# Practical strategies for improving farm animal welfare: an information resource

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**Contents**

Chapter 2: Background and benefits of the viable welfare improvement strategies identified both outside and within the Welfare Quality® project.

- Minimising handling stress
- Genetic solutions to welfare problems
- Eliminating injurious behaviours
    - feather pecking and cannibalism in chickens
    - tail biting in pigs
- Reducing lameness
    - in broiler chickens
    - in dairy cattle
- Minimizing neonatal mortality in pigs
- Alleviating social stress
    - in beef cattle
    - in pigs

## Introduction

The present information resource is one of the outcomes of the work in Sub Project 3 (To define integrated, knowledge-based, practicable species-specific strategies to improve farm animal welfare) of the Welfare Quality® research project (www.welfarequality.net). 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 participated 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. These problem areas were identified in a joint exercise involving biologists, social scientists and citizens and they include handling stress, harmful traits in pigs and cattle, injurious behaviours (feather pecking and cannibalism in laying hens, and tail biting in pigs), lameness in broiler chickens and dairy cattle, neonatal mortality in pigs, and social stress in pigs and cattle. Their alleviation could greatly improve the quality of life for farm animals as well as often improving productivity and product quality and thereby generating economic benefits for the farmers.

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 resource is web-based, it is freely available and it is intended to enable farmers, advisors, researchers, policy and other stakeholder groups to easily identify practical strategies that can help to solve specific welfare problems or at least to minimize their occurrence or intensity. 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 some generic 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 that have been generated outside the Welfare Quality® project. Instructions for their possible application 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, reports, regulatory documents and other websites.

# Chapter 1

Welfare Quality® researchers drew together the views of consumers, industry representatives, biologists, social scientists and legislators to establish the following four Principles of Good Welfare which are considered essential to safeguard and improve the well-being of our farm animals: good feeding, good housing, good health and appropriate behaviour. Twelve clear criteria were also defined within the 4 principles (Botreau et al., 2007). The original principles and criteria have since been slightly updated and the most recent version is shown below. Collectively, they complement and extend the ´Five Freedoms` published by the Farm Animal Welfare Council in 1992 (FAWC, 1992). Herein, we describe each of the above criteria in terms of what problems might arise, what causes these problems and what might be done to prevent or alleviate them, with special relevance to cattle, pigs and poultry.

**Welfare Quality® Principles and Criteria of good farm animal welfare**

<u>Good feeding</u>

- 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 thirst, i.e. they should have a sufficient, accessible and potable water supply.

<u>Good housing</u>

- 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 therapeutic or preventative interventions; neonatal mortality in piglets included here). Animals should be free from 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. prolonged and damaging aggression, and positive aspects, e.g. social licking). Animals should be able to express normal, non-harmful and presumably positive social behaviours, e.g. foraging, 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 / stockpersons should promote good human-animal relationships.

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

## The 12 criteria, the causes of associated welfare problems and potential remedies

## Criterion 1: Absence of prolonged hunger

Introduction

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

Why is prolonged hunger a welfare problem?

- Both malnutrition and undernutrition cause the animal psychological and physiological 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 are also dealt with in the section on "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 or not permitted.

- 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 or providing unpalatable food, 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 always be sufficient to compensate for the strong production demands. This can lead to a severe loss of body weight and 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.

- Lameness can hamper access to feeders e.g. broilers

What strategies can be implemented to prevent prolonged hunger?

- 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 (see Chapter 2).

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

## Criterion 2: Absence of prolonged thirst

Why is prolonged thirst a welfare problem?

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

- Thirst also reduces food intake, which in turn may cause all the welfare problems that result from prolonged hunger (see Criterion 1).

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 and/or difficult to control 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 can cause thirst because the animals may refuse to drink even when offered water during the journey. This may reflect fear-induced inhibition of drinking, either due to the overall frightening effects of loading and transportation or to neophobia, e.g., fear of novel water containers or unfamiliar locations. It is also conceivable that the animals may fail to recognise water presented in such an unfamiliar context.

- Lameness can hamper access to waterers e.g. broilers

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.

- It may be necessary to "show" the water and water containers to the animals in novel situations, e.g. lairage, transportation.

## 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/other injuries 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 is likely to cause them physical and psychological 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 stockpersons and by improving the animals' housing facilities, particularly by providing more space, proper flooring, appropriate substrate, adequately-designed 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 that minimises stress, i.e. the thermal range in which animals are able to balance heat inputs and outputs. 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 age. They may also vary among different breeds of the same species. Even animals of the same breed may respond differentially to the ambient conditions 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, flooring and solar radiation. The relative importance of each of these variables may vary across species.

<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 the water supply is limited.

- Both heat and cold stress can cause the animal to suffer psychological distress.

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

- Cold stress is a particular hazard for newborn animals and, together with starvation, is a significant contributing factor to neonatal mortality, particularly in piglets and lambs. This will also 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 hot 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.

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

- Differences between breeds and between individuals within the same breed in their response to the thermal environment are partly genetically determined, e.g. large difference between *Bos taurus* and *Bos indicus*. Therefore, targeted genetic selection may increase the animals' resistance to heat and/or cold. A genetic approach should not however be used to compensate for poor housing or husbandry.

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

- Providing showers, and training the animals to use them, can also reduce the occurrence of heat stress, at least in pigs and dairy cows. Fans may also be used with or without misters for dairy cows.

- Adequate training of the stockpeople (to improve their understanding of problematic husbandry conditions and to enable them to detect the likelihood of thermal distress or its early stages) is important. It can also encourage the adoption of remedial measures.

## 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 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 may also prevent animals from moving normally, as is often evident in broiler chickens approaching slaughter age. However, this must be balanced by the contention that chickens often seek high density areas and that lameness is the main cause of restricted movement (Dawkins et al, 2004)

- 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.

- Injuries and disease can seriously limit the animals’ ease of movement.

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

What strategies can be implemented to enhance ease of movement?

- Ease of movement can be increased through improved husbandry, including, for example, by adopting an appropriate stocking density and by monitoring and safeguarding the animals´ physical health.

- In some circumstances, a change in the housing system may be necessary, e.g. away from farrowing crates and 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 in farrowing crates.

## Criterion 6: Absence of injuries other than those due to disease or voluntary interventions.

Why are injuries a welfare problem?

- 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 exert an additional 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. The presence of infectious, systemic diseases secondary to injuries as well as the debilitating effect of some injuries per se may result in the animals being culled with the attendant economic loss. High culling rates may also reflect an underlying welfare problem.

- 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 increase the risk of crushing.

What are the causes of injuries?

- Injuries may be caused by abuse or rough handling, the latter being particularly 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 wall, a fence or some other obstacle. Free-range 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 receive a sudden fright, e.g. by an overhead aircraft or predator, and become panicked.

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

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

- Tail-biting in pigs and feather pecking and cannibalism in laying hens are common causes of injuries. 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 percheries and aviaries. Laying hens develop osteoporosis because of their high turnover of calcium in producing eggshells and their relatively low activity; this means their bones are more likely to break, especially when they are removed from their cages or make crash-landings when attempting to jump from one perch to another.

- 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, particularly during harvesting.

- Changes in the design of housing facilities and improvements in their maintenance can reduce accidental injuries. For instance, the provision of perches may promote increased activity and reduce osteoporosis in hens although their placement, inter-perch distance, height and gradients are very important factors that must be taken into account. The provision of shelter in free range units might also reduce the occurrence of panic-related injuries at the pop holes. Care must be taken to ensure that there are no protrusions or sharp edges in the environment that could cause injury (to the animals and the stockperson).

- 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 might 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 (that is well maintained), and an appropriate stocking density will reduce the occurrence of hock burn, breast burn and breast blisters in broilers.

- Neonatal mortality in pigs may be reduced through improved husbandry as well as by appropriate 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, suffering and distress and interfere with the expression of normal behaviour. Chronic diseases may have a debilitating effect on the animal and could 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 spread of the disease.

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

- Transport poses major challenges to the animals because they 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 the many 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, pigs 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 micro-organism.

- 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.

What strategies can be implemented to prevent disease?

- Disease should be treated or prevented primarily by adequate veterinary care, herd/flock health plans and supervision of staff.

- Adequate (and 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 stockpersons and the use of climate-controlled vehicles such as the Transport 2000 concept. In pigs, genetic selection to eliminate the ´stress-susceptibility´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 hens; castration in pigs and less frequently in cattle; teeth clipping in pigs, and dehorning and disbudding in cattle.

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

<u>Why are management procedures that cause pain a welfare problem?</u>

- Pain is defined as an aversive emotional experience and is therefore a welfare problem per se. The above-mentioned mutilations and management procedures may cause pain and distress 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, with some evidence suggesting that they may feel more pain than adults.

- Both acute and chronic pain can hamper the expression of normal behaviours, such as feeding and social interaction, thereby resulting in associated welfare problems like hunger, social withdrawal etc.

