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What can carcass-based assessments tell us about the lifetime welfare status of pigs?

G.A. Carroll[a,*], L.A. Boyle[b], A. Hanlon[c], L. Collins[d], K. Griffin[e], M. Friel[e], D. Armstrong[f], N.E. O'Connell[a]

[a] Institute for Global Food Security, Northern Ireland Technology Centre, Queens University Belfast, Malone Road, Belfast BT9 5HN, United Kingdom
[b] Animal & Grassland Research & Innovation Centre, Teagasc Moorepark, Fermoy, Co Cork, Ireland
[c] School of Veterinary Medicine, University College Dublin, Belfield, 4, Dublin, Ireland
[d] Faculty of Biological Sciences, University of Leeds, Leeds, West Yorkshire LS2 9JT, United Kingdom
[e] School of Biological Sciences, Queens University Belfast, 97 Lisburn Road, Belfast BT9 7BL, United Kingdom
[f] Agri-Food and Biosciences Institute Pig Unit, Large Park, Hillsborough, County Down BT26 6DR, United Kingdom

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ABSTRACT

There is increasing interest in developing abattoir-based measures of farm animal welfare. It is important to understand the extent to which these measures reflect lifetime welfare status. The study aim was to determine whether lesions acquired during different production stages remain visible on the carcass, and the degree to which carcass-based measures may reflect broader health and welfare issues. 532 animals were assessed at 7, 9 and 10 weeks of age (early life, EL), and at 15 and 20 weeks of age (later life, LL) for tail lesions (TL), skin lesions (SL) and a number of health issues (HI) including lameness and coughing. Pigs were categorised according to when individual welfare issues occurred in the production process; 'early life' [EL], 'later life' [LL], 'whole life' [WL], or 'uninjured' (U) if showing no signs of a specific welfare issue on-farm. Following slaughter, carcasses were scored for tail length, tail lesions, and skin lesions and cold carcass weights (CCW) were obtained. Generalised linear, ordinal logistic and binary logistic fixed model procedures were carried out to examine the ability of TL, SL and HI lifetime categories to predict carcass traits. Pigs with TL in EL, LL and WL had higher carcass tail lesion scores than U pigs ($P < 0.001$). Pigs with TL in LL ($P < 0.05$) and WL ($P < 0.001$), but not in EL ($P > 0.05$), also had shorter tails at slaughter than U pigs. In relation to TL scores, U pigs also had a higher cold carcass weight compared to LL and WL ($P < 0.001$), but not EL pigs ($P > 0.05$). Pigs with SL in EL, LL and WL had higher healed skin lesion scores on the carcass than U pigs ($P < 0.001$). Health issues recorded during lifetime were not reflected in carcass measures used ($P > 0.05$). The current study shows that tail lesions and skin lesions, acquired at least 10 weeks before slaughter, remain evident on the carcass and consequently, may be useful as tools to assist in determining the lifetime welfare status of pigs. Low CCW was associated with tail lesions, supporting previous research suggesting that tail lesions have a negative impact on growth performance in pigs.

1. Introduction

Input-based measures of animal welfare, for example, recording of environmental factors such as stocking density or flooring type, are increasingly viewed as inadequate in reflecting the welfare of individual animals. The development of outcome-based animal welfare assessment methods has received substantial attention from the scientific panel for Animal Health and Welfare (AHAW) of the European Food Safety Authority (EFSA, 2007). This, in turn, has led to an increased interest in outcome-based measures by animal welfare scientists and assurance scheme providers, resulting in the development of novel outcome-based welfare assessment methods (Mullan et al., 2009; Velarde and Dalmau, 2012). Animal-based 'outcome' measures allow the effect of the environment on the animal to be directly assessed by examining how animals respond to, and are affected by, resource and management-based measures (Velarde and Dalmau, 2012; Otten et al., 2014). By directly recording the results of interactions between the environment and the animal, the true consequences that a particular management practise has on animal welfare can be measured (Welfare Quality, 2009).

* Corresponding author.
E-mail address: gcarroll05@qub.ac.uk (G.A. Carroll).

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However, biosecurity issues associated with entering farms, and poor visibility associated with dim lighting, high stocking densities and dirty conditions, may hamper animal-based welfare assessments (Edwards et al., 1997; Velarde et al., 2005). Hence, the prospective benefits of using abattoir-based animal welfare assessments are increasingly recognised (Harley et al., 2012b). In the EU, all animals that are slaughtered for meat are subjected to a meat inspection (MI) process, with the primary aim of ensuring that meat is fit for human consumption. The integration of outcome-based welfare measures into a pre-existing MI system would minimise costs (Harley et al., 2014), and allow a large number of animals from a variety of farms to be assessed in a relatively short period of time. However, it is possible that lesions sustained early in the production cycle may not be detectable at the abattoir (Harley et al., 2012a), and the source of the damage may be difficult to ascertain (Grandin, 2007). Furthermore, only a limited number of welfare-related measures are suitable for post-mortem assessment and the extent to which these measures reflect general health and welfare on-farm is unclear. Previous abattoir-based research has tended to focus on assessing the effects of the marketing process on animal welfare. For example, a number of factors may affect animal welfare on the day of slaughter, including poor training of employees, fast slaughter line speed and inadequate equipment maintenance (Chulayo and Muchenje, 2015; De Lama, 2012). Issues such as these can lead to visible skin damage to the carcass (De Lama et al., 2014), which may be caused by issues such as the presence of rough edges within the abattoir, excessive goad usage or intra-specific aggression. However, assessments of the carcass may also tell us something about the welfare standards on-farm.

