RECOMMENDATIONS FOR THE ON-FARM WELFARE OF PIGS

SUBMISSION TO THE OIE BY THE INTERNATIONAL COALITION FOR ANIMAL WELFARE[1]

March 2016

Introduction

The International Coalition for Animal Welfare (ICFAW) welcomes the decision by the OIE to produce a chapter of the *Terrestrial Animal Health Code* concerning the on-farm welfare of pigs.

ICFAW's submission focuses on the health and welfare problems that are associated with industrial production. Globally, at least 55% of pigs are produced industrially[2] and this proportion is likely to increase as the Food and Agriculture Organization (FAO) reports that industrial animal production systems have been growing rapidly.[3] Such systems do not proactively support—or even enable—management of the animals in a way that respects their individual needs, and hinder the performance of normal behaviours to such an extent that welfare is compromised.

ICFAW prefers pigs to be reared in well-designed, well-managed outdoor systems. However, good welfare can be achieved in many different systems, including indoor, outdoor and free range. Key features of systems that can provide good welfare include ample space, enrichment materials and bedding, shelter, fresh air and good lighting. ICFAW is opposed to the use of tethers and stalls or crates, and works toward an end to painful mutilations and issues like chronic hunger of breeding sows.

ICFAW welcomes the emphasis placed by the OIE on welfare outcomes, but believes that the OIE chapters should give equal weight to resource- and management-based inputs, as guidance on how to produce desired outcomes will be helpful to producers. Good inputs, for example regarding housing, space allowance and environmental enrichment, are essential for creating acceptable welfare potential. In addition, good husbandry and management are required for that potential to be

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[1] The member organisations of the International Coalition for Animal Welfare include: the Animal Welfare Institute, Compassion in World Farming, Eurogroup for Animals, Humane Society International, the International Fund for Animal Welfare, the National Council of SPCAs, the Japanese Farm Animal Welfare Initiative, the Pan African Animal Welfare Alliance, the Royal Society for the Prevention of Cruelty to Animals, RSPCA Australia, World Animal Net, World Animal Protection, and World Horse Welfare.

[2] Steinfeld H, Gerber P, Wassenaar T, Castel V, Rosales M, and de Haan. 2006. Livestock's Long Shadow: Environmental Issues and Options. Chapter 3. Food and Agriculture Organisation of the United Nations. Rome. www.fao.org/docrep/010/a0701e/a0701e00.HTM. Accessed January 11, 2016.

[3] Food and Agriculture Organization of the United Nations. Protecting Animal Genetic Diversity for Food and Agriculture. Time for Action. Animal genetic resources group, FAO, Rome. www.fao.org/ag/AGAinfo/programmes/en/genetics/documents/ITWG-AnGR4/Brochure3.pdf. Accessed January 11, 2016.

fulfilled. In short, the quality of resources and management cannot be ignored as, if these are poor, one cannot expect to achieve good welfare outcomes.

ICFAW hopes that the OIE standards will address the following matters.

Sow stalls (also known as gestation crates)

Sows are often kept throughout their 16.5 week pregnancy in sow stalls. These metal-barred stalls are so narrow that the sow cannot even turn round. In some cases sows are tethered by a chain to the ground or the stall. Sows are kept like this for one pregnancy after another. Scientific research shows that, as compared with sows kept in groups, sows kept in stalls have reduced bone and muscular strength, reduced cardiovascular fitness and a higher incidence of foot and leg pathologies.[4]

In addition stereotypic behavior (e.g. bar biting and sham chewing) is common in sows confined in stalls or tethers. Stereotypies are forms of repetitive behaviour induced by repeated coping attempts, frustration, and/or brain dysfunction.[5] This repetitive behavior is an indicator of poor welfare. Abnormal inactivity and unresponsiveness are widespread in confined sows.[6] Tethering in particular has been shown to induce neurophysiological changes that indicate a state of depression.[7,8]

In light of their detrimental impact on sow health and welfare, many countries across the globe have taken significant steps to ban the use of stalls or to phase them out, and major international pig producers and retailers have declared they will remove them from their supply chains. The use of sow stalls from four weeks after breeding of the sow has been prohibited in the European Union since 1 January 2013 and the use of tethers since the beginning of 2006. Some European countries have gone further and implemented a full ban on stalls, for example the United Kingdom in 1999. Sow stalls have also been prohibited in nine U.S. States[9] and in New Zealand.[10] The Code of Practice for Canada calls for a phase-out by 2024.[11] The Australian pork industry has committed to voluntarily phasing out sow stalls in favour of group housing by 2017.[12] In South Africa, the South African Pork

[4] Panel for Animal Health and Welfare (AHAW). 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. European Food Safety Authority. The EFSA Journal 572:1-107. www.efsa.europa.eu/sites/default/files/scientific_output/files/main_documents/572.pdf. Accessed January 11, 2016.

[5] Mason G and Rushen J. 2006. Stereotypic Animal Behaviour: Fundamentals and Applications to Welfare, 2nd Edition (Wallingford, U.K.: CABI, p. 347).

[6] Scientific Veterinary Committee, Animal Welfare Section. 1997. The welfare of intensively kept pigs. http://ec.europa.eu/food/fs/sc/oldcomm4/out17_en.pdf. Accessed January 11, 2016.

[7] Van der Staay FJ, Schuurman T, Hulst M, et al. 2010. Effects of chronic stress: a comparison between tethered and loose sows. Physiology and behavior 100(2):154-164.

[8] De Vry J, Prickaerts J, Jetten M, et al. 2012. Recurrent long-lasting tethering reduces BDNF protein levels in the dorsal hippocampus and frontal cortex in pigs. Volume 62(1):10-17.

[9] Humane Society of the United States. 2012. Rhode Island enacts legislation to prohibit extreme confinement crates for pigs and calves and the routine docking of cows' tails. www.humanesociety.org/news/press_releases/2012/06/rhode_island_gestation_crates_ban_062112.html?credit=web_id311355019. Accessed January 21, 2016.

[10] Ministry for Primary Industries, National Animal Welfare Advisory Committee. 2010. Pigs Code of Welfare, p.21. file:///C:/Users/sshields/Downloads/Final-2010-Pigs-Code.pdf. Accessed January 21, 2016.

[11] National Farm Animal Care Council. 2014. Code of Practice for the Care and Handling of Pigs, p.11. www.nfacc.ca/pdfs/codes/pig_code_of_practice.pdf. Accessed January 21, 2016.

[12] Australian Pork. Industry focus: housing. http://australianpork.com.au/industry-focus/animal-welfare/housing/. Accessed January 11, 2016.

Producers organization (SAPPO) has committed to a final phase out date of 2020. At least 30% of their producers have removed sow stalls from their farms.[13] The largest South African supermarket chain, Pick n Pay, which has 770 retail stores in South Africa alone, have committed to not source any pork products from farming operations that utilize sow stalls by January 1, 2017.[14] Woolworths, another large South African supermarket chain, has stopped purchasing fresh pork products from facilities that confine sows in stalls for prolonged periods of time.[15] In 2007, Smithfield Foods, the United States' and the world's largest pig producer, committed to phase out gestation crates by 2017 (although, sows are housed individually until confirmed pregnant), and the company announced in 2016 it has moved over 80% of its pregnant sows from crates to group housing.[16] In 2014, Smithfield announced that it is also asking its U.S. contract farmers to convert to sow group housing by 2022.[17] Every major pork processor in Brazil including BRF (the country's largest pork producer), JBS (the world's largest meat processing company and owner of SEARA, Brazil's second largest pork producer) and Aurora (Brazil's third largest pig producer), have announced they will phase out the use of sow gestation crates.[18,19,20] Pork processors around the world are reacting to announcements from major international corporations, such as McDonalds, Nestlé and Walmart (among many others), that are keenly aware of the growing social demand for better farm animal welfare. Following the announcement by McDonalds in 2012, more than 60 major food brands have followed in their lead. Companies often make these pledges to rid sow stalls from their supply chains, not only because it's what their customers want, but simply because they feel it is the right thing to do.

