

APPENDIX 1

The current status of animal welfare science relating to housing of pregnant sows

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Summary

The current Code setting out standards for housing of pigs allows pregnant sows to be held in stalls for the entirety of any pregnancy (which lasts about 16 weeks in a pig) until 2017, after which this form of housing can only be used in the first 6 weeks of any gestation period.

This brief review of the current science relating to the housing of pregnant sows in stalls compared to groups shows that:

- sows housed in stalls are virtually unable to express many important natural behaviours;
- sows housed in stalls suffer severe behavioural impairment, as indicated by the high incidence of stereotypic and other abnormal behaviour indicative of poor welfare;
- sows housed in stalls suffer significant leg problems, resulting in lameness;
- sows in groups may suffer from aggressive interactions with other sows, but this can be controlled by good management techniques, particularly the use of partial sow stalls to afford protection to individual sows while feeding;
- the reproductive performance of sows housed in either stalls or groups is equivalent where properly-managed group housing is employed.

Consequently, the current animal welfare science supports a ban on the use of sow stalls in Australia.

Introduction

The 'standards' of the *Model Code of Practice for the Welfare of Animals – Pigs* (3rd Edition – the Code) have so far been made mandatory by adoption in legislation in New South Wales and South Australia. The Code contains several standards relating to the housing of sows in stalls and specifically permits the keeping of pregnant sows in stalls for the entirety of the gestation period until 2017, after which a sow can only be kept in a stall for a maximum of 6 weeks of any gestation period.

Given the moves away from sow stall housing in several jurisdictions (both in terms of legislation and producer policy), it is appropriate to review current scientific evidence concerning the welfare of pregnant sows held in sow stalls compared to housing in groups. This process has been aided by several excellent reviews which cover the scientific literature in this area up to about 2004.^{24 25 26 27}

24 Von Borell EH, Broom DM, Csermely D, Dijkhouzen AA, Edwards SA, Jensen P, Madec F, Stamataris C. The welfare of intensively kept pigs. Report of the Scientific Veterinary Committee of the European Union.

The aim of this review is to summarise and update the latest evidence; in doing so it will refer to conclusions from those reviews and also to more recent studies which have been published since the most recent Code review was initiated (in about 2005).

Welfare of pregnant sows housed in stalls versus groups

As a preliminary comment, it is important to note that the Code, while stipulating that new sow stalls must have dimensions of at least 0.6m by 2.2m, allows existing stalls of any size to be used provided that sows can in effect be accommodated in the stall without touching both sides of the stall (when standing), and without simultaneously touching both the rear and front of the stall (when lying down). Most reported studies do not report the dimensions of the subject animals. Consequently, it may be that the data in those studies (and conclusions from those studies) may not relate to what happens in practice. It is clear (albeit from studies carried out outside Australia) that industry-standard sow stalls may not be large enough for sows, especially with increasing parity numbers and at advanced stages of pregnancy, when sows are at their maximum size.^{28 29} Furthermore, it is apparent that, even though the Code stipulates that pregnant sows should be able to easily stand up and lie down, the width of the stalls specified in the Code (0.6m) is inadequate to allow this to occur in any case.³⁰

The assessment of a pregnant sow's welfare should relate to the state of each individual animal. This is currently reflected in Australian animal cruelty law.³¹ There is no justification for assessing welfare on a "herd" or "group" basis, as has been espoused by the pork industry.³²

Broom's view, which is widely accepted, is that the welfare of an animal is its state as regards its attempts to cope with its environment.³³ The consideration of the state of welfare of an animal is a complex issue and the accepted current practice is that assessment of welfare must consider a range of indicators, including behaviour, physiology, ability to grow and breed and injury.³⁴

Behaviour

Sows show preferences for food, water, social companions and avoidance of danger. Pigs are highly

http://ec.europa.eu/food/fs/sc/oldcomm4/out17_en.pdf. 1997. Accessed 18 June 2010.

