

Lameness in Pigs

Moorepark Research Dissemination Day

Authors

Amy Quinn, BSc., M.Sc.

Julia Adriana Calderón Díaz, B.Agr.Sc., M.Sc.

Laura Boyle, B.Agr.Sc., M.Agr.Sc., Ph.D.

Friday 26th July, 2013



Table of Contents

Preface	6
The problem of lameness on Irish pig farms	8
Prevalence of lameness	8
Economics of lameness	8
Causes of lameness	9
Limb lesions	9
Claw lesions	10
Osteochondrosis	11
Risk factors for lameness	12
Housing type	12
Floor type	13
Improving sow comfort to ensure good health and welfare in group housing systems	16
Introduction	16
Study 1: Longitudinal study in a commercial farm	17
Study 2: Effect of rubber flooring on the behaviour of group housed sows	19
Feeding a gilt developer diet will improve sow longevity and productivity	21
Introduction	21
Study 1: Limit feeding a developer diet	22
Study 2: Ad libitum feeding a developer diet	25
Key project findings	28
Acknowledgments	28
Appendix	29
Detection, prevention and treatment of lameness in sows	29
Lameness detection	29
Lameness prevention	29
Claw inspections	29
Feed trace minerals	30
Incorporate a lime box in the ESF station	30
Treatment of lame sows	30

List of Tables

Table 1.	Number of sows housed in individual gestation stalls or in a single dynamic group with an electronic sow feeder during gestation that received each lameness score on transfer to the farrowing crate at day 110 of pregnancy	12
Table 2.	Feeding regime for developer, finisher and gestating sow treatments for study 1 (limit fed=2.25 kg/day)	22
Table 3.	Composition of experimental diets (kg/t)	23
Table 4.	Gilts (%) affected by lameness (scores of >1) in each of three dietary treatments at four stages during study 1	23
Table 5.	Gilts [% (number) of animals affected] with claw lesions and uneven claw size in the three dietary treatments at three inspection points in study 1	24
Table 6.	Gilts [% (number) of animals affected] affected by surface lesions on the cartilage of bones in the elbow joint in study 1	24
Table 7.	Feeding regime for developer, finisher and gestating sow treatments for study 2	25
Table 8.	Gilts (%) affected by lameness (scores of >1) in each of three dietary treatments at day 0 and over 3 periods of the trial in study 2	26
Table 9.	Gilts [% (number of animals)] with claw lesions and uneven claw size in the three dietary treatments at three inspection points in study 2	26

List of Figures

Figure 1.	The proportion of pigs affected by lameness in different production classes on 68 Irish integrated pig units	8
Figure 2.	Limb lesions commonly seen in pigs: (a) callus; (b) swelling; (c) wounds; (d) bursitis; (e) external abscess/severe wound (f) skin abrasions in piglets	10
Figure 3.	Claw lesions: (a) toe overgrowth; (b) heel overgrowth and/or erosion; (c) white line damage; (d) heel sole crack; (e) dew claw injuries; (f) vertical cracks in the wall	11
Figure 4.	Proportion of sows housed in individual gestation stalls or in a single dynamic group with an electronic sow feeder during gestation affected by high claw lesion scores	13
Figure 5.	Proportion of sows housed on slatted steel or cast iron floor during lactation affected by high claw lesion scores	14
Figure 6.	The prevalence of limb and claw lesions in preweaner piglets	15
Figure 7.	Proportion (average across inspections) of sows housed on concrete slats or on rubber slat mats that were lame and the proportion of sows affected by high claw and limb lesion scores during their first parity	17
Figure 8.	Proportion (average across inspections) of sows housed on concrete slats or on rubber slat mats that were lame and the proportion of sows affected by high claw and limb lesion scores during their second parity	18
Figure 9.	Proportion of time spent in the group area or in the feeding stalls	19
Figure 10.	Proportion of time spent in different postures in the group area	20
Figure 11.	The proportion of lame replacement gilts that were housed separately from finisher stock at various weights	21
Figure 12.	Average body weight of gilts on three treatments at day 0, week 4, week 10, week 12 in study 1	25

Preface

Lameness is a major production disease of pigs. It poses a major threat to the sustainability of current pig production methods not least because it represents a serious welfare problem but also because it has a detrimental impact on profitability. The prevalence of lameness, risk factors for lameness and ways of addressing it (focusing on replacement gilts), was the topic of a three year program of research the findings of which will be presented at today's Moorepark research dissemination event.

Discussions of pig welfare are often focused on the behavioural aspects of welfare leading to disagreements between scientists, farmers, animal welfare charities, policy makers and industry groups as to what constitutes poor welfare. However, there is considerable agreement amongst stakeholders as to what constitutes poor welfare when we focus on welfare problems that result from production diseases such as lameness. Lameness has very poor welfare because they are in pain, suffer discomfort, are at a disadvantage when it comes to competing for resources, are more susceptible to other diseases and fail to thrive/reproduce. The considerable impact of lameness on pig welfare is too often overlooked on pig units.

Often with lame sows the only 'treatment' is to cull her after production of the litter. Less regularly, lame sows are euthanized. With finishers, treatment more often includes antibiotics and anti-inflammatory drugs. Relieving the pain associated with lameness hastens recovery simply because the pig can stand up to eat. As in the case of lame sows, our experience is that euthanasia is too often delayed for finisher pigs. Some of the reasons for the delay include the fact that euthanasia of a lame pig results in the loss of carcass value and imposes carcass disposal costs in addition to the actual euthanasia cost. Furthermore, farm staff are often uncomfortable euthanising casualty pigs. However prolonging the suffering of chronically/severely lame animals is ethically unjustifiable. It is also potentially threatening to the image of the entire pig industry.

Of course prevention of lameness is better than cure and a major reason to prevent lameness is to help reduce the amount of antibiotics used in its treatment. Overuse of antibiotics in intensive animal production contributes to antimicrobial resistance which represents a global health challenge. Lameness is the 3rd most common cause for treatment with antibiotics in weaner and finishing pigs. Clearly reducing the prevalence of lameness could go a long way towards reducing antibiotic usage on pig farms.

The root cause of most production diseases lies in the interaction between the demands placed on animals for high productivity and the sub-optimal environment/management systems under which they are produced. Over the past three years our research has attempted to address this complex interaction to reduce lameness, focusing on improving the environment and the nutrition of the replacement gilt to improve sow longevity. Addressing lameness in growing pigs represents an even more challenging research topic because of the clear positive relationship between growth rates and lameness and because of the ubiquitous use of fully slatted flooring which is a major risk factor for lameness. While our research did not directly address lameness in these animals we hope to be able to give some insights into how the problem might be addressed.

Thanks to you all for coming, we hope you will find the day interesting and informative.

Laura Boyle
Project leader

The problem of lameness on Irish pig farms

Amy Quinn & Julia Adriana Calderón Díaz

Prevalence of lameness

In a recent survey involving 68 Irish pig farms we established the prevalence of lameness in finishers, replacement gilts and loose housed pregnant gilts and sows (Figure 1). This was achieved by scoring the pigs' walking ability from 0 to 5 according to severity (0=sound and 5=severely lame). All animals receiving scores >1 were considered lame. In total 643 finishers of 18 weeks of age and 646 finishers of 22 weeks of age, 525 replacement gilts, 518 pregnant gilts and 604 pregnant sows were inspected. We found high levels of lameness in all classes of pigs confirming that lameness is a major production disease on Irish farms.