The International Finance Corporation (IFC) Good Practice Note on *Improving Animal Welfare in Livestock Operations* states that "There is an international trend from sow stall use towards group housing systems".[21] The huge Muyuan intensive pig operation in China is being funded by the IFC. The IFC states the "housing of sows, however, is the one area that could be subject to a change in practice to better align it with contemporary practices in the industry elsewhere in the world. In recognition of this opportunity, the company has been piloting a new approach based upon the use of Electronic Sow Feeding (ESF) systems [used in group housing] supplied from Europe and designed to provide more room for the animals while providing them individually tailored nutrition that

[13] South African Pork Producers' Organization. 2013. South African Pork Producers' Organisation making strides to loose housing for sows. Organisation says not enough credit is given for developments so far to reach targets by 2020. Press release, March 18. www.sapork.biz/news-2/. Accessed February 22, 2016.
[14] Pick n Pay. 2014. Pick n Pay to phase out sow stalls from fresh supply chain. www.picknpay.co.za/news/pick-n-pay-to-phase-out-sow-stalls-from-fresh-supp. Accessed February 22, 2016.
[15] Woolworths. 2015. Sow-friendly pork. www.woolworths.co.za/store/fragments/corporate/corporate-index.jsp?content=corporate-content&contentId=cmp204847. Accessed February 22, 2016.
[16] Smithfield. 2016. Smithfield Foods reports significant progress toward conversion to group housing systems for pregnant sows. Press release, Jan 4. www.smithfieldfoods.com/newsroom/press-releases-and-news/smithfield-foods-reports-significant-progress-toward-conversion-to-group-housing-systems-for-pregnant-sows. Accessed February 22, 2016.
[17] Gyton G. 2015. Smithfield Foods announces progress on sow housing. Global Meat News, January. www.globalmeatnews.com/Industry-Markets/Smithfield-Foods-announces-progress-on-sow-housing. Accessed December 6, 2015.
[18] JBS. Animal welfare. www.jbs.com.br/en/content/animal-welfare. Accessed December 6, 2015.
[19] Pacelle W. 2014. Brazil adds its might to the move to end gestation crates. Huffington Post, November 25. www.huffingtonpost.com/wayne-pacelle/brazil-adds-its-might-to_b_6221032.html. Accessed January 11, 2016.
[20] Globo Rural. 2015. Aurora diz que vai eliminar gaiolas de gestação de suínos, December 29. http://revistagloborural.globo.com/Noticias/Criacao/Suinos/noticia/2015/12/aurora-diz-que-vai-eliminar-gaiolas-de-gestacao-de-suinos.html. Accessed January 22, 2016.
[21] International Finance Corporation. 2014. Good Practice Note: Improving Animal Welfare in Intensive Livestock Operations. www.ifc.org/wps/wcm/connect/67013c8046c48b889c6cbd9916182e35/IFC+Good+Practice+Note+Animal+Welfare+2014.pdf?MOD=AJPERES.

promotes productivity. This pilot scheme is in keeping with other pig producers in the country who are trying out this approach and, as noted above, is a practice already adopted in other countries."[22]

The risk of aggression in group housed sows can be prevented by good management. The main causes of aggression are competition for food and mixing sows that are unfamiliar with each other. Unfamiliar sows should not be mixed. The Scientific Opinion of the European Food Safety Authority concluded that "Keeping sows in intact groups from weaning to the end of pregnancy reduces aggression to a minimum compared to keeping them in dynamic groups, where new animals are repeatedly introduced".[23]

Key factors to manage potential aggression are gradual familiarisation of unfamiliar animals (via fence contact), sufficient space and pen layout during mixing, and minimising opportunities for dominant sows to steal food from subordinates.[24] Insufficient space in group housed sows increases the risk of aggressive behaviours at mixing and feeding.[25,26]

A number of approaches have been developed to reduce competition and aggression at feeding in group-housed sows. These include: electronic sow feeders, individual feeding stalls; trickle feed systems where food is delivered slowly over long periods into individual feeders; and dump and scatter feeders where sows are occupied for long periods in rooting for food. Producers all over the world are successfully using group housing systems, and clearly, the future of the industry is crate-free.

> ***ICFAW recommendation on sow stalls:*** ICFAW is opposed to the use of stalls for pregnant sows. The OIE chapter should not endorse the use of sow stalls or tethers.

Chronic hunger in sows

The high-energy grain-based feeds widely used for sows are quickly digested and result in long-term periods of hunger.[27] However, chronic hunger primarily arises from restricted feeding of gestating sows. This is practised to control the body condition of the sow, who shares the same genetic propensity for rapid weight gain as her offspring, but the lack of feed results in hunger.[28,29] The

[22] International Finance Corporation. 2015. Muyuan loan: environmental & social review summary. http://ifcext.ifc.org/ifcext/spiwebsite1.nsf/ProjectDisplay/ESRS32156. Accessed January 11, 2016.
[23] Panel for Animal Health and Welfare. 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. European Food Safety Authority. The EFSA Journal 572:1-107. www.efsa.europa.eu/sites/default/files/scientific_output/files/main_documents/572.pdf. Accessed January 11, 2016.
[24] Spoolder HAM, Geudeke MJ, Van der Peet-Schwering CMC, and Soede NM. 2009. Group housing of sows in early pregnancy: A review of success and risk factors. Livestock Science 125(1):1-14.
[25] Remience V, Wavreille J, Canart, B. et al. 2008. Effects of space allowance on the welfare of dry sows kept in dynamic groups and fed with an electronic sow feeder. Applied Animal Behaviour Science 112:284-296.
[26] Hemsworth P, Morrison, R, Tilbrook A et al. 2015 Effects of floor space on the welfare of group housed sows, Report prepared for the Co-operative Research Centre for High Integrity Australian Pork. http://porkcrc.com.au/research/program-1/program-1-projects/. Accessed February 1, 2016.
[27] Panel for Animal Health and Welfare. 2007. Animal health and welfare aspects of different housing and husbandry systems for adult breeding boars, pregnant, farrowing sows and unweaned piglets. European Food Safety Authority. The EFSA Journal 572:1-107. www.efsa.europa.eu/sites/default/files/scientific_output/files/main_documents/572.pdf. Accessed January 12, 2016.
[28] Edwards S. 2014. Feeding behaviour, productivity and welfare of sows. Joint Annual Meeting Symposium, July 22 (Kansas City, Missouri). https://asas.confex.com/asas/jam2014/webprogram/Paper1698.html. Accessed January 11, 2016.

provision of fibrous food gives the sow a means of adding bulk to her diet, thereby helping to satisfy feelings of hunger that can otherwise be a factor leading to aggression.

