences when the birds have lost up to 30% of their body weight.

- In high-producing animals, particularly dairy cows and laying hens, food intake may not be sufficient to compensate for the strong production demands. This can lead to a severe loss of body condition.

- Intense hunger and starvation is a hazard for newborn animals, particularly piglets, and is a main cause of neonatal mortality (see “Absence of injuries”).

- Food intake can be insufficient when animals are exposed to stressful conditions because fear and stress predominate over the expression of other behavioural states, like feeding. This is very often the case with weaning pigs. Long distance transport of farm animals may also cause hunger because some animals refuse to eat when food is offered during the journey.

<u>What strategies can be implemented to prevent prolonged hunger?</u>

- Further research and development is required in a number of areas to help prevent prolonged hunger in farm animals. For example, the identification of new feeding practices or feeds for the breeding stock may minimize the occurrence of reproductive problems without compromising nutritional requirements. Strategies intended to reduce neonatal mortality in piglets will also reduce the number of animals suffering starvation.

- Adequate training of the stockpersons is vital to prevent poor husbandry and neglect.

Criterion 2: Absence of prolonged thirst

<u>Why is prolonged thirst a welfare problem?</u>

- Prolonged thirst causes stress and, if long-lasting or severe, leads to debilitation, loss of body condition and disease. For example, low water intake in pregnant sows may cause urinary infections.

- Thirst also reduces food intake, which in turn may cause all the welfare problems that result from prolonged hunger.

What are the causes of prolonged thirst?

- Prolonged thirst can occur when animals are given water of poor quality or when drinking facilities are insufficient or inadequate, mainly due to neglect or poor husbandry. Water availability may also be inadequate in extensive conditions.

- Competition with conspecifics may also lead to prolonged thirst when access to water is limited by, for example, insufficient drinking space.

- Long distance transport of farm animals may cause thirst because the animals may refuse to drink even when offered water during the journey.

What strategies can be implemented to prevent prolonged thirst?

- Adequate training of the stockpeople is important to ensure that thirst is not caused by poor husbandry and neglect.

Criterion 3: Comfort around resting

Why is lack of comfort around resting a welfare problem?

- Lack of comfort is likely to reduce resting time. This can lead to at least two major welfare problems. First, the risk of lameness increases if animals receive inadequate rest, this is particularly important in dairy cattle. Second, animals are often strongly motivated to rest and preventing them from doing so may cause them distress.

- When housing is inadequate or inappropriate, the animals may have to use abnormal sequences of movements to lie down and get up, thereby increasing the risk of injury, pain and distress.

- Insufficient resting space may lead to increased competition and aggression.

- A lack of space may prevent animals adopting an appropriate resting position, e.g. lateral recumbency in pigs, when the effective temperature is high. This may lead to heat stress (see "Thermal comfort")

What are the causes of lack of comfort around resting?

- Lack of comfort around resting may be a consequence of an excessive stocking density or of inadequate housing facilities, particularly inadequate flooring or an inappropriate number or design of cubicles on dairy farms.

What strategies can be implemented to ensure comfort around resting?

- Comfort around resting can be enhanced by better training of the stockpeople and by improving the animals' housing facilities, particularly by providing more space, proper flooring, appropriate substrate, cubicles etc.

Criterion 4: Thermal comfort

Introduction

- The relationship between animals and their thermal environment can be explained by using the concept of thermoneutral zone. This is defined as the range of ambient temperatures that provides a sensation of comfort and minimises stress. Temperatures which are too low or too high cause cold and heat stress respectively.

- The temperatures that define the thermoneutral zone depend on the species and may also vary among different breeds of the same species. Even animals of the same breed may respond differentially to the ambient temperature if they have been raised in different environments. Furthermore, the level of production and the amount and type of food given to the animals can all influence their response to the thermal environment.

- The effects of the thermal environment are not solely dependent on air temperature but on "effective temperature", which is the end-result of the interaction between air temperature, relative humidity, ventilation and flooring. Solar radiation is also important.

<u>Why is the lack of thermal comfort a welfare problem?</u>

- Temperatures which are too low or too high cause stress which if severe or prolonged enough can lead to disease and even death.

- Heat stress reduces feed intake thus leading to poor welfare as explained in the section on "Prolonged hunger". Heat stress also increases the amount of water required and can therefore incur the risk of prolonged thirst if water supply is limited.

<u>What are the causes of thermal discomfort?</u>

- Cold stress is a particular hazard for newborn animals and, together with starvation, plays an important role in neonatal mortality, particularly in piglets. This will be dealt with under "Absence of injuries".

- Poor ventilation, inadequate housing conditions and an overly high stocking density may all cause heat stress. Heat stress is also a very common and important welfare problem for dairy cows kept in warm countries.

- Under extensive conditions, particularly in the tropics, non-adapted, exotic breeds of animals may suffer an increased risk of heat stress

- Animals may suffer thermal discomfort during transport, particularly if the vehicle lacks climate control.

What strategies can be implemented to prevent thermal discomfort?

- Differences between breeds and between individuals within the same breed in their response to the thermal environment are partly genetically determined. Therefore, targeted genetic selection may increase the animals' resistance to heat and cold.

- Strategies to reduce neonatal mortality in piglets will, by association, lead to fewer animals suffering cold stress.

- Adequate training of the stockpeople is also important to prevent poor husbandry practices that may lead to thermal stress.

Criterion 5: Ease of movement (other than health or resting-related issues)

Why is ease of movement a welfare issue?

- The ability of animals to turn round, groom, lie down, get up and stretch their legs or wings has long been considered a basic requisite for good welfare. These movements are part of the behavioural repertoire of all species, and animals are highly motivated to perform them. They are also play important roles in maintaining the adequate functioning of the body.

What can cause difficulty of movement?

- Difficulty of movement may reflect a lack of space in the home environment. Typical examples include laying hens kept in battery cages or sows housed in farrowing crates.

- Too high a stocking density can also prevent animals from moving normally, as is often evident in broiler chickens approaching slaughter age.

- Inadequate design of housing facilities may prevent animals from lying down and getting up normally. This issue is covered in the "comfort around resting" section.

- The presence of dominant individuals, particularly when stocking density is high or housing facilities are inadequate, may severely curtail the movement of subordinate animals.

<u>What strategies can be implemented to enhance ease of movement?</u>

- Ease of movement can be increased through improved husbandry, including, for example, by adopting an appropriate stocking density.

- In some circumstances, a change in the housing system may be necessary, e.g. away from farrowing crates or traditional battery cages. In this and similar cases, however, the benefits of increased ease of movement should be balanced against possible negative effects on welfare, such as a greater risk of piglet crushing.

Criterion 6: Absence of injuries other than those due to disease or voluntary interventions, (neonatal mortality in piglets is included here)

<u>Why are injuries a welfare problem?</u>

- Injuries can cause acute and/or chronic pain. Pain is defined as an aversive emotional experience and is therefore a welfare problem.

- The legs and the feet are the parts of the body that are most frequently injured in farm animals. These injuries interfere with normal behaviour and locomotion, and may have a debilitating effect by preventing the animal from feeding normally. Mouth lesions can also hamper feeding.

- Wounds may become infected and, under some circumstances, may lead to systemic disease. Infectious, systemic diseases secondary to injuries as well as the debilitating effect of some injuries may result in the animals being culled.

- Neonatal mortality is a major welfare problem in pigs with as much as 10-15% of all piglets dying shortly after birth, most within the first 48 hours of life. Neonatal mortality often results from injuries caused by the piglet being crushed by the sow. Hypothermia and starvation in weak piglets may also cause death or, alternatively, may increase the risk of crushing.

<u>What are the causes of injuries?</u>

- Injuries may be caused by abuse or rough handling, the latter being more common when animals are loaded and unloaded during transport. Rough handling during depopulation of battery cages is also a common cause of injury.

- Injuries can be the result of accidents, such as when animals become entangled in wire, run into a fence or other obstacle. Hens can also be crushed if several try to re-enter the poultry house through the pop holes at the same time. Such accidents are particularly prevalent when animals are frightened and become panicked.

- Poor flooring and the inadequate design or maintenance of housing facilities (e.g. slippery floors, sharp protrusions) may also cause injuries.

- Injuries can result from fighting with other animals. Fighting is more common when animals are mixed with unacquainted individuals (particularly in pigs and to some degree cattle) and when they have to compete for access to feed, water or resting space.

- Tail-biting and feather pecking and cannibalism are important causes of injuries in pigs and laying hens respectively. Feather pecking can also develop in broiler chickens that are kept till they are 12 weeks old or more, i.e. far beyond the usual slaughter age of 40-45 days.

- Broken bones are relatively common in laying hens and, according to some studies, may occur in up to 12% or 25% of hens kept in free-range units or battery cages, respectively. Injuries caused by crash landings are also common in hens housed in

- In broiler chickens, hock burn, breast burn and breast blisters may occur when animals are kept on wet or inadequate litter.

<u>What strategies can be implemented to prevent injuries?</u>

- Improving the skills and attitudes of the stockpersons is essential in order to avoid injuries cause by mistreatment or rough handling. Careful handling may also reduce the occurrence of broken bones in laying hens.

- Changes in the design of housing facilities and improvements in their maintenance can reduce accidental injuries. Provision of perches may increase activity and reduce osteoporosis in hens, but placement, inter-perch distance, height and gradient are veryimportant factors. Provision of shelter in free range units may also reduce the occurrence of panic-related injuries at the pop holes.

- Lesions caused by aggression, tail-biting and feather pecking may be reduced through improved management and husbandry, e.g. environmental enrichment, increased monitoring. Genetic selection may also produce animals that are less aggressive or less prone to developing tail-biting or feather pecking. This will be described in greater detail in the "appropriate behaviour" section.

- Good ventilation, good quality litter and an appropriate stocking density will reduce hock burn, breast burn and breast blisters in broilers.

- Neonatal mortality in pigs may be reduced through improved husbandry as well as by genetic selection.

Criterion 7: Absence of disease (as well as neonatal and transport related mortality)

Why is disease a welfare problem?

- Absence of disease is a basic requisite for good welfare.

- Diseases can cause pain and interfere with normal behaviour. Chronic diseases may have a debilitating effect on the animal and may result in it being culled.

- Control of infectious diseases, e.g. BSE, foot and mouth, can cause major welfare problems when large numbers of animals have to be killed to avoid transmission of the disease.

- Neonatal mortality is a serious welfare problem in all farm species, particularly in piglets; the latter is dealt with in the "absence of injuries" section.

- Transport poses major challenges to the animals because are exposed to a variety of physical, psychological, social and climatic stressors over a relatively short period of time. Poor conditions during transport may cause injury, debilitation or even death, particularly in pigs and poultry.

What are the causes of disease?

- Reviewing the causes of disease is beyond the scope of this resource and the reader is referred to texts on veterinary medicine for further information.

- Some of the diseases that are more relevant from an animal welfare standpoint are called "multifactorial diseases", meaning that they are caused by the interplay of several factors. Examples include lameness in dairy cows and broilers, digestive diseases in weaning pigs and respiratory diseases in all species. Poor housing and husbandry may in some cases predispose the animals to infection, even when the disease is caused by a microrganism.

Some diseases are more common in animals that have been selected for improved production. Examples include lameness in broiler chickens, which is partly a result of genetic selection for appetite and fast growth, and metabolic diseases associated with selection for very high milk yield in dairy cows.

- In pigs, transport related mortality varies according to the animals'genetic background, transport conditions and effective temperature. Mortality during transport in broilers is very much dependent on effective temperature, transport conditions and duration of the journey.

<u>What strategies can be implemented to prevent disease?</u>

- Disease should be prevented primarily by adequate veterinary care and supervision.

- Improved housing and husbandry are important in the prevention of multifactorial diseases.

- Genetic selection could potentially play an important role in disease prevention by eliminating the negative effects of selection for improved production and by selecting for animals that are more resistant to disease.