25 Barnett JL, Hemsworth PH, Cronin GM, Jongman EC, Hutson GD. A review of the welfare issues for sows and piglets in relation to housing. *Aust J Agric Res* 2001;52:1-28.

26 McGlone JJ, Von Borell EH, Deen J et al. Review: compilation of the scientific literature comparing housing systems for gestating sows and gilts using measures of physiology, behavior, performance and health. *Prof Anim Sci* 2004; 20:105-117.

27 Rhodes RT, Appleby MC, Chinn K et al. A comprehensive review of housing for pregnant sows. *J Am Vet Med Assoc* 2005;227:1580-1590.

28 O'Connell MK, Lynch PB, Bertholot, S, Verlait F, Lawlor PG. Measuring changes in physical size and predicting weight of sows during gestation. *Animal* 2007; 1:1335-1343.

29 McGlone JJ, Vines B, Rudine AC, DuBois P. The physical size of gestating sows. *J Anim Sci* 2004; 82:2421-2427.

30 see the review of this issue in Algers B et al (2007) Scientific report on animal health and welfare aspects of different housing and husbandry systems for adult breeding boars, pregnant, farrowing sows and unweaned piglets. *EFSA J* 572, 1.

31 Caulfield MP *Handbook of Australian Animal Cruelty Law*. Animals Australia, Melbourne, 2009.

32 Plowman K, Peason A, Topfer J. Animals and the law in Australia: a livestock industry perspective. *Reform* 2008;91:25-29.

33 Broom DM. Indicators of poor welfare. *Br Vet J* 1986;142:524-526.

34 Broom DM, Johnson KM *Stress and Animal Welfare*. Chapman and Hall, London, 1993.

intelligent animals and social interactions between sows are usually friendly rather than aggressive. They will, if allowed, spend considerable time exploring their environment, particularly exhibiting rooting behaviour and manipulating materials such as straw. Sow stall housing severely restricts movement, foraging and social behaviour leading to changes in behaviour which indicate poor welfare.

Stereotypic behaviour is repetitive, invariant behaviour that lacks any obvious function. It includes behaviour such as prolonged sham chewing or bar biting. Sterotypic behaviour is an indication that a sow is having difficulty coping with its environment and indicates a state of poor welfare. Many studies of sows housed in stalls have reported a high incidence of stereotypic behaviour, which occurs at a much lower incidence in group-housed sows.³⁵ That behaviour can be reduced where the sow has access to manipulable material such as straw.

The movement of pregnant sows into stalls was originally driven by the industry perception that stall housing reduced aggression between sows and made handling and feeding easier; misgivings about the negative behavioural effects of confining sows in stalls were tempered by the perceived production and economic benefits. The small size of sow stalls is primarily based on the need to minimise costs.³⁶

Sows kept both in stalls and in group housing can suffer from aggression from other sows. However, the welfare consequences of aggression in group housing can be greater, as sows may injure one another in that situation. Much of this aggression in group housing is related to competition for food, and feeding in individual feeding stalls can significantly reduce fighting at feeding time to low levels. There appears to be a particular problem where group-housed sows are kept in large groups necessary for the economically-viable use of electronic sow feeders. Aggression may also occur at high levels when unfamiliar sows are mixed in a group. Aggression can be managed by appropriate husbandry measures, including keeping groups of stable composition, managing mixing, minimising competition at feeding time and providing an enriched environment. A key consideration is that stockpersons must be trained to recognise the behavioural problems which can occur. Consideration must also be given to the amount of space allowed to individual pigs in group housing.^{37 38}

Physiology

Physiological measures which may indicate the state of a sow's welfare include assessment of activation of the hypothalamic-pituitary-adrenal axis, the status of the immune system and secretion of catecholamines.³⁹ All of these measures may be changed when a sow is stressed (although it should be noted that these measures may also alter in response to an increase in the state of arousal – which is not stress as such). Thus, cortisol may be elevated, or immune function may be inhibited. But care must be taken in interpreting changes in these parameters as reflecting poor welfare. The elevation of

35 Chapinal N, Ruiz de la Torre JL, Cerisuelo A et al. Evaluation of welfare and productivity in pregnant sows kept in stalls or in 2 different group housing systems. *J Vet Behav* 2010;5:82-93.