> ***ICFAW recommendation on hunger in sows:*** Bulky or high fibre food should be available at all times for sows. The best way to satisfy the need for access to fibrous food in housed sows is to provide a deep bed of straw or similar material. Other ways of providing fibrous food include the provision of grass silage and the addition of vegetable pulp to the feed, making it more bulky and therefore more satisfying.

Farrowing crates

Some farmers believe that crates are necessary to prevent sows from crushing their piglets by lying on them. However, farrowing crates restrict the sows' movement and usually prevent her from carrying out an important behavioural need – nest building. Recent research shows that well-designed farrowing pens in which the sow has ample space can be just as effective as crates in preventing piglet mortality. A number of such systems are available and research shows that piglet mortalities in loose farrowing systems can be as low as—or lower than—in crates.[30,31] Loose farrowing systems that have been developed include the Solari Pen, the FAT Pen and the free farrowing system developed in the United Kingdom by Scotland's Rural College and the Newcastle University (also known as PigSAFE).[32] These systems cater for the behavioural needs of the sow and her piglets as well as the safety of the stockperson.

Factors that are important in preventing mortality in loose farrowing systems include the quantity of enrichment/bedding/nesting material, the thermal environment, an appropriate area to which the piglets can escape, the genetics and mothering ability of the sow, and a means of protecting the piglets from the sow, e.g. sloped walls. Good results can be obtained in such systems if sows are kept in sufficiently large pens, structured for preference into a nest area and an activity area.[33]

In 2011, the UK Pig Health and Welfare Council (a multi-stakeholder group bringing industry, government and NGO stakeholders engaged in pig heath or welfare related activities or policy development) stated in its 20:20 Strategy that "There will continue to be a focus on finding solutions to…freedom around farrowing…". In addition, the Strategy states that "The key areas for which targets will be developed in the 20:20 Pig Health and Welfare Strategy are…improvements in the farrowing environment."[34] In a 2015 report, the UK Farm Animal Welfare Committee stated that it

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[29] Hansen A. 2012. Feed intake in reproducing sows. In: Nutritional Physiology of Pigs – with emphasis on Danish production conditions, Chapter 8. Electronic publication, SEGES, Videncenter for Svineproduktion, Copenhagen, Denmark, 2012. http://vsp.lf.dk/~/media/Files/Laerebog_fysiologi/Chapter%2018.pdf. Accessed January 21, 2016.
[30] Weber R, Keil NM, Fehr M and Horat R. 2007. Piglet mortality on farms using farrowing systems with or without crates. Animal Welfare 16(2):277-279.
[31] Baxter EM, Lawrence AB, and Edwards SA. 2012. Alternative farrowing accommodation: welfare and economic aspects of existing farrowing and lactation systems for pigs. Animal 6(1):96-117.
[32] Baxter EM, Lawrence AB, and Edwards SA. 2012. Alternative farrowing accommodation: welfare and economic aspects of existing farrowing and lactation systems for pigs. Animal 6(1):96-117.
[33] Spoolder H, Bracke M, Mueller-Graf C, and Edwards S. 2011. Report 1: Preparatory work for the future development of animal based measures for assessing the welfare of sow, boar and piglet including aspects related to pig castration. Technical report submitted to the EFSA.
www.efsa.europa.eu/sites/default/files/scientific_output/files/main_documents/178e.pdf. Accessed January 12, 2016.
[34] BPEX. 2011.20:20 Pig Health and Welfare. A Vision for 2020. http://pork.ahdb.org.uk/media/2233/2020-pig-health-and-welfare.pdf. Accessed March 4, 2016.

"favours movement in the pig industry towards well designed and operated free farrowing systems."[35]

> ***ICFAW recommendation on farrowing crates:*** ICFAW is opposed to the use of farrowing crates as these severely restrict sows' freedom of movement and do not permit them to show normal nest-building behaviour or to excrete in a separate area. Farmers should be encouraged not to use farrowing crates, and to switch to well-managed and designed crate-free systems that aim to have equally low piglet mortality.

Lameness in sows

Lameness may affect up to 46% of breeding sows,[36,37] with adverse consequences on their welfare and longevity in the herd.[38] Specific factors have been identified that increase the risk of developing lameness, such as large and/or dynamic groups during gestation (leading to aggression), dirty and hard concrete flooring, absence of bedding, presence of claw lesions, competition for food and severe food restriction.[39,40] Lameness can be reliably assessed by various methods, of which the simplest is visual gait scoring.[41,42]

> ***ICFAW recommendations for lameness:*** Breeding sows should be kept in static groups throughout gestation. For housed sows, the floor should provide sufficient friction to prevent sows slipping, but not be abrasive. In addition, sows should be provided with comfortable lying areas with deep bedding or, in the case of housed sows, at least rubber mats.[43] Lameness should be assessed visually when sows are moved between different accommodations. Lame sows should be given prompt veterinary care.

Environmental enrichment

[35] Farm Animal Welfare Committee. 2015. Opinion on free farrowing systems. www.gov.uk/government/publications/farm-animal-welfare-committee-fawc-opinion-on-free-farrowing-systems. Accessed February 1, 2016.

[36] Seddon Y and Brown J, 2013-14, Annual research report of the Prairie Swine Centre, Canada, pp. 11-12. www.prairieswine.com/wp-content/uploads/2014/09/Annual-Report-2013-14.pdf. Accessed January 20, 2016.

[37] Quinn AJ. 2014. Limb health in pigs: the prevalence and risk factors for lameness, limb lesions and claw lesions in pigs, and the influence of gilt nutrition on indicators of limb health. PhD thesis, University of Warwick. http://webcat.warwick.ac.uk/record=b2753467~S1. Accessed January 20, 2016.

[38] Heinonen M, Peltoniemi O, and Valros A. 2013. Impact of lameness and claw lesions in sows on welfare, health and production. Livestock Science 156(1-3):2-9.

[39] Deen J, Anil SS, and Anil D. 2007. Claw lesions as a predictor of lameness in breeding sows. In: van der Honing Y (Editor-in-Chief), Book of Abstracts of the 58th Annual Meeting of the European Association for Animal Production (Dublin, Ireland, pp. 274).

[40] Cador C, Pol F, Hamoniaux M, et al. 2014. Risk factors associated with leg disorders of gestating sows in different group-housing systems: a cross-sectional study in 108 farrow-to-finish farms in France. Preventive Veterinary Medicine 116:102-110.

[41] Main DCJ, Clegg J, Spatz, and Green LE. 2000. Repeatability of a lameness scoring scale for finishing pigs. Veterinary Record 147:574-576.

[42] Nalon E, Maes D, Van Dongen S, et al. 2014. Comparison of the inter- and intra-observer repeatability of three gait-scoring scales for sows. Animal 8(4):650-659.

[43] Diaz JAC and Boyle LA. 2014. Effect of rubber slat mats on the behaviour and welfare of group housed pregnant sows. Applied Animal Behaviour Science 151:13-23.