- Transport related mortality may be reduced by improving transport conditions, mainly through training of the stockpeople and the use of climate-controlled vehicles such as the Transport 2000 concept. In pigs, genetic selection to eliminate the halothane gene may also be useful.

Criterion 8: Absence of pain induced by management procedures (including stunning)

<u>Introduction</u>

- Several procedures that cause pain are routinely carried out in farm animals. These include tail docking in pigs and less frequently in cattle; beak trimming in laying

- Stunning is a legal requirement in the EU and in many other countries when animals are slaughtered, with the exception of religious slaughter. Stunning is intended to render the animal immediately unconscious until death, so that it does not feel pain or anxiety while being bled.

Why are management procedures that cause pain a welfare problem?

- Pain is defined as an aversive emotional experience and is therefore a welfare problem per se. The above-mentioned management procedures normally cause pain that lasts a few days, but in some cases chronic pain may also result.

- These management procedures are often carried out on young animals but they too can feel pain.

- Both acute and chronic pain can hamper the expression of normal behaviour, such as feeding and social interaction

- In some circumstances, wounds caused by the management procedures may become infected and lead to disease.

- Stunning is not a welfare problem in itself, but a procedure intended to avoid pain and anxiety. However, it can cause pain if it is inadequately performed. An issue of particular concern when animals are slaughtered is the interval of time between stunning and bleeding. If this interval is too long and the stunning method only causes reversible unconsciousness, the animal may regain consciousness before dying and experience severe pain and fear.

Why are management procedures that cause pain carried out?

- Some of these procedures are carried out to prevent other, potentially more severe, welfare problems. For example, beak trimming in laying hens prevents feather loss and injury during feather pecking.

- Other management procedures are intended to improve the quality of the product. For instance, castration of male pigs eliminates the strong and often unpleasant odour of meat from intact mature male pigs.

- Some procedures are difficult to justify and seem merely to be a consequence of misconceptions or traditions. Tail docking in dairy cows, for example, is still performed in some countries to reduce mastitis even though there is no scientific evidence for such an effect.

- As mentioned above, stunning is used to avoid pain and anxiety while the animal is being bled at the slaughterhouse.

What strategies can be implemented to avoid management procedures that cause pain?

- Improving stockmanship is the single most effective way of avoiding unjustified painful management procedures and of reducing the pain caused by necessary procedures, e.g. by the use of analgesics.

- Some painful management procedures may be replaced by painless ones. For example, surgical castration in pigs may be replaced by immunocastration, the latter procedure is much less painful if at all.

- Some of the problems (e.g. feather pecking in laying hens) that are currently prevented by painful management procedures (beak trimming) may be reduced through better husbandry and targeted genetic selection. This is dealt with in the section on “appropriate behaviour”

Criterion 9: Expression of social behaviours (balance between negative, such as aggression, and positive aspects, such as social licking)

Why is the expression of inappropriate social behaviours a welfare problem?

- All farm species are social animals and as such are strongly motivated to make and maintain contact with conspecifics.

- Positive social interactions such as social licking have a desirable effect on welfare for at least two reasons. First, they have been shown to elicit physiological responses regarded as pleasant. Second, they reduce the negative effects of stressful events; this is known as “social buffering” of the stress response.

- Negative social interactions, such as aggression, cause fear and stress. Fear is an aversive emotional state and is therefore a welfare problem per se. Stress may harm body functioning by impairing immune function and reproductive performance, and decreasing food intake and growth rate.

- Negative social interactions may interfere with the expression of normal behaviour, particularly in low ranking animals, and thereby reduce food intake and resting time. This may lead to debilitation and health problems, such as lameness.

- Aggression can cause injuries. The effects of injuries on welfare have been covered in the section “Absence of injuries”.

What can cause the expression of inappropriate social behaviours?

- Rearing in isolation prevents the expression of normal social behaviour.

- Disruption of social groups (through mixing of unacquainted animals, for example) may lead to an increase in aggressive behaviour and a reduction in positive social interactions.

- Housing conditions that increase competition for resources may cause an increase in negative social interactions. This may happen when stocking density is too high or when access to resources such as feeding or resting space is limited.

What strategies can be implemented to prevent the expression of inappropriate social behaviour?

- Improved husbandry practices may help to minimize the expression of inappropriate social behaviour, for example by avoiding or reducing the mixing of unacquainted animals, and by not rearing animals in isolation.

- Reducing stocking density and improving housing conditions by decreasing the need to compete for resources is also likely to minimize the expression of inappropriate social behaviour.

- Providing adequate and appropriate environmental enrichment may help to reduce aggression and other undesirable behaviours.

Criterion 10: Expression of other normal behaviours (balance between negative, such as stereotypies, and positive aspects, such as exploration)

Why is reduced expression of other normal behaviours a welfare problem?

- Animals are strongly motivated to perform particular behaviour patterns. Clear examples include rooting in pigs, nest building in sows and hens, ground pecking and scratching in poultry, and exploration in all species.

- In some circumstances, the inability to perform such behaviour patterns may cause distress, frustration and eventual apathy.

- Stereotypies are defined as sequences of movement that are repetitive and invariant, and have no obvious function. Stereotypies are regarded as indicators of poor welfare, particularly when comparing different production systems, rather than

- The inability to express some behaviour patterns may lead to the development of damaging behaviours. For example, tail biting in pigs and feather pecking in poultry are thought to reflect a lack of opportunities to perform rooting and ground pecking / scratching, respectively. Tail biting and feather pecking can cause damaging lesions and potential cannibalism (see “Absence of lesions” section). Furthermore, the need to minimize the occurrence of these harmful effects may itself necessitate the use of certain pain-inducing husbandry procedures such as tail docking and beak trimming.

<u>What can reduce the expression of normal behaviours and increase the occurrence of undesirable ones?</u>

- Barren environments that fail to provide the relevant stimuli for the expression of normal behaviours are the main cause of their absence.

- The propensity of animals to develop stereotypies and damaging behaviours like tail biting and feather pecking is also affected by diet, husbandry and the genome.

<u>What strategies can be implemented to promote normal behaviours and reduce the expression of potentially harmful ones?</u>

- Improvement of housing conditions by the provision of appropriate environmental enrichment is one of the main strategies used to stimulate the expression of normal behaviours and to avoid that of undesirable ones.

- Improved nutrition and husbandry, as well as selective breeding for more favourable characteristics may contribute to the achievement of the above aims.

- Positive human-animal interactions may also contribute to the prevention of undesirable behaviours (see next section).

Criterion 11: Good human-animal relationship (no fear of humans)

Why is a poor human-animal relationship a welfare problem?

- A poor human-animal relationship results in the animals being fearful of the stockperson and other humans. Fear is an aversive and potentially damaging emotional state and is therefore a welfare problem per se. Fear of humans is likely to have a chronic effect or a series of acute negative effects on welfare.

- Fear causes a stress response which, if long lasting, can impair immune function, reproductive performance, food intake, food conversion, growth and product quality.

- Fear of humans may cause injuries in animals as they try to move away from the stockperson, catchers or other handlers. The effects of injuries/lesions on welfare have been covered in the "absence of injuries" section.

- Prolonged fear can lead to increased anxiety, apathy and the expression of harmful behaviours.

What are the causes of poor human-animal relationships?

- Poor stockmanship is undoubtedly the main cause of unsatisfactory human-animal relationships. Fear of humans is largely determined by the behaviour of the stockpersons, which normally reflects their beliefs, attitudes and skills.

- In some production systems (e.g. extensive farming) animals are less likely to have frequent contact with stockpeople which could in turn make them more fearful of humans through a lack of habituation.

- Fear has a relatively important genetic component. Therefore, some breeds (and individuals within breeds) are more likely to be frightened of humans than others.

What strategies can be implemented to achieve a good human-animal relationship?

- Training programmes aimed at improving stockmanship represent the main strategy for achieving and maintaining a good human-animal relationship. These programmes have a very positive impact on the welfare of the animals, but to be fully effective, they must be tailored to the particular production system and the characteristics of the producers in each country.

- A simple regime of regular positive contact with people can reduce fear of humans and thereby improve the human-animal relationship. Visual contact alone can sometimes suffice, particularly in poultry.

Criterion 12: Positive emotional state (avoiding negative emotional states (fear, distress, frustration, apathy), and promoting positive ones (security, contentment).

Why is general fear a welfare problem?

- Fear is an aversive emotional state and is therefore a seriously damaging welfare problem per se. General fear becomes a problem particularly when animals encounter new or unexpected stimuli, (e.g. a sudden noise or movement, an unfamiliar animal or object), or novel situations, e.g. a new housing facility, transportation.

- Fear causes a stress response that, if prolonged, can cause economic losses by reduceing reproductive performance, food intake, food conversion, growth and product quality. It may also result in increased mortality by impairing immune function and, consequently, disease resistance.

- Prolonged frustration may also elicit chronic stress and apathy, with the harmful effects described above.

What are the causes of general fear, stress, frustration and insecurity?

- Fear has an important genetic component. Therefore, some breeds or individuals within breeds are more likely to be easily frightened than others.

- Animals reared in barren environments are likely to become more fearful of new situations than those that have been reared in enriched and varied environments.

- Frustration and apathy are also more likely to occur in barren environments which deprive animals of the opportunity to exhibit strongly motivated natural behaviours.

- Insecurity is more common in environments lacking the opportunity to seek shelter or to escape from potentially threatening stimuli.

What strategies can be implemented to prevent general fear and other negative emotions and to promote positive ones?

- Genetic selection could be used to develop less fearful breeds.

- Changes in housing and husbandry aimed at providing adequate environmental enrichment, particularly during the early phases of development, may decrease general fear and frustration in animals.

- Environmental enrichment could promote exploration, play and contentment.

- A feeling of security may be promoted by the provision of shelter, (e.g. trees in free range systems), or other opportunities to escape from threatening stimuli (e.g. predators), such as tunnels, or pop holes allowing re-entry to the barn or shed.

Chapter 2

Stockmanship

Scientific background and work done outside WQ

The term ”stockmanship” covers that way animals are handled, the quality of their daily management and health care, and how well problems other than disease are recognised and solved (Waibingler and Spoolder, 2007). At least three factors underlie individual differences in the quality of stockmanship: personality, attitude and behaviour (Hemsworth and Coleman, 1988; Jones, 1996). Personality can be defined as a person’s unique combination of traits that affects how he/she interacts with the environment; personality is relatively stable over time. Attitudes (including those towards animals) are learnt and can be modified through experience; they are often seen as the most important factor explaining how a person interacts with social objects, including animals (see summary and references in Waibingler and Spoolder, 2007). Clearly, personality and attitudinal factors influence the way that stockpersons behave towards the animals in their care.

The quality of stockmanship has a profound effect on the animals’ welfare and productivity (Boivin et al., 2003. For instance, despite centuries of domestication exposure to human beings remains one of the most potentially alarming experiences for many farm animals. More specifically, unless they have become accustomed to human contact of either a neutral or positive nature the predominant reaction to people if one of fear (Duncan, 1990; Jones, 1997). Not surprisingly, the problem is exacerbated by exposure to rough, aversive and/or unpredictable handling. Indeed, many human-animal interactions in current farm practice are frightening, e.g. restraint, depopulation, veterinary treatment, while few, other than feeding, are positive reinforcing. It is worth bearing in mind that contact with humans could become even more distressing if increasing automation has reduced opportunities for animals to habituate to people. The stockpersons’ behaviour, which can vary from calm, gentle, frequent and “friendly” to infrequent, rough and rushed, is a major variable determining animals fear of or confidence in humans and, hence, the quality of the human-animal relationship. Chronic fear is a major animal welfare problem that can lead to handling difficulties, injury, stress and impaired growth, reproductive performance and product quality (Hemsworth and Coleman, 1988; Jones, 1997). For example, a series of studies found negative (and probably causal) correlations between fear of humans and productivity in the dairy, egg, broiler and pig industry (for a review, see Hemsworth, 2003). Conversely, experience of positive human-animal interactions can decrease the animals’ general level of stress (Seabrook and Bartle, 1992) and enhance reproductive performance (Waiblinger et al., 2006). Furthermore, the presence of a familiar person can calm the animal in potentially aversive situations (Waiblinger et al, 2006).