- 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. For instance, chickens can sometimes avoid electrical stunning by raising their head above the water bath and therefore their necks are cut while they are still conscious. An issue of particular concern when animals are slaughtered using a reversible stunning method 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 thereby experience severe pain and fear.

<u>Why are management procedures that cause pain carried out?</u>

- 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. Furthermore, it causes chronic pain and hampers the animal´s ability to deter insects

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

<u>What strategies can be implemented to avoid management procedures that cause pain?</u>

- Improving stockmanship, care and husbandry is the single most effective way of avoiding unjustifiable  and painful management procedures, as well as a means 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 which is much less painful. Of course, the potential pain and distress of repeated handling and injection must also be taken into account.

- 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 prolnged, intense and damaging aggression, can cause fear, pain and distress. Fear and pain are aversive emotional states and are therefore welfare problems per se. Stress may harm body functioning by impairing immune function and reproductive performance, and by 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 can 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 established social groups, for example by the introduction of unfamiliar animals or the mixing of unacquainted animals, may lead to an excessive and damaging 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.

<u>What strategies can be implemented to prevent or minimise the expression of inappropriate social behaviour?</u>

- 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 as well as the expression of other undesirable behaviours.

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

<u>Why is the reduced expression of other normal behaviours a welfare problem?</u>

- 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.

- A restricted ability to perform normal behaviours (particularly foraging) may contribute to the development of stereotypies (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 individuals within a particular system.

- The inability to express certain behaviour patterns can 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.

- Facilities that restrict the animals´ movement may lead to the development of frustration, stereotypies and apathy.

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

<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.

- Increased space allowance may promote positive behaviours and minimise the expression of undesirable ones.

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

## Criterion 11: Good human-animal relationship (no or reduced 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 negative 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. For example, exposure to unfamiliar people or even to familiar ones wearing novel clothing can induce panic and its related injuries in poultry: trampling can cause bruising and claw-inflicted scratches while "piling up" can lead to suffocation of the birds at the bottom of the heap. 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 stockpersons which could in turn make them more fearful of humans through a lack of habituation.

- Fear has a strong 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 significantly reduce fear of humans and thereby improve the human-animal relationship. Visual contact alone can reduce fear and increase performance, particularly in poultry. Walking through or near the flock regularly not only reduces fear (through habituation / socialisation) but it also enables the stockperson to monitor the birds´ health and ensure that the resources (e.g. feeders, drinkers) are functioning properly.

## Criterion 12: Positive emotional state: avoiding negative emotional states such as anxiety, fear, distress, frustration and apathy, and promoting presumed positive ones like security, comfort and contentment.

Why are general fear, distress and frustration considered welfare problems?

- Fear is an aversive emotional state and is therefore a seriously damaging welfare problem per se. General fear is adaptive in ideal circumstances but it becomes a problem particularly when animals encounter new or unexpected stimuli, (e.g. a sudden noise or movement, an unfamiliar animal or object, a new food source), or novel situations, e.g. a new housing facility, transportation, and cannot show appropriate flight or avoidance responses without risk of injury. Anxiety, which might be defined as raised awareness of an imagined or unreal threat, can also be extremely damaging.

- Fear causes a stress response that, if prolonged, can cause economic losses by reducing 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 that deny the animals the opportunity to seek shelter or to escape from potentially threatening stimuli.

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

- Genetic selection could be used to develop less fearful breeds. In any breeding programme it is essential to ensure that selection for a beneficial trait (e.g. no feather pecking or tail biting, reduced fear) is not associated with the unconscious co-selection of undesirable characteristics (in terms of welfare or economics).

- 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.

- The provision of appropriate 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

The primary objective of Sub Project 3 (SP3) of the Welfare Quality® Project was to develop and test practical ways of improving the welfare of farmed animals (pigs, chickens and cattle), and it embraced both environmental and genetic approaches. The six main sections of Chapter 2 respectively reflect the aims of the six work packages (WP) in SP3. Each of these WPs addressed a key welfare issue perceived as important by farmers, retailers, academics, government, consumers and other stakeholders and they were:

WP 3.1. Minimizing handling stress: improving stockmanship;

WP 3.2. Genetic solutions to welfare problem: a) leg conformation and longevity in pigs, and b) psychobiological characteristics and adaptation in dairy cattle;

WP 3.3. Eliminating injurious behaviour: a) feather pecking and cannibalism in laying hens, and b) tail biting in pigs;

WP 3.4. Reducing lameness in a) broiler chickens and b) dairy cattle;

WP 3 .5. Minimising neonatal mortality in pigs;

WP 3.6 Alleviating social stress in a) pigs (genetics of aggression and dietary changes to reduce aggression in group-housed pregnant sows), and b) intensively kept beef cattle

Each of these sections is subdivided into two parts. The first part provides the scientific background by describing the main influential variables underpinning that particular issue, its welfare and economic consequences, and the advantages and disadvantages of the remedial measures that have been generated outside the Welfare Quality® project. The second part of each section focuses on the viable welfare improvement strategies that were identified in Sub Project 3. Before they could be considered viable these strategies / recommendations not only needed to satisfy welfare and economic requirements but they also had to be practicable, i.e. safe, affordable and easy to implement by the farmer and/or breeding company.

# WP 3.1: Minimising handling stress

## Scientific background and work done outside WQ

The term ”stockmanship” covers the way animals are handled, the quality of their daily management and health care, and how well problems other than disease are recognised and solved (Waiblinger 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 and education; they are often seen as the most important factor explaining how a person interacts with social objects, including animals (see summary and references in Waiblinger 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 (Hemsworth and Coleman, 1998; 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 is 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 inherently frightening, e.g. restraint, depopulation, veterinary treatment, while few, other than feeding, are positively reinforcing. It is worth bearing in mind that contact with humans could become even more stressful if increasing automation results in 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 and stress as well as 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 fear and distress (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 stockperson shouting, sneezing, slamming a door, dropping a bucket etc. The impact of sudden/novel noises may also be reduced if they are heard against a background of noises rather than silence. Whatever the underpinning mechanism, playing the radio is probably the easiest, most practicable way of enriching the environment for both the animals and the stockperson.

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, committed 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 stockpersons that have a direct effect on animal fear and welfare (Hemsworth, 2003). Educational and 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 stockpersons, and the potential influence of interactions between the effects of handling and housing systems (Hemsworth, 2003; Raussi, 2003).

## Work done in Welfare Quality®

### Overall Objectives

- To determine the variability in the farmers' and stockpersons´practices and their underlying motivations as well as their consequences on the behaviour of the animals
- To determine if: a) the presence of the dam during regular handling of the calf influenced its later response to humans; b) positive human contact in the dry period is more effective than during lactation in cattle; c) calm, quiet and gentle handling improves the learning speed of sows and the working environment of stockmen, and c) regular positive contact with humans during rearing reduces laying hens' fear of humans.
- To establish if hens' reactions to humans varied across flocks and to assess the likely importance of farmers´/stockpersons´ attitudes and behaviour.
- To determine whether regular positive contact with human beings reduced subsequent fear of humans in chickens.
- To assess the influence of farmers' attitudes and behaviour on pigs' reactions to humans.
- To determine if farmers had problems in moving pigs.
- To establish whether calm, gentle and quiet handling might improve both the human animal relationship and learning speeds in sows.
- To develop training materials for cattle, pigs and poultry stockpersons in Europe through close collaboration with Australian researchers

Welfare Quality® researchers carried out several studies in pursuit of these objectives which are briefly described below:

### Minimising handling stress: attitudes & behaviour of beef and dairy cattle farmers to human-animal contact and the human-cow relationship

### Methods

A questionnaire focusing on animal handling problems was mailed to 300 beef cattle farmers / breeders in France. This questionnaire covered the perceived ease of handling the cattle, the husbandry conditions, the farmers' attitudes towards cattle and their behaviour during husbandry and handling procedures. Some of these breeders were then visited and interviewed regarding husbandry and handling practices. Their calves' behaviour was also observed in a crush test (where the animals are restrained individually in a specific apparatus) in the presence of a human.

WQ researchers observed 61 transfers of beef bulls from commercial farms to a slaughter plant, (loading and unloading of 1,202 bulls from 108 farms). Questionnaires on farmers' attitudes towards bulls and to working with them were completed by 88 farmers. Plasma cortisol concentration and meat pH were also measured in 891 and 821 carcasses, respectively.

Dairy cattle husbandry was also examined in randomly chosen farms in Austria (300) and Italy (155). This effort also involved surveys of farmer attitudes and behaviour as well as direct assessment of the cows' reactions to humans in standardised tests (with or without prior handling) and of the stockpersons' behaviour when milking.

**Results and conclusions**

Both beef and dairy farmers emphasised the importance of good human contact (quality and frequency) and the quality of the facilities in increasing the ease of handling.

Twenty-eight per cent of farmers did not recognise genetic background as important in determining the ease of handling. This is particularly surprising since the temperament of heifers or cows was the first trait they considered in decisions on culling.

Farmers showed some negative behaviour (hitting, shouting) in certain situations but their attitudes towards such behaviours were independent of those towards animals.