Scientific research has established that exploratory and foraging behaviours such as manipulating and investigating materials and rooting are important for pigs.[44] Indeed, in semi-natural conditions pigs are highly active, spending 75% of the day engaged in such activities.[45] Environmental enrichment improves pigs' cognitive ability,[46] and ability to cope with stress.[47] When suitable rooting and manipulation materials are not available, pigs are likely to direct their exploratory behaviour towards companions, e.g. in the form of tail- and ear-biting.[48]

A Technical Report submitted to the European Food Safety Authority (EFSA) states that an "appropriate enrichment material can be defined as a material which stimulates exploratory behaviour for an extended length of time, preferably comparable to the level of occupation provided by straw."[49] The Report adds that "all new data reinforce the importance of providing suitable enrichment materials to allow expression of species relevant behaviours and reduce risk of injurious biting". Suitable enrichment materials are those that are manipulable, destructible, rootable and, often, edible. Novelty and hygiene are also important elements to consider when objects are used as enrichment.

The provision of appropriate enrichment materials to all pigs is obligatory in the EU under Directive 2008/120/EC, Annex I, paragraph 4.[50] Practical science-based guidelines on materials that can be given to pigs to enable proper investigation and rooting activities have been published online (EuWelNet project).[51]

> ***ICFAW recommendation on environmental enrichment:*** Indoor-housed pigs must at all times have access to sufficient quantities of straw or other suitable materials such as hay, wood chips, wood shavings, sawdust, peanut shells or rice hulls to allow and encourage proper expression of their investigation and manipulation behaviour. Objects or toys, even when rotated frequently to maintain novelty, are not appropriate enrichment materials alone and are not considered suitable alternatives to straw or the other materials listed above.

Concentrated diet

[44] Panel for Animal Health and Welfare. 2007. Animal health and welfare in fattening pigs in relation to housing and husbandry. The EFSA Journal 564:1-14. www.efsa.europa.eu/sites/default/files/scientific_output/files/main_documents/564.pdf. Accessed January 12, 2016.
[45] Stolba A and Wood-Gush DGM. 1989. The behaviour of pigs in a semi-natural environment. Animal Protection 48:419-425.
[46] Grimberg-Henrici CG, Vermaak P, Elizabeth Bolhuis J, Nordquist RE, and van der Staay FJ. 2015. Effects of environmental enrichment on cognitive performance of pigs in a spatial holeboard discrimination task. Animal Cognition 1-13.
[47] Reimert I, Rodenburg TB, Ursinus WW, Kemp B, and Bolhuis JE. 2014. Selection based on indirect genetic effects for growth, environmental enrichment and coping style affect the immune status of pigs. PLoS One 9(9):e108700.
[48] Panel for Animal Health and Welfare. 2007. Animal health and welfare in fattening pigs in relation to housing and husbandry. The EFSA Journal 564:1-14. www.efsa.europa.eu/sites/default/files/scientific_output/files/main_documents/564.pdf. Accessed January 12, 2016.
[49] Spoolder HAM, Geudeke MJ, Van der Peet-Schwering CMC, and Soede NM. 2009. Group housing of sows in early pregnancy: A review of success and risk factors. Livestock Science 125(1):1-14.
[50] Council Directive 2008/120/EC of 18 December 2008. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:047:0005:0013:EN:PDF. Accessed January 12, 2016.
[51] EU Welnet: Coordinated European Animal Welfare Network. http://euwelnet.hwnn001.topshare.com/. Accessed January 15, 2016.

Pigs' stomachs are biologically designed for small amounts of high fiber feedstuffs.[52] However, in much commercial production, pigs are fed concentrated diets. Finely ground or pelleted, low fiber diets can cause gastrointestinal acidity and mucosal damage,[53] leaving pigs prone to gastric ulcers.[54,55,56] The incidence is highly variable, but it has been suggested that the number of cases increases with the intensification of pig production and may be due in part to the associated stresses of confinement, crowding, the emphasis on feed efficiency and digestibility, and thus the use of finely ground rations.[57,58] In one study of the effect of finely ground feeds on ulcer incidence, 53% of pigs already had signs of ulceration, and five pigs had bleeding ulcers, before the experiment even started, when pigs were just 30 kg (66 lb).[59] In severe cases, pigs may suffer from gastric hemorrhage, bleeding into the stomach, and sudden death.[60,61] Pigs with access to straw, sawdust, or outdoor paddocks have fewer ulcers than those confined on bare, solid or slatted concrete floors.[62,63,64,65]

> ***ICFAW recommendation on concentrated diets:*** Pigs should be fed a diet that does not cause ulcers, such as one including more roughage and fibrous feedstuffs.

Floor type and bedding

Flooring type and availability of bedding will influence the pig's ability to thermoregulate, decide where to defecate and the extent to which the animal can lie comfortably and explore its surroundings.[66] Pigs need to have access to a solid floored lying area as fully slatted floors can lead to

[52] Nielsen BL, Thodberg K, Dybkjaer L, and Vestergaard EM. 2006. Feeding behaviour in pigs. In: Bels V (ed.), Feeding in Domestic Vertebrates: from Structure to Behaviour (Wallingford, U.K.: CAB International, pp. 156-78).
[53] Bergeron R, Badnell-Waters AJ, Lambton S, and Mason G. 2006. Stereotypic oral behaviour in captive ungulates: foraging, diet and gastrointestinal function. In: Mason G and Rushen J (eds.), Stereotypic Animal Behaviour: Fundamentals and Applications to Welfare, 2nd Edition (Wallingford, U.K.: CABI, pp. 19-57).
[54] Nielsen BL, Thodberg K, Dybkjaer L, and Vestergaard EM. 2006. Feeding behaviour in pigs. In: Bels V (ed.), Feeding in Domestic Vertebrates: from Structure to Behaviour (Wallingford, U.K.: CAB International, pp. 156-178).
[55] Eisemann JH and Argenzio RA. 1999. Effects of diet and housing density on growth and stomach morphology in pigs. Journal of Animal Science 77:2709-2714.
[56] Liesner VG, Taube V, Leonhard-Marek S, Beineke A, and Kamphues J. 2009. Integrity of gastric mucosa in reared piglets – effects of physical form of diets (meal/pellets), pre-processing grinding (coarse/fine) and addition of lignocellulose (0/2.5 %). Journal of Animal Physiology and Animal Nutrition 93:373-380.
[57] Radostits OM, Gay CC, Blood DC, and Hinchcliff KW. 2000. Veterinary Medicine: A Textbook of the Diseases of Cattle, Sheep, Pigs, Goats and Horses, 9th Edition (New York, NY: W.B. Saunders Company Ltd., p. 1776).
[58] Kowalczyk T. 1969. Etiologic factors of gastric ulcers in swine. American Journal of Veterinary Research 30(3):393-400.
[59] Ayles HL, Friendship RM, Bubenik GA, and Ball RO. 1999. Effect of feed particle size and dietary melatonin supplementation on gastric ulcers in swine. Canadian Journal of Animal Science 79:179-185.
[60] Radostits OM, Gay CC, Blood DC, and Hinchcliff KW. 2000. Veterinary Medicine: A Textbook of the Diseases of Cattle, Sheep, Pigs, Goats and Horses, 9th Edition (New York, NY: W.B. Saunders Company Ltd., p. 1776-1779).
[61] Nielsen BL, Thodberg K, Dybkjaer L, and Vestergaard EM. 2006. Feeding behaviour in pigs. In: Bels V (ed.), Feeding in Domestic Vertebrates: from Structure to Behaviour (Wallingford, U.K.: CAB International, pp. 156-178).
[62] Amory JR, Mackenzie AM, Pearce GP. 2006. Factors in the housing environment of finisher pigs associated with the development of gastric ulcers. Veterinary Record 158:260-264.
[63] Guy JH, Rowlinson P, Chadwick JP, and Ellis M. 2002. Health conditions of two genotypes of growing-finishing pig in three different housing systems: implications for welfare. Livestock Production Science 75:233-243.
[64] Nielsen EK, and Ingvartsen KL. 2000. Effects of cereal disintegration method, feeding method and straw as bedding on stomach characteristics including ulcers and performance in growing pigs. Acta Agriculturae Scandinavica, Section A, Animal Science 50:30-38.
[65] Ramis G, Gómez S, Pallarés FJ, and Muñoz A. 2005. Comparison of the severity of esophagogastric, lung and limb lesions at slaughter in pigs reared under standard and enriched conditions. Animal Welfare 14:27-34.
[66] European Food Safety Authority. 2005. The welfare of weaners and rearing pigs: effect of different space allowances and floor types. Annex to the EFSA Journal 268:1-19.

foot and leg problems,[67] abnormal gait[68] and discomfort, and also make it very difficult to provide effective bedding materials.

