Meat Science 94 (2013) 402–407

Contents lists available at SciVerse ScienceDirect

Meat Science

journal homepage: www.elsevier.com/locate/meatsci

Effect of surgical castration, immunocastration and chicory-diet on the meat quality and palatability of boars

M. Aluwé [a,*], K.C.M. Langendries [a], K.M. Bekaert [a], F.A.M. Tuyttens [a], D.L. De Brabander [a], S. De Smet [b], S. Millet [a]

[a] Institute for Agricultural and Fisheries Research (ILVO), Animal Sciences Unit, Scheldeweg 68, 9090 Melle, Belgium
[b] Ghent University, Faculty of Bioscience Engineering, Department of Animal Production, Laboratory of Animal Nutrition and Animal Product Quality, Proefhoevestraat 10, 9090 Melle, Belgium

ARTICLE INFO

Article history:
Received 1 September 2011
Received in revised form 25 January 2013
Accepted 26 February 2013

Keywords:
Entire male pigs
Immunocastration
Meat quality
Boar taint
Chicory

ABSTRACT

This study evaluates 1) carcass quality, meat quality and palatability for barrows, immunocastrates and boars and 2) the effect of chicory supplemented feed during 10 days before slaughter on boar meat quality.
At comparable carcass weights, estimated carcass lean meat percentage was higher in immunocastrates and boars than in barrows. Muscle thickness was higher for immunocastrates and barrows compared to boars, while fat thickness was lowest for immunocastrates and boