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Effect of housing system, slaughter weight and slaughter strategy on carcass and meat quality, sex organ development and androstenone and skatole levels in Duroc finished entire male pigs

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ABSTRACT

This study aimed at evaluating the effect of housing system (HS), slaughter weight (SW) and strategy (SS) on carcass a nd meat quality, sexual organ development and boar taint in entire males. Twelve pens of 10 pigs were used (two trials). Half of male pens were allowed visual contact with females (MF) and half with males (MM). Half MM or MF were slaughtered at 105 or 130 kg in trial 1, or penwise or by split marketing in trial 2 at 120 kg. Housing system showed no significant effect on carcass or meat quality. MF presented significantly longer testicles and heavier bulbourethral glands compared to MM. The distribution of androstenone and skatole levels was affected by SW but not by HS or SS, samples with androstenone >1 μg/g of the different groups falling within the range of 16 to 22%. All correlations between androstenone and sex organs were significant. Housing system and slaughter strategy did not reduce the risk of boar tainted carcasses.

1. Introduction

Piglet surgical castration is widely practised in most European countries to prevent boar taint, increase carcass fat content for high value products like cured ham and prevent aggressive behaviour after puberty. According to the "Attitudes, practices and state of the art regarding piglet castration in Europe" (PIGCAS) project approximately 79.3% (Fredriksen et al., 2009) of the EU male pig population is castrated each year. However, social claims against painful practises (see Prunier et al., 2006 for a review) have increased the pressure on pig producers to stop castration. Some countries (Norway and Switzerland) have already banned surgical castration without anaesthesia and the topic is under review in other European countries. Recently, the European Commission initiated talks with the European farmer's organisation Copa-Cogeca, the European organisation for the meat sector UECBV, retailers, veterinarians, the European animal welfare organisation Eurogroup for Animals which finally resulted in a voluntary agreement to stop castration by 2018. Therefore, alternative methods are currently evaluated in more detail and more research programmes for entire male pig production have been established to ensure that a ban could be accomplished without large negative consequences for the industry and the pig producers, and that the consumers would be offered quality pork without boar taint. The ALCASDE project (www.alcasde.es) has recently evaluated different aspects of these alternatives to surgical castration with a broad approach (from on farm to on line possibilities), with the aim of providing research results to support EU policy to promote demand and acceptance by consumers of pig meat from entire male pigs or produced with alternatives to surgical castration.

The onset of puberty is related to age and live weight (Einarsson, Holtman, Larsson, Settergren, & Bane, 1979; Prunier, Bonneau, & Etienne, 1987) and depends to a great extent on genetics (Wilson, Johnson, & Wetterman, 1977). Other factors such as nutrition (Prunier & Quesnel, 2000) or social environment may play a role in puberty onset as well. It has been suggested that contact between boars and gilts enhances the development of the testes (Andersson et al., 1999) or that the introduction of a mature boar to female pigs triggers the attainment of puberty (Patterson, Willis, Kirkwood, & Foxcroft, 2002). However, contradictory to this, preliminary results of a study by Salmon and Edwards (2006) showed that boars with gilt contact were less physiologically mature at slaughter and showed reduced levels of sexual behaviours.

Boar taint is an unpleasant odour and flavour mostly attributable to the presence of androstenone and skatole in the meat (Bonneau et al., 1992). Androstenone levels primarily depend on the stage of puberty (Bonneau, 1982) and genetics (Sellier, Le Roy, Fouilloux, Gruand, & Bonneau, 2000). Skatole is produced in the large intestine of pigs, but puberty status may also affect skatole levels by the interaction with either its metabolism (Babol, Squires, & Lundström, 1999; Doran, Whittington, Wood, & McGivan, 2002) or production (Babol et al., 1999; Zamaratskaia, Babol, Andersson, & Lundström, 2004). It has also been

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suggested that social factors can exert a noticeable effect on the occurrence of boar taint (Giersing, Lundström, & Andersson, 2000).

The objective of this study was to investigate the effect of different housing systems (with and without visual contact between males and females) on pubertal development and carcass and meat quality traits (including carcass taint compounds) of pigs slaughtered either at 105 or 130 kg live weight or by split marketing vs. penwise slaughter.

2. Material and methods

2.1. Animals and housing

Two trials with a similar experimental design were carried out. The first trial implied a winter growing period of the pigs with an early spring slaughter whereas for the second trial growing period was in spring and slaughter in summer. For both trials, one hundred and forty piglets (90 entire males and 50 females) were moved from a commercial farm to the weaning unit at IRTA-Monells at a mean age of 21 days. The piglets were from the commercial cross (Large White x Landrace) x Duroc and a maximum of 4 piglets per litter were chosen.

At a mean age of 63 days, 120 pigs per trial were enrolled on the study ensuring the highest homogeneous body weight possible for all the treatment groups. Forty females and 80 males were selected and identified using an 8-digit electronic chip that permitted the recording of individual feed intake. Pigs were allocated in groups of 10 pigs in 12 fattening pens. All pens were single sex with sight, sound and touch contact but not direct mixing with the same gender or opposite gender, in adjacent pens depending on the treatment. The pens were distributed in three rooms of the same building, with the same farming conditions. As shown in Fig. 1, in room A and C, two pens of females and two pens of males were allocated, whereas in room B there were 4 pens of males.