Despite the relatively small sample the results confirm that calves were much calmer if the farmers enjoyed contact with their animals than if they had little interest in them.

The dam's behaviour affects the calves' responses to a gentle handling regime; the beneficial effects were only retained when the dam was docile.

Most dairy farmers agreed that calm, gentle and patient handling is important but nearly 20% of them felt that cows should be fearful of humans in order to make them easier to handle.

Dairy cows that had received positive human contact approached closer to an unfamiliar human at test. Calves reared outdoors, separated from the dam each day and gently handled during the first weeks of age were consistently and durably (up to 40 weeks) less fearful of humans than non-handled ones.

Beef bulls from farms where the farmers had positive attitudes towards them showed lower cortisol and better meat quality after transport. Paradoxically though, handling and loading beef bulls prior to transport was more difficult if they had received regular human contact. Loading beef bulls into the truck was easier on farms equipped with a corridor or a loading ramp, thus underlining the importance of using appropriate equipment. Unloading was easier when the journey was short and when the local temperature was high.

## Improving the relationship between humans and dairy cows: relevance of dry or lactating periods.

### Methods

Sixty Holstein Friesian were used: 15 dry and 15 lactating cows were positively handled for 3 minutes on each of 3 days per week for 4 weeks, whereas 15 dry and 15 lactating cows received no handling treatment and could neither see nor interact with the treated animals.

All the subjects were exposed to the approach of known and unknown persons (Waiblinger et al., 2003) both before gentle handling and at 1, 30 and 45 days after the handling treatment. In each case, the distance at which they first showed avoidance of the test person was recorded. Behaviour in the milking parlour was also recorded before and after the handling period.

### Results and conclusions

Handled cows came significantly closer to the known and unknown test person at each of the post-handling test periods (P=0.012, 0.005 and 0.018, respectively. In this respect, regular positive human contact during the dry period was more effective than during lactation. There were no detectable effects of the handling regime on the cows' behaviour at the milking parlour, milk production or average milking time.

## Poultry husbandry and laying hens responses to humans

### Objectives

- To establish if variations in hens' reactions to human beings were apparent across flocks and to assess the importance of farmers' attitudes and behaviour.
- To determine if regular positive contact with human beings (an experimenter) reduced subsequent fear of humans in chickens.

**Methods**

Data on chicken' relationships to humans, farming practices, farmers' attitudes (questionnaire), housing and farm characteristics were collected from 25 grower and 50 layer flocks (non-cage systems). Data on plumage condition and pecking injuries were also made available for analysis from another study. Birds' responses to an approaching person were also recorded in 6 flocks at 5 different farms.

**Results and conclusions**

It was confirmed that hens' reactions to humans varied markedly from flocks where no birds approached the experimenter to those in which the birds were easily touched by him/her.

The importance of positive farmer attitudes was established.

Previous suggestions that maintaining regular gentle and calm contact with the birds reduced their fear of humans and benefited welfare (Barnett et al., 1994; Jones, 1996; Hemsworth and Coleman, 1998) were confirmed.

Evidence suggests that regular human contact was associated with better plumage condition, (perhaps because of reduced feather pecking).

## Handling stress in pigs

**Objectives**

- To assess the influence of farmers' attitudes and behaviour on pigs' reactions to humans.
- To determine if farmers had problems in moving pigs.
- To establish whether calm, gentle and quiet handling might improve both the human animal relationship and learning speeds in sows.

These premises were tested in two studies:

**a) On-farm survey of pig husbandry**

**Methods**

A 9 page questionnaire was sent to 600 pig farmers. It included technical questions, but also sought responses to statements regarding farmer's 'attitude', 'behaviour' and 'empathy' towards pigs. Subsequently, 37 farms were visited and blood samples collected from the pigs. Whilst sampling, the behaviour of the animals and the farmer were observed. Additionally, the pigs´ reactions in a human approach test were observed at 27 of these farms.

**Results and conclusions**

Only limited variation in farmer practices towards their pigs were observed, but there was wide variation in the propensity of pigs to approach unknown humans.

Farmers did not have problems when moving piglets, but many admitted to not having supported pigs when lifting them by their hind legs, so the handling can be rather rough.

Pigs responded better to restraint and were calmer after release if the handlers had approached them in a quiet, unhurried manner.

Differences in dealing with handling problems, e.g, training gilts to use an electronic sow feeder) were apparent.

**b) Training pregnant sows to use a feeder station**

**Methods**

Eighteen groups of 4 naïve gilts were trained to use an electronic sow feeder (ESF) station using one of three training techniques:

Treatment 1 = minimal interaction (minimal involvement of the farmer other than supervision)

Treatment 2 = active physical encouragement by the farmer (physically driven to the feeder)

Treatment 3 = gentle vocal and 'soft-physical (hand on back) coaching (use of food a bait)

Three different stockmen trained 2 groups of gilts according to each method. The time taken for all 4 gilts to use the system without fail, the gilts' heart rate during training, the level of input required from the farmers (time and effort), and the quality of work as rated by the stockmen were all recorded.

**Results and conclusions**

- All the gilts reached (passed) the feeder at least once per day, including those receiving minimal intervention by the farmer, with an average time for all 4 pigs of 81 min
- Although no significant benefits of coaching were found there were no adverse effects of human intervention on the gilts' behaviour or heart rate.

## Developing a multi-media stockmanship training programme

**Methods**

This task combined and built on existing literature, the data and material (photographs, videos, technical reports etc) generated in related studies, and the team's collective experience of training to develop an effective multi-media training programme for stockpersons working with cattle, pigs and poultry. Inter-continental collaboration also married key expertise from Europe and Australia. First, the team defined its objectives (prepare a script, story board, visual aids etc), methodologies (e.g., literature review, questionnaires) and agreed on a common structure (even if some aspects varied across species). It was agreed that the training package should utilise cognitive-behavioural intervention techniques to specifically target those key attitudes and behaviours of stockpersons that are known to have a direct effect on farm animals' fear of humans.

**Results**

A "Quality Handling" programme (software, trainer´s manuals, newsletters etc) has been developed and tested in the various species. This programme describes;

- How animals' fear responses to humans vary between farms.
- How fear of humans can adversely affect productivity and ease of handling.
- How animals perceive their environment.
- How to build a positive human-animal relationship.
- How to improve the stockpersons' attitudes and behaviour towards the animals.
- How to maintain the above improvement when the stockpersons return to the farm after training.

**Conclusions / strategies**

- The “Quality Handling” training package will soon be commercially available for the cattle industry in English, French and German, and for the pig and laying hen industries in English and Dutch. Versions in other languages will be added as they become available. A link to Quality Handling will also be provided in this resource.

**General conclusions and strategies developed in WP 3.1**

- The variability found in farmers’ attitudes and behaviour in all study countries emphasises the importance of knowledge transfer and training courses.
- There is considerable scope for improving farmers’ attitudes and behaviour and thereby reducing handling stress in cattle, calves, pigs and poultry.
- A regime of regular positive human contact can markedly reduce animals’ fear of humans, improve their welfare and performance, and safeguard or increase profitability
- It should be possible to develop apply a practical “human contact regime” suitable for both small farms and large production systems.
- Findings like the ones reported above are key to motivating farmers to pursue a training programme aimed at improving the human-animal relationship.
- The “Quality handling” programme should soon be available on a commercial basis.

# WP 3.2: Genetic solutions to welfare problems

## Scientific background and work done outside WQ

Despite the use of sophisticated feeding and management regimes many farm animals still suffer from a range of behavioural and 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 enable 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; 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) that the individual adopts when challenged. Research in molecular and behavioural genetics is gradually 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, they 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 as well as safeguarding profitability.

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 the co-selection of several undesirable traits and 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 in its own right. Surprisingly, although 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.

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.

Some of the above welfare problems and potential remedial measures developed in the Welfare Quality® project are also described elsewhere (Jones and Manteca 2009a; b).

**Work done in Welfare Quality® (I) - Leg conformation and longevity in sows**

**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 productivity and reproduction traits.
- 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

**Methods**

Longevity data from 587 Duroc, 239 Landrace and 217 Large White sows were analyzed applying survival analysis techniques 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, , Landrace and Large White sows, with a higher hazard ratio (HR) for poorly-conformed sows than for well-conformed ones. Abnormal hoof growth reduced survivability in Duroc and Landrace sows, the presence of splayed feet or bumps and injuries increased the risk of culling in Duroc sows, and the incidence of straight pastern increased the HR in Large White sows. In all 3 breeds, longevity was reduced in plantigrade sows, with a higher HR in Duroc than in Landrace and Large White sows. Interestingly, teat conformation did not influence sow longevity. Estimates of heritability for longevity in Duroc sows ranged from 0.052 to 0.072 depending on the algorithm applied.

**Conclusions and recommendations**

- 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 leg conformation.

The results should help to guide decisions on the criteria used in future breeding programmes and thereby optimize the productive lives of gilts.