In view of the above findings the implementation of reliable methods of reducing animals’ fear of humans is likely to substantially improve their welfare and productivity. While a regime of regular gentle handling is known to reduce stress and fear of humans in domestic chicks, cattle, sheep and pigs (for reviews see Hemsworth and Coleman, 1988; Jones, 1993; 1996) it is clearly not feasible for farmers to apply such treatment to the sometimes very large flocks or herds that are common in modern farming. Encouragingly though, even the avoidance of negative contact was beneficial for dairy cattle (Waiblinger et al., 2003), and in chickens at least, the handling phenomenon appears quite flexible. For example, simply allowing chicks to either observe the handling procedure or just to see the experimenter standing close to their cage were as effective in reducing fear of humans as actual physical handling (Jones, 1995). Fear of humans was also reduced in caged layers between 19 – 36 weeks of age when they received daily visual contact in addition to that associated with normal husbandry (Barnett el al., 1994). There is also some evidence in chicks for generalization of the handling phenomenon across people, at least if their clothing remained similar (see Jones, 1996). These findings have important practical implications; they suggest that more frequent close examination of the flock by the stockperson would not only provide a better check that the birds are healthy and that the system is working properly but it could also help to reduce the birds' fear of humans.

Although it is difficult to validate experimentally because of the diffuse nature of sound it has often been suggested that radio music helps farm animals to thrive. A survey of more than 100 UK poultry farmers revealed that 46% of them routinely played the radio; of these 96%, 52%, 20% and 16% claimed that it made the hens calmer, less aggressive, healthier and more productive, respectively (see Jones, 2004). Potential explanations include: a) farmers who play music may care more about their animals' welfare and hence adopt better practice; b) playing the radio may help the birds to learn that unfamiliar sounds are not necessarily frightening, thereby reducing the likelihood of alarm if they hear the stockman shouting, sneezing, slamming a door, dropping a bucket etc. Whatever the underpinning mechanism, playing the radio is probably the easiest, most practicable way of enriching the environment for both the animals and the farmer.

Aspects of stockmanship other than handling and general behaviour are also important. Since attitudinal factors underpin behaviour it is not surprising that a strong influence of stockpersons' attitudes on farm animal welfare and production has been demonstrated in several species (Boivin et al; Hemsworth, 2003). For example, attention to detail is essential in a farrowing house to reduce neonatal mortality in piglets (Holyoake et al., 1995). Positive correlations have also been found between farmers' attitudes to dairy cows and the degree to which their housing was designed and managed in order to fulfil the animals' needs (Mülleder and Waiblinger, 2004 in Waibingler and Spoolder, 2007). Furthermore, a good attitude is associated with increased contact which, in turn, improves the stockperson's knowledge of the animals and facilitates the early recognition and solution of any problems (Waiblinger et al., 2006).

Intervention studies in the dairy and pig industries have recently shown the potential of cognitive-behavioural intervention techniques designed to target and improve those attitudes and behaviours of stockpeople that have a direct effect on animal fear and welfare (Hemsworth, 2003). Training programmes developed in Australia have met with success (Hemsworth and Coleman, 1998) and are being evaluated in the European context in Welfare Quality®.

Despite the experimental evidence accumulated over the last 20 years, there are still some areas in which research is required to improve our understanding of the effects that human-animal interactions may have on the animals. These include: the ability of farm animals to discriminate between humans, the best methods for selecting and training stockpeople, and the potential influence of interactions between the effects of handling and housing systems (Hemsworth, 2003; Raussi, 2003).

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Work done in Welfare Quality

Objectives

- To determine the variability in the farmers' practices and their underlying motivations as well as their consequences on the behaviour of the animals
- To identify the main obstacles to good handling and potential practical solutions
- To test the hypotheses that (1) the presence of the dam could have a strong influence in the later human-cattle relationship, (2) positive human contact during the dry period is more effective when compared to such contact during lactation in cattle, (3) calm and quiet handling will improve learning speed by sows and the working environment of stockmen, and (4) laying hens that have been in regular contact with humans during rearing are less fearful than those that received no such contact.
- To develop training materials for cattle, pigs and poultry stockpersons in Europe through close collaboration with Australian researchers

Material and methods, results and conclusions - cattle

Material and methods
Three studies were performed in Welfare quality ®: one on French beef breeders, one on transfer of beef bulls to slaughter and one on separation of the calves from the dam.

<u>Study on French beef breeders about the human-animal contacts</u>
A mailed questionnaire sent to French beef breeders showed that many farmers are concerned by problems due to animal behaviour during handling. Farmers emphasised the human contact (qualitatively or quantitatively) as more important for cattle ease of handling than others factors. This can be a key to motivate beef cattle farmers to follow a training program in order to improve the human-animal relationship. During the second part of this study, a sample of these breeders was visited, interviewed on their husbandry and handling practices. Their calves' behaviour was also observed in a crush test in presence of the human.

<u>Study on transfer of beef bulls to slaughter</u>
A survey was conducted on 61 transfers of bulls from commercial finishing units to a slaughter plant. A total of 1 202 bulls from 108 farms were observed. On farms, farmers were asked to answer a written questionnaire with the aim to assess their attitudes towards bulls and working with bulls. They were also asked to give information on their farm and their bulls. Questionnaire was completed by 88 farmers. Drivers were asked to obtain information on the transfer (loading of the bulls, duration of the survey, etc). At the arrival at slaughter, unloading was observed by a technician. Observations were obtained for 1 171 bulls. At slaughter, carcass characteristics were obtained (1 073 bulls), 1 000 blood samples were collected to determine cortisol concentration and meat pH was measured in the *Longissimus Dorsi* of 891 carcasses and in the *Rectus Abdominis* of 821 carcasses.

Study on separation of the calves from the dam.

A study was made to test if calves that are reared under outdoor conditions, but daily separated from the dam, and individually gentled during the first weeks of age, were durably less fearful of humans than calves not gentled.

Results

Study on French beef breeders about the human-animal contacts

Despite the limited number of farms in this study, the results confirm previous studies: in the group of the farms with the calmest calves, farmers enjoyed the contact with the animals. Observations of calves in the crush test have also shown that the multi activity of the farm or of the farmer is one of characteristics leading on a risk of poor human-animal relationship or difficult handling in suckling herd farm. These farmers have more agitated calves and less interest for human contact. Results have also shown that housing conditions affects the ease of handling in calves with a better docility in tied stables. The mailed questionnaire study emphasised also new factors such as a negative relationship between a positive attitude towards handling facilities and calves' docility.

Study on transfer of beef bulls to slaughter

In beef bulls, handling and particularly loading was also linked to farmer's attitudes. Loading during transfer to slaughter has shown to be more difficult when the farmer reported that he enjoyed observing bulls and that he touched them often. In bulls, too many contacts with human may render them too familiar of people and more thus more difficult to handle. Moreover bulls are more stressed when they have been separated form their usual social partners before arrival at the slaughter plant.

Loading was easier on farms equipped with a corridor or a loading ramp and thus appropriate equipment should be used to load animals into the truck.

Physical environment during transfer may also influence handling of bulls: unloading was easier when the journey was short and when the local temperature was high.

Study on separation of the calves from the dam.

The results have shown that calves stroked individually for three weeks in early age reduced their avoidance responses towards an unfamiliar person just after the stroking period and even at 40 weeks of age. Nevertheless, stroked calves did not approach the human more than the controls did when exposed to a motionless experimenter.

The duration of the separation from the dam did not impact the effects of the early human contact neither affect later responses of the calves to human. Results suggest that the beneficial effects of early human contact could be strongly limited if no particular attention is paid to the behaviour of the dam.

The existence of sensitive periods to human contact in animal's life, estimated at the first ten day of age, in dairy calves, could be very important for establishing a durable and positive human-animal relationship. However, the simple presence of the dam was sufficient to strongly limit the effect of gent le human contact.

Conclusions

Study on French beef breeders about the human-animal contacts

Improved facilities could maybe allow the farmers to keep wilder animals and handle them more safely. Nevertheless this relationship has to be further explored.

Study on transfer of beef bulls to slaughter

Short transport and heat are likely to result in animals being more disturbed in the truck and probably more ready to get out of it when they arrive at the slaughter plant, thus making unloading easier. Nevertheless, transport of animals on warm days should be avoided.

Study on separation of the calves from the dam.

In practice, it can be beneficial for the human-animal relationship to provide human contact in early age but the persistence of the effect could depend strongly on maternal influences. Separating physically but not visually the calves for some hours in early age seem not effective enough to limit maternal influences. In an applied perspective, breeders should clearly pay attention to the poor behaviour of their cows during handling as it could strongly impact handling stress for the next generations of calves.

Genetics and welfare

Scientific background and work done outside Welfare Quality

Despite the use of sophisticated feeding and management regimes many farm animals still suffer from a range of behavioural or health problems, which may seriously compromise their welfare and require frequent use of medication. The usual approach to these problems focuses on modifying the environment in an attempt to accommodate behavioural and other needs and to provide those environmental conditions that allow farm animals to successfully adapt to challenging stimulation without suffering harmful consequences. However, although this is a highly appropriate and socially accepted strategy for improving farm animal welfare, it may not be sufficient for maintaining good welfare in the long run.

Production systems are generally designed and implemented to fit the needs of the average animal rather than the individual. Given the profound individual differences in many important biological characteristics within the same farm animal species or breed (Erhard and Schouten, 2001; Faure et al, 2003), a production system that is favourable for one individual may be less favourable or even detrimental for another. Extensive work in rodents, poultry and primates, including humans, suggests that adaptability to environmental change - in terms of the propensity to develop disease or stress-related pathologies - is mediated by a number of underlying psychobiological characteristics that are to a certain extent (epi)genetically controlled (Kagan et al., 1988; Suomi, 1991; McEwan and Stellar, 1993; Koolhaas, 1994; Boissy, 1995; Jones, 1996; Jones and Hocking, 1999; Ramos and Mormède, 1998; Kavelaars et al., 1999; Koolhaas et al., 1999). These characteristics include: (i) fearfulness (also sometimes labelled temperament or emotionality) which is defined as the propensity to be easily frightened in novel or unpredictable situations, (ii) sociality, i.e. the motivation to be with companions and the ability to adapt to the social environment (Jones et al., 2002, and (iii) activity or coping style, the qualitative type or strategy of response (e.g., active or passive) the individual adopts when challenged. Research in molecular and behavioural genetics is unravelling the genomic basis of these traits (Flint et al., 1995; Eley and Plomin, 1997; Mormède et al., 2002). So far, results support the notion that responsiveness to environmental challenge across species may involve common biological (e.g. neural) substrates, probably determined by homologous genes. Studies in bovines, sheep and pigs also imply the existence of similar characteristics and, encouragingly, reveal associations between individual differences in stress responsiveness and contrasting immunological responses, disease incidence and production efficiency (Hessing et al., 1995; Burrow, 1997; Hopster et al., 1998; Schutz and Pajor, 2001; Boissy et al., 2002; Désautés et al., 2002). Thus, identifying and utilizing fundamental psychobiological traits underlying adaptation to the physical and social environment might represent an effective strategy for improving farm animal welfare in a broad sense.