Ventilation and temperature at the experimental barn were mechanically controlled. Each pen measured 4 × 2.3 m (0.9 m^2/pig), had a partly slatted floor (comprising 60% solid concrete and 40% slatted) and had one drinking bowl. Each pen was equipped with an IVOG®-station (INSENTEC, Marknesse, The Netherlands). The feeding station consisted of a single-space food hopper with a trough which weighed continuously and had an electronic identification system that was activated by ear responders as pigs entered the station. Each time a pig visited the feeder, time, the pig identification number and weight of the food at the beginning and at the end of the visit were recorded automatically. To enable competition for food, the entrance of the hopper was always open.

All pigs were fed the same commercial diet (14.09 MJ DE/kg, 17.9% crude protein, 7% crude fat, 1.95% lysine, 6.55% ash).

2.2. Slaughter procedure

The slaughter procedure was similar in both trials, but the following slaughter weights and strategies differed. In trial 1, two target slaughter weights were chosen: 105 and 130 kg, respectively. For trial 2, pigs were slaughtered either by split marketing (SM) when their individual weight was approximately 120 kg or penwise (PW) when the mean weight of the pen was 120 kg. Two pens of females (FE), two pens of males in visual contact with females (MF) and two pens of males in visual contact with males (MM) were included in each slaughter weight in trial 1 (105 or 130 kg) or slaughter strategy in trial 2 (SM or PW) (see Fig. 1). For trial 1, the pigs were slaughtered in 4 days, two for each slaughter weight and including 1 pen of each housing system every day of sacrifice (mean age of sacrifice 152 days for the 105 kg group and 170 days for the 130 kg group). For trial 2, pigs were slaughtered within 6 days. In each day one complete pen of the PW slaughter strategy and several animals from three of the SM strategy were slaughtered. The SM pens were slaughtered in a total of three batches. Age of sacrifice for the trial 2 was in the range of 159 to 180 days.

The slaughter procedure was the same for both trials: standard ante mortem procedure to minimise the stress and stunning with CO_2 85%.

2.3. Carcass and meat quality data

The weight of each half carcass was recorded within 45 min post-mortem following the standard European presentation. Cold carcass weight was also recorded 24 h post-mortem. Carcass lean meat percentage was predicted using the equation published by Font-i-Furnols and Gispert (2009) using the Fat-o-Meat'er (FOM, Carometec, Herlev, DK) measurements (i.e. backfat thickness LR3/4FOM and muscle depth (MFOM) both measured 6 cm away from the midline at the intercostal space between the 3rd and 4th ribs, starting from the last rib). Moreover the fat thickness at 8 cm of the midline between the 3rd and 4th lumbar vertebrae (VLFOM) was also measured with FOM. The minimum fat thickness over the *Gluteus medius* muscle (MLOIN) was taken with a ruler.

During the evisceration process, the weight and dimensions of the reproductive organs were recorded. Testicles and bulbourethal glands were separated from the rest of the reproductive tract. The left and right testicles were weighed separately, epididymus included. The length of testicles and bulbourethral glands was measured using a 30-cm ruler. Bulbourethral glands were cleaned by removing the surrounding connective tissue using a scalpel and afterwards weighed.

To determine the skatole and androstenone content a full thickness subcutaneous fat sample (approximately 50 g) between the 3rd and 4th ribs, including all fat layers. Another sample of 200 g of *Longissimus thoracis* (LT) muscle was also collected at the last rib level for the determination of intramuscular fat content. Both samples were vacuum packed and frozen until processed. Androstenone and skatole levels were measured following the methodology described by García-Regueiro and Rius (1998) and Rius, Hortós and García-Regueiro (2005). Intramuscular fat (%) was determined using the NIT (Near Infrared Transmitance, Infratec, 1265 TECATOR, DK) equipment.

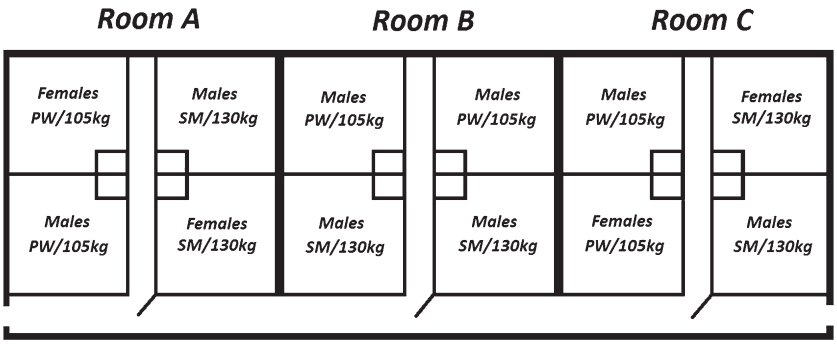

Fig. 1. Distribution of the different genders (trial 1 and trial 2), slaughter weights (105 or 130 kg, trial 1) and slaughter strategies (Penwise or Split Marketing, trial 2).