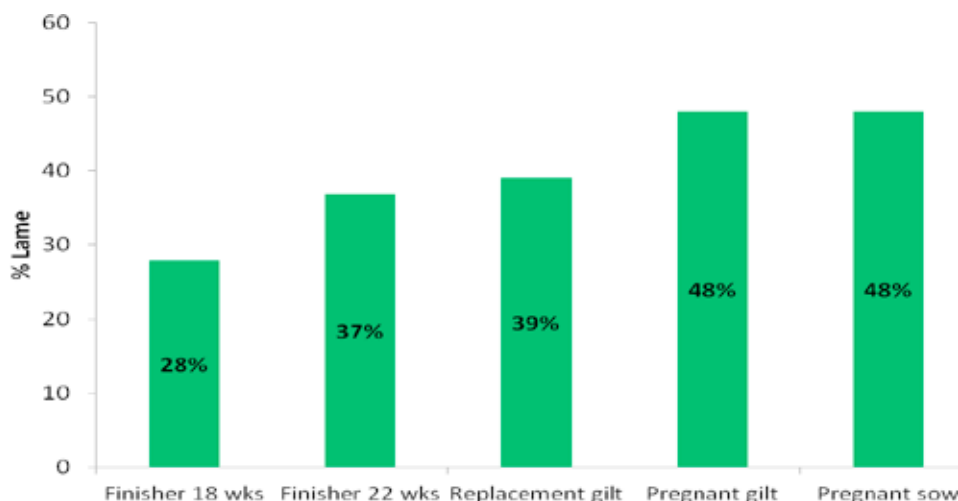


Figure 1. The proportion of pigs affected by lameness in different production classes on 68 Irish integrated pig units

Economics of lameness

From an economic point of view, lameness reduces the productivity of a unit by 1) reducing sow longevity by increasing the involuntary culling rate of sows; 2) reducing the number of pigs produced per sow per year; 3) increasing expenses as a result of the cost incurred in replacing sows, increased work load and treatment expenses and 4) reducing the numbers of finisher pigs reaching the factory. The latter occurs because an increase in the rate of sow culling results in a decrease in the average age of the herd and younger animals produce smaller litters.

Currently in Irish pig herds almost 50% of sows are culled before they reach the 3rd parity. As a sow does not become profitable until after she has had her 3rd litter this means that currently 50% of sows do not 'pay for themselves'. A 1997 survey by Laura Boyle found that almost 70% of sows culled for lameness had not produced a fourth litter. Hence, lameness is a substantial contributor to the premature culling of

sows and young sows in particular are more susceptible. In herds with a young parity profile due to premature culling for lameness there is a reduction in the number of pigs weaned per year because younger animals yield fewer pigs per litter than sows. This ultimately reduces the number of finisher pigs reaching the factory and farm income.

Culling for lameness is probably underestimated by producers because animals that are culled for poor body condition or reproductive failure are often lame too. Indeed lameness is likely a major driver of poor reproductive performance and infertility in sows. In a high proportion of lame sows internal infectious and inflammatory responses (i.e. the immune system) associated with pain are activated. This is very costly in terms of energy. Furthermore, the inflammatory process changes amino acid metabolism and the sow's amino acid requirements with proline and phenylalanine becoming more important than lysine. This explains why a lame sow could consume the same amount as a non lame sow but be in a poorer body condition. She is simply not utilising the nutrients consumed properly or efficiently. Furthermore, products of the inflammatory response such as cytokines are not only involved in connective tissue degradation which exacerbates the lameness problem but also disrupt the hormones controlling reproduction leading to poor fertility. This is why lame sows produce at least 1.5 fewer litters than sound sows during their productive life. Poor mobility and pain caused by lameness results in reduced lactation feed intake which has an indirect negative impact on the future performance of the litter and on the sow's subsequent reproductive performance. Poor mobility also increases the likelihood of piglets being crushed. Indeed piglet losses due to crushing by lame sows are 15% higher than from sound animals.

The extent of the expenses associated with treating lameness in sows is firstly dependent on whether or not any veterinary action is taken. Often with lame sows the only 'treatment' is to cull after production of the litter. It is less regular that lame sows are euthanised. In the 1997 culling survey lameness was responsible for 11.3% of sow removals in a study on a sample of Irish commercial pig farms. Similarly, a Swedish study found that lameness and foot lesions were responsible for 8.6% of sow removals, with 32.1% of these requiring euthanasia. It is worth noting that as it is illegal to sell lame sows in some Scandinavian countries the rates of euthanasia for lameness are much higher than in Ireland. With finishers, treatment more often includes antibiotics. Indeed lameness is the 3rd most common cause for treatment with antibiotics in weaner and finishing pigs. Pain relievers are used much less often but all of these measures are associated with substantial costs (labour, drugs etc.).

Causes of lameness

Limb lesions

Injuries to the limbs may result in lameness. The most common limb lesions in weaners, finishers and sows are calluses, swellings, wounds, external abscesses and bursitis. Their severity can vary from mild to very severe (Figure 2, a-e). Studies reported an increased risk of lameness associated with higher callus, bursitis and capped hock scores on the limbs of finishing pigs. It is difficult to say whether this is because limb lesions cause discomfort or because lame pigs spend more time lying and that this increases the risk of limb lesions. Limb lesions are highly prevalent in piglets with between 80-90% of piglets being affected by lesions; largely skin abrasions to the front limbs (Figure 2, f).

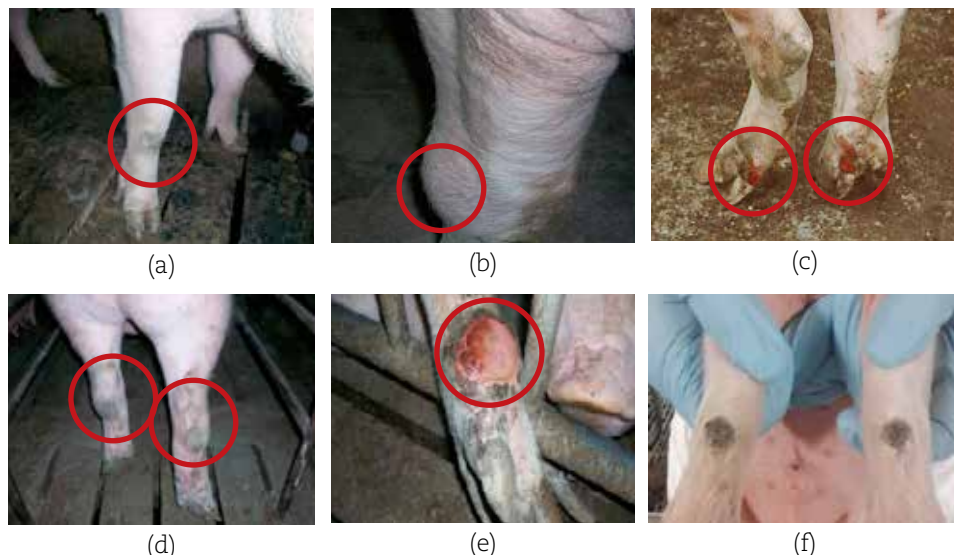


Figure 2. Limb lesions commonly seen in pigs: (a) callus; (b) swelling; (c) wounds; (d) bursitis; (e) external abscess/severe wound; (f) skin abrasions in piglets

Claw lesions

While a high proportion of sows (between 96-100%) have at least one lesion present on each claw, claw lesions only account for between 5-20% of sow lameness. The relationship between lameness and claw lesions may be dependent on the location and seriousness of the lesion. Some areas of the claw are more sensitive than others meaning that minor lesions may not result in pain and therefore not cause the animal to be lame. One of the major causes of injuries to the claws (and limbs) is fighting on concrete/slatted flooring at mixing. Even after the dominance hierarchy is established pigs will continue to fight if they are overstocked or have to compete for access to food (e.g. in long trough/floor feeding systems). Injuries to the claws (Figure 3) and limbs commonly include partial or whole amputation of the dew claws, tearing of pre-existing areas of overgrowth in the heel or splitting of existing cracks in the weight bearing claws. In the absence of any treatment such injuries can become infected and in extreme cases lead to osteomyelitis (infection of the bone) and ultimately to death or culling. Claw lesions are thought to be more severe in sows than in weaners and finishers. There is also a high prevalence of claw lesions in piglets with sole bruising and erosion being among the most common lesions.