## Work done in Welfare Quality® (II) - Time budgets, psychobiological traits, adaptation and welfare in dairy cattle and calves

### Objectives

- To determine the welfare implications of the time budget (activity patterns).
- To establish phenotypic and genetic correlations between psychobiological characteristics and measures of on-farm welfare and production in dairy cows and calves.

### a) Time budgets

### Methods

Working closely with the breeding industry a protocol for recording measures of welfare (feeding, lying, walking, body condition etc) and production (milk yield, cell counts, reproduction, veterinary treatment) were established. The production scores were obtained from the National data base. Additionally, the use of a newly developed pedometer for on-farm measurement of activity patterns was validated. Data was collected from 10 commercial farms in Denmark. Eating was always observed in the first 3 hours after food delivery each morning. Each farmer gave a qualitative score of a number of characteristics (fearfulness, sociability etc) of the same cows on two occasions. A detailed description of the barn design was also taken at each farm.

### Results

Time budget traits were moderately heritable and highly repeatable over consecutive days in dairy cows. With higher milk yield, lying times decreased and the time spent standing increased. Shorter lying times were associated with poorer body condition.

### Conclusions and recommendations

- Selection for increased milk yield is likely to have been associated with a reduction in lying time, possibly because higher yielding cows need to spend longer standing and eating, at the expense of lying behaviour

- Continued selection for high milk yield may jeopardize cow welfare. This finding should be considered when breeding companies formulate future selection programmes.

**b) Psychobiological traits**

A protocol for recording behavioural and psychobiological characteristics in dairy cows and calves was established. Observations of adult dairy cows were carried out at a large testing facility of the Dutch breeding company Holland Genetics approximately 6-12 weeks after calving. These included: (i) the daily activity pattern (time budget) on four consecutive days, and (ii) responses to a human approach test, performed twice with a one-day interval between successive tests. Facilities were created at another farm for behavioural testing (novel object and open field test) in calves. These calves were studied longitudinally, i.e. they were followed up till they reached first lactation. In addition to behavioural data, measures were also taken of the calves' heart rate (inter-beat intervals) and the plasma cortisol response to the above tests. Approximately 1000 animals have been tested. Initial heritability estimates of behavioural and heart rate data in calves were obtained using ASREML.

**Results**

Individual differences in several measures of the daily time-budget of cows (% of time lying, number of lying bouts, number of steps, % of time moving around) were consistent over time, suggesting that certain aspects of the time budget of dairy cows may exhibit trait-like characteristics. Similarly, the cows' responses to a human were repeatable between days.

Observed heritabilities revealed a genetic component in calf reactivity (behaviour, heart rate and plasma cortisol) to a fear test. Interestingly, heifers that had been classed as fearful calves were reluctant to approach people and they showed an unfavourable milking temperament at first lactation. Furthermore, high fearfulness and a poor milking temperament were significantly associated with low milk yield. This supports previous findings in a number of farm animal species, where high fearfulness is associated with reduced production

**Conclusions and recommendations**

- Selection for increased milk production may have resulted in animals that are more difficult to handle in certain circumstances. This relationships merits further in-depth investigation.
- Selection for calves showing low fear may have beneficial effects on welfare and performance.
- Close collaboration with the dairy breeders will facilitate the rapid and effective uptake of results and recommendations.

# WP 3.3: Eliminating injurious behaviours (I)

## Feather pecking and cannibalism in laying hens

### Scientific background and work done outside WQ

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 a painful death for 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 (without pulling of feathers) was traditionally not regarded as a welfare problem it may actually ruffle or damage the pecked bird’s feathers thereby making it more susceptible to severe FP because hens readily peck at anything that is noticeably different (stimulus contrast).(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 inform and 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 inter-bird pecking in broiler chickens (see Jones, 2005). The results of a systematic study of pecking preferences in chicks and laying hens helped to guide the development of effective environmental enrichment. Bunches of string elicited 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 significantly 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).

Vent pecking is directed specifically at the small downy feathers below the cloaca and at the red area at the top of the cloaca and generally occurs after the hens have come into lay. Although vent pecking is probably distinct from feather pecking and one form of pecking does not inevitably lead to the other (Savory, 1995), there are some common features and vent pecking might be a precursor to feather pecking and cannibalism in certain circumstances (Savory and Mann, 1997; Potsch et al., 2001).

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 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.

## Work done in Welfare Quality® - feather pecking and vent pecking

**Objective 1:**

- To identify the most important risk factors for feather pecking and vent pecking in laying hens.

**Methods**

First, potential risk factors for feather pecking and vent pecking were identified based on literature and expert opinion. Subsequently, WQ scientists visited fifty rearing farms in Germany and Austria (27 conventional, 23 organic) followed by 2 laying farms of each of the rearing farms (total = 100 laying farms) when the birds were 16 to 18 weeks and 30 to 40 weeks old, respectively. Pullets were kept in 19 aviaries and 31 floor systems. Standardized data collection with regard to potential risk factors as well as the skin and plumage condition of a random sample of 30 birds per farm was carried out. Associations between potential risk factors and skin and plumage condition were analysed using a regression tree.

**Results**

Feather pecking was present in 91 % and cannibalism in 62 % of laying flocks in differing degrees. Organic and conventional flocks did not differ significantly differ in this respect. Risk factors during rearing and laying, as identified by regression tree analysis, explained between 51 % and 73 % of the total variance between flocks with respect to the prevalence of injuries, feather damage, or the feather score. Risk factors occurring during rearing had a markedly higher effect in conventional than organic flocks (e.g. for cannibalism it was 91 % versus 16 %).

The most important risk factors for the occurrence of feather pecking were:

| |
|---|
| Lack of dry, loose substrate |
| Lack of maniupulable materia |
| Lack of elevated perches |

| |
|---|
| Nutrient imbalances |
| High stocking density |
| Little experience of farmer |
| Unsuitable hybrid |
| No beak trimming |
| Large group size |
| Inappropriate food structure |
| High light intensity |
| Stress |
| Poor air quality |

Similarly, the most important risk factors for vent pecking were:

| |
|---|
| Lack of elevated perches |
| Unsuitable hybrid |
| High stocking density |
| Lack of dry, loose substrate |
| Lack of manipulable material |
| Nutrient imbalances |
| No beak trimming |
| Little experience of farmer |
| Large group size |
| Inappropriate food structure |
| High light intensity |
| Poor air quality |
| Stress |

## Conclusions

- Programmes could be designed to minimise the occurrence of feather pecking and vent pecking in laying hens on the basis of the risk factors identified above.
- The remedial strategies could conceivably target one or more of the risk factors, e.g., provision of suitable material for the birds to manipulate, improved ventilation, lower stocking densities, farmer training.
- Alternatively, a programme addressing all the above risk factors could perhaps be developed. The nature of the control programme may depend on the requirements of individual farms.

**Objective 2:**

- To develop a decision support tool for minimising feather and vent pecking

## Methods

Based on literature and expert opinion, potential risk factors during both rearing and laying periods for feather pecking (FP) and cannibalism, inclusive of vent pecking (C) in laying hens kept in non-cage systems (aviaries and deep litter systems) were identified and theoretical models were set up. Body condition (integument scores), mortality, feeding space, substrate condition, perch length, light intensity, ammonia concentrations were measured on 23 organic and 27 conventional rearing units and two laying units of each rearing unit in Austria and Germany. Farmer-interviews were also carried out.

For laying hen flocks, 3 output variables were measured: prevalence of injuries per flock, prevalence of damaged plumage and an average plumage score per flock were calculated. Independent variables listed in the theoretical models were checked for strong inter-correlations and distribution and accordingly selected for analysis. Regression tree analysis was used to explore the relative contribution of potential risk factors from the rearing and laying periods for FP and cannibalism; this was done for organic and conventional flocks as well as the whole data set.

**Results**

Integument-scoring showed that feather pecking was present in 91 % and cannibalism in 62 % of laying flocks at differing degrees. Organic and conventional flocks were not significantly different. Risk factors during rearing and laying explained between 51 % and 73 % of the total variance between flocks in the prevalence of injuries, feather damage or feather score.

Strong potential risk factors in the rearing period for later FP and C included; stocking density, length of raised perches, ratios of feeding- and drinking- place to birds, air ammonia concentration, final weight of pullets, stockperson´s knowledge of FP and C, and provision of grain in the litter. Risk factors were identified for the laying period included; a temporary increase in stocking density after hens are moved to the laying house, lack of access to free range, moving pullets to the laying house after the 126 days of age, poor litter quality, no covered outdoor run, family nests rather than single ones, and an ammonia content of more than 9 ppm.

**Conclusions and strategies**

Changes in pullet rearing designed to eliminate/minimise risk factors may have strong effects on the occurrence of feather pecking and cannibalism during the laying period. A check sheet based on the risk factors identified above has been developed for use as a decision support tool if problems with feather pecking and cannibalism occur.