Commercial breeding programmes generally emphasize genetic improvement in production efficiency and, therefore, tend to incorporate production-related traits only. However, selection for high production has unconsciously resulted in several undesirable side-effects, including behavioural and health problems, in many species (Rauw et al., 1998). For example, over recent decades, the genetic improvement of pigs has focused on productive (growth, leanness and meat quality) and reproductive traits (e.g. accelerated puberty and larger litter size). Nevertheless, in view of its close relationship with culling costs the economic relevance of functional characters such as sow longevity has also increased. Furthermore, sow longevity can be considered an important indicator of animal welfare. A bodily feature such as leg conformation can play a key role in determining sow longevity although little is known about its impact on culling decisions. The main aim of this research project was to evaluate the influence of the overall leg conformation score as well as several leg conformation deficiencies on the longevity of Duroc, Landrace and Large White purebred sows applying survival analysis techniques. The results should help to guide decisions on the criteria used in future breeding programmes and thereby optimize the productive lives of gilts.

Therefore, in addition to environmental conditions, the biological qualities of the individual animal should be taken into consideration in order to improve or optimize animal welfare. At present, there is insufficient information about relevant characteristics or traits underlying adaptability and their relationships with production-related traits and the ability to perform (in terms of welfare and production) in commercial conditions.

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Welfare Quality work

Objectives

- To identify and record inherited genetic disorders affecting pig welfare, and to unravel the genetic basis of functional traits in pigs, including leg weakness and longevity, as well as the relationships of these characteristics with (re)production traits.
- To establish phenotypic and genetic correlations between psychobiological characteristics and measures of on-farm welfare and production in dairy cows.

Material and methods, results and conclusions - leg conformation and longevity in sows

Material and methods

Longevity data from 587 Duroc, 239 Landrace and 217 Large White sows were analyzed with special emphasis on the effect of leg conformation. Sow longevity was analyzed twice for each breed, testing the effect of a subjective overall score for leg conformation, or the presence/absence of 6 specific leg conformation defects. Each preliminary model also included teat conformation score with 3 levels, farm, origin and backfat thickness at 6 mo of age, and 2 continuous sources of variation, age at the first farrowing and the number of piglets born alive at each farrowing.

Results

The overall leg conformation score significantly influenced sow longevity in Duroc ($P < 0.001$), Landrace ($P < 0.001$) and Large White sows ($P < 0.01$), with a higher hazard ratio (HR) for poorly-conformed sows (1.556, 2.160 and 1.786, respectively) than for well-conformed sows (0.317, 0.661 and 0.682, respectively). Abnormal hoof growth reduced survivability in Duroc (HR = 2.775; $P < 0.001$) and Landrace sows (HR = 1.876; $P < 0.01$), the presence of splayed feet ($P < 0.05$) or bumps and injuries ($P < 0.001$) increased the risk of culling in Duroc sows (HR = 2.081 and 3.567, respectively), while the incidence of straight pastern increased the HR in Large White sows (HR = 2.488; $P < 0.01$). In all 3 breeds, longevity was reduced in plantigrade sows, with a higher HR in Duroc (HR = 3.380; $P < 0.001$) than in Landrace (HR = 1.528; $P < 0.1$) and Large White sows (HR = 1.725; $P < 0.05$). Interestingly, teat conformation did not influence sow longevity ($P > 0.1$). Estimates of heritability for longevity in Duroc sows ranged from 0.052 to 0.072 depending on the algorithm applied.

Conclusions

Leg conformation has a substantial impact on sow longevity and the removal of candidate gilts with poor leg conformation from the breeding population before first mating could improve sow survival and reduce culling costs. The estimates of heritability indicated that survivability of Duroc sows could be genetically improved by direct selection for this trait.

Injurious behaviours (I) Feather pecking and cannibalism in laying hens

Scientific background and work done outside Welfare Quality

Feather pecking (FP) can be defined as pecking at or pulling out and eating feathers of another hen (Bilcík and Keeling, 2000). The term cannibalism refers to the behaviour of pecking and pulling at the skin and the underlying tissue of another hen (Keeling, 1994). There are several forms of cannibalism in laying hens, including vent pecking, toe pecking and cannibalism in feathered body regions. Although the latter can develop as a consequence of the injuries caused by feather pecking, vent and toe pecking are independent from feather pecking.

Feather pecking is a major welfare and economic problem in laying hens and turkeys. In terms of reduced welfare, FP can cause pain (Gentle and Hunter, 1990) and lead to cannibalism and the painful death of target birds. FP can be particularly problematic in alternative systems, such as percheries, free range etc, because it is more difficult to control when birds are kept in large flocks (Nicol et al., 2003: Jones et al., 2004). This can hamper the uptake of replacements for the battery cage. Common management practices to reduce FP and cannibalism include beak trimming and/or keeping the birds under dim light but these can cause chronic pain (Gentle, 1992), sensory deprivation and the development of eye abnormalities, respectively. From an economic perspective, feather pecking results in decreased laying performance (El-Lethey et al., 2000) and poorer feed conversion efficiency due to increased heat loss in poorly feathered hens (Tauson and Svensson, 1980), whereas cannibalism increases mortality.

Feather pecking is a multifactorial problem influenced by environmental, management and genetic variables. For example, there is a large body of evidence indicating that it evolves as misdirected foraging behaviour (e.g. Blokhuis, 1986) since the frequency of FP is influenced by the availability of a suitable substrate for scratching and pecking. Good use of free range (Nicol et al., 2003) and/or the availability of elevated perches during the rearing and laying periods can reduce the risk of feather pecking (Huber-Eicher and Audigé, 1999; Wechsler and Huber-Eicher, 1998). Other factors such as nutrient imbalance, stress, stocking density and light levels can also contribute to the development of feather pecking (Hughes, 1982).

In addition, the existence of marked differences within and between breeds implies that there is a strong genetic component (e.g. Jones & Hocking, 1999; Jones et al, 2004; Kjaer and Sorensen, 1997). Indeed, selection programmes resulting in reduced FP have been established, at least in the laboratory (Kjaer et al, 2001; Muir & Craig, 1998). Similarly, two lines originally selected for differences in a production characteristic were found to show low (LFP) and high (HFP) levels of both gentle and severe feather pecking, respectively (Blokhuis et al., 2001). The work also suggested that hens with an active coping style and low sociality may be more likely to become feather peckers (Blokhuis et al., 2001). Although gentle FP was traditionally not regarded as a welfare problem it may ruffle or damage the pecked bird’s feathers thereby making it more susceptible to severe FP (Jones et al., 2004). Furthermore, it has been proposed that severe FP develops from gentle FP because its first expression is embedded in bouts of gentle pecking (Riedstra & Groothuis, 2001). Findings such as these may guide future breeding programmes.

It has also been proposed that environmental enrichment might reduce feather pecking. For example, the Agritoy (a blue frame with red and blue moving parts) was reported to reduce "aggressiveness" in caged layers while Peckablocks, (a compacted cereal based device) decreased pecking in broiler chickens (see Jones, 2005). A systematic study of pecking preferences was carried out in chicks and laying hens in order to guide the development of effective environmental enrichment. Bunches of string were found to elicit substantially greater interest than other stimuli, including baubles, Peckablocks and feathers, and white or yellow string was the most attractive (Jones et al., 2004; Jones, 2005). The birds' manipulation of the string resembles preening. String sustained lengthy interest, reduced FP in birds of the HFP line, and decreased feather damage in caged layers at a commercial farm (Jones et al., 2004).

Although cannibalism often develops independently from feather pecking, both behaviours share several risk factors. For instance, cannibalism is affected by the genotype of the hens (Keeling 1994), the risk of cannibalism in alternative systems can be decreased by offering substrate materials such as straw (Redmann and Lüders, 2005), while the likelihood of its occurrence is increased by high light intensity (Frölich and Oester, 2001), dietary imbalances (Ambrosen and Petersen, 1997) and a lack of perches during the rearing period (Gunnarson et al., 1999).

Despite the abundant literature on both feather pecking and cannibalism, the occurrence of these behaviours is still difficult to predict, mainly due to the interaction between all the risk factors mentioned above. Genetic selection and/or genetic de Jong, I C, Keeling, L J, McAdie T M and Preisinger R manipulation may prove to be a very useful strategy for decreasing or even eliminating both feather pecking and cannibalism. However, further work is needed to establish whether or not such a genetic strategy might have deleterious effects on other welfare or production characteristics.

In conclusion, the integrated application of appropriate environmental and genetic strategies is likely to reduce the expression of feather pecking and its harmful consequences.

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Welfare quality work

Tail biting in pigs

Scientific background and work done outside Welfare Quality

Tail biting has been an economic problem in intensive pig production since the Second World War and there is still no definitive solution (Valros et al, 2004). Furthermore, not only has tail biting become an increasingly important welfare issue over the last few decades but its occurrence is apparently more prevalent. For example, data from Denmark shows a significant increase in evidence of tail biting in slaughtered pigs from 1994 to 1998 (Anon, 1998). Whether this increase reflects a true worsening of the situation or just a higher sensitivity to the problem remains to be clarified.

A well-accepted description sub- divides tail biting into two phases. In stage one, also called pre-injury stage, a pig chews lightly on the tail of another who tolerates this behaviour. In many cases stage one is followed by stage two, also termed the injury state, which results in wounding and bleeding (SchrØder-Petersen & Simonsen, 2001). Cases of tail biting in the second stage can be further characterized according to two main criteria: their acute or chronic evolution and the severity of the lesions (SchrØder-Petersen & Simonsen, 2001). The inflicted wounds, particularly those with an acute onset, may result in infection that can lead to abscesses, osteomyelitis, pyaemia and death (SchrØder-Petersen & Simonsen, 2001; Kritas & Morrison, 2007). Besides physical injuries, tail biting is also associated with for reduced weight gain, disease transmission and cannibalism (SchrØder-Petersen & Simonsen, 2001).

Tail biting can be understood as an abnormal behaviour for it is rarely reported in pigs living in extensive or semi-natural production systems (Moinard, 2003). According to the most widely accepted hypothesis, tail biting seems to be a form of redirected behaviour derived from the thwarting of normal exploratory, feeding, social and sexual motivations. As is true for other behaviour problems in intensive pig production, tail biting is a multi-factorial problem involving both internal and environmental risk factors; these include genetic background, sex, age, health status, diet, feeding management and different characteristics of the pen (SchrØder-Petersen & Simonsen, 2001; Moinard, 2003; SchrØder-Petersen et al, 2003; SchrØder-Petersen et al, 2004). Tail biting seems to be related to some extent to the pig’s level of activity and restlessness. Consequently, any factor inducing stress may indirectly promote tail biting by making pigs more active and restless and thus favouring the appearance of redirected behaviour. Also, once the problem is present, the wounded tail seems to encourage further biting. Nevertheless, different studies looking at the effect of one particular factor often show contradictory results, thereby highlighting the need for further research and supporting the view of tail biting as the result of different interplaying and mutually dependent factors.

Main risk factors for tail biting in pigs:

- Genetic characteristics: it has been hypothesised that hereditary nervousness present in certain breeds or genetic lines could predispose them to tail biting.
- Gender: according to some studies castrated males seem more prone to suffer tail biting than females and entire males.
- Age: the risk of tail biting seems to increase as the pig grows older and heavier.