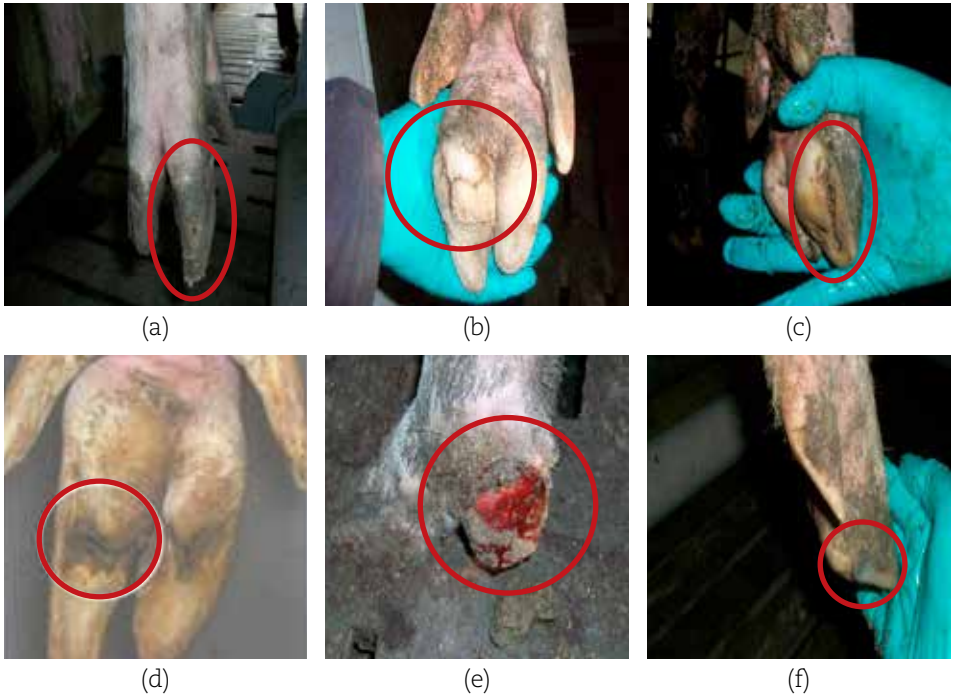


Figure 3. Claw lesions: (a) toe overgrowth; (b) heel overgrowth and/or erosion; (c) white line damage; (d) heel sole crack; (e) dew claw injuries; (f) vertical cracks in the wall

Osteochondrosis

Osteochondrosis is another major cause of lameness (and secondary degenerative joint disease or osteoarthritis) in pigs. Osteochondrosis develops when areas of the growth cartilage (or growth 'plates' which are responsible for the growth of bones in length) experience restricted blood flow and die causing pain and lameness. It causes increased pressure on the surface of an affected joint in developing animals. It is most common and severe in the elbow joint of pigs however, unlike claw and joint lesions Osteochondrosis is difficult to diagnose in live animals.

Other causes of lameness include infectious arthritis, arthrosis and trauma to the limbs/fractures.

Risk factors for lameness

Housing type

Housing type is one of the major factors influencing lameness in commercial pig farms. It influences the amount and type of movements the pig can make. Individual housing in gestation stalls contributes to lameness via reduced bone strength and muscle mass, and joint damage due to lack of exercise. The EU Directive 2001/88/EC states that in all 25 member states “sows and gilts shall be kept in groups during a period starting from 4 weeks after the service to 1 week before the expected time of farrowing” since January 2013. Group housing during gestation has several welfare benefits for sows including greater freedom of movement which allows for exercise and social interactions. However, group housing also present some disadvantages such as fighting among newly mixed unfamiliar sows and injuries that could ultimately lead to lameness.

In a study conducted at the Moorepark Pig Unit, lameness, claw and limb lesion scores were compared between 42 multiparous sows housed in stalls and 43 sows kept in a single dynamic group with an electronic sow feeder during gestation. All sows were on concrete, predominately fully slatted flooring, although the group housed animals had solid floored lying bays. Seventy-four-percent of group housed sows and 33% of individually housed sows were lame on transfer to the farrowing crate (day 110 of gestation). Furthermore, the number of severely lame sows was higher among the group housed sows (Table 1). Additionally, group housed sows had higher scores for claw lesions on the heel area such as heel overgrowth and/or erosion (Figure 4) and a higher risk of wounds on the limbs and swellings on the hind limbs (i.e. bursitis; Figure 2) compared to sows housed individually. However, individually housed sows were at greater risk of a wider range of claw lesions including white line damage, horizontal cracks in the wall and dew claw injuries on the day of transfer to the farrowing crate.

Table 1. Number of sows housed in individual gestation stalls or in a single dynamic group with an electronic sow feeder during gestation that received each lameness score on transfer to the farrowing crate at day 110 of pregnancy		
Lameness score	Group housing	Gestation stalls
0	0	5
1	11	23
2	19	11
≥3	13	3
Total	42	43

These findings confirm that the problem of lameness in Irish sows will increase with the change to group housing systems. The main reason for this is the widespread use of fully slatted concrete flooring, minimal space allowances and competitive feeding systems all of which are associated with an increased risk of lameness.

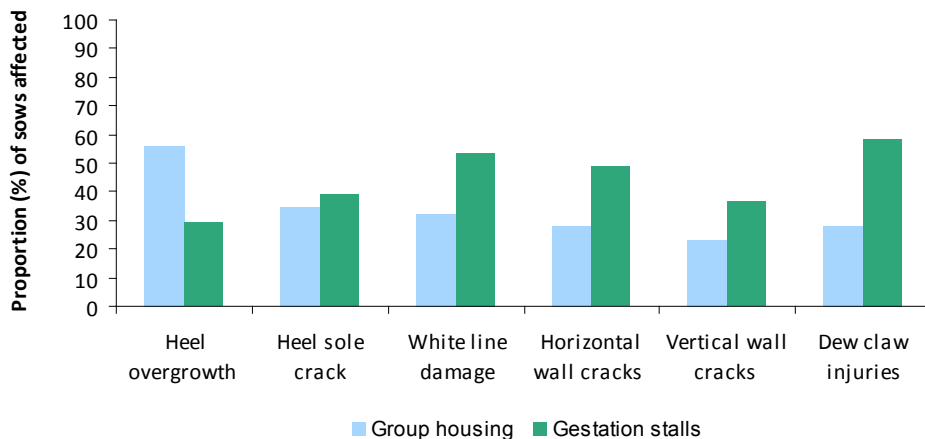


Figure 4. Proportion of sows housed in individual gestation stalls or in a single dynamic group with an electronic sow feeder during gestation affected by high claw lesion scores

Floor type

Flooring type can be a major influencing factor on lameness and claw health as the pig has continual contact with the floor surface. An ideal floor for pigs should be soft, clean, not slippery and not abrasive; the surface should be even and without sharp edges. It should not become deformed, deteriorate or demand high maintenance. Furthermore, it should minimise animal discomfort and the risk of injuries and provide the pigs with the opportunity of a normal gait.

In the majority of Irish pig units, slatted concrete floors are used and such floors increase the risk of lameness. Slatted floors present some disadvantages to the animals such as an uneven walking surface and the lack of bedding. Finnish researchers found that sows housed on slatted floors were 3.7 times more likely to be severely lame compared to sows housed on solid floors. Softness plays an important role in physical comfort and softer floors like straw bedding or rubber mattresses are preferred to harder floors. However, the use of bedding is not compatible with modern intensive pig production systems. Rubber mattresses appear to be a good alternative to the use of bedding since it is comfortable and firm, dry and clean and has low thermal conductivity. Research from Moorepark showed that the use of rubber mats in farrowing crates improved the posture changing ability of sows by providing more comfort and better foothold on slatted steel (Tribar type) floors.