> ***ICFAW recommendation on floor type***: Pigs should not be kept on fully slatted floors. They must at all times have access to a solid (i.e. not perforated or slatted) lying area that is provided with a sufficient quantity of clean, dry bedding to avoid discomfort. The solid area can be combined with a slatted dunging area. Indoor pigs in hot conditions need access to a cool floor or evaporative cooling aided by higher air-flow rates or water on the skin (e.g. through showering or misting systems or opportunities to wallow). More drinking water may also need to be provided.

Space allowance

Overcrowding is a risk factor for disease expression, skin lesions, tail biting, foot injuries and aggression and should be avoided.[69,70]

> ***ICFAW recommendation on space allowance:*** Pigs must have sufficient space to be able to exercise, for all the group to lie down on their sides simultaneously with their legs fully outstretched without being obstructed by another animal, and to be able to move away from other pigs if they desire. The minimum space required for a pig to lie down with legs fully outstretched[71] is area = $0.047W^{0.66}$, where W represents bodyweight (kg). There must also be sufficient space for pigs to separate their lying area from their dunging area. Providing additional space at higher temperatures is important so that pigs can lose heat by reducing physical contact with pen mates.

Air quality

Odors, dust, and noxious gases, including ammonia, hydrogen sulfide, and methane, can be problematic in industrial confinement operations due to decomposing animal waste. Prolonged ammonia exposure above 35ppm has been found to cause a physiological immune response in pigs, including increases in monocyte, lymphocyte, and neutrophil cell counts.[72] Although a maximum concentration of 25 ppm is recommended for safety,[73] in pig production buildings with poor

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[67] Kilbride AL, Gillman CE, and Green LE. 2008. Prevalence of foot lesions, limb lesions and abnormal locomotion in pigs on commercial farms in Britain and risks associated with flooring. The Pig Journal 61:62-68.

[68] KilBride AL, Gillman CE, Green LE. 2009. A cross-sectional study of the prevalence of lameness in finishing pigs, gilts and pregnant sows and associations with limb lesions and floor types on commercial farms in England. Animal Welfare 18:215-224.

[69] Panel on Animal Health and Welfare. 2005. The welfare of weaners and rearing pigs: effects of different space allowances and floor type. The EFSA Journal 268:1-19. www.efsa.europa.eu/sites/default/files/scientific_output/files/main_documents/268.pdf. Accessed January 12, 2016.

[70] Scollo A, Contiero B, and Gottardo F. 2015. Frequency of tail lesions and risk factors for tail biting in heavy pig production from weaning to 170 kg live weight. Veterinary Journal, Nov 9. doi: 10.1016/j.tvjl.2015.10.056.

[71] Petherick JC and Phillips CJC. 2009. Space allowances for confined livestock and their determination from allometric principles. Applied Animal Behaviour Science 117:1-12.

[72] Von Borell E, Özpinar A, Eslinger KM, Schnitz AL, Zhao Y, and Mitloehner FM. 2007. Acute and prolonged effects of ammonia on hematological variables, stress responses, performance, and behavior of nursery pigs. Journal of Swine Health and Production 15(3):137-145.

[73] PQA Plus Education Handbook, Version 2.0, p.66. http://porkcdn.s3.amazonaws.com/sites/all/files/documents/PQAPlus/V2.0/TrainingAdults/PQAPlusEducationHandbookVersion2.0.pdf. Accessed January 12, 2016.

environmental control, ammonia concentrations may exceed 30 ppm.[74] Studies have shown that juvenile pigs can detect and will avoid atmospheres that contain ammonia, even at concentrations as low as 10 ppm, and that they prefer fresh air.[75,76,77] High ammonia concentrations are known to suppress pigs' activity levels.[78]

High concentrations of ammonia and dust can reduce the ability of pigs to resist bacterial infections, including infectious atrophic rhinitis. Atrophic rhinitis is more severe when pigs are raised in environments with high concentrations of dust and ammonia.[79] Poor air quality may also be a factor in the onset of other diseases, including enzootic pneumonia, porcine reproductive and respiratory syndrome (PRRS), and swine influenza.[80] For growing pigs in the United States, the majority of deaths are due to respiratory problems.[81]

> ***ICFAW recommendation on air quality:*** Air quality should be monitored and ammonia levels should not exceed 25 ppm.

Age at weaning

Naturally, the diet of piglets changes gradually as they grow,[82] and they continue to nurse even as their reliance on milk slowly shifts to other feed types.[83] When left to wean naturally, the process takes approximately 18 weeks to complete.[84,85,86,87,88] In industrial production systems however, artificial weaning occurs much earlier. Weaning is associated with an abrupt dietary change, altered housing and mixing with unfamiliar pen mates. Weaning before four weeks of age is a stressful

[74] Wathes CM, Jones JB, Kristensen HH, Jones EKM, and Webster AJF. 2002. Aversion of pigs and domestic fowl to atmospheric ammonia. Transactions of the American Society of Agricultural Engineers 45(5):1605-1610.
[75] Jones JB, Burgess LR, Webster AJF, and Wathes CM. 1996. Behavioural responses of pigs to atmospheric ammonia in a chronic choice test. Animal Science 63:437-445.
[76] Wathes CM, Jones JB, Kristensen HH, Jones EKM, and Webster AJF. 2002. Aversion of pigs and domestic fowl to atmospheric ammonia. Transactions of the American Society of Agricultural Engineers 45(5):1605-1610.
[77] Wathes CM. 2001. Aerial pollutants from weaner production. In: Varley MA and Wiseman J (eds.), The Weaner Pig: Nutrition and Management (Wallingford, U.K.: CAB International, pp. 259-271).
[78] Kim KY, Ko HJ, Kim HT, Kim CN, and Byeon SH. 2008. Association between pig activity and environmental factors in pig confinement buildings. Australian Journal of Experimental Agriculture 48:680-686.
[79] Robertson JF, Wilson D, and Smith WJ. 1990. Atrophic rhinitis: the influence of the aerial environment. Animal Production 50:173-82.
[80] Wathes CM. 2001. Aerial pollutants from weaner production. In: Varley MA and Wiseman J (eds.), The Weaner Pig: Nutrition and Management (Wallingford, U.K.: CAB International, pp. 259-271).
[81] U.S. Department of Agriculture, Animal and Plant Health Inspection Service. 2007. Swine 2006 Part I: Reference of Swine Health and Management Practices in the United States. www.aphis.usda.gov/animal_health/nahms/swine/downloads/swine2006/Swine2006_dr_PartI.pdf. Accessed January 12, 2016.
[82] Petersen V. 1994. The development of feeding and investigatory behaviour in free-ranging domestic pigs during their first 18 weeks of life. Applied Animal Behaviour Science 42:87-98.
[83] Worobec EK, Duncan IJH, and Widowski TM. 1999. The effects of weaning at 7, 14 and 28 days on piglet behaviour. Applied Animal Behaviour Science 62:173-182.
[84] Jensen P and Recén B. 1989. When to wean – observations from free-ranging domestic pigs. Applied Animal Behaviour Science 23:49-60.
[85] Stolba A and Wood-Gush DGM. 1989. The behaviour of pigs in a semi-natural environment. Animal Production 48:419-425.
[86] Petersen V. 1994. The development of feeding and investigatory behaviour in free-ranging domestic pigs during their first 18 weeks of life. Applied Animal Behaviour Science 42:87-98.
[87] Jensen P. 1988. Maternal behaviour and mother-young interactions during lactation in free-ranging domestic pigs. Applied Animal Behaviour Science 20:297-308.
[88] Jensen P and Stangel G. 1992. Behaviour of piglets during weaning in a semi-natural enclosure. Applied Animal Behaviour Science 33:227-238.