**Objective 3:**

- **To study pecking preferences and locomotor activity in chickens selected for and against feather pecking behaviour.**

**Part 1**

**Methods**

This study focused on neonatal pecking preferences in lines of chickens selected for high (HFP) or low feather pecking (LFP). Chicks reared in groups of 14 were tested at 2 wks of age for pecking at various coloured figures presented on an electronic touch screen. This tested the ‘changed template’-hypothesis that HFP chicks would peck more at ‘feather like’ than ‘food like’ stimuli.

**Results**

HFP chicks pecked significantly more at the touch screen figures than LFP ones but they showed no preferences for feather-like or food like stimuli or for a particular colour (red, yellow, green). FP was higher in HFP than LFP chicks from 6-21 days.

**Part 2**

**Methods**

The above hypothesis was tested by measuring locomotor activity in HFP, LFP and control (CON) line birds using two techniques. Firstly, electronic transponders were used to record general locomotor in mixed-line groups of birds from 13-17 weeks. Secondly, locomotion (distance travelled) was measured in 40 HFP and 40 LFP birds at 5 weeks of age using a computer-facilitated LED tracking system

**Results**

Locomotor activity was significantly higher in HFP than CON than LFP birds. Similarly, distance travelled was greater in HFP than LFP birds.

**Part 3**

**Methods**

Heart rate variability (HRV) was measured in adult hens of the selected and control line birds using implanted radio transmitters to test the hypothesis that HFP birds would show stronger sympathetic stress reactivity while LFP ones would have higher parasympathetic reactivity, with unselected controls showing intermediate values.

**Results**

At rest heart rate was higher, and R-wave intervals were shorter in the LFP and HFP lines compared to the Control line. There were no line effects on HRV when the birds were at rest. However, in a stressful situation HFP birds typically showed higher heart rate and lower HRV parameters than LFP ones, with the control hens occupying intermediate positions.

**Collective conclusions and recommendations**

- A genetic-based neuronal hyperactivity disorder may induce and/or enhance feather pecking in concert with a range of environmental and social factors.
- Genetic selection for higher levels of feather pecking may increase the susceptibility to stress whereas selection against FP may reduce it.
- Selective breeding for reduced feather pecking could exert direct and indirect beneficial effects on FP and stress susceptibility. As long as no undesirable characteristics are simultaneously and unconsciously selected this could significantly improve welfare, productivity and profitability.

# WP 3.3: Eliminating injurious behaviours (II)

## Tail biting in pigs

### Scientific background and work done outside WQ

Tail biting has been an important welfare and economic problem in intensive pig production over the past few decades and there is still no definitive solution (Valros et al, 2004). Indeed, its occurrence is apparently more prevalent, e.g, 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 it or increased awareness when reporting remains to be clarified.

In an accepted description tail biting is sub-divided into two phases. In the first (pre-injury) a pig chews lightly on the tail of another who tolerates this behaviour. In many cases this is followed by stage two (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). 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).As well as physical injury, tail biting is also associated with reduced weight gain, disease transmission and cannibalism (Schrøder-Petersen & Simonsen, 2001).

Tail biting is considered an abnormal behaviour since 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 is a form of redirected behaviour derived from the thwarting of normal exploratory, feeding, social and sexual motivations. 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 pen characteristics (Schrøder-Petersen & Simonsen, 2001; Moinard, 2003; Schrøder-Petersen et al, 2003; Schrøder-Petersen et al, 2004), and it seems related to some extent to the pig's level of activity and restlessness. Consequently, any stress-inducing factor 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 focusing on the effect of just one particular factor often show contradictory results, thereby highlighting the need for a more integrated approach 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:

- Lack of substrate for exploratory behaviour: tail biting is more prevalent in pens that have no rooting materials, e.g. peat and straw. The fact that slatted floors increase the risk of tail biting may also reflect the lack of rooting material. Environmental enrichment also reduces tail biting. The lack of access to straw and other suitable rooting materials is probably the single most consistently reported risk factor for tail biting in pigs.
- Genetic characteristics: hereditary nervousness in certain breeds or genetic lines could predispose them to tail biting.
- Gender: castrated males seem more prone to suffering 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, but 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. 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 correlated with tail biting. Limited space may result in a lower food intake leading to stress, frustration and consequently redirection of behaviour. In addition, small or weak individuals may attack other pigs from behind to gain access to the feeding area.
- Level and type of artificial lighting: 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 the most common and successful way of preventing tail biting for more than 50 years but recent studies have questioned its efficacy (Chambers et al, 1995; Moinard et al, 2003) and there are many arguments against its 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 mutilation of 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 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.

## Work done in Welfare Quality® – tail biting in pigs

**Objectives:**

- To establish the effects of providing straw at different stages of life
- To determine if it is possible to predict future tail biters

**Methods**

Since previous studies suggested that the provision of straw might protect against tail biting this study established the effects of providing straw at different stages of life. It was carried out on a commercial farm by manipulating the presence and timing of straw provision. Six replicates of 4 treatments were used: No Straw (NS); Straw From 12 weeks (SF); Straw From Weaning (SW); Straw Throughout Life (ST). Each replicate comprised one group (N=30±9 pigs) from each of the 4 treatments, and over 700 pigs were followed from birth to slaughter.

Additionally, a test of tail-chewing propensity was developed to determine if performance in this test predicted subsequent tail biting behaviour. It involved presenting a board with 10 simulated tails, lengths of rope, hanging from it to a sub-group of 10 pigs, and recording the investigatory and rope-chewing behaviour of individual animals. Propensity-to-chew tests (PCT) were carried out at around 6 and 21 weeks of age. In addition, behaviour in the home pen was observed throughout the study period to record the amount of tail-orientated behaviour and tail biting that each individual performed, and each pig was subsequently classified as a *Definite*, *Probable* or *Non-Biter*. Over the period of the study each group of pigs was classified as having *No Outbreak*, an *Underlying Outbreak* (only detected by formal tail examinations) or a *Severe Outbreak* (detected when blood was observed on the tails of at least two pigs by farm or research staff).

**Results**

Straw provision had only limited effect on pigs' behaviour. Paradoxically, most outbreaks of tail biting were seen in the ST treatment, perhaps because of frustration and redirection of behaviour when straw provision dipped in the finisher stage (because of the farm's management practices).

Although there was a significant positive correlation between performance in the two PCT tests this was not high. There were suggestions that *Non-Biters* were those pigs who performed less rope chewing and those groups that had no tail biting outbreaks tended to be those where the group-level measures of rope contact and rope tugging behaviour in the first test were lower than groups which went on to show tail biting. Overall, there may be some relationship between performance in the test and subsequent tail biting behaviour, but it is not yet strong enough to be used as a means of predicting which individuals will become tail-biters.

Activity levels were significantly higher in the 4 days before a Severe Outbreak. At 11 weeks of age (prior to an outbreak), those groups that went on to develop No Outbreaks showed fewer 'tail-tucked under' postures but more non-damaging 'tail interest' than those groups that subsequently developed an outbreak. In some outbreaks a small runty pig (an indicator pig perhaps) was tail -bitten some time before a full outbreak occurred.

**Conclusions and recommendations**

- If straw is provided the farmer must ensure that there is no dip in its provision.
- While some indicators may predict tail biting it is difficult to reliably predict all outbreaks from a single measure, probably because tail biting outbreaks have widely varying trigger factors.

The presence of 'indicator pigs' (those bitten before an outbreak) appeared to be a sensitive predictor of future tail biting and therefore a useful warning sign for farmers.

# WP 4: Reducing lameness (I): Lameness in broiler chickens

## Scientific background and work done outside WQ

Lameness resulting from leg disorders is commonly regarded as one of the main welfare problems in broiler chickens (FAWC 1992; FAWC 1998; European Commission 2000). Leg problems have serious consequence for welfare as lame birds may suffer pain (Pickup et al., 1997), their behavioural repertoire can be significantly restricted, e.g., they may have difficulty accessing feeders and drinkers (Weeks et al., 2000). Lameness can also have economic costs, some birds may have to be culled and the surviving lame birds may lose weight and are more likely to be downgraded at slaughter (Kestin et al., 1999).

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 considerably between farms. In a large-scale study Dawkins et al. (2004) 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.

The aetiology of leg disorders in broilers includes many factors such as genetic background, gender, growth rate, feed conversion efficiency, 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 can 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).

Over the last 40 years, genetic selection for rapid growth and improved feed efficiency, together with changes in the feed encouraging high nutrient intake, have markedly increased growth rate which, in turn, has been implicated in the increasing prevalence of leg problems (Kestin et al., 2001; Bradshaw et al., 2002; Sanotra et al., 2003; Julian, 2005)

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). Higher growth rates may also predispose birds to bacterial infection (McNamee et al., 1999; Corr et al., 2003). Leg weakness is positively correlated with live weight gain and is more pronounced in males than females (Kestin et al., 1994; Sanotra, 2000; Sorenson et al., 2000), possibly because of the differences in conformation and growth. It has also been suggested that selection for feed conversion has reduced the birds' performance of energy consuming behaviours; indeed locomotor activity is much lower during the finishing period in chickens from fast-growing genetic types than in slow-growing ones. 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).