A more recent Moorepark experiment found that sows kept on slatted steel (Tribar) floors in the farrowing crate were at higher risk of heel overgrowth and/or erosion, heel sole crack and horizontal cracks in the wall than sows on cast iron flooring (Figure 5). These results are most likely related to the high void ratio associated with slatted steel floor types. If the void ratio is higher than 40%, pigs weighing 100 kg or more experience injuries in the heel region. This is likely due to the greater pressure applied to the claw when the area of contact of the foot with the ground is decreased.

The high void area associated with slatted steel/metal (Tribar type) floors is also a major contributor to limb and claw injuries in piglets. Injury to the coronary band often occurs when piglets feet slip between these slats or become caught in the slats. This injury is much less common with plastic/plastic covered woven wire floor types. In farrowing crates piglets commonly get skin abrasions to the front legs as they fight to establish the teat order on abrasive flooring. The majority of piglets have sole bruising and they may also incur sole erosion due to the abrasive properties of the floors used in farrowing crates. Indeed, the prevalence of skin and foot abrasions in piglets is positively associated with concrete flooring.

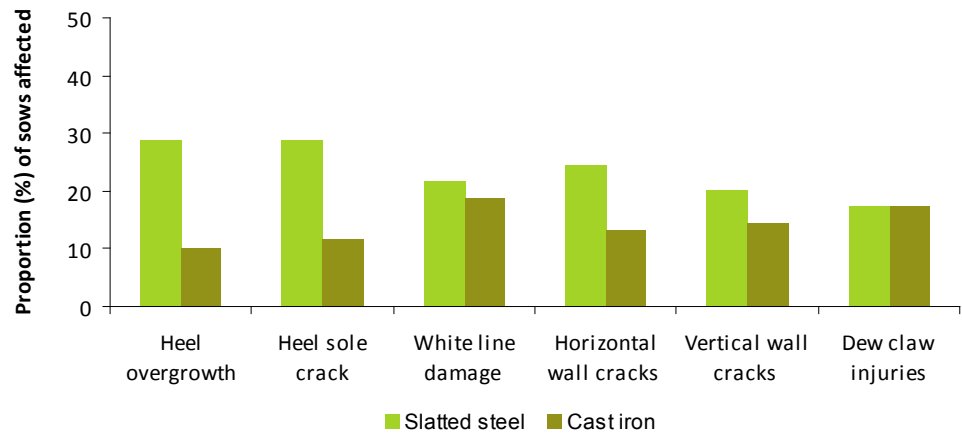


Figure 5. Proportion of sows housed on slatted steel or cast iron floor during lactation affected by high claw lesion scores

In our lameness survey we found a high prevalence of limb abrasions, sole bruising and coronary band damage in suckling piglets (Figure 6). Most of these were strongly associated with piglet age (Figure 6). For example, the proportion of piglets affected by skin abrasions increased with age while the proportion of piglets affected with coronary band damage decreased with age. All of the lesions recorded were strongly associated with the presence of metal/steel slatted flooring in the farrowing crate. As such lesions are a potential route for the entry of infection and are a welfare concern. The use of such flooring in farrowing crates should be re-considered.

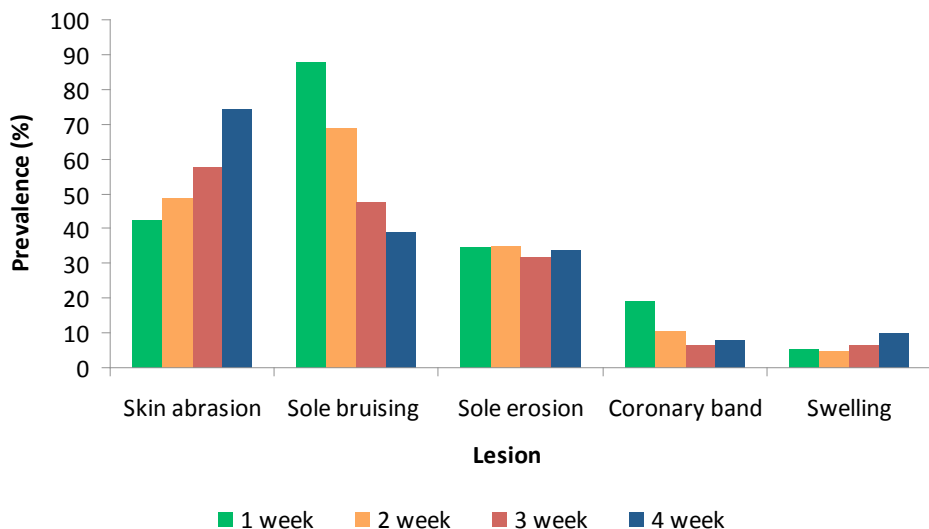


Figure 6. The prevalence of limb and claw lesions in preweaner piglets

For finishers, replacement gilts and pregnant sows we identified an increased risk of lameness associated with concrete slats having voids wider than 1.8cm. Finally for finishers on farms where the pens were cleaned fewer than 4 times per year there was more lameness.

Improving sow comfort to ensure good health and welfare in group housing systems

Julia Adriana Calderón Díaz

Introduction

Concrete flooring is commonly used in pig units because of advantages such as durability, resistance to wear and ease of cleaning. However, hardness, abrasiveness and slipperiness are less desired characteristics of concrete flooring because of their relationship with lameness. The abrasiveness of concrete contributes to removal of claw horn which predisposes to claw lesions. The hardness of concrete floors means that increased pressure is applied to the claw while animals are standing and this irritates the corium (the living tissue inside the claw from which claw horn is produced) and disturbs blood flow in the foot. This accelerates the development of sole lesions and other forms of lameness. The hardness of concrete flooring also places considerable strain on the joints while animals are lying down.

Bedding in the form of straw, sawdust, wood chips etc. overcomes many of the challenges presented by concrete floors; however, the use of bedding is not practical in the majority of modern intensive pig production systems because of the liquid manure disposal systems, the associated increase in production costs and labour and perceived hygiene issues (e.g. salmonella).

The use of rubber mats in conjunction with concrete flooring offers a novel means of addressing lameness. Rubber can improve animal comfort while lying as it is more yielding than concrete and the fact that its thermal conductivity is low means that it has good insulating properties. The compressibility of rubber means that it provides more secure footing compared with concrete floors by ensuring a greater area of contact between the claw and the floor. This also ensures a better distribution of pressure in the claw which in turn reduces the impact load on joints and claws when walking and standing. The cushioning effect of rubber even seems to improve the circulation of blood in the foot. Finally if an animal falls on rubber, the flooring absorbs more of the impact/shock than concrete reducing the likelihood of lameness arising from traumatic injuries to the joints.

There is limited research on the use of rubber slat mats in sow accommodation. However, two short term studies, reported welfare benefits for group housed sows on rubber flooring such as lower body lesion scores and greater ease of changing posture. Furthermore, sows preferred to rest on rubber flooring compared with concrete flooring during the early post weaning period.

Two experiments were conducted to determine the prevalence and risk factors for lameness in group housed sows and to evaluate the effect of rubber flooring on the welfare of group housed sows.

Study 1: Longitudinal study in a commercial farm

The negative effect of group housing sows on concrete slats could be ameliorated by the use of bedding. Indeed anecdotal reports from pig producers suggest that lame sows recover rapidly if kept on bedding. Bedding improves the physical and thermal comfort of the floor. However, as previously mentioned, the use of straw is impractical in modern pig production systems and rubber slat mats could be an alternative to bedding for pigs. Numerous studies with dairy cows and beef cattle point to substantial health, welfare and productivity improvements associated with the use of rubber mats.

In a study on a commercial farm, 164 replacement gilts were housed in groups of 8 in pens with free access feeding stalls during two parities. The entire flooring in the pen was either left uncovered or was fitted with rubber slat mats. Our results showed that sows on rubber slat mats were at lower risk of lameness, swellings and wounds on their limbs compared to sows housed on concrete slats. It is important to note that the claw lesions recorded in this study were generally not severe (although 11 sows were culled due to leg problems). However, sows on rubber were at higher risk of claw lesions such as toe overgrowth, heel sole crack and white line damage (Figures 7 & 8).