event,[89,90] and is linked to increased abnormal behaviour, such as belly nosing.[91,92] Weaning early also adversely affects piglet gastrointestinal processes causing underdeveloped intestinal immunity,[93] diarrhoea and weight gain retardation.[94] For these reasons, early weaning is the main reason why antimicrobials are systematically given to piglets in a preventive way to avoid the insurgence of potentially deadly gastrointestinal infections. One such antimicrobial, colistin, is also used as a vitally important last-resort treatment for multidrug resistant Gram negative bacteria in human medicine. There is now evidence of antimicrobial resistance to colistin in human and animal strains of Enterobacteria.[95] Some farmers are considering later weaning (e.g. at around 4-5 weeks) to ensure piglet health without routine use of antibiotics, increase piglet growth rates and reduce the incidence of post-weaning multi-systemic wasting syndrome. Indeed some farmers prefer to wean at 40 or even 56 days to ensure healthier piglets.

> ***ICFAW recommendation on weaning age:*** Weaning of piglets should not be carried out before they have a significant feed intake from creep feed and in any case never before four weeks of age.

Genetic selection

The genetic selection of pigs for rapid growth and lean meat without enough consideration of other factors has led to some widespread and serious problems, in particular leg disorders, cardiovascular malfunction when high levels of activity are needed or stressful conditions are encountered, and inadequate maternal behaviour.[96]

The breeding of sows for large litters results in high levels of mortality before birth and among piglets born alive.[97] The latter is due to an increased proportion of piglets with low birth weights; low birth weights are also associated with a variety of negative long-term effects on piglets, such as increased reactivity to stress throughout the pig's lifetime.[98] Large litters can result in intense teat competition

[89] McLamb BL, Gibson AJ, Overman EL, Stahl C and Moeser AJ. 2013. Early weaning stress in pigs impairs innate mucosal immune responses to Enterotoxigenic *E. coli* challenge and exacerbates intestinal injury and clinical disease. PLoS ONE 8(4): e59838.

[90] Smith F, Clark JE, Overman BL, et al. 2010. Early weaning stress impairs development of mucosal barrier function in the porcine intestine. American Journal of Physiology: Gastrointestinal Liver Physiology 298(3):G352-363.

[91] Gonyou HW, Beltranena E, Whittington DL, and Patience JF. 1998. The behaviour of pigs weaned at 12 and 21 days of age from weaning to market. Canadian Journal of Animal Science 78:517-523.

[92] Worobec E, Duncan IJH, and Widowski TM. 1999. The effects of weaning at 7, 14 and 28 days on piglet behaviour. Applied Animal Behaviour Science 62:173-182.

[93] Bailey M, Vega-Lopez MA, Rothkötter HJ, et al. 2001. Enteric immunity and gut health. In: Varley MA and Wiseman J (eds.), The Weaner Pig: Nutrition and Management (Wallingford, U.K.: CABI Publishing, pp. 207-222).

[94] Panel for Animal Health and Welfare. 2007. Animal health and welfare aspects of different housing and husbandry systems for adult breeding boars, pregnant, farrowing sows and unweaned piglets. The EFSA Journal 572:1-107. www.efsa.europa.eu/sites/default/files/scientific_output/files/main_documents/572.pdf. Accessed January 12, 2016.

[95] Quesada A, Porrero MC, Téllez S, Palomo G, García M, and Domínquez L. 2015. Polymorphism of genes encoding PmrAB in colistin-resistant strains of *Escherichia coli* and *Salmonella enterica* isolated from poultry and swine. Journal of Antimicrobial Chemotherapy 70(12):71-74.

[96] Panel for Animal Health and Welfare (AHAW). 2007. Animal health and welfare in fattening pigs in relation to housing and husbandry. The EFSA Journal 564:1-14. www.efsa.europa.eu/sites/default/files/scientific_output/files/main_documents/564.pdf. Accessed January 12, 2016.

[97] Panel for Animal Health and Welfare (AHAW). 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. The EFSA Journal 572:1-107. www.efsa.europa.eu/sites/default/files/scientific_output/files/main_documents/572.pdf. Accessed January 11, 2016.

[98] Rutherford KMD, Baster EM, Ask B, et al., 2011. The Ethical and Welfare Implications of Large Litter Size in the Domestic Pig: Challenges and Solutions, 2011. The Danish Centre for Bioethics and Risk Assessment and The Scottish

which can be painful for the sow and lead to some piglets failing to gain adequate access to milk.[99] When the litter size exceeds the number of functioning teats, late fostering can result in a sow being confined to a farrowing crate for a prolonged period of time, while she raises a second litter.[100]

> ***ICFAW recommendation on genetic selection:*** Selection for production traits should be avoided where this is likely to lead to health and welfare problems. Selective breeding should focus on improving the welfare of pigs by selecting for breeds which make good mothers and are less likely to crush their young, smaller litters of healthier, more robust piglets, pigs that are less prone to tail biting and resistance to stress and disease. Improvements to health and welfare that may follow from such selection would have benefits for productivity.

Tail docking

Tail docking is painful and in some cases can result in long-term pain and changes to pain perception mechanisms (through the formation of neuromas of the tail stump).[101] Tail biting is multi-factorial in causation but the major underlying motivation is the need to perform exploration and foraging behaviour. Scientific research has identified the principal causes of tail biting as being a barren environment, the absence of straw and the use of slatted floors.[102] Research has established that the proper way to prevent tail biting is not to dock the pigs' tails but to keep them in good conditions and in particular to provide them with appropriate enrichment materials such as straw.[103,104] Docking does not prevent tail biting from occurring; it can still occur in a significant proportion of docked pigs.[105]

Routine tail docking is not allowed in the European Union. Farmers may only lawfully tail dock if they have first tried to prevent tail biting by "other measures" and in particular have changed "inadequate environmental conditions or management systems" but nonetheless still have a tail biting problem (Directive 2008/120/EC, Annex 1, paragraph 8).