36 McGlone J. Is science driving the change? *Alberta Pork News and Reports* 2001

37 Remience V, Wavreille J, Canart B et al. Effects of space allowance on the welfare of dry sows kept in dynamic groups and fed with an electronic sow feeder. *Appl Anim Behav Sci* 2008;112:284-296.

38 Salak-Johnson JL, Niekamp SR, Rodriguez-Zas SL, Ellis M, Curtis SE. Space allowance for dry sows in pens: body conditions, skin lesions and performance. *J Anim Sci* 2007;85:1758-1769.

39 Broom DM. Animal welfare defined in terms of attempts to cope with the environment. *Acta Agric Scand Sect A Suppl* 1996;27:22-28.

cortisol or catecholamines in response to stress, for example, is not sustained, and therefore may not be a good reflection of long-term stress related to a sow's housing environment. For this reason, testing adrenal function in response to adrenocorticotrophic hormone (ACTH) may be more useful as a welfare measure, as it may indicate how much the adrenal cortex response has been activated previously.⁴⁰ ACTH responsiveness has been found to be no different between sows housed in stalls compared to those in groups. There have been similar findings regarding differential lymphocyte counts in sows in stalls and groups. Even though stressed sows may exhibit measures of the immune system indicating decreased responsiveness, there is no evidence (in well-managed pig units) that the incidence of chronic infectious disease is any different in sows housed in stalls compared to groups.

Some early studies found higher cortisol levels in stall-housed sows than in group housed sows, but recent comparable analyses did not show any differences in serum or salivary cortisol between sows housed in stalls and those housed in groups.⁴¹ Physiological measures therefore provide limited evidence of a difference in the welfare of stall and group housed sows.

Production measures

It has been generally assumed that stress negatively affects reproductive processes in pigs and that substances released by the hypothalamo-pituitary-adrenal axis (particularly ACTH and cortisol) during stress are responsible for the presumed effect. Recent studies have found that various stressors applied early in pregnancy, such as regrouping, did not negatively affect reproductive performance.⁴² There are also reports that application of stressor during early pregnancy which produce large elevations of cortisol are nevertheless without effect on reproductive performance. Thus, food deprivation in the first two weeks of pregnancy increased cortisol without affecting number of foetuses.⁴³ These data question the putative link between stress and reduced reproductive performance.

Authors of some early studies reported that sows housed in stalls had delayed return to oestrus compared to group-housed sows. However, other studies have reported that sows which have been bullied by other sows in group housing can be late coming into heat. In general, papers reviewed to 2005 reported that sows in stalls perform as well, in terms of reproductive performance, as sows kept in groups.

A more recent study, diagnosing pregnancy on the basis of ultrasound scanning and salivary progesterone levels, reported a detrimental effect of group housing (with individual feeding stalls)

40 Broom DM. A review of animal welfare measurement in pigs. *Pig News Info* 1996;17:109N-114N.

41 Karlen GAM, Hemsworth PH, Gonyou HW, Fabrega E, Strom AD, Smits RJ. The welfare of gestating sows in conventional stalls and large groups on deep litter. *App Anim Behav Sci* 2007;105:87-101. Note that while these authors found no statistically significant difference in salivary cortisol levels between the housing treatment, they nevertheless engaged in a lengthy discussion about the possible physiological significance of this statistically insignificant effect. There is no justification for this, particularly given that even if larger group sizes were to reveal a significant effect in statistical terms, that effect would be relatively small physiologically.