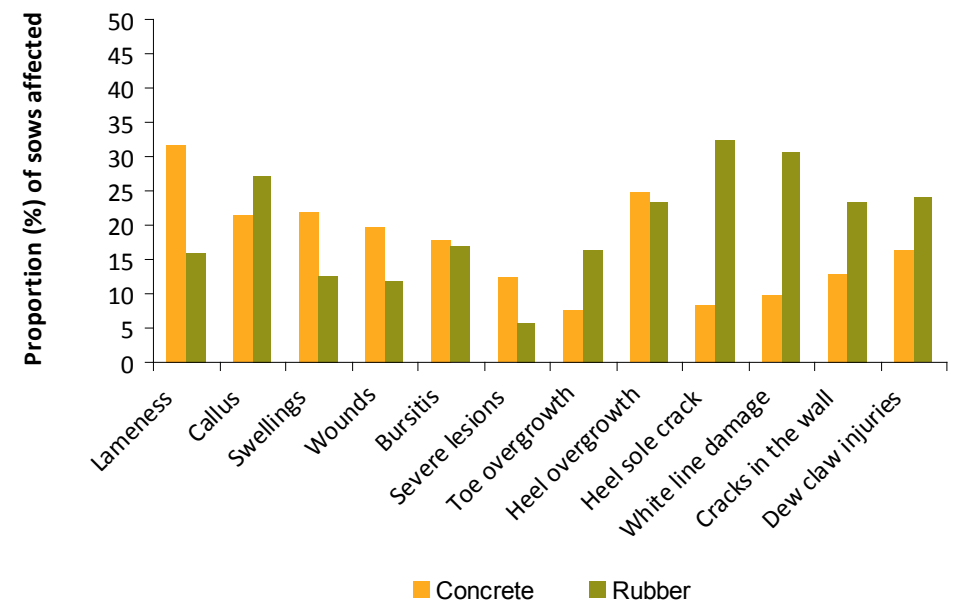


Figure 7. Proportion (average across inspections) of sows housed on concrete slats or on rubber slat mats that were lame and the proportion of sows affected by high claw and limb lesion scores during their first parity.

It is likely that this was related to the dirtiness of the rubber flooring treatment which was due to the slightly lower void area (9.7%) in the pens covered with rubber slat mats compared to the uncovered pens (6%). Contact with manure and wet surfaces can reduce claw hardness. This combined with the chemical and bacterial challenges associated with dirty conditions makes the claws more susceptible to injury. This would likely have the greatest impact on lesions to the white line and

heel sole junction as these locations represent the weakest parts of the hoof. It is also likely that the rubber slat mats were less abrasive than the concrete slats. Hence the higher scores for toe length in sows housed on rubber mats could be explained by insufficient wear of the claws.

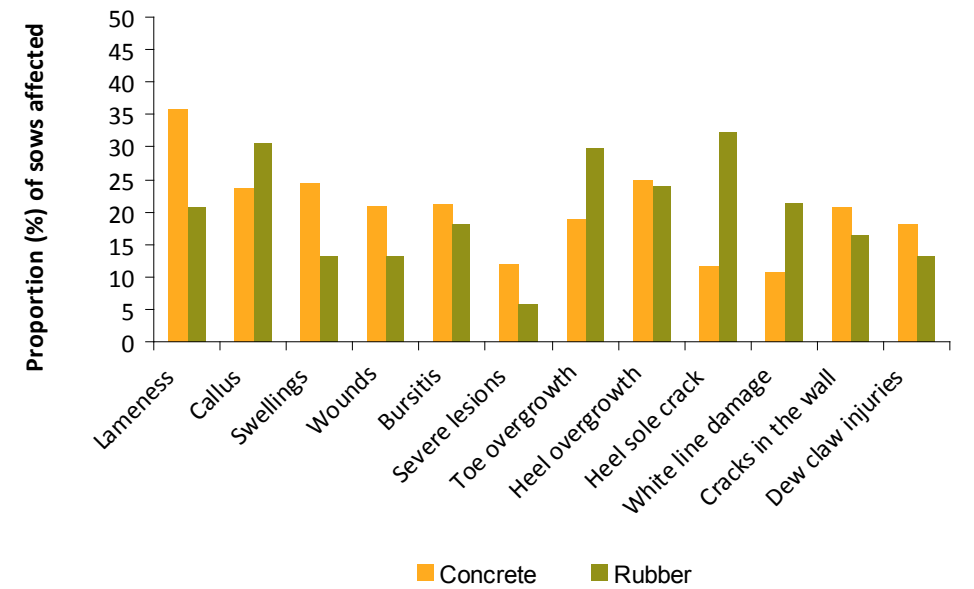


Figure 8. Proportion (average across inspections) of sows housed on concrete slats or on rubber slat mats that were lame and the proportion of sows affected by high claw and limb lesion scores during their second parity

Key Findings

- Sows housed in groups on rubber slat mats had a lower risk of becoming lame during both parities.
- All sows included in the study were affected by at least one claw lesion.
- Sows housed on rubber slat mats were at higher risk of claw lesions but these were unrelated to lameness in this study.
- Sows housed on rubber slat mats had fewer/less severe swellings and wounds to the limbs over both parities.
- The majority of sows culled for lameness/leg problems came from pens in which the flooring was bare concrete slats.

Study 2: Effect of rubber flooring on the behaviour of group housed sows

As pregnant sows spend about 80% of their time lying, comfort during this time is of vital importance to their health and welfare. Lack of comfort while lying increases the risk of decubital ulcers (pressure sores), fluid filled bursae on the limbs (bursitis) and places strains on the locomotory system. Given that the majority of pregnant sows worldwide are kept on concrete floors it is likely that their comfort needs are not being met.

In this experiment, 64 sows were housed in groups of four in pens with solid concrete floored feeding stalls and a slatted group area from 28d after service. In two of the experimental pens the slatted group area was covered with rubber slat mats and in the other two pens the group area was uncovered. In all pens the feeding stalls were unaltered. Sow behaviour was recorded on video for 24h on five days during pregnancy and we calculated an index of the proportion of time they spent in different postures [standing, ventral and lateral lying and total time lying (ventral and lateral lying summed)], locations (group area or feeding stalls) and postures by location. We did not find any difference between the time sows spent in the different postures. However, sows with rubber slat mats in the group area spent more time there than in the feeding stalls (Figure 9) and stood less and lay more in the group area compared with sows housed on concrete slats (Figure 10). This reflects sows preference for a comfortable surface for lying.

Key Findings

- There was no difference in the time sows spent in different postures.
- Sows with rubber slat mats in the group area spent more time in the group area.
- Sows with rubber slat mats spent more time lying in the group area, particularly lateral lying which is regarded as an indicator of comfort in pigs.

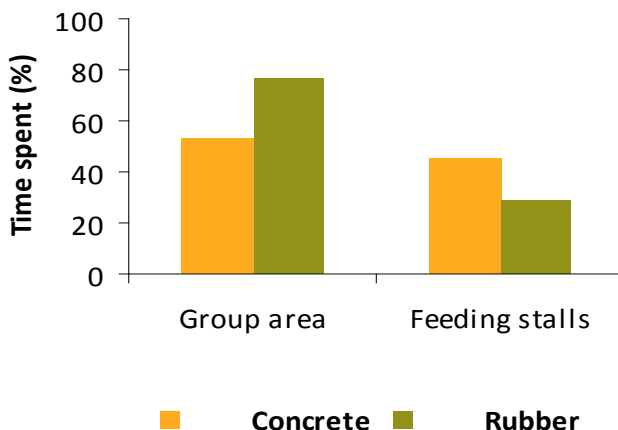


Figure 9. Proportion of time spent in the group area or in the feeding stalls.