This study will examine the extent to which carcass-based measures of tail lesions, tail length, fresh skin lesions, healed skin lesions, loin bruising and carcass weight in pigs reflect welfare measurements recorded throughout the production cycle. In particular, the extent to which certain lesions acquired during different production stages remain visible on the carcass and the degree to which carcass-based measures may reflect broader health and welfare issues throughout life was assessed.

2. Material and methods

This non-invasive observational study complies with ARRIVE guidelines. The research was conducted at the Agri-Food and Biosciences Institute, Hillsborough, Northern Ireland. Data were collected between April 2013 and December 2014. Five hundred and thirty-two pigs were assessed from a total of 720 pigs reared over 10 batches (each batch was reared at approximately 6-week intervals). A number of pigs (188) were not included in the final data set due to issues such as missing ear tags, being moved between pens or premature death. The final sample size of 532 pigs (male: n = 254, female: n = 278) allows for 95% confidence with a confidence interval of 0.039. This was calculated using the Statistics Service sample size calculator (NSS, 2014), and involved entering a generic large pig population of 100,000 (Select Statistics, 2016) and an average proportion of pigs with skin lesions of 0.7 (Carroll et al., 2016).

2.1. Animals and housing

Pigs used in this experiment were PIC 337/Landrace mixed breed. Piglets had approximately 50% of their tail length docked within 24 h of birth, and were housed within standard farrowing crate systems until weaning at 4 weeks of age. Pigs were provided with a suspended wooden block as a form of enrichment in all pens during the pre-weaning, growing and finishing periods.

During the growing phase (4–9.5 weeks of age) pigs in each batch were housed in the 'weaning unit' within one of four groups of 18 pigs, which were balanced for sex and weight. Two of the pens were 'enriched' with deep straw bedding (replenished weekly) and a space allowance of 0.62 m^2 per pig. The other two pens were 'barren' and had no straw and a space allowance of 0.41 m^2 per pig. In both types of pens, floors were part slatted and constructed from concrete.

At 9.5 weeks of age, each batch of pigs was transferred to a 'finishing unit'. At this stage, approximately 90% of pigs were mixed into new groups that were balanced for sex and weight, while remaining pigs stayed in their original groups. Pigs were housed in one of two finishing houses in fully slatted pens within groups of either 10 (in house 1) or 20 (in house 2) pigs. All pigs had an average space allowance of 0.64 m^2 during this period. Pigs were slaughtered at 21 weeks of age.

2.2. Data collection

Each pig was assessed at 7 and 9 weeks of age (in the weaning unit) and at 10, 15 and 20 weeks of age (in the finishing unit). Assessments were carried out over two days in each observation week.

Two trained observers entered each pen. Individual ear tag numbers were recorded and each pig was given a unique spray mark to allow for individual identification. In order to carry out injury scoring, one observer slowly circled each pig and determined the scores that were to be assigned. A second observer recorded the injury scores onto data sheets. Pigs were injury scored in random order. The animals were sometimes brought into the corridor of the barn to allow additional space for assessment of larger pigs.

2.3. Lifetime welfare measures

2.3.1. Skin lesions

Twelve areas of the body were assessed for aggression-related skin lesions, namely; the left ear, right ear, snout, left shoulder, right shoulder, front legs, back legs, left flank, right flank, left hindquarter, right hindquarter and back. A six point scoring system (0–5) (adapted from Calderón Díaz et al., 2014; Conte et al., 2012; Manciocco et al., 2011) was used (Table 1). Weekly scores were condensed into absent, mild, moderate and severe categories based on the following criteria; (0) absent: all regions scoring 0, (1) mild: regions scoring 0–2 with a maximum of four regions scoring 3, (2) moderate: regions scoring 0–3 with a maximum of two regions scoring 4 or one region scoring 5, (3) severe: regions scoring 0–3, with three or more regions scoring 4 or two or more regions scoring 5.

2.3.2. Tail lesions

Tail lesions were scored using an adapted version of Kritas and Morrison's (2007) tail scoring system used by Harley et al. (2012b) (Fig. 1).

2.3.3. Health issues

Each pig was assigned a score for a number of health issues namely; lameness, bursitis, hernias, rectal prolapse, scouring, coughing and

Table 1
Skin lesion scoring method for pigs.

Score	Description
0	No injuries
1	One small (approximately 2 cm) superficial lesion (not penetrating the skin)
2	More than one small, superficial lesion or just one red (deeper than score 1) but still superficial lesion
3	One or several big (2–5 cm) and deep (a lesion penetrating the skin) lesions. If deep; only one single lesion. If not so deep; several red lesions
4	One very big (> 5 cm), deep and red lesion or many deep, red lesions
5	Many very big, deep and red lesions covering the skin area

Adapted from Manciocco et al. (2011), Conte et al. (2012) and Calderón Díaz et al. (2014).