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 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. Furthermore, activity is inversely related to stocking density, and increased activity reduces Valgus/Varus deformity

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, e.g. high gait score birds tend to feed while sitting down where possible rather than standing (Weeks et al., 2000). A more recent method of gait scoring developed by Garner et al. (2002) is thought to offer even better reliability.

A UK study (Knowles et al., 2005) revealed that the following factors were significantly associated with high gait score, and hence leg problems:

*2.1 Environment / management*

- season (summer months)
- the age of the bird (older birds)

- bird genotype (lower % in Ross)
- not feeding whole/cracked wheat
- shorter dark period during the day
- higher stocking density at the time of assessment
- no use of antibiotics
- intact rather than 'dusty' feed pellets
-

*2.2 Bacteriological risk factors: E. caecorum* and *S. aureus* can cause lameness (higher gait scores) and *E. coli* and *Enterococcus* are weakly associated with higher gait scores, though not necessarily causal. Including whole/cracked wheat in the diet may protect against bacterial infection.

*2.3 Skeletal pathologies:* These diminish the birds' ability to walk.

*2.4 Bird weight:* Many people, including production staff, assume that broilers are 'lame because they are heavy'. However, at slaughter, birds that were lighter than average had worse gait scores, whilst heavier birds had slightly better ones.

*2.6 Husbandry Factors Associating Bacterial infection with lameness:* Infection may be a primary cause of lameness but is of less overall significance than skeletal (non infectious) effects, (but a combination of skeletal and infectious pathologies exacerbates the problem). Heavily soiled birds were more likely to be infected, gait scores were 'best' in March and 'worst' in September, feed dust aids survival and transmission of bacteria (Meldrum *et al* 2005) and the probability of infection tends to increase throughout the lifetime of a flock.

*2.7 Bird gender & genotype:* Males tend to have worse gait scores than females. A higher percentage of Ross birds in a flock was associated with reduced lameness. Genotype is a factor affecting leg weakness (Rauw, 1998; Kestin *et al* 1999) and Tibial Dyschondroplasia (TD) (Sauveur & Mongin 1978; Wonge-Valle *et al* 1993). TD is a metabolic disease of young broilers (and other poultry bred for fast growth rates); the tibial cartilage does not mature enough to become bone) so the growth plate is prone to fracture, infection, and deformity. TD is the leading cause of lameness, mortality, and carcass condemnations in commercial poultry.

*2.8 Bird hygiene:* Each increment in feather soiling score (clean 0, mild 1, moderate 2, severe 3) is associated with a 0.35 increase in gait score, i.e. > lameness.

*2.9 Skeletal measures*: Increased tibiotarsal curve was related to increased lameness.

*2.10 Hock burn:* Each increment in hock burn score was associated with a 0.27 increase in gait score. Hock burn may be both causal and associative – it may contribute to lameness but could equally, wholly or in part, be caused by more time spent sitting on the litter.

The clear involvement of the background genotype in the aetiology of leg weakness implies that appropriate modification of future breeding programmes could help to alleviate the problem, at least as long as this does not incur prohibitive economic loss.

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).

Modification of the type of food and the feeding regime (Su et al., 1999) as well as using step-up lighting programmes (Classen et al., 1991) may also help to reduce the occurrence and/or intensity of leg problems.

Some of the work carried out, both within and outside WQ, on leg weakness in broiler chickens is described in greater detail in the Welfare Quality® Assessment Protocol for Poultry (2009).

## Work done in Welfare Quality® – Lameness in broilers

### 1. Feeding regime and lameness

**Objective**

- To determine if lameness in broiler chickens could be alleviated by sequential feeding of two diets

**Material and methods**

Sequential feeding of broiler chickens 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, and it might 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. Neither feed conversion nor carcass conformation was impaired by sequential feeding, and an increase in abdominal fat was small enough to be avoided by improving diet composition.

**Conclusions**

Lameness in broilers can be reduced by slowing down their early growth rate and speeding it up once their bones have developed. By using the new combination of diets and a sequential feeding method (see above), WQ researchers found they could slow down the chick's early growth without any reduction in final carcass weight. They 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 28 the birds should be fed a low energy-high protein diet (E-P+) on the first 2 days and a high energy-low protein diet (E+P-) on the second 2 days; i.e. the two diets should rotate every 48 hours so that there are 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 for any additional feeding days. The researchers are still analyzing the exact price differences between the broiler standard diet and the sequential diets, but initial results suggest that the latter were not 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.

## 2. A lameness control strategy for commercial broiler fowl production

**Objective:**

- To develop a control strategy for improving leg health in commercial broiler flocks.

There is no single set of recommendations to reduce lameness in all farms, in all systems, and in all countries. Clinical and commercial findings show that individual broiler sheds and individual crops of birds can suffer fluctuating levels of lameness. Many farmers (and vets) find the 'fluctuating'nature of broiler lameness frustrating and non-rewarding to 'treat'. Since lameness is unpredictable it cannot be cured by, for example, routine use of antibiotics at a particular point in the growth cycle. Therefore, many experienced people in the poultry industry consider lameness a 'disease' and an inevitable periodic irritant.

However, some risk factors and control strategies are consistently linked with reduced or improved leg health, respectively. To alleviate lameness, a company could identify and target the following 'objectives':

1. To determine the variation in: a) broiler leg health across different commercial production and, b) in parameters (mortality, growth rate, hock burn, footpad, post-mortem reject data etc) that may relate to broiler leg health.

2. To use this information to detect poor and good farms with respect to leg health, as well as the environmental and management risk factors for poor and good farms.

3. To inspect the birds and estimate the incidence of specific pathologies and leg disorders within the company flocks.

4. To use the information gathered in Objectives 1 to 3 to formulate recommendations for breeder units, hatcheries, individual farms and groups of farms within the company which may be used to improve broiler leg health under commercial conditions.

**Methods / Strategy**

Each broiler company can achieve objectives 1 to 4 via the following steps. a) Establish the prevalence and severity of leg disorders in the company flocks, and assess the economic impact of small, moribund and culled birds related to lameness. b) Compare good and poor farms to help identify management, environment, feeding, medication, stockmanship and genotype factors that differ between them. c) Determine if there is water leakage; by damaging litter management chronic leakage can harm leg health. d) Establish if bacterial pathologies linked to lameness originated in the hatchery, the transport system, or through lapses in farm biosecurity. e) Compare the diets and the hybrids and determine if any of these have an effect on leg health.

WQ researchers recognised the need for trained assessors to carry out the above steps and devised the following protocol.

**Protocol for the training of assessors**

To ensure standardisation of assessment and data collection a formal training course is proposed. This comprises:

- Training on post-mortem protocols
- Completion of on-farm assessment forms
- Sample collection techniques
- Assessment of bird gait

Assessment of leg health through gait scoring will be achieved by;

- Training via on-farm visits and video training sessions.
- Assessment of inspectors during the training course to ensure uniform scoring.
- Sending video sequences of the range of gait scores to the inspectors at approximately 6 and 12 months.
- Monitoring scoring of the video tapes ensure the assessors remain in agreement.

**On farm assessment**

This consists of three main stages:

a) Completion of a farm questionnaire or standard inspection report with the farmer's assistance to provide a description of the farm, house and flock.This is likely to form part of the bigger WQ on farm assessment protocol (see WQ Technical Documents).

b) Gait-scoring of 250 randomly selected birds (see WQ Technical Documents).

c) *Post mortem* examination of 10 birds selected (preferably) from high gait score individuals within the flock to determine the main pathological causes of lameness. (This could enable the company to carry out a risk assessment and HACCP).

The on-farm recording system used in related studies consisted of over 130 questions which included: broiler breeder genotype, history and age; hatchery vaccination programme; chick transportation; number and weight of chicks placed + sex, time of year etc; husbandry, e.g. brooding, stocking density, thinning; nutritional profile; growth, mortality and leg cull profiles; carcass information from the processing plant; background information on farm and company management (stock person ratios, training), size of houses, numbers of birds, biosecurity etc.

**Protocol for gait scoring on farm**

A method for assessing the birds' walking ability of birds was developed by Kestin *et al* (1992) and forms the basis of the assessments; randomly selected birds are given a score from 0 to 5, with 5 being the poorest gait. Full descriptions are given in

*Note - WelfareQuality® will establish training programmes for assessors / inspectors (see above + LINKS). Commercial training is also available (www.awtraining.com).*

**Possible control strategies**

Consideration of the literature and our own work in WQ enables us to suggest a set of control measures. The steps outlined above and the photographic resources would provide a company with the information required to identify which of the following control strategies are relevant and applicable to their own business.

*1. Growth rate - to reduce growth rate and to slaughter a younger and lighter bird.* Slower growth rates might be achieved by dietary and dark period manipulation but some such strategies may have other welfare implications. Remedial measures should not compromise the EU broiler industry to an extent that would encourage imports of broilers from sources where bird welfare is less well regulated.