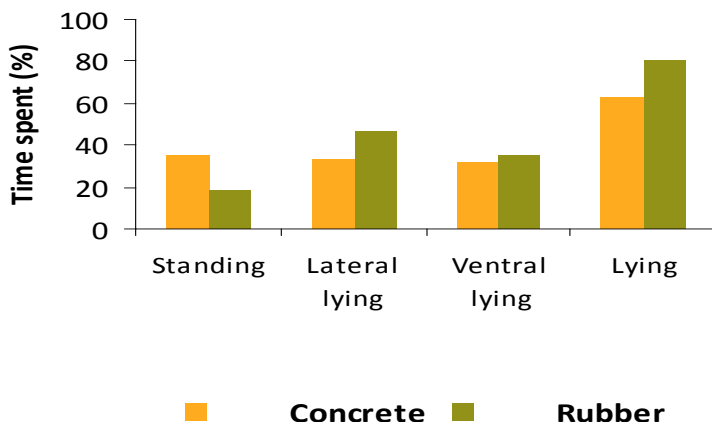


Figure 10. Proportion of time spent in different postures in the group area

Overall conclusions

Covering concrete slatted floors with rubber slat mats has the potential to improve sows' locomotory ability/reduce lameness. Sows housed on rubber slat mats had a reduced risk of lameness, swellings and wounds on the limbs during the first and second parity and a higher risk of calluses during the second parity compared with sows on concrete slatted floor. Additionally, sows housed on rubber slat mats had an increased risk of claw lesions such as toe overgrowth, heel sole crack, cracks in the wall and white line damage. Slurry accumulation on the rubber flooring used in this study suggests that if the sows were to have been housed on it long term their claw lesions may have deteriorated to the point where they exacerbated lameness. However, as the dirtiness problems were likely related to the low void area in the rubber slat mats this problem could be overcome by improvements to the design of the flooring. Additionally, when sows had access to rubber flooring in the group area they spent more time in that area and lay more there compared with sows in pens where the concrete slats were bare. This confirms the preference of group housed sows for a comfortable surface for lying during pregnancy. In conclusion, the protective cushioning effect of rubber flooring leads to welfare improvements for group housed pregnant sows and this could help to improve the longevity of animals in the breeding herd.

Feeding a gilt developer diet will improve sow longevity and productivity

Amy Quinn

Introduction

Sow longevity is a key component of an efficient and profitable pig farming enterprise. However, the sow culling rate is steadily increasing at a rate of between 0.7% and 1% p.a. and currently stands at 50%, indicating that the longevity of Irish sows is declining. Efforts to improve sow longevity should be aimed at the replacement animals which are undervalued on many units. They need to be managed, housed and fed appropriately during the developmental phase to ensure that they are at a high level of health and are both physiologically and behaviourally mature on entry to the breeding herd. Our farm survey of lameness found that farms which housed gilts separately from finisher stock had a reduced risk of lameness in the replacement gilts and in the pregnant gilts and sows. We also found that the earlier gilts are managed separately to the finishers the larger the reduction in lameness (Figure 11).

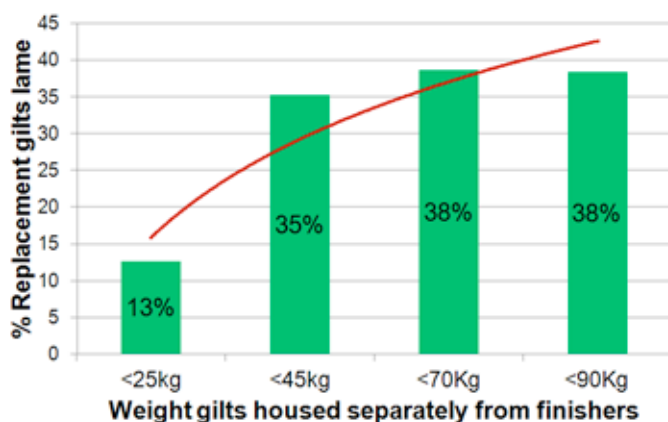


Figure 11. The proportion of lame gilts that were housed separately from finisher stock at various weights

Inappropriate nutrition during the developmental phase can contribute to the problem of lameness in replacement gilts. Many producers feed their replacement gilts one of two feeding regimes; a finisher diet to service or a gestation sow diet from 100 kg until service. Such regimes may not be optimum for the developing gilt; finisher diets are formulated for fast growth rates and high lean meat deposition and a gestating sow diet is formulated for a sow that has finished growing. In contrast, diets specifically formulated for the developing gilt take into account the nutritional requirement for bone development and fat deposition. High growth rates are linked with several pig welfare issues including osteochondrosis, leg weakness, postural defects, cardiovascular issues, increased skeletal injuries, modification of the release of various hormones and behavioural modifications. Replacement gilts require higher levels of calcium (Ca) and phosphorous (P) for bone mineralisation to prevent bone weaknesses and as a backup source of Ca and P for the litter requirement if

needed during gestation and lactation.

Studies suggest that trace minerals such as zinc, manganese and copper are crucial to hoof health. Zinc is essential for cellular repair and replacement and therefore increases the rate of wound healing. Copper is essential in the development of antibodies and the replication of lymphocytes, while manganese is vital for the formation and maintenance of cartilage and bone. Copper deficiency is associated with joint stiffness and enlargement, and weak or short bones. The dietary supplement Availa Sow® (www.zinpro.com) contains trace amounts of organic zinc, copper and manganese in a structure that makes the minerals more bioavailable than other forms, thus easier to absorb and utilise. Inclusion of Availa Sow® in the diet of breeding sows reduces heel erosion, heel overgrowth and white line lesions in sows and in one study reduced the removal rate of young sows from the herd (< parity 3) by 20%.

Two experiments were conducted at Moorepark to determine the effect of feeding a gilt developer diet on indicators of lameness in group housed replacement gilts.

Study 1: Limit feeding a developer diet

Limit feeding a gilt developer diet has the potential to reduce weight gain while providing the requirements of bone and claw development and maintenance and may result in improved locomotory ability and overall limb health when compared to the two most common feeding regimes. In the first experiment 36 Large White x Landrace gilts were selected, housed individually and assigned to one of following dietary treatments; finisher, gestating sow and developer, at 65 kg (Table 2). The dietary composition of the three treatments is detailed in Table 3.

Table 2. Feeding regime for developer, finisher and gestating sow treatments for study 1 (limit fed=2.25 kg/day)			
Weight range (kg)	Dietary treatment		
	Developer	Finisher	Gestating sow
65 - 100	Developer (limit fed)	Finisher (<i>ad-lib</i>)	Finisher (<i>ad-lib</i>)
100 - 130	Developer (limit fed)	Finisher (<i>ad-lib</i>)	Gestating (limit fed)
130 - 140	Developer (<i>ad-lib</i>)	Finisher (<i>ad-lib</i>)	Gestating (<i>ad-lib</i>)

Table 3. Composition of experimental diets (kg/t)			
Item	Developer	Finisher	Gestating sow
Barley	811.95	500	897.4
Wheat	0	348.7	0
Soybean (48%CP)	103.1	120	70
Soya oil	60	10	10
Lysine HCl	1	4	1
DL-Methionine	0	1	0
L-Threonine	0	1.2	0
Vit-Min Finisher	0	1	0
Vit-Min Sow	1.5	0	1.5
Phytase	0.1	0.1	0.1
Salt feed grade	4	3	4
Di-Calcium phosphate	6.5	0	5
Limestone flour	11	11	11
Availa Sow®	0.85	0	0
Chemical composition			
Digestible energy (MJ of DE/kg)	14.04	13.54	12.96
Lysine (g/kg)	7	9.76	6.35
Calcium (g/kg)	7.58	6.06	6.96
Phosphorous (g/kg)	4.9	3.74	4.62
Digestible phosphorus (g/kg)	3.32	2.41	3.2

The experiment lasted 12 weeks and the gilts were then slaughtered at c. 140 kg which was the target weight that corresponded to service. None of the gilts were lame when entering the experiment however, we found that from the fifth week of the trial onwards there were more lame gilts on the finisher and gestating sow dietary treatments than on the developer treatment (Table 4).