- Weaning age: since suckling can be considered a behavioural need for pigs the motivation to suckle may remain high in early-weaned piglets, thus favouring its redirection.
- Stocking density and social stress: many authors claim that a high stocking density increases the risk of tail biting. However, recent studies yielded inconclusive results on the relationships between herd size, density and the risk of tail biting.
- Health status: different physical conditions, both of the aggressor and the victim, have been linked to tail biting in pigs. These range from external parasites to infections causing anaemia. Although it is difficult to establish a cause and effect relationship, it has been hypothesized that health problems could cause stress that, in turn, might reduce the threshold for redirected behaviours such as tail biting.
- Diet: low protein and low fibre diets, as well as those with deficiencies in certain nutrients, particularly iodized salt, may be a risk factor for tail biting.
- Feeding management: a reduced feeding space seems to be correlated with tail biting. Limited space may result in a lower food intake leading to stress, frustration and consequently redirected behaviour. In addition, it has been proposed that small and weak individuals would attack other pigs from behind to gain access to the feeding area.
- Lack of substrate for exploratory behaviour: several studies show that tail biting is more prevalent in pens that have no rooting materials, such as peat and straw. The fact that slatted floors increase the risk of tail biting may also reflect the lack of rooting material. Furthermore, pigs living in an enriched environment are generally less prone to tail biting than those in a barren environment, perhaps because stress levels are lower in enrichment environments. The lack of access to straw and other suitable rooting materials is probably the single risk factor most consistently reported in the literature on tail biting in pigs.
- Level and type of artificial lighting: it is thought that neon lighting could irritate the animals and consequently increase the occurrence of tail biting.
- Temperature and ventilation: temperatures outside the optimal range and the presence of draughts seem associated with increased tail biting.

The classical approach to alleviating tail biting has focused on the implementation of treatment strategies once the problem is present; these include isolating the tail biter, treating the lesions with antibiotics, and amputating the tail, particularly in severe cases. Tail docking has been considered the most common and successful way of preventing tail biting for more than 50 years. However, recent studies have questioned the efficacy of tail docking in preventing tail biting (Chambers et al, 1995; Moinard et al, 2003) and there are many arguments against the use. These include: pain sensitization in the affected area, (thus making the pig more reactive to any manipulation and eliciting pain through accidental contact with other pigs, walls, objects etc), the risk of infection, the possibility that the abnormal behaviour could be redirected to other parts of the body, and ethical concerns regarding the necessity to mutilate animals in order to accommodate them to modern production systems. Ideally, tail docking should only be considered an acceptable strategy in farms repeatedly experiencing severe tail biting.
In view of the deleterious effects of tail biting and the undesirable side-effects of tail docking there is a growing belief that attention should be directed towards identifying preventative strategies aimed at minimising the aforementioned risk factors. Examples found in the literature include the provision of rooting materials, a balanced diet, good

access to the feeding area, toys / enrichment stimuli to encourage natural foraging behaviour, as well as encouraging lower stocking densities, substituting neon lights with tungsten ones, and maintaining the chill factor within the optimum range (SchrØder-Petersen & Simonsen, 2001; Van de Weerd and Docking, 2003; Van de Weerd and Docking, 2005). In addition, routine examination of the animals is important in order to detect cases of tail biting while in the early pre-injury stage.

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Lameness in broiler chickens

Scientific background and work done outside Welfare Quality

Lameness resulting from leg disorders is commonly regarded as one of the main welfare problems in broiler chickens. The aetiology of leg disorders in broilers includes factors such as genetic background, growth rate, feed conversion efficiency and body conformation, exercise, nutrition and stocking density. These categories are not mutually exclusive as one factor may affect another (Bradshaw et al., 2002). Leg disorders may be classified according to their underlying pathology as infectious, developmental and degenerative (Bradshaw et al, 2002), with tibial dyschondroplasia and long bone deformities being particularly common (Julian, 1988).

As many as 90% of birds in some flocks show at least some degree of lameness by slaughter age (Kestin et al., 1992), and some studies report up to 30% of birds moderately to severely lame (Sanotra et al., 2001). However, prevalence of lameness in broilers varies to a large extent between farms. Dawkins et al. (2004) conducted a large scale study on broiler welfare and found a mean percentage of severely lame birds of 9%, with a range of 0 to 20. As intensive broiler chicken production now exceeds 2 x 10^{10} birds worldwide (Dawkins et al., 2004), lameness in broilers is likely to be one of the most widespread farm animal welfare problems in modern agriculture.

Leg problems have serious consequence for welfare as lame birds may suffer pain (Pickup et al., 1997) and their behaviour is significantly altered (Weeks et al., 2000). Lameness can also result in negative economic effects, as lame birds may lose weight and are more likely to be downgraded at slaughter (Kestin et al., 1999).

Lameness in broilers is usually assessed by means of a gait scoring system (Kestin et al., 1992; Garner et al., 2002). The system initially developed by Kestin et al (1992) has been validated in a number of studies. For example, high gait score birds tend to perform behaviours such as feeding while sitting where possible (Weeks et al., 2000). The more recent method developed by Garner et al. (2002) offers even better reliability.

Over the last 40 years, genetic selection for rapid growth and improved feed efficiency, together with changes in the feed that have encouraged a high nutrient intake, have caused a significant increase in growth rate. This, in turn, has been implicated in the increasing prevalence of leg problems. However, metabolic imbalances induced by high nutrient intake may cause some of the conditions that result in lameness and these might be corrected without reducing growth rate (Julian, 1988).

Although high stocking density was generally thought to be one of the major risk factors for lameness in broilers (Bradshaw et al, 2002), stocking density per se was, within limits, recently found to be less important than other factors such as temperature, humidity and stockmanship (Dawkins et al, 2004). Nevertheless, stocking density still had some effect, and at the highest densities there were fewer birds with no signs of lameness.

Bone quality is influenced by the mechanical stresses that are applied to the bones.Increased levels of exercise strengthen bones and reduce bone deformities, whereas a lack of exercise can increase the incidence of leg abnormalities (Lanyon, 1992). It has been suggested that selection for feed conversion has reduced the performance of energy consuming behaviours in broiler chickens. Indeed, locomotor activity is dramatically reduced during the finishing period in chickens from fast-growing genetic types compared to slow-growing genetic types. In addition, the correlation between activity levels at early and later ages indicate the involvement of genetic factors in the expression of locomotor behaviour in very young chicks (Bizeray et al., 2000).

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Welfare quality work

Objectives

Material and methods, results and conclusions

Material and methods

Sequential feeding was carried out during ten 48-H sequential-feeding cycles from 8 to 28 days of age. Three treatments were compared: complete diet (C) and two alternations of diets varying in protein and energy contents (S1: E+P- followed by E-P+; S2: E-P+ followed by E+P-). Chickens received the same feed during the starter and finisher periods (0-7 and 29-38 d of age). Body weight, feed intake, general activity and gait score, bone quality and carcass conformation were measured to evaluate leg condition and general performance.

Results

Gait score was improved in birds fed the sequential feed (mean GS = 2.41 vs. 2.61 in controls) without significant changes in body weight at slaughter. However, this gait score enhancement was only significant in birds fed with the poor-energy/high-protein diet during the first day of each cycle. The reduction in lameness in the sequential group could be related to the increased motor activity that was observed during the sequential feeding phase linked to more time spent feeding and in exploratory behaviour. Feed conversion and carcase conformation were not impaired by sequential feeding, and only abdominal fat increased, but we think this increase was small enough to be avoided by improving diet composition.

Conclusions

Lameness in broilers can be reduced by slowing down the speed at which they grow during their first few weeks, and speeding it up once their bones have developed. By using a new combination of diets and a sequential feeding method, the researchers discovered that they could slow down growth during a chick's early stages without any reduction in final carcass weight. The researchers recommend a 48-hour feeding cycle with two diets instead of the traditional continuous distribution of a single diet. For the first seven days of life, broiler chicks should be fed a standard starter diet. Then, from day 8 to day 28 the birds should be fed a low energy-high protein diet (E-P+) on the first day and a high energy-low protein diet (E+P-) on the second day. During this period the two diets should rotate every 48 hours. That makes for a total of 10 cycles of E-P+, E+P-. The birds should then be given a standard finishing diet from day 29 onwards.

In short, this novel regime not only reduced instances of lameness but also brought the broilers up to standard slaughter weight without the need any additional feeding days. The researchers are still analyzing the exact price differences between the broiler standard diet and the sequential diet, but initial results suggest that the sequential diet was never more expensive than the standard diet.

This sequential feeding method could improve the birds' welfare by reducing lameness at no extra cost while safeguarding the farmers' profits at the same time.

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Lameness in dairy cattle

Scientific background and work done outside Welfare Quality

Lameness in dairy cattle is an important and increasing problem in the modern dairy industry. Actual levels of clinical lameness show a very large variability across farms, for example, they range between 5 and 70 cases / 100 cows per year in the United Kingdom (Green et al., 2003). Several scoring systems have been developed to assess the severity of lameness (Manson and Leavar, 1988; Sprecher et al., 1997).

Lameness compromises the animals' welfare by causing long-term pain and impairing their normal behaviour.. In addition, it can results in significant economic losses. For example, Green et al. (2003) found that in clinically lame cows, milk yield was reduced up to 4 months before a case was diagnosed and treated and for the 5 months after treatment; (the total mean estimated reduction in milk yield per 305-d lactation was about 360 Kg). In England, mastitis and lameness were the main health problems in dairy herds and they accounted for 38 and 27% of the total illness-related financial cost, respectively (Kossaibati and Esslemont, 1997).

Diseases of the claw (hoof) account for about 90% of all lameness incidents (Weaver 2000). Most claw disorders are only noticed when the locomotion of the animals is seen to be compromised but the affected, cows may have already suffered the claw disorder for some time before locomotion disturbances became apparent.

Lameness is a multifactorial condition resulting from an interaction between several factors (Clarkson et al., 1993). Floor type is one of the most critical factors and, in particular, concrete floors have a number of features (such as hardness, abrasiveness and slipperiness) that can increase the risk of lameness (Telezhenko and Bergsten, 2005). For example, Somers et al. (2003) found that over 80% of cows housed on concrete flooring had at least one claw disorder at the time of observation, whereas this percentage was reduced to between 55 – 60% in straw yards. In addition, the provision of yielding rubber mats has a positive effect on locomotion in both lame and non-lame cows (Telezhenko and Bergsten, 2005).

The risk of lameness is also sensitive to the amount and type of concentrate feed given to the animals (Manson and Leaver, 1988; Kelly and Leaver, 1990). For example, the incidence of lameness was lower in cows receiving 7 Kg rather than 11 Kg. of concentrate (Manson and Leaver, 1988). These findings strongly suggest that dietary manipulations can be effective remedial measures.

Low ranking cows spend less time lying and more time standing still than high-ranking cows and this may in turn lead to an increased risk of lameness (Galindo et al., 2000). Overcrowding may also exacerbate the risk of claw lesions (Leonard et al., 1996). However, despite the above evidence little is known about how the different factors interact with each other (Waiblinger et al., 2001).

To prevent the evolution of claw disorders from the subclinical to the clinical stage, the management practice of hoof trimming is applied routinely. It has been shown empirically that both subclinical and clinical claw disorders occur less frequently when the feet are trimmed 2-3 times a year and that those cases of lameness that still occur are less severe (van der Tol et al., 2004). However, the precise mechanisms underlying the positive effects of hoof trimming remain unclear. Van der Tol et al. (2004) showed that hoof trimming results in a significant increase in the weight-bearing contact area and, therefore, in a decrease in average pressure. However, maximum pressures on the hoof remain unaltered after trimming and these authors suggested that the main focus of hoof trimming should be that the strongest part of the hoof capsule (i.e., the wall) will be subjected to the highest pressure.

Training farmers to recognise early cases of lameness and to immediately request veterinary inspection and appropriate treatment(s) result in a marked reduction in the duration of lameness (Clarkson et al., 1996).

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Neonatal mortality in pigs

Scientific background and work done outside Welfare Quality

Pigs show a high prevalence of neonatal mortality. Data from the UK indicates that 11.85% of all live-born pigs die within the 72h post-parturition period (Meat and Livestock Commission, 2006). Besides constituting an important economic problem, piglet mortality is also becoming an increasingly significant welfare concern.