42 Soede NM, van Sleuwen MJW, Molenaar T, Rietveld FW, Schouten WPG, Hazeleger W, Kemp B Influence of repeated regrouping on reproduction in gilts. *Anim Reprod Sci* 2006;96:133-145. Soede NM, Roelofs JB, Verheiken RJE, Schouten WPG, Hazeleger W, Kemp B Effect of repeated stress treatments during the follicular phase and early pregnancy on reproductive performance of gilts. *Reprod Dom Anim* 2007;42:135-142.

43 See Einarsson S, Brandt Y, Lundheim N, Madej A. Stress and its influence on reproduction in pigs: a review. *Acta Vet Scand* 2008;50:48-56.

compared with stalls (housing for 4 weeks) on sow fertility in terms of pregnancy. This study found a 7.4% difference in rebreeding rate between the two housing configurations.⁴⁴ A comparison of the reproductive performance of sows housed in stalls compared to group-housed sows fed with an electronic feeding system found that stall housing improved return to oestrus and farrow rate, but sows housed in groups produced litters with higher birthweight and wean weight.⁴⁵

However, a study of the effect of mixing gilts in groups compared with stall housing found that reproductive performance was equivalent in both housing configurations; neither pregnancy rate nor embryo survival was improved by individual housing in stalls.⁴⁶ Similar findings of equivalent reproductive performance have been reported in another study using groups of four gilts.⁴⁷ In a US study, sows housed in deep-bedded hoop barns with individual feeding stalls were also found to have comparable performance to those in stalls; sows in barns had more live pigs per litter (10.0) than those in stalls (9.3), while sows in stalls had a shorter wean-to-breed interval.⁴⁸ A recent Australian study compared sows housed in stalls with sows housed in large groups. The authors found that there was no difference in reproductive failure between the two housing conditions, while stall-housed sows had a lower number of weaned piglets (8.3) compared to group-housed sows (9.0).²⁰ A recent Spanish study also found few significant differences in reproductive performance when comparing stall-housed with group-housed sows; there were no differences in live-born piglets or total weight of live-born piglets.¹³ A 2009 study from Taiwan, comparing sow stall housing with group housing using electronic feeders found that total litter size did not differ between gestation housing treatments, but that sow stall housed pigs had the longest interval for rebreeding. The authors concluded that confinement on sow stalls had several detrimental effects on sow performance relative to group housing.⁴⁹

It has been suggested that reproductive problems resulting from aggression between sows housed in groups may be alleviated by housing pregnant sows in stalls up to the time of embryo implantation. A recent report compared sows grouped 2-9 days post-breeding (ie pre embryo implantation) with sows grouped 37-46 days post-breeding (ie post implantation). It found there was no difference in the groups for aggressive encounters (number or duration), although pre-implant sows initiated more aggressive encounters. However, pre-implant sows had lower cortisol levels than post-implant sows, and there was no difference in injury scores;⁵⁰ it therefore appears the observed difference in initiation of aggressive behaviour is of little significance to welfare or production.

44 Munsterhjelm C, Valros A, Heinonen M, Halli O, Peltoniemi OAT. Housing during early pregnancy affects fertility and behaviour of sows. *Reprod Dom Anim* 2008;43:584-591.

45 Bates RO, Edwards DB, Korthals RL. Sow performance when housed either in groups with electronic sow feeders or stalls. *Livestock Prod Sci* 2003;79:29-35.

46 Van Wettere WHEJ, Pain SJ, Stott PG, Hughes PE. Mixing gilts in early pregnancy does not affect embryo survival. *Anim Reprod Sci* 2008;104:382-388.

47 Harris MJ, Pajor EA, Sorrells AD, Eicher SD, Richert BT, Marchant-Forde JN. Effects of stall or small group gestation housing on the production, health and behaviour of gilts. *Livestock Sci* 2006;102:171-179.

48 Lammers PJ, Honeyman MS, Mabry JW, Harmon JD. Performance of gestating sows in bedded hoop barns and confinement stalls. *J Anim Sci* 2007;85:1311-1317.