A Technical Report prepared for EFSA stressed that:

Agricultural College, Project Report 17. http://curis.ku.dk/ws/files/37642367/17_Ethics_welfare_pig_litter_size.pdf. Accessed January 12, 2015.

[99] Rutherford KMD, Baster EM, Ask B, et al., 2011. The Ethical and Welfare Implications of Large Litter Size in the Domestic Pig: Challenges and Solutions, 2011. The Danish Centre for Bioethics and Risk Assessment and The Scottish Agricultural College, Project Report 17. http://curis.ku.dk/ws/files/37642367/17_Ethics_welfare_pig_litter_size.pdf. Accessed January 12, 2015.

[100] Farm Animal Welfare Committee. 2015. Opinion on Free Farrowing Systems, October. www.gov.uk/government/uploads/system/uploads/attachment_data/file/478588/Opinion_on_Free_Farrowing_Systems.pdf. Accessed December 11, 2015.

[101] Herskin MS, Thodberg K, and Jensen HE. 2015. Effects of tail docking and docking length on neuroanatomical changes in healed tail tips of pigs. Animal 9(4):677-681.

[102] Panel on Animal Health and Welfare. 2007. The risks associated with tail biting in pigs and possible means to reduce the need for tail docking considering the different housing and husbandry systems. The EFSA Journal 611:1-13. www.efsa.europa.eu/sites/default/files/scientific_output/files/main_documents/611.pdf. Accessed January 12, 2016.

[103] EU Welnet: Coordinated European Animal Welfare Network. http://euwelnet.hwnn001.topshare.com/. Accessed January 15, 201.

[104] D'Eath RB, Arnott G, Turner SP, et al. 2014. Injurious tail biting in pigs: how can it be controlled in existing systems without tail docking? Animal 8(9):1479-1497.

[105] Harley S, More SJ, O'Connell NE, Hanlon A, Teixeira D, and Boyle L. 2012. Evaluating the prevalence of tail biting and carcase condemnations in slaughter pigs in the Republic and Northern Ireland, and the potential of abattoir meat inspection as a welfare surveillance tool. Veterinary Record 171(24):621.

"An intact curly tail may well be the single most important animal-based welfare indicator for weaned, growing and finishing pigs (at herd level). In addition, it stands for high-quality management and respect for the integrity of the pig."[106]

> ***ICFAW recommendation on tail docking:*** Tail docking should not be carried out. Instead tail biting should be prevented by the provision of enrichment materials that enable pigs to carry out their exploration and manipulation behaviours. In addition, the following measures can help reduce tail biting:
> - ensuring that each pig has adequate feed intake and avoiding competition for feed
> - ensuring sufficient space is provided
> - ensuring diet is adequate in salt and essential amino acids
> - avoiding heat or cold stress and high airspeed
> - avoiding mixing
> - removal of tail biters and victims from the group
> - preventing disease; outbreaks of disease can increase the risk of tail biting so extra vigilance is required at such times
> - considering the breed that is used, as the genetics of the pigs on the unit can affect the risk of tail biting.

Teeth clipping

It is likely that tooth clipping induces severe pain, and it is certain that it increases the risk of injuries and infections in piglets.[107,108] Both teeth clipping and grinding can induce lesions such as pulp cavity opening, fracture, hemorrhage, infiltration or abscess, and osteodentine formation, with most of these effects appearing sooner and being of greater magnitude after clipping than after grinding.[109]

Competition for access to the teats is increased in large litters.[110] Increased competition for teats and milk can lead to an increase in teat and face injuries. Risk of damage to teats and to each other's faces is reduced if all the piglets get a plentiful supply of milk. Ensuring sufficient milk supplies to piglets can be achieved by a combination of breeding sows with smaller litters as well as breeding and managing sows so that they reliably produce sufficient milk for their piglets.

Research indicates that the provision of enrichment and adequate space has a beneficial effect on sow health and welfare leading to higher feed intake and increased milk production. Better milk production means less competition for teats and higher weaning weights. Research also shows that overall, tooth clipping or grinding has very little effect on sow mammary injuries and litter

[106] Spoolder HAM, Geudeke MJ, Van der Peet-Schwering CMC, and Soede NM. 2009. Group housing of sows in early pregnancy: A review of success and risk factors. Livestock Science 125(1):1-14.
[107] Sutherland M. 2015. Welfare implications of invasive piglet husbandry procedures, methods of alleviation and alternatives: a review. New Zealand Veterinary Journal 63(1):52-57.
[108] Panel for Animal Health and Welfare (AHAW). 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. European Food Safety Authority. The EFSA Journal 572:1-107. www.efsa.europa.eu/sites/default/files/scientific_output/files/main_documents/572.pdf. Accessed January 11, 2016.
[109] Hay M, Rue J, Sansac C, Brunel G, and Prunier A. 2004. Long-term detrimental effects of tooth clipping or grinding in piglets: A histological approach. Animal Welfare 13:27-32.
[110] Panel for Animal Health and Welfare (AHAW). 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. European Food Safety Authority. The EFSA Journal 572:1-107. www.efsa.europa.eu/sites/default/files/scientific_output/files/main_documents/572.pdf. Accessed January 11, 2016.

performance.[111] The EU Scientific Veterinary Committee has condemned this practice, stating that "It seems unlikely that the causing of pain in every tooth of every piglet could be justified by the relatively minor advantages which occur [from] the practice".[112]

Routine teeth clipping and grinding is not allowed in the European Union. Farmers may only lawfully carry out these procedures if they have first tried to prevent injuries to sows' teats by "other measures" and in particular have changed "inadequate environmental conditions or management systems" but nonetheless still have a problem with injuries to sows' teats (Directive 2008/120/EC, Annex 1, paragraph 8).

> ***ICFAW recommendation on teeth clipping:*** Tooth clipping should not be carried out. Tooth grinding should also be avoided, but if practiced, should be carried out by trained operators with well-maintained equipment and only the tip of the tooth removed.

Castration

Castration at any age causes both acute and prolonged pain.[113] Castration without anaesthetic and prolonged analgesia should be brought to an end. However, the various forms of anaesthesia are not problem-free; hence anaesthesia should only be used on a temporary basis pending the complete ending of surgical castration. Immunocastration is clearly preferable to surgical castration and is currently the only non-surgical option for pigs that are slaughtered at heavy live weights (up to 180 kg).

Alternative approaches to preventing boar taint in uncastrated boars include slaughter at lower weights and dietary and management measures (e.g. preventing wallowing in excreta, avoiding mixing, providing fibre rich feedstuffs like chicory or lupins and providing a thick layer of complex natural enrichment material).[114] Genetic selection of males for reduced levels of boar taint and/or slightly later sexual development could also facilitate the rearing of entire males. Boar taint is being detected at slaughter with the human nose method and an 'electronic nose' is under development.[115]

Some countries are able to raise entire males and have been doing so for some time. For example, castration is uncommon in the United Kingdom and Portugal; less than 5 and 10% of commercial pigs are castrated in these countries respectively.[116]

> ***ICFAW recommendation on castration:*** Surgical castration without anaesthetic should not be carried out. Castration with anaesthesia and prolonged analgesia as well as immunocastration are clearly preferable to surgical castration without pain relief.

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[111] Gallois M, Le Cozler Y, and Prunier A. 2005. Influence of tooth resection in piglets on welfare and performance. Preventive Veterinary Medicine 69:13-23.