Neonatal mortality in pigs is a complex multi-factorial problem, which involves elements related to piglet health status and behaviour, the behaviour of the sow and the characteristics of the physical environment (Baxter et al., 2008). The most common event preceding live-born death is crushing or overlying by the sow. Thus, the traditional approach to preventing neonatal mortality in pigs has been the implementation of a farrowing crate which reduces the likelihood of crushing by restricting the movement of the sow. Various studies have confirmed the efficacy of such sow restraint systems in reducing crushing (Edwards and Fraser, 1997). However, confinement at the time around parturition seems to be a very stressful experience for the sow. Levels of distress may be particularly high for sows that have been used to being loose-housed during gestation, a practice that will become mandatory for all farms in the EU in 2013. In addition, the use of farrowing crates might compromise some aspects of maternal behaviour that could promote offspring survival (Baxter et al., 2008). In any case, public concerns regarding animal welfare may limit the use of restraint systems in the future, thereby highlighting the pressing need to develop alternative welfare-friendly strategies for preventing crushing (Edwards, 2002).

Although crushing is often viewed as the ultimate cause of most piglet mortality, it may be just the end of a chain of events that could start even before parturition. In fact, current research on neonatal mortality in pigs is no longer strongly focussed on environmental factors but rather on the biological characteristics of both the piglet and the sow.

It has been proposed that perinatal mortality in pigs could be a species-specific evolutionary strategy to select the most viable offspring and to reduce maternal investment. The fact that perinatal mortality is more prevalent in large litters gives some support to this hypothesis (Andersen et al., 2005). Thus, artificial selection over numerous generations for highly productive large size litters may have exarcebatedexacerbated a pre-existing biological trait in pigs. A logical extension of this presumed adaptive function would lead to the prediction that less competitive piglets and sows showing less active maternal behaviour would be more frequently linked to episodes of crushing; this actually seems to be the case.

The piglet's level of development and physical condition at birth has a major impact on survival. According to recent data, stillborn mortality is correlated with having a reduced body weight and, more precisely, with having a disproportionately long and thin body shape,abnormal shape proportions, as well as with being born late in the farrowing birth order (Baxter et al., 2008). Live-born mortality is also highly dependent on the vigorousness of the piglet, irrespective of its relation to body weight. Less active individuals face a higher risk of being crushed through a variety of interplaying factors. For example, it takes longer for them to locate the udder and to suck the colostrum, which in turn prevents themn from gaining additional weight and also increases the risk of hypothermia and starvation. Piglets experiencing hypothermia tend to seek closer contact with the sow, thus raising their chances of being crushed. Indeed, crushing is more prevalent in outdoor (colder conditions) than in indoor herds (Edwards, 2002). Moreover, less vigorous piglets show reduced mobility and attentiveness which may further increase the risk of crushing (Baxter et al., 2008). Both the lack of vigorousness and a poor physical condition of newborn piglets are correlated with some physiological traits, such as rectal temperature, and some laboratory measures, e.g. reduced plasma concentrations of urea, phosphor, calcium and a poorer index of in vitro cellular immune function (Tuchscherer et al., 2000). Encouragingly, many aspects of piglet survival are heritable and there is sufficient genetic variance to allow economically viable selection for welfare-friendly characteristics (Knol, 2002).

The influence of the sow on neonatal mortality is linked to three main factors: her body condition, the duration of parturition, and the quality of maternal behaviour.

The general body condition of the sow during pregnancy and lactation could have a major impact on the piglet's viability, particularly in situations where the initial mortality rate is high. In farms that are already well managed the influence of nutrition on piglet mortality seems mainly linked to some specific nutrients, as well as to the extent to which the nutrients are transferred to the piglet. Recently attention has been focused on certain nutrients, like long chain essential fatty acids, that could affect neural development and consequently the vigorousness of the piglet (Edwards, 2002). Also, a recent study points out that fetal survival partially depends on some anatomic characteristics and the quality of the placenta (Baxter et al., 2008).

A prolonged parturition increases the risk of intra-partum hypoxia, which greatly influences the latency to suck and subsequent survival (Edwards, 2002). Besides genetic influences, exposure to acute stressors, including fear of humans, could cause disturbance and increase the duration of parturition. Thus, refining management procedures, particularly around the time of parturition, may help to reduce newborn mortality.

Although crushing by the sow has been historically understood as a passive and involuntary phenomenon due to constraints in the physical environment, recent data indicates that crushing is related to mothering style (Andersen et al., 2005). Sows that tend not to crush any of their piglets show a more protective maternal attitude, including more nest-building activity, more active contacts with the piglets and a shorter response latency to stress calls (Andersen, 2005). Interestingly, these and other aspects of maternal behaviour in the sow vary between genotypes and are therefore sensitive to genetic selection (Edwards, 2002).

Practical measures to reduce neonatal mortality have been centred around alteration of the farrowing environment based on the different causes of piglet death. Crushing is the most common and ultimate event preceding live-born death, although hypothermia and starvation are often underlying and important factors resulting in the piglet mortalitybeing more susceptible (Edwards 2002). Logically thenThus, implementing strategies to reducethat target hypothermia and starvation should decrease mortality. From the moment the piglet is born and exitsmakes the transition from the intrauterine and thermoneutral intrauterine environment to the extrauterine oneenvironment, it is exposed to a 15-20˚C drop suffering from the reduction ofin temperature (approximately a 15-20˚C drop – Herpin et al.,. 2002). Providing additional heat sources at the birth site during farrowing can decrease mortality. For instance, Morrison et al. (1983) improved survival by providing the provision of heat lamps at the site of farrowing can improve survival, a method that can be implemented when the sow is restrained in a crate (Morrison et al., 1983). However, farrowing sows in loose-housed accommodation requires different methods ofto providinge thermal comfort. It was recently shown ; Malmkvist et al. (2006) showed that using under-floor heating at the time of farrowing improved piglet survival; (Malmkvist et al., 2006). pProviding deep-straw bedding (a common practice in outdoor systems) can also help by slowing heat loss and thereby creatinge a more suitable microclimate; indeed as it slows heat loss, havingthe thermal resistance of such bedding is 11 and 22 times greater than that of concrete slats and 22 times greater than solid, wet concrete flooring, respectively (Wathes & Whittemore 2006). Additional management strategies designed to decrease mortality include supervision and intervention at the time of farrowing to assist the birth process and therebyfore limit the incidence of stillbirths and to help weak piglets find the teat and suckle colostrum (White et al. 1996).

Concluding remarks

- Piglet neonatal mortality is a highly prevalent problem in intensive pig production systems.

- Crushing is by far the main cause of mortality in newborn piglets.

- Traditional restraint systems will be phased out in the near future and should be replaced by alternative systems / strategies that are more sensitive to animal welfare issues.

- The risks of hypothermia, stillbirths, and starvation can be reduced by providing heat lamps or deep-straw bedding at farrowing; assisted birth, and guiding weak piglets to the teat.

- Current scientific knowledge indicates that the causes of crushing are diverse and that they include genetic, nutritional and management related factors. However, there is a pressing need for more fundamental research to fully elucidate the precise roles of all these factors and consequently to develop effective and economically viable intervention strategies.

- Future management intended to eliminate or at least reduce the risk of crushing may involve multi-faceted strategies combining genetic selection, changes in nutrition and the refinement of management procedures.

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Welfare Quality work

Objectives

- To identify genotypes that vary in relation to piglet survival and to investigate the effects of these lines, under differing environmental conditions, on maternal and piglet characteristics that relate to piglet survival
- To collate information on management and other farm factors that affect pre-weaning mortality from epidemiological study and the existing literature.
- To produce an information pack, including a prototype decision support tool, for increasing piglet survival.

Material and methods, results and conclusions

Social stress

Scientific background and work done outside Welfare Quality

Social stress caused by aggressive interactions or competition for resources such as food or lying space can be a major cause of poor welfare in many species and housing systems (D'Eath, 2002). Besides the deleterious effects of stress itself, aggressive interactions can cause injury, pain and death (Edwards, 1998). They can also increase the incidence of disease, such as lameness in cows (Phillips, 2002). Furthermore, competition for food can disrupt the normal feeding pattern of subordinate animals and, in turn, reduce food intake and increase the risk of metabolic disturbances, such as rumenal acidosis in cattle (Albright, 1993; Phillips and Rind, 2002). All these consequences of social stress are important not only on welfare grounds, but also because they can reduce production and product quality, and therefore economic revenue (Edwards, 1998; D'Eath, 2002). In the case of pigs, social stress will become even more important as a consequence of EU legislation banning the individual housing of pregnant sows. Indeed, aggression and competition between animals is considered one of the main welfare problems in group-housed sows (SVC, 1997; Edwards, 1998).

Social stress can be reduced via two different approaches: firstly genetic selection aimed at decreasing aggressiveness in animals (van Oortmerssen and Bakker, 1981; Cairns, 1983), and secondly changes in housing conditions and feeding systems designed to reduce the need or motivation for animals to behave aggressively or to compete with each other for resources (Roberts et al., 1993).

Social stress in cattle

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Cattle are social animals that would naturally live in groups. Social interactions among individuals within a group, such as dominance-subordinance relationships, allow a social organization that improves success and fitness of the group. Such social organization is called social hierarchy or rank order. However, this social order is established through aggressions and allows priority of access to resources for those animals situated higher in the social hierarchy in detriment of lower rank counterparts (Wierenga, 1990). Therefore, this may cause social stress in certain situations. One individual is dominant over another when the outcome of agonistic interactions consistently favours the former (Drews, 1993). Many physical (e.g. body weight and size, health) or psychological (e.g. age or experience) characteristics of the animals are more or less closely related to social rank (Wierenga, 1990; Phillips and Rind, 2002). Agonistic interactions (aggressions) may or may not involve physical contact (Miller and Wood-Gush, 1991). Threatening and avoidance behaviours do not lead to injuries or physical damage as opposed to aggressions with physical contact, however both may cause social stress. For instance, cortisol concentration in a subordinate pig increases when confronted to a dominant one even in the absence of physical contact (Dantzer and Mormède, 1983). The social environment has therefore a profound effect on the behaviour of animals living as a group where competition for resources such as feed, water, shade, and space may lead to marked effects on several behaviours of cattle such as feeding (Friend et al., 1977), resting (Fisher et al., 1997; Galindo et al., 2000), drinking (Andersson et al., 1984), and spatial distribution (Manson and Appleby, 1990). Furthermore, social dominance mandates that subordinate cows spend less time resting when lying space is limited. This may increase the occurrence of lameness in such animals leading to another welfare problem added to the social stress (Galindo et al., 2000). Similar principle may occur when feeding space is limited and feeding behaviour is altered due to a stressful social environment. Health problems associated to digestive disorders such as ruminal acidosis, left displaced abomasum, laminitis, or liver abscesses may appear under such situations although this hypothesis has not previously been tested (Cameron et al., 1998; Nagaraja and Chengappa, 1998; Shaver, 2002; Cook et al., 2004; Stone, 2004; Krause and Oetzel, 2006).

Based on the definition of stress given by Broom and Kirkden (2004), social stress occurs when the social environment overtaxes the control mechanisms or reduces fitness of an individual or the entire group. Under this scenario, animals fail to cope with the social environment and their welfare is reduced. However, such stress reactions depend of the situation, success, experiences and individual coping pattern. There are several physiological and behavioural indicators of the degree of stress suffered by animals as a result of failure to cope with the environment. Production (e.g. growth rate or milk production) is an easily measureable indicator of stress in cattle although animals may show acceptable production levels even under severe psychological stress. Cortisol concentration, or its metabolites, is the main hormone used to indicate the degree of activation of the hypothalamic-pituitary-adrenal axis due to stress and welfare conditions (Mormède et al., 2007). Acute phase proteins in blood such as haptoglobin increase in response to inflammation and tissue trauma or bacterial infection (e.g. castration and digestive disorders), but also in response to the social stress of weaning (Hickey et al., 2003) and transportation and commingling of cattle (Arthington et al., 2003). Finally, changes in behaviour seem to be one the most sensible indicators of animal well-being (Gonyou, 1994) and feeding behaviour has been proposed as a good indicator of social constraints (Nielsen, 1999).