*2. Age at slaughter.* In the short term, slaughtering birds at younger ages would markedly improve leg health in the European broiler industry but this would require increased bird numbers to meet demand.  Moreover, the size (weight) of birds at slaughter is determined by the retail customer.

*3. Whole cereals*. Incorporating whole grain or cracked wheat in the diet can slow growth, stimulate the crop and gizzard, and encourage a healthy gut micro flora.

*4. Feed type.* Feeding less easily consumed forms of feed (dusty pellet) could improve leg health indirectly by slowing growth rate and possibly reducing the incidence of infection.

*5. Biosecurity and bacterial exposure.* Bacterial infections are associated with high gait scores / lameness and high growth rates and poor quality feed increase the risk of infection. Antibiotics can improve leg health but there are concerns about selection for multi-resistant bacteria. Alternatives to consider include: improving water hygiene (better drinker design and maintenance), air and litter quality and clean-out standards; vaccination programmes.

*6. Litter condition.* Steps to safeguard litter quality, e.g. control of drinker leakage, attention to enteritis and other conditions causing loose faeces, and reduced humidity through ventilation and temperature control, all lead to improved living conditions for the birds and may directly and indirectly improve leg health.

*7. Genotype.* Selecting birds for good leg health from existing genotypes and trialling of new genotypes by broiler breeding companies could leads to reduced leg health problems (leg weakness, Tibial Dyschondroplasia) in the medium to long term. Care must be taken so as not to unconsciously select for traits resulting in prohibitive economic loss.

*8. Incentive schemes.* The use of incentive schemes, for which growers receive a premium for demonstrating improved leg health, if designed, implemented and marketed effectively to the consumer, would improve bird leg health in Europe.

*9. Feed restriction.* Reducing feed quantity or nutrient density during the first 2 weeks of life significantly reduces development of skeletal disorders. Feeding the daily ration in a number of discrete meals is effective but it can pose practical problems.

*10. Feeding regime*. The sequential feeding of two diets differing in protein and energy contents from day 8 to day 28 reduced lameness without compromising final slaughter weight (see ‘Feeding regime’ section above). This could improve welfare and still safeguard profitability.

*11. Photoperiod and Light Intensity.* Step-up programmes, in which the photoperiod is shortened to 6 or 8 hours after brooding then gradually increased to approximately 23h at 21 days, reduces leg abnormalities and lameness compared to traditional 23-hour lighting.

*12. Bird activity and stocking density*. Activity is higher with shorter photoperiods and lower stocking densities. Increased activity is known to reduce leg deformity and spodylolysthesis

# WP 4: Reducing lameness (II)

## Lameness in dairy cattle

### Scientific background and work done outside WQ

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 result 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 substantial proportions 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 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 progressing 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).

## Work done in Welfare Quality® – lameness in dairy cattle

### 1. Survey of lameness and cubicle condition

**Methods**

Welfare Quality® researchers visited one hundred and eight farms in Germany and Austria in order to identify risk factors and possible ways of reducing lameness and hock lesions in dairy cattle. All the cows were housed in cubicles. Lameness and hock condition were scored in randomly selected cows at each of the farms. The environmental features of the cubicles were also recorded. Lameness was also assessed in herds fed an average of 0 to 0.44 kg concentrates per kg milk

**Results**

Our research in the 108 cubicle housed dairy cattle herds revealed that, on average, 32 % of the cows were lame with 16 % showing severe lameness. Furthermore, 46 % of the cows examined had hock lesions (scabs, wounds or swellings). A positive correlation between lameness and hock lesions suggests that they are partly influenced by similar factors. There was a higher risk for hock lesions when cubicles had no curb (which serves to keep the bedding material inside the cubicle) or when lying surfaces were hard. More lame cows were observed in the herd with decreasing bedding height in the cubicles.

Lameness problems increased with decreasing number of available cubicles per cow and were more prevalent when the cows took longer to lie down. The duration of lying down mainly depended on cubicle dimensions and other cubicle features

Finally, the risk of lameness was higher when the cows were fed larger amounts of concentrate relative to their milk production.

**Conclusions and recommendations**

- Lameness and hock lesions can be prevented by supplying dairy cows with soft, well maintained and bedded lying surfaces.
- Lameness problems can be reduced through improved cubicle design (e.g. incorporate a curb and make it more comfortable) and ensuring adequate availability.

- It is important to ensure that the ration is appropriate for a ruminants' digestive system. While lowering the concentrate level is likely to reduce lameness it may compromise the energy status of high producing cows, so the challenge is in finding the right balance between forage and energy

## 2. Lameness control programme

### Methods

The University of Bristol has been working on a lameness control programme for dairy herds intended to help farmers reduce the prevalence of lameness. The programme includes diagnosis, risk assessment, prioritised control strategies and monitoring. An interactive web-based tool provides a checklist of risk factors for different lesions, and suggested control measures. A survey was carried out on 46 farms in 5 countries to discover farmers' views on the above control programme.

### Results

Twenty-six of the 46 farmers surveyed said that they would consider using a lameness control programme. The most commonly mentioned attractions were: a structured approach, increased awareness of the causes of lameness, and the monitoring facility. The most common reasons given for lack of interest were a belief that the knowledge and skills for lameness control already existed on the farm, the opinion that lameness was not a major problem, and a lack of time.

### Conclusions

- Most of the farmers who were positive about the lameness control programme expressed a need for some help and instruction. So, it is important to train advisers, veterinarians and foot trimmers.
- The barriers to acceptance mentioned above must be overcome before recalcitrant farmers can be persuaded to invest more effort in confronting lameness.

## 3. Lameness and walking surfaces

**Methods**

Almost 60 dairy cows that were housed on four different types of floors in the same loose housing system were compared for locomotory function. The 4 substrates consisted of a square grooved concrete floor, a slatted concrete floor, a rubber slatted floor or a flat solid concrete floor covered with rubber.

**Results**

Of the 4 different floors the slatted concrete one was particularly associated with suboptimal locomotory function in terms of gait asymmetry, signs of hesitant walking and unfavourable distribution of load when the cows' performance was measured on a pressure plate. However, there were no detectable floor effects on claw health and gait scores.

On concrete floors, as compared with rubber floors, cows had a significantly increased growth and wear of claws, increased claw lengths and diagonals, and harder claws. This was particularly pronounced in cows on slatted concrete floors; these animals also had relatively steep hoof walls. Cows on slatted concrete floors had negative net horn growth and thin soles; this could explain their hesitant and unbalanced walking.

**Conclusions**

- The above findings indicate a number of negative effects of slatted concrete surfaces on the pressure distribution parameters of dairy cows that may lead to locomotion problems.
- However, slatted concrete floors do have favourable effects on the cows' cleanliness, foothold and claw hardness, so a balance must be found.

# WP 5: Minimizing Neonatal mortality in pigs

## Scientific background and work done outside WQ

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 that 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 exacerbated 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 them 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; Jones and Manteca 2009a).

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. Recent 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 foetal 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 being more susceptible (Edwards 2002). Logically then, the implementation of strategies to reduce hypothermia and starvation should decrease mortality. When the piglet is born and makes the transition from the thermoneutral intrauterine environment to the extrauterine environment, it is exposed to 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 applied when the sow is restrained in a crate (Morrison et al., 1983). However, farrowing sows in loose-housed accommodation requires different methods of providing thermal comfort. It was recently shown that using under-floor heating at the time of farrowing improved piglet survival;

(Malmkvist et al., 2006). Providing deep-straw bedding (a common practice in outdoor systems) can also help by slowing heat loss and thereby creating a more suitable microclimate; indeed the thermal resistance of such bedding is 11 times greater than that of concrete slats and 22 times greater than solid, wet concrete flooring, respectively (Wathes and Whittemore 2006). Additional management strategies designed to decrease mortality include supervision and intervention at the time of farrowing to assist the birth process and thereby 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.

## Workd done in Welfare Quality® – reducing piglet mortality

**Objectives:**

- To identify behavioural and physiological characteristics of piglet survival
- To consider the effects of genetic selection for survival in alternative farrowing systems to the conventional farrowing crate

**Methods**

Welfare Quality® researchers studied piglets and sows from two genotypes: High piglet Survival and Average lines. These were farrowed in an outdoor system and an indoor loose-housed system in the UK and in crates or pens in Denmark. Sow measures included: pre-farrowing and farrowing behaviour, stock-person directed aggression, weight, body condition and colostrum quality. For the piglet the researchers measured piglet vigour, behaviour following birth, rooting response (a neurobehavioural test), weight, length, rectal temperature and blood glucose. All piglet deaths were recorded and a post-mortem carried out.

**Results**

Placental quality affects survival at birth. Piglet birth weight and shape, first time behaviours and thermoregulation all influenced survival.
The selection strategy had its greatest impact outdoors with only 12% total mortality in the High Survival line compared with 18% in the Average survival line. Regardless of the farrowing environment, maternal behaviour was significantly influenced by genotype. High Survival sows were observed to be better mothers; displaying more careful behaviours than Average sows. They also performed significantly less crushing behaviour during farrowing than sows of the Average line.