Table 4. Gilts (%) affected by lameness (scores of >1) in each of three dietary treatments at four stages during the Study 1			
Stage	Developer (%)	Finisher (%)	Gestating sow (%)
Day 0	0	0	0
Wk 1-4	0	9.1	9.1
Wk 5-8	0	9.1	20.8
Wk 9-12	0	17.7	14.6

We also found that by week 12, gilts on the developer treatment had the lowest occurrence of claw lesions when compared to the finisher and gestating sow treatments (Table 5). Additionally all gilts on the finisher and gestating sow treatments had uneven claws by week 12. Interestingly, on the developer treatment the proportion of gilts with uneven claws reduced as the trial progressed from 90.9% to 27.3%. These improvements in claw health may be attributed to the inclusion of the zinc, copper and manganese supplement, Availa Sow® in the developer treatment.

Table 5. Gilts [% (number) of animals affected] with claw lesions and uneven claw size in the three dietary treatments at three inspection points in study 1				
	Period	Dietary treatment		
		Developer	Finisher	Gestating sow
Claw lesions	wk 0	54.5 (6)	54.5 (6)	50 (6)
	wk 6	45.5 (5)	72.7 (8)	83.3 (10)
	wk 12	81.8 (9)	100 (12)	91.7(11)
Uneven claw size	wk 0	90.9 (10)	100 (11)	91.7 (11)
	wk 6	81.8 (9)	100 (11)	100 (12)
	wk 12	27.3 (3)	100 (11)	100 (12)

In addition we found that gilts on the developer treatment had lower surface lesion scores on the elbow joint than gilts in the gestating sow and finisher treatments (Table 6). It should be noted that gilts on the finisher treatment had the highest incidence of osteochondrosis dessicans (OCD) (score 5). We also observed differences in weight gain at weeks 4 and 10, with gilts on the developer treatment weighing less than gilts on the finisher and gestating sow treatments (Figure 12). This reduction in weight gain in the developer treatment may have contributed to the reduced joint lesion scores as fast weight gain is a known risk factor for joint lesions. We found no effect of treatment on limb lesions, bone mineral density (BMD) and carcass characteristics.

Table 6. Gilts [% (number) of animals affected] affected by surface lesions on the cartilage of bones in the elbow joint in study 1				
Joint surface lesions	Score	Dietary Treatment		
		Developer	Finisher	Gestating sow
Humeral condyle	1	36.4 (4)	0 (0)	0 (0)
	2	36.4 (4)	9.1 (1)	8.3 (1)
	3	0 (0)	18.2 (2)	16.7 (2)
	4	0 (0)	36.4 (4)	50 (6)
	5	27.3 (3)	36.4 (4)	25 (3)
Anconeal process		45.5 (5)	72.7 (8)	58.3 (7)

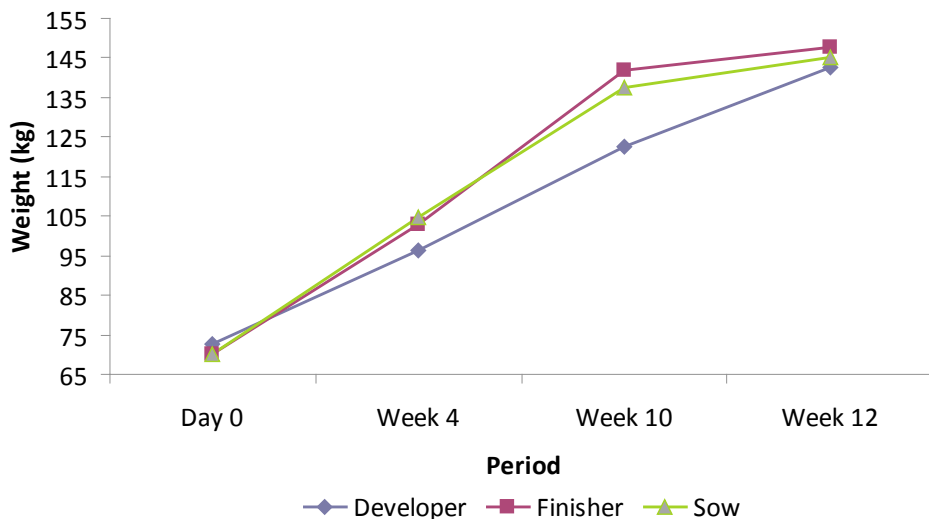


Figure 12. Average body weight of gilts on three treatments at day 0, week 4, week 10, week 12 in study 1.

Study 2: *Ad libitum* feeding a developer diet

Several advantages for pig locomotory health were detected when gilts were restricted fed a developer diet. However, on most farms replacement gilts are currently fed *ad libitum* so switching to a restricted feeding regime could be costly. Therefore we decided to investigate if the same benefits to locomotory health of limit feeding a developer diet could be seen when *ad libitum* feeding the same diet. In this experiment one hundred and eighty Large White x Landrace gilts were housed in 18 pens and assigned to the finisher, gestating sow and developer dietary treatments, from 65 kg to 140 kg over a 12 week period and fed according to Table 7. At selection, four focal pigs per pen were identified for more detailed measurements.

Table 7. Feeding regime for developer, finisher and gestating sow treatments for study 2

Weight range (kg)	Dietary treatment		
	Developer	Finisher	Gestating sow
60 - 100	Developer (<i>ad lib</i>)	Finisher (<i>ad lib</i>)	Finisher (<i>ad lib</i>)
100 - 140	Developer (<i>ad lib</i>)	Finisher (<i>ad lib</i>)	Gestating (<i>ad lib</i>)

We found that from week 5-8 and 9-12 more gilts were lame on the finisher and gestating sow dietary treatments than on the developer treatment (Table 8). We also found that by week 12, gilts on the finisher and gestating sow treatment had more claw lesions than gilts on the developer treatment but there was no effect of treatment on uneven claw size (Table 9). These improvements in claw health could be attributable to the inclusion of the Zinc Copper and manganese supplement, Availa Sow® in the developer treatment. In an *ad libitum* group feeding situation we found no effect of treatment on joint lesion scores, bone mineral density, body weight, lying behaviour or on carcass characteristics.

Ad libitum feeding a diet specifically formulated for developing gilts from 65 kg reduced lameness and claw abnormalities. Joint lesion benefits were not observed in this situation. The lack of a difference in weight gain between treatments may explain no difference in joint surface lesions in this scenario.

Table 8. Gilts (%) affected by lameness (scores of >1) in each of three dietary treatments at day 0 and over 3 periods of the trial in study 2			
Period	Developer	Finisher	Gestating sow
Day 0	0	0	0
Wk 1-4	0	8.3	3.1
Wk 5-8	5.2	7.3	10.4
Wk 9-12	8.3	21.9	17.7

Table 9. Gilts [% (number of animals)] with claw lesions and uneven claw size in the three dietary treatments at three inspection points in study 2				
	Period	Dietary treatment		
		Developer	Finisher	Gestating sow
Claw lesions	wk 0	33.3 (8)	29.2 (7)	37.5 (9)
	wk 6	83.3 (20)	79.2 (19)	83.3 (20)
	wk 12	83.3 (20)	95.8 (23)	100 (24)
Uneven claw size	wk 0	91.7 (22)	91.7 (22)	95.8 (23)
	wk 6	58.3 (14)	58.3 (14)	66.7 (16)
	wk 12	41.7 (10)	54.2 (13)	75 (18)

In conclusion, feeding a diet specifically formulated for developing gilts from 65 kg reduced lameness when both limit and *ad libitum* fed when compared to the two most commonly practiced feeding regimes. Gilts limit fed a developer diet showed reduced claw abnormalities and joint surface lesions of the cartilage in the elbow joint. Gilts that were *ad libitum* fed a developer diet showed reduced claw abnormalities. *Ad libitum* feeding a developer diet showed no difference in weight gain and as a result may have resulted in no difference in joint surface lesions between treatments. The improvements observed would be expected to translate into improved welfare, longevity and productivity of the breeding herd.