Several frequent situations occurring in the livestock industry may lead to social stress such as management practices and environmental conditions. Commingling of unacquainted animals and weaning the young from the mother are examples of management practices that may cause social stress. Similarly, environmental conditions causing social stress may be the result of inappropriate design of the facilities that lead to overcrowding and excessive competition for resources. In this case, some animals may not be able to satisfy their needs in a timely fashion which leads to frustration and aggressive behaviour. Therefore, animals should be provided with sufficient space allowance (and quantity) to access resources such as feed, resting space, shade or water. However, sufficient space should also be provided for animals to perform escape or avoidance behaviours and maintain individual space requirements, which should reduce fear and aggressions received by subordinate animals (Manson and Appleby, 1990).

Commingling of unacquainted animals is a very frequent management practice in livestock farms. For beef cattle, the most frequent time of mixing of unfamiliar animals occurs at the time of marketing. For dairy cattle, the most frequent time of social stress is likely to occur after parturition and introduction to the milking herd but also after dry-off and relocation into the breeding herd. The situation is critical for both, marketed beef cattle and post-partum dairy cows, because several stressing factors converge at the same time in addition to social mixing. For instance, both groups are likely to suffer physiological stress either due to long-transport time or abrupt hormonal/metabolic changes, as well as introduction to a new diet, facilities and management.

Unfortunately, both are also likely to suffer social stress throughout the establishment of the new social hierarchy. This results in reduced feed intake and production, and increased disease and mortality rates during these periods. Moreover, the situation could be further complicated if competition for feed is high due limited feeding space, or those characteristics related to dominance rank (e.g. body size and age) differ markedly among pen mates. Typical examples of the later case occur upon introduction of post-partum primiparous dairy heifers to the milking herd with older, more experienced and bigger cows. They are likely to suffer social stress due to their lower position in the social hierarchy (Wierenga, 1990; Grant and Albright, 1995). Nevertheless, regrouping or relocation of animals at later stages of the production cycle is usually carried out by both beef and dairy farmers to deal with more homogeneous groups. This facilitates management tasks such as feeding of balanced diets according to production level, reproductive medical programs, or marketing programs.

Grouping of unfamiliar animals may affect all aspects of behaviour, decrease feed intake, body weight, growth rate, and milk yield; increase aggression, disturb the social hierarchy, change the dominance rank of individuals, and distress animals (Bøe and Færevik, 2003; Hasegawa et al., 1997; Gupta et al., 2005). Great amounts of agonistic behaviour with physical contact (e.g. fights and butts) occur during the first days after mixing. However, if the establishment of the social hierarchy is successful then agonistic interactions with physical contact should rapidly decrease while interactions without physical contact increase until the group reaches a social stabilization (Tennessen et al., 1985; Kondo and Hurnick, 1990; Raussi et al., 2005). The faster this process occurs the lesser social stress is likely to be suffered by the animals. Contrarily, if social stabilization is delayed or not reached due to an inappropriate environment then aggressions continue and social stress arises.

Excessive competition for resources may eventually cause social stress because the effects of social dominance are accentuated. For example, reduction of feeding space increases competition for feed which increases aggressions and displacements among animals at the feeders. Animals respond with shorter time spent feeding per day and faster eating rate (Nielsen, 1999). These changes are directly correlated to the amount of competition for feed. Subordinate animals show the greatest effects on those feeding characteristics, are more often displaced from the feeders, shift feeding patterns towards the nighttimes to avoid aggressions, choose to eat apart from dominants, and spend longer waiting times around feeders to access the feed (McPhee et al., 1964; Harb et al., 1985; Ketelaar-de Lauwere et al., 1996; Olofsson, 1999; Hasegawa et al., 1997). Increasing competition strengthens the relationship between social rank (or body weight) and feeding characteristics or feed intake (Friend et al., 1977; Collis, 1980; Harb et al., 1985; Olofsson, 1999; Katainen et al., 2005).

Grouping animals of different body size or age also accentuates the effects of dominance on behaviour and production and, consequently, on social well-being. For instance, heifers housed isolated from older cows in a freestall cubicle system had 10-15% longer daily feeding time, 0.5 to 2 more visits to the feeders, and 18% greater feed intake compared to heifers housed with older cows (Konggard and Krohn, 1978). However, Phillips and Rind (2001) reported that primiparous kept separately from multiparous cows under grazing conditions had the same milk production but were involved in less aggressive interactions and spent less daily standing time compared to those kept together with multiparous. In another study, separating dominants from subordinates has also improved performance in both groups of grazing cows offered hay as a supplement (Phillips and Rind, 2002). Similarly, lighter and younger calves showed lower growth rate when grouped together with heavier calves than in homogeneous light-weight groups (Hindhede et al., 1999). Therefore, separating first parturition heifers from older cows may reduce the social stress suffered, particularly under intensive production systems where the competition for resources is usually greater.

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Social stress in pigs may be caused by mixing of unfamiliar animals, insufficient space allowance or insufficient feeding space.

Mixing of unfamiliar animals (often with a change of physical environment) is a common practice in pig husbandry and happens commonly at weaning and at the beginning of the growing-finishing period. Mixing of unacquainted pigs has adverse effects on welfare and production, mainly because pigs fight with each other in order to establish dominance relationships, most aggressive interactions being typically shown during the first few hours after grouping (Meese and Ewank, 1972).

The frequency, duration and intensity of aggression interactions after mixing varies depending on a several variables, such as enrichment of the environment, whether food is provided as libitum or restricted and time of day when pigs are mixed. Weaned pigs offered tyres and chain devices within the pen displayed a reduction in the frequency of aggressions (Simonsen, 1990). Barnett et al. (1994) found that offering food ad libitum and regrouping after sunset reduced the number of aggressive interactions among the group.

In order to reduce the amount of aggression at mixing the use of tranquillizing drugs has been widely advocated for many years. Although they effectively reduce aggression among grouped pigs, their effect is limited over time and they cannot avoid a rise of the frequency of agonistic interactions to develop the social hierarchy at the end of the drug effect (Gonyou et al., 1998). Pheromones from pigs can modulate aggressive behaviour after regrouping (McGlone et al., 1987; Guy et al., 2009).

It has also been shown that socialised piglets (piglets that have been mixed with piglets from another litter before weaning) learn social skills that allow them to more rapidly form stable hierarchies when regrouped after weaning (Eath, 2005). Group size may also have an effect on how pigs react to being mixed with unacquainted individuals, as described previously.

Although some studies have found a negative effect of social mixing on production parameters (e.g. Stookey and Gonyou, 1994), others have failed to do so (e.g. Coutellier et al., 2007). As stressors have an additive effect (Hyun et al., 1998), it is likely that social mixing will have a greater effect when combined with other stressors. This is probably the case at weaning, when piglets are subjected to nutritional, environmental and psychological stressors (including regrouping) that are imposed simultaneously (Pluske et al., 1995) and, as a result, piglets usually show a period of reduced feed intake that may have long-lasting effects on performance (Pollmann, 1993).

Space allowance is important from both an economic and animal welfare standpoint. Several studies have reported a decrease in feed intake caused by reduced floor space allowance (e.g. Randolph et al., 1981; Kornegay and Notter, 1984; Kornegay et al., 1993). Other studies have failed to find such an effect, although decreasing space allowance caused a reduction in growth rate (Hyun et al., 1998). In general, individual pig productivity decreases as space allowance is reduced, signifying a welfare concern, but production per unit area may increase (Edwards et al., 1988).

The most common means to express space allowance is as space per animal, but this has the limitation that space requirements increase with body weight. A second option is to express space allowance as weight density (i.e. kg/m^2), but space requirements are not directly proportional to body weight. A third means is to use an allometric approach in which $A = k\ BW^{0.667}$ where A is floor space allowance and k is a space allowance coefficient (Petherick, 1983, Baxter, 1984). The allometric expression can be applied over a wide range of weights (Gonyou et al., 2006) and has been supported by several studies (e.g. Hurnik and Lewis, 1991).

Petherick and Baxter (1981) estimated k values for sternally recumbent pigs (k = 0.019) and for lateral recumbent lying pigs (k = 0.047). By applying these k values in the equation above it can be calculated how much physical space a pig needs for each posture at a given body weight. The actual space needed is dependent on how many pigs want to lie down at any given time and on the posture the pigs adopt when lying. Lying posture is to a large extent determined by air temperature (Petherick, 1983): at high temperatures, pigs will try to lose body weight by increasing the contact area between the body and the floor and therefore lateral lying will be preferred (Ducreaux et al., 2002).

Ekkel et al. (2003) addressed the issue of huddling or space sharing and number of pigs lying at any given time. Their results showed that pigs of all weight categories lie down for a great part of the day, but spend little time in contact with conspecifics. This seems to confirm Petherick's suggestion that at thermoneutral conditions the floor area occupied by lying pigs fits the allometric equation with a k value of 0.033 (Petherick, 1983). This, however, does not take into account the extra space needed for activity. On average, over the day, 10-20 % of pigs are active at any one time (Ekkel et al., 2003). Although how much space an active pig needs has not been assessed, it is reasonable to assume that for any activity such as exploration, walking to the dunging area or feeder or for social interaction, pigs require an amount of space equivalent to a k value of 0.038 (EFSA, 2005). Taking all these considerations together, it can be suggested that overall k value would be 0.8 x 0.033 + 0.2 x 0.038 = 0.034. In order to take into account the additional space required for a separate dunging area, the European Food Safety Authority has recommended a final k value of 0.036 (EFSA, 2005). Interestingly, minimum space allowances in the European Union are significantly lower and approximate k values of 0.028 for grower-finisher pigs (European Community, 2001).

After reviewing more than 10 published peer-reviewed studies on the effect of space allowance on average daily gain, Gonyou et al. (2006) concluded that the critical k value, below which a decrease in average daily gain occurred, varied from 0.0317 to 0.0348. Thus, empirical evidence seems to support theoretical considerations on space requirements.

Several factors (including group size, type of floor, health status and temperature) may modify space requirements. It has been suggested that pigs in large groups may need less space per animal than in small groups due to the sharing of free space (McGlone and Newby, 1994). Although some studies provide support for this hypothesis (e.g.

Wolter et al., 2000), others have not found any difference in response to crowding between large and small groups (Street and Gonyou, 2005).

Some codes of practice recommend an increase in space allowance if pigs are on partially rather than on fully slatted floors (e.g. AAFC, 1993). Gonyou et al. (2006) did not find any difference between the two types of floor. However, this study did find a greater slope for the growth and intake responses in the crowded range of the data for pigs on partially slatted floors compared with pigs on fully slatted floors. This would suggest that, although space requirements are similar on both types of floor, the effects of crowding are more severe on partially slatted floors.

When pigs are likely to be challenged by disease, space allowance needs to be increased if feed intake and performance are to be maintained. The benefits of increasing space allowance and the penalties of decreasing it are greater if certain diseases are present (Whittemore, 1993). The effect of ambient temperature on lying posture and thus space requirements has already been explained.

Feeding space requirement

In addition to the cross sectional profile of a feeder, modelled in the work of Baxter (1989), the lateral feeding space required by a pig can also be calculated mathematically. When groups of pigs are restrict-fed in discrete meals, they must be allowed at least a body width of trough space for all to be able to eat simultaneously. This body width can be related to liveweight using allometry. The width of a pig at the shoulders can be defined as:

$W = 0.064 \times \text{liveweight}^{0.33}$ (Petherick, 1983)

and this defines the minimum necessary feeding space. When pigs are fed from circular feeders, the trough circumference for one pig feeding place can be less than the linear shoulder width, since the radial effect means that only a head width is required. This makes circular feeders theoretically more space efficient for a given number of feeding places, although this has not been rigorously tested.