The following illustration summarises the piglet and sow behavioural and physiological characteristics found to be most important for survival:

**Conclusions and strategies**

- In order to implement more sow-welfare-friendly farrowing systems, we must improve piglet survival so that it equals or surpasses levels reported in conventional systems.
- Good maternal behaviour reduces crushing after birth.
- Genetic selection strategies using survival traits offer an opportunity to improve pre-weaning piglet survival and production

# WP 6: Alleviating 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).

### 6.1 Reducing social stress in beef cattle

Several management practices and environmental conditions that are common on cattle farms may lead to social stress. These include mixing of unacquainted animals and inappropriate design of the facilities leading to overcrowding, excessive competition for resources (e.g., feed, water, shade, space) and marked effects on 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, as a result of social dominance, subordinate cows spend less time resting when lying space is limited. This may increase the occurrence of lameness (Galindo et al., 2000). Similarly, limited feeding space compromises feeding behaviour. Health problems related to digestive disorders such as ruminal acidosis, left displaced abomasum, laminitis, or liver abscesses may appear under such situations (Cameron et al., 1998; Nagaraja and Chengappa, 1998; Shaver, 2002; Cook et al., 2004; Stone, 2004; Krause and Oetzel, 2006).

Mixing of unacquainted animals is a very frequent management practice in livestock farms. In beef cattle, it most commonly occurs at the time of marketing; for dairy cattle it is most 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 in addition to social mixing and the stress of establishing a new social hierarchy they are exposed to several other stressful factors at the same time. These include long transportation, abrupt hormonal/metabolic changes, and introduction to a new diet, facilities and management. Reduced feed intake and production, and increased disease and mortality rates are apparent during these periods. The situation could be further complicated if competition for feed is high due to limited feeding spaceif there are marked differences between pen mates in body size and age. Typical examples of the latter case occur upon the introduction of post-partum primiparous dairy heifers into a milking herd of older, more experienced and bigger cows. The newcomers are likely to suffer social stress due to their lower position in the social hierarchy (Wierenga, 1990; Grant and Albright, 1995). Despite the above effects, regrouping or relocation of animals in the 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). Much agonistic behaviour with physical contact (e.g. fights and butts) occurs during the first days after mixing. However, if the establishment of the social hierarchy is successful then such agonistic interactions should rapidly decrease while interactions without physical contact increase until the group attains social stabilization (Tennessen et al., 1985; Kondo and Hurnick, 1990; Raussi et al., 2005). The faster this process occurs the less 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 aggression continues and social stress occurs.

Excessive competition for resources can exacerbate social stress because the effects of social dominance are accentuated. Animals then often spend less time feeding and they eat faster (Nielsen, 1999). These changes are directly correlated to the amount of competition for feed. Subordinate animals show the greatest effects; they are more often displaced from the feeders, shift their feeding patterns towards nighttime, eat apart from dominants, and spend longer waiting 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 accentuates the effects of dominance on behaviour, production and social well-being. For instance, heifers housed in isolation 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, primiparous kept separately from multiparous cows under grazing conditions showed similar milk production but were involved in less aggressive interactions and spent less standing than those that were housed with multiparous cows (Phillips and Rind, 2001). Separating dominants from subordinates 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 rates when grouped 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.

## 6.2 Reducing Social stress in pigs (genetics of aggression)

Social stress and aggression in pigs may be induced by several management practices, including mixing of unfamiliar animals and an insufficient space allowance. Mixing of unfamiliar animals (often with a change of physical environment) is a common practice in pig husbandry, particularly at weaning and at the beginning of the growing-finishing period. Mixing unacquainted pigs can damage welfare and production, mainly because pigs fight in order to establish dominance relationships, most aggressive interactions being typically shown during the first few hours after grouping (Meese and Ewbank, 1972).

The frequency, duration and intensity of aggression after mixing varies according to several variables, e.g. environmental enrichment, whether food is provided *ad libitum* or restricted, and the time of day when pigs are mixed. Weaned pigs offered tyres and chain devices in the pen showed less aggression (Simonsen, 1990). Offering food *ad libitum* and regrouping after sunset also reduced the number of fights in the group (Barnett et al., 1994). The use of tranquillizing drugs to reduce aggression at mixing has been widely advocated for many years. Although these are effective in grouped pigs their efficacy becomes limited over time and agonistic interactions increase as the effects of the drugs wane (Gonyou et al., 1998).

Socialised piglets (those that were mixed with piglets from another litter before weaning) learn social skills that allow them to more rapidly form stable hierarchies when regrouped after weaning (D'Eath, 2005). Group size may also affect how pigs react to mixing with unfamiliar individuals. Pheromones can also modulate aggressive behaviour after regrouping (McGlone et al., 1987; Guy et al., 2009).

Some studies report that social mixing reduced production (e.g. Stookey and Gonyou, 1994), though others failed to do so (e.g. Coutellier et al., 2007). As stressors exert additive effects (Hyun et al., 1998), it is likely that the effects of social mixing will be more pronounced if it is combined with other stressors. This is almost certainly the case at weaning, when piglets are simultaneously subjected to nutritional, environmental and psychological stressors (Pluske et al., 1995); as a result the piglets usually show a period of reduced feed intake that may have long-lasting effects on performance (Pollmann, 1993).

Several reports suggest that reduced floor space allowance leads to decreased feed intake (e.g. Randolph et al., 1981; Kornegay and Notter, 1984; Kornegay et al., 1993). Others found no such 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 production and economic concern as well as a welfare issue (Edwards et al., 1988).

The most common expression of space allowance as 'space per animal' has limitations because space requirements increase with body weight. A second option is to express space allowance as weight / density (i.e. $kg/m^2$), but then 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 is 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 laterally recumbent ones (k = 0.047). By applying these k values in the above equation we can calculate how much physical space a pig needs for each posture at a given body weight. The actual space needed depends on how many pigs want to lie down at any given time and on the posture they 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 heat by increasing the area in contact with the floor so lateral lying will be preferred (Ducreaux et al., 2002).

Ekkel et al. (2003) found that pigs of all weight categories lie down for a great part of the day but spend little time in contact with conspecifics. This supports Petherick's (1983) suggestion that at thermoneutral conditions the floor area occupied by lying pigs fits the allometric equation with a k value of 0.033, but it 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). It seems reasonable to assume that for activities 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 into account, it can be suggested that the overall k value would be 0.8 x 0.033 + 0.2 x 0.038 = 0.034. In order to accommodate a separate dunging area, the European Food Safety Authority recommends a final k value of 0.036 (EFSA, 2005). Interestingly, minimum space allowances in the European Union are significantly lower, with approximate k values of 0.028 for grower-finisher pigs (European Community, 2001). After reviewing several studies 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, the empirical evidence supports theoretical considerations on space requirements.

Several other factors (including group size, type of floor, health status and temperature) may influence space requirements. For instance, 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; Wolter et al., 2000), but there is some debate (Street and Gonyou, 2005).

Some codes of practice recommend greater space allowance if pigs are on partially rather than fully slatted floors (e.g. AAFC, 1993). Gonyou et al. (2006) found no difference between the two types of flooring, though the slope for the growth and intake responses in the crowded range of the data was greater for pigs on partially slatted than on fully slatted floors. This suggests that, although space requirements are similar on both types of floor, the effects of crowding are more severe on partially slatted floors.

When disease challenge is likely, space allowance must be increased if feed intake and performance are to be maintained. The benefits of increasing space allowance and the penalties of decreasing it vary according to the disease (Whittemore, 1993).

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 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.

## Work done in Welfare Quality® – alleviating social stress

### 1. Genetics of aggression in pigs

### Objectives

- To estimate the genetic contribution to individual aggressiveness,
- To 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.
- To investigate genetic correlations between aggressive behaviour and other traits.

### 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 1660 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). Positive correlations were found between LS observed 24h and 3 weeks after mixing, especially for lesions to the centre and rear of the body, thus indicating that post-mixing lesions are predictive of those received under stable group conditions.

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), but 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.
- 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.
- 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.
- Selective breeding for reduced post-mixing lesion scores should have a long-term ameliorative effect on aggression and its related injuries even after dominance relationships have been established (i.e. pigs will be generally less aggressive).

## 2. Social stress in intensively kept beef cattle

### Objectives

- To determine if there is a threshold (in terms of health and welfare) for the number of animals per feeder

### Methods

In order to improve our understanding of the influence of social stress in intensively housed fattening cattle, Welfare Quality® 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). Observations began 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 (8%, 4% and 20% in T2, T4 and T8 animals, respectively). The times spent eating concentrate decreased and eating rate increased linearly, whereas 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 numbers of displacements from the concentrate feeders 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 (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

Observations of altered feeding behaviour, reduced resting time, and increased aggression strongly suggest that increased competition at the feeding trough has detrimental effects on the animals' welfare.

- Ruminal lactate and blood haptoglobin levels indicate that the risk of rumen acidosis might also increase with competition.
- Fewer abscessed livers were found when the competition for food was reduced, thereby indicating 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.

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