[112] Scientific Veterinary Committee, Animal Welfare Section. The welfare of intensively kept pigs. Adopted September 30, 1997. http://ec.europa.eu/food/fs/sc/oldcomm4/out17_en.pdf. Accessed January 12, 2016.

[113] Panel on Animal Health and Welfare. 2004. Welfare aspects of the castration of piglets. The EFSA Journal 91:1-18. www.efsa.europa.eu/sites/default/files/scientific_output/files/main_documents/91.pdf. Accessed January 12, 2016.

[114] Boars heading to 2018. Boars 5 years underway. http://boars2018.com/wp-content/uploads/2011/05/history-boars-eng-fin-18-11-2018.pdf. Accessed January 12, 2016.

[115] Boars heading to 2018. Boars 5 years underway. http://boars2018.com/wp-content/uploads/2011/05/history-boars-eng-fin-18-11-2018.pdf. Accessed January 12, 2016

[116] Spoolder HAM and Baltussen WHM. 2008. PIGCAS Stakeholder Congress Report 103 (Wageningen University: Animal Sciences Group, February).

Ovariectomy

In some countries, female pigs are spayed without anaesthesia or pain relief, especially those raised in extensive or semi-extensive farming systems. This is an extremely invasive, painful procedure, and is illegal under EU legislation on the protection of pigs.[117] Spain is one country where this practice was widespread. On the request of the competent authorities, an immunological product that reversibly and effectively suppresses ovarian function in female pigs has received marketing authorisation to avoid the need for this painful surgical intervention.[118,119]

> ***ICFAW recommendation:*** Female pigs should not be spayed without anaesthetic and prolonged analgesia. Immunological prevention of oestrus should be encouraged.

Ractopamine

In several countries, beta-agonists are sometimes used to increase lean growth in the finishing stages of pig production. Ractopamine is administered in feed the last 20-42 days before slaughter. The animal welfare concerns associated with ractopamine are becoming more evident, as research continues to uncover disconcerting side-effects. These include hoof lesions,[120] elevated heart rates and catecholamine concentrations, and behavioral changes such as reduced willingness to walk,[121,122] abnormal behavior,[123] and increased impulsive aggression.[124,125] Pigs treated with ractopamine also show increased stress reactions in response to transportation, initially becoming more active and then more difficult to handle. The difficulty walking due to ractopamine may also be a contributing factor in the greater incidence of non-ambulatory or "downed" pigs, i.e. those too weak to stand and walk on their own accord, found with pigs given the beta-agonist.[126]

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[117] Council Directive 2008/120/EC http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:047:0005:0013:EN:PDF. Accessed January 15, 2016.

[118] Agencia Española de Medicamentos y Productos Sanitarios. 2014. Nota informativa de la reunión 153 del Comité de medicamentos veterinaries. www.aemps.gob.es/informa/notasInformativas/medicamentosVeterinarios/comiteEvaluacion-vet/2014/docs/codem-vet_5-feb-2014.pdf. Accessed January 21, 2016.

[119] Dalmau A, Velarde A, Rodríguez P et al. 2015. Use of an anti-GnRF vaccine to suppress estrus in crossbred Iberian female pigs. Theriogenology 84(3):342-347.

[120] Poletto R, Rostagno MH, Richert BT, and Marchant-Forde JN. 2009. Effects of a "step-up" ractopamine feeding program, sex, and social rank on growth performance, hoof lesions, and Enterobacteriaceae shedding in finishing pigs. Journal of Animal Science 87:304-313.

[121] Marchant-Fordel JN, Lay DC Jr., Pajor EA, Richert BT and Schinckel AP. 2002. The effects of ractopamine on behavior and physiology of finishing pigs. Purdue University, Swine Research Report. www.ansc.purdue.edu/swine/swineday/sday02/19.pdf. Accessed December 6, 2015.

[122] Marchant-Forde JN, Lay DC Jr., Pajor EA, Richert BT, and Schinckel AP. 2003. The effects of ractopamine on the behavior and physiology of finishing pigs. Journal of Animal Science 81:416-422.

[123] Poletto R, Richert BT and Marchant-Forde JN. 2007. Behavioral effects of 'step-up' ractopamine feeding program on finishing pigs. In: Galindo F and Alvarez L (eds.), Proceedings of the 41st International Congress of the ISAE (Merida, Mexico: International Society for Applied Ethology, p. 90).

[124] Poletto R, Meisel RL, Richert BT, Cheng HW, and Marchant-Forde JN. 2010. Behavior and peripheral amine concentrations in relation to ractopamine feeding, sex, and social rank of finishing pigs. Journal of Animal Science 88:1184-1194.

[125] Poletto R, Cheng HW, Meisel RL, Garner JP, Richert BT, and Marchant-Forde JN. 2010. Aggressiveness and brain amine concentration in dominant and subordinate finishing pigs fed the β-adrenoreceptor agonist ractopamine1,2. Journal of Animal Science 88:3107-3120.

[126] Marchant-Forde JN, Lay DC Jr., Pajor EA, Richert BT, and Schinckel AP. 2003. The effects of ractopamine on the behavior and physiology of finishing pigs. Journal of Animal Science 81:416-422.

ICFAW recommendation on ractopamine: Pigs should not be fed beta-agonists such as ractopamine.

Resources on good pig welfare

A resource on the animal welfare aspects of good agricultural practice in pig production has been published by ICFAW member Compassion in World Farming. This consists of a book, a film, a PowerPoint presentation and lecturers' notes drawing on good practice from across the world. It is a valuable tool for lecturers, educationalists, vets, farmers, students of agricultural and veterinary science and for all who make decisions that affect the welfare of farm animals. This resource can be downloaded and a free DVD-ROM ordered at www.ciwf.org.uk/resources/education/good_agricultural_practice/default.aspx

The RSPCA, also an ICFAW member, has produced *Welfare Standards for Pigs* which can be found at http://science.rspca.org.uk/ImageLocator/LocateAsset?asset=document&assetId=1232729716304&mode=prd. These standards, which are set at the limit of what is achievable in terms of animal husbandry and commercial viability, aim to deliver improved animal welfare above and beyond 'standard' or typical production. The standards, which are updated every two years to take into account the latest scientific research and practical farming experience, have been used for over 20 years by the RSPCA's farm assurance and food labeling scheme RSPCA Assured (formerly Freedom Food).

RSPCA Australia, another ICFAW member, also has standards for on-farm production and slaughter of pigs which can be found at: www.rspca.org.au/what-we-do/rspca-approved-farming-scheme/rspca-standards-pigs. These standards are currently under review.

Guides to good practice to prevent tail biting and to provide suitable environmental enrichment for pigs can be found on the website of the EuWelNet project: http://euwelnet.hwnn001.topshare.com/

A very comprehensive overview of the state of the art on raising entire boars can be found on the website of Wageningen UR (Project "Boars heading to 2018"): http://boars2018.com/wp-content/uploads/2014/02/Boars-on-the-way.herzien-11-2-2014.pdf

Further resources on alternatives to surgical piglet castration can be found on the website of the BOARS2018 platform (http://boars2018.com/) and on the website of the European Commission, DG SANTE (European Declaration on Alternatives to the surgical castration of pigs: http://ec.europa.eu/food/animals/welfare/practice/farm/pigs/castration_alternatives/index_en.htm