However, the provision of the minimum trough length for restrict-fed pigs does not ensure that all animals will access adequate feed. Baxter (1983) recorded the behaviour of pigs when feeding at a trough space allowance 9% greater than shoulder width. He found that all pigs fed simultaneously for only 24% of the feeding time, as a result of aggression at the trough. A pig withdrew from feeding because of aggression on average every 2 minutes throughout the feeding period. This aggression was initiated by feeding pigs, often socially subordinate animals, whilst defending their position at the trough rather than by pigs trying to gain access. Such aggression could be markedly reduced, and the simultaneous utilisation of trough space improved, by the inclusion of trough dividers. Head barriers reduced aggression by 60%, and head and shoulder barriers by almost 100%, with associated reduction in feed wastage (Baxter, 1989).

Where pigs are fed ad libitum, the calculation of necessary feeding space for a group is a more complex issue, since the possibility of feed space sharing over time exists. In the wild, pigs need to forage for much of the day to obtain sufficient food. However, when given more concentrated feed under farm conditions, the time required to locate food is minimal, and the time required to ingest the daily feed requirement is relatively small. Thus pigs spend only 60-80 minutes per day in ingestive behaviour (de Haer and de Vries, 1983; Hyun et al., 1997; Bruininx et al., 2001). These data would suggest that 18-24 pigs could share a feeding place if trough space was used with perfect efficiency throughout the 24 hour period. Such efficiency would seem unlikely, since pigs show both diurnal patterns of feeding behaviour and also social facilitation of feed intake. In unconstrained situations, pigs generally show a bimodal distribution of feeding bouts, analogous to behaviour in the wild, with peaks at the beginning and end of the light period (de Haer and Merks, 1992; Nielsen et al., 1995; Hyun et al., 1997; O'Connell et al., 2002), and feed relatively little over the night period. They also show social facilitation, such that feeding activity by one pig promotes initiation of the behaviour by others and results in group synchrony of behaviour and increased competition a peak times (Hsia and Wood-Gush, 1983, 1984).

Despite these apparent contrary influences, it has been found in practice that high feeder utilisation rates are possible in some situations, with no detrimental effects on performance being seen when 18, 20 or even 30 finishing pigs have been required to share a feeding space (Walker and Overton, 1989; Walker, 1991; Nielsen et al., 1995; Spoolder et al., 1999), despite increased levels of queuing and aggression at the feeder. This is because pigs show great flexibility in feeding behaviour. Feeding rate depends on the age of the pig and the form of the food, being fastest with liquid food, intermediate for pellets, and slowest for meal (Gonyou and Lou, 2000). It is therefore rather surprising that a study of fattening pigs fed via sensor-controlled liquid feeding showed detrimental effects on growth rate as the number of pigs per feeding place increased from 4 to 7 to 13 (Rasmussen et al., 2006). This might be explained by the fact that feed availability was not truly ad libitum, since feed was available on demand only in 5 pre-defined 80-minute feeding periods spaced throughout the day.

Pigs are able to show adaptive changes in feeding behaviour and feeding rate when social constraints on feeding time are increased. In comparison with individually-housed pigs, group-housed pigs eat fewer meals per day of longer duration (de Haer and Merks, 1992; de Haer and de Vries, 1993). When social pressure is increased, either by increasing group size (Nielsen et al., 1995), reducing the number of feeding places (Nielsen et al., 1996; Gonyou and Lou, 2000), or increasing stocking density (Hyun et al., 1998), pigs show a further reduction in meals per day, increased feeding at night and an increase in eating rate in order to maintain feed intake. This flexibility makes it difficult to predict the feeding pressure at which performance will start to be adversely affected. Research suggests that productivity is maintained at feeder occupation rates of up to 80-90% of the 24 hour period (Walker, 1991; Gonyou and Lou, 2000), but the point at which such rates are reached will depend on feeder design, feed form, age of pig and possibly other social factors within the group. A safe recommendation would seem to be up to 12 growing/finishing pigs per feeding place with dry feed, and up to 20 with wet-and-dry feeders. Data for weaned piglets is less comprehensive, but lower feeding pressure would seem appropriate. However, in a series of trials with different numbers of individual feeding places for different group sizes, Lindemann et al. (1987) found no effect on feed intake or growth of weaned piglets over the range from 1 to 6 pigs per feeding space.

Where linear troughs, rather than feeders providing discrete feeding places with head protection, were used for ad libitum feeding, Turner et al. (2002) showed that a feed space allowance of 32.5 mm per pig reduced intake and growth in pigs of 40-56 kg liveweight when compared with an allowance of 42.5 mm per pig. This suggests that a pressure of more then 5 pigs per feeding place reduced performance. The contrast with the studies on single-space feeders summarised previously may reflect the earlier observation that two pigs would only eat simultaneously at a feeder space allowance that was almost double that required to accommodate their physical dimensions (McGlone et al., 1983). It was of interest to note that Turner et al. (2002) found no interaction between feeding space allowance and group size over the range from 20 to 80 pigs, suggesting that social facilitation effects at larger group sizes did not lead to a requirement for different feed space recommendations.

Wellock et al. ((2003) attempted to model the effects of changing feed space allowance on pig performance, taking account of changes with age in feed requirement and maximum feeding rate, and the effect of feed composition as described by water holding capacity. The model assumed that pigs do not avoid feeding immediately adjacent to one another, which may not in fact be the case with all designs of feeder. The model also sought to take account of the influence of other social stressors, as reviewed in the following sections, on food intake and performance by incorporating these relationships into a general growth simulation model. The conceptual equations developed to describe these relationships gave quantitative predictions which were in reasonable agreement with previous empirical studies on social stressors such as space allowance and group size, but it was not possible to compare the predictions for changing feed space allowance since no comprehensive previous published studies existed.

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Welfare Quality work-genetics of aggression in pigs

Introduction

Post-mixing aggression in commercial pig production is common, compromises welfare and profitability and cannot be significantly reduced by low-cost changes to the environment. A genetic component to individual aggressiveness has been described in pigs and other species. Selective breeding against aggressiveness ought to be possible if an easily measured indicator trait can be shown to be genetically associated with aggressive behaviour. However, selection aimed at reducing aggressive behaviour might also exert negative effects impacts if genetic correlations exist between aggressiveness and other characteristics, including practical (e.g. reduced handling ease) and/or ethical and welfare (e.g. reduced responsiveness or inactivity) traits. The objectives of the present study were: (1) to estimate the genetic contribution to individual aggressiveness and, through the analysis of genetic correlations, validate a method of predicting a pig's likely involvement in aggressive encounters based on a count of skin lesions (lesion score, LS) suffered following mixing, and (2) to investigate genetic correlations between aggressive behaviour and other traits.

Material and methods

In order to estimate the genetic contribution to individual aggressiveness and to validate a method of predicting involvement in aggressive encounters (based on LS scores), aggressive behaviour was recorded continuously for 24h after mixing and LS was recorded at 24h and 3 weeks post-mixing in 1663 pigs. In order to investigate genetic correlations between aggressive behaviour and other traits, pigs' behaviour during handling as well as their general activity were scored in the same population of 1660 pigs. Subjects were 895 purebred Yorkshire pigs and 765 Yorkshire x Landrace of both sexes. All were housed in partially slatted pens with straw bedding

Results

Two behavioural traits were found to have a moderate to high heritability similar to that of growth traits; these were the duration of involvement in reciprocal fighting (0.43±0.04) and the delivery of non-reciprocated aggression (NRA) (0.31±0.04). On the other hand, receipt of

NRA had a lower heritability (0.08±0.03). Genetic correlations (r_g) suggested that lesions to the anterior region of the body apparent 24h after mixing were associated with reciprocal fighting (r_g=0.67±0.04), receipt of NRA (r_g=0.70±0.11) and, to a lesser extent, delivery of NRA (r_g=0.31±0.06). Lesions to the centre and rear were associated primarily with receipt of NRA (r_g=0.80±0.05, 0.79±0.05). Pigs which engaged in reciprocal fighting delivered NRA to other animals (r_g=0.84±0.04) but rarely received NRA themselves (r_g= –0.41±0.14). A genetic merit index using lesions to the anterior, central and rear regions recorded at 24h post-mixing as separate traits should allow selection against animals that participate in reciprocal fighting and in NRA. Positive correlations between LS observed 24h and 3 weeks after mixing, especially for lesions to the centre and rear of the body, indicate that post-mixing lesions are predictive of those received under stable group conditions. Selective breeding for reduced post-mixing LS should have a long-term ameliorative effect on aggression-related injuries even after dominance relationships are initially established (e.g pigs will be generally less aggressive).

Inactivity was weakly heritable (h^2=0.06±0.02) and negatively associated with bullying (r_g=-0.28±0.17), suggesting that pigs selected for reduced aggression might also be slightly less active. A greater diversity of scores and a higher heritability (h^2=0.29±0.02) were found for the ease with which pigs entered a weigh crate than for the behaviour they showed in the crate (h^2=0.13±0.01) or on exit (h^2=0.11±0.01). The ease with which the pigs entered and exited the crate had low positive genetic correlations with aggressive behaviours (fighting and bullying, r_g between 0.08 and 0.25), although aggressive pigs were also more active during weighing (r_g -0.23 to -0.33).

Conclusions

Genetic selection for reduced aggression is feasible. Fighting and bullying post-mixing were moderately heritable, and skin lesion counts 24hrs after mixing could be used as a proxy trait. Because of the low genetic correlations, selection for reduced aggression is likely to have only a small negative impact on the ease of handling at weighing.

Welfare Quality work - social stress in intensively kept beef cattle

Material and methods

In order to improve our understanding of the influence of social stress in intensively housed fattening cattle, Welfare Qulaity® researchers studied the effects of increasing the number of heifers per concentrate feeding place on performance, behaviour, welfare indicators, and ruminal fermentation in feedlot heifers. Seventy-two Friesian heifers were used in a factorial arrangement with 3 treatments and 3 blocks of similar body weight (BW). The treatments consisted of 2 (T2), 4 (T4), and 8 (T8) heifers per feeding place in the concentrate feeder (8 heifers/pen). Measurements started after 4 wk of adaptation to these treatments. Concentrate and straw were offered separately at 08:30 and animals were fed ad libitum. During 6 periods of 28 d each, dry matter intake (DMI) and average daily gain (ADG) were measured, and blood and rumen samples were taken. The behaviour of the animals was also recorded.

Results

The variability in final BW between heifers sharing the same pen tended to rise and concentrate intake decreased linearly as competition increased. The proportions of abscessed livers increased quadratically with increased competition, being 8%, 4% and 20% in T2, T4 and T8 animals, respectively. The times spent eating concentrate decreased and eating rate increased linearly, whereas the variability between pen-mates in concentrate eating time was greatest in T4 and T8. Increasing competition also resulted in a linear decrease in the time spent lying. The number of displacements from the concentrate feeders among pen-mates, as well as the total sum of displacements, increased linearly with increasing competition. The pen-average faecal corticosterone level was not affected by treatment but the maximum pen concentrations rose quadratically, being greatest in T8, and dominant heifers were the most affected. Serum haptoglobin concentration increased linearly with competition, particularly in the most subordinate heifers. Increased competition reduced ruminal pH in some of the experimental periods and increased ruminal lactate.

Conclusions

Our observations of altered feeding behavior, reduced resting time, and increased aggression strongly suggest that increased competition at the feeding trough has detrimental effects on the animals' welfare. Moreover, ruminal lactate and blood haptoglobin levels indicate that the risk of rumen acidosis might also increase with competition. The fact that fewer abscessed livers were found when the competition for food was reduced shows that improved welfare can result in better product quality. In summary, the results suggest that increasing social pressure at the concentrate feeders beyond the threshold of 4 heifers per feeder has a negative effect on performance, health, product quality and animal welfare.

Welfare Quality
Science and society improving animal welfare

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