Key Findings:

Restricted feeding of a diet specially formulated for developing gilts from 65 kg:

- Reduced lameness
- Reduced claw lesions
- Reduced joint surface lesions of the humeral condyle
- Did not affect time to reach target weight

Ad libitum feeding of a diet specially formulated for developing gilts from 65 kg:

- Reduced lameness
- Reduced claw lesions
- No effect on joint lesions
- No effect on growth rate

Key recommendation:

House gilts separately from finisher stock and feed a diet specially formulated for gilt development (restrictively if possible) from 65 kg or earlier.

Key project findings

- Very high levels of lameness in finishers, gilts and sows on Irish farms. Almost 50% of loose housed pregnant sows and gilts are lame.
- Lameness is set to become more of a problem in the breeding herd with the change to group housing because of the higher risk of injuries to the claw on fully slatted floors
- Rubber flooring can help to overcome the problem of lameness in fully slatted group housing systems, it significantly improves sow comfort and may reduce culling for lameness
- The use of cast iron rather than slatted metal/steel floors in farrowing crates can also help to reduce lameness in sows
- Housing gilts separately from finisher stock from a young age reduces gilt lameness
- There is an increased risk of lameness in finishers associated with voids wider than 1.8mm and with infrequent cleaning of pens
- The use of slatted steel/metal flooring in the farrowing crate increases the risk of claw lesions in piglets
- 100% of multiparous sows are affected by claw lesions irrespective of the way they are housed during pregnancy
- On finisher or gestating sow diets over 90% of replacement gilts are affected by claw lesions at the time of service (i.e. at 140 kg)
- Mineral supplements reduce claw lesions in group housed gilts
- Slowing the growth rate of replacement gilts reduces the severity of joint lesions
- Combining these two features in a specially formulated 'developer diet' for replacement gilts could improve sow productivity and longevity

Acknowledgements

The research which will be presented today was partially funded by Enterprise Ireland and EasyFix™ Rubber Products through an Innovation Partnership Grant Agreement (research work by Ms. Julia Calderon Diaz). Ms. Amy Quinn's research was funded by Teagasc grant in-aid. Other partners on the project included Dr. Peadar Lawlor of Teagasc, Dr. Alan Fahey of University College Dublin and Prof. Laura Green and Dr. Amy Kilbride of The University of Warwick in the UK. We'd like to acknowledge the team at Zinpro Animal Nutrition Inc., for several insightful discussions on lameness. Recognition is also due to the pig producers who participated in the lameness survey and flooring trials. Finally great credit is due to the two PhD candidates Amy Quinn and Julia Calderon Díaz who have worked diligently on this project over the past three years. During this time they were ably assisted by staff at Moorepark pig unit and too many work placement students to mention individually!

Appendix

Detection, prevention and treatment of lameness in sows

Lameness detection

Awareness is the first step in addressing the problem of lameness. This has to start with an assessment of reasons for culling sows, and sow replacement and mortality rates. It can also help to note whether sows being culled for reproductive/poor performance are also lame and to start keeping track of the number of sows you see with missing dew claws and external abscesses on their limbs. The farrowing house is a good place for this. Lameness is much easier to identify in group compared to individually (i.e. stall) housed sows. Provided that gilts/sows are not overstocked clinical (i.e. severe) lameness is relatively easy to detect in any group system but especially those in which sows are fed simultaneously at specific times of the day. In such systems, sows are usually observed during feeding and animals that don't stand up or that have obvious difficulty moving to the trough at the point of feed delivery are clearly visible. However, detecting sows in the earlier stages of lameness at which time they are more likely to respond to treatment requires a more specific lameness protocol or locomotion scoring system. Visual locomotion scoring systems take the speed of walking and indications of asymmetry such as step length, head and hindquarter movements, willingness to walk and contact between the feet and the floor into account. They do not give any information as to the cause of lameness. The best time to do locomotion scoring is on transfer to the farrowing house when sows walk down dry level surface. A simple scoring system involves a three point scale where no lameness = 0, mildly lame = 1 and clearly lame = 2. A mildly lame animal moves freely from one location to another but has an abnormal gait and a clearly lame sow needs encouragement to move. It is important to remember that lame sows will tend to move better immediately after weaning when their body condition is lighter so this is not a good time to diagnose lameness in the sow herd.

Lameness prevention

Clearly there are very good reasons why we should try to prevent lameness in sows. This is complicated by the fact that lameness is a multi-factorial problem with genetic, mechanical, chemical and biological processes involved. However, the majority of sows are affected by claw lesions and the risk factors for these are well understood. For example, improvements can be made to the housing environment such as replacing damaged slats and to management by ensuring that gilts have good conformation at selection and mixing them in specialised pens to protect the feet. However, two less well known, but essential factors in the prevention of claw lesions is a claw care/trimming program and supplementing the diet with trace minerals.

Claw inspections

Incorporating routine foot inspections into the management program for breeding sows is the first step in addressing claw lesions. This will enable the producer to become familiar with different types of claw lesions and the anatomy of the foot.

Routine inspections will also mean that the lesions can be monitored such that intervention happens early rather than later to prevent lameness occurring. The best time to do this is when sows are lying down in the farrowing accommodation. The ultimate goal should be to incorporate corrective claw trimming into the management program for breeding sows.

Feed trace minerals

Research in North America shows that sows in a highly prolific herd maintained mineral stores across 7 parities. This is also likely to be the case in Europe where feeding regimes are even better matched to requirements. Nevertheless nutrition is vital in developing the hoof structure and the importance of the trace minerals manganese, zinc and copper in the keratinisation process is well known. Hence, supplementing the diet with additional trace minerals could help to prevent lameness caused by claw lesions. Research from the University of Minnesota showed that sows fed a diet iso-substituted with complex trace minerals (CTM) had lower total claw lesion scores and a lower proportion of lame sows compared to sows fed inorganic trace minerals. Interestingly sows fed CTM also had more piglets born alive compared to sows fed inorganic trace minerals (11.07 vs. 10.44 piglets per litter). Biotin is another essential component of hoof health. However, if biotin levels are too high the claws can become overgrown. It is best to check biotin levels in the sow diet with your nutritionist on a regular basis.

Incorporate a lime box in the ESF station

Dutch vets recommend putting a tray filled with dry lime (seek veterinary advice) into the ESF station for sows to stand in while eating. The lime dries out and disinfects the feet every time the sow enters the station and this could help to prevent lameness.

Treatment of lame sows

Prevention is clearly better than cure but where sows become lame they can recover with appropriate care and treatment. Unfortunately this is lacking on many units where often the only 'treatment' is to cull and too less often, to euthanize, the affected animal. We forget the tremendous investment of money, time and resources that are associated with bringing a replacement female into the herd. It may make better economical sense to try and keep a lame sow with good performance records in the herd by treating her rather than to introduce a young and unproven gilt in her place.

Lame sows and especially those with claw injuries (e.g. dew claw amputation) should be kept in a solid floored, bedded or rubber mat covered recovery pen where they do not have to compete for food and water. Treat sows with anti-inflammatory drugs and broad-spectrum antibiotics to improve chances of recovery lame sows should also be given analgesics (pain killers); the pain relief they provide encourages sows to get up and walk around and to eat and drink thereby speeding up their recovery. The surface of exposed, cleaned lesions may be sprayed with antibiotic, e.g. tetracycline or dusted with an antibiotic wound powder. Culling should not be delayed for sows that do not recover following the treatment outlined above. Sows that have great difficulty walking or that are clearly in a lot of pain should not be sent for slaughter and instead euthanised as soon as possible.

Contact Details

Pig Development Department,
Teagasc,
Moorepark,
Fermoy,
Co. Cork

Tel : 353 (0)25 42389

Fax : 353 (0)25 42340

Email: PigDepartment@teagasc.ie

www.teagasc.ie