49 Weng RC, Edwards SA, Hsia LC Effect of individual, group or ESF housing in pregnancy and individual or group housing in lactation on the performance of sows and their piglets. *Aisan-Aust J Anim Sci* 2009;22:1328-1333.

50 Strawford ML, Li YZ, Gonyou HW. The effect of management strategies and parity on the behaviour of gestating sows housed in an electronic sow feeding system. *Can J Anim Sci* 2008;88:559-567.

Properly-managed group housing throughout a sow's pregnancy is capable of production outcomes, in terms of number of piglets produced per sow and weight of piglets, which are comparable to those seen with stall housing.

Injury

Sows kept in stalls suffer a reduction in leg muscle mass and a decrease in leg bone strength. Lameness can occur in both group-housed and stall-housed sows where there is badly-designed flooring. A recent large Australian study found that culling rates due to lameness were much higher in stall-housed sows than in group-housed sows and that the former group had significantly impaired locomotion.⁵¹ However, a recently-reported Irish study did not find any difference in the incidence of lameness, bone strength or joint pathology between sows housed in stalls or group housing.⁵²

Aggression between sows can cause injury, but in group housed systems this can be minimised by good management practices, particularly by providing sows with separate feeding stations (eg using partial stalls).

Conclusions

Caveats

Best practice for the assessment of animal welfare involves taking many measures. Behavioural, physiological, anatomical and reproductive measures have all been used in assessing welfare of sows in stalls, but the challenge is that different measures cannot be compared on the same scale. Thus, how can one assess the welfare impact of the behavioural impairment of a sow in a stall (which can barely move and cannot interact socially with other sows) compared to the impact of aggression inflicted on that same sow were it housed in a group? The answer is one cannot. Any overall conclusion about welfare must therefore represent a serious compromise.

Broad generalisations about housing systems are inappropriate. It is apparent that the design of housing (of whatever sort) can have a significant influence on welfare outcomes.⁵³ Moreover, it is obvious that the training and competence of stockpersons is likewise a very important factor.

Overall conclusion

Behavioural studies indicate that housing in sow stalls is associated with high levels of stereotypic behaviour, which in turn is indicative of poor welfare. There is no question that sow stalls seriously restrict the ability of pregnant sows to express normal behaviour.

While there is no conclusive evidence from physiological measures such as cortisol levels that sow stalls impose a greater welfare burden on sows than housing in groups, it should be remembered that these measures are but one indication of stress, and absence of effect does not indicate absence of a welfare problem.

51 Karlen GAM, Hemsworth PH, Gonyou HW, Fabrega E, Strom AD, Smits RJ. The welfare of gestating sows in conventional stalls and large groups on deep litter. *App Anim Behav Sci* 2007;105:87-101.

52 Ryan WF, Lynch PB, O'Doherty JV. A survey of bone integrity from cull sows in Ireland. *Irish Vet J* 2010;63:754-758.

53 Spooler HAM, Geudeke MJ, Van der Peet-Schwering, Soede NM. Group housing of sows in early pregnancy: A review of success and risk factors. *Livestock Sci* 2009;125:1-14.

Although there is no clear consensus, nevertheless it is apparent that properly-managed group housing systems can deliver equivalent production outcomes compared to stall housing.

Stall housing systems can be associated with leg problems, particularly lameness.

Poorly-managed group housing systems may allow aggressive interaction between sows, with resultant stress and injury. These interactions may be minimised or eliminated by protecting sows from bullying, especially at feeding time.

The current scientific evidence therefore supports the conclusion of the EU Scientific Veterinary Committee that *"since overall welfare appears to be better when sows are not confined throughout gestation, sows should preferably be kept in groups. However, only housing systems resulting in minimal aggression or injury should be used...sows in groups should be fed using a system which ensures that each individual can obtain sufficient food without being attacked..."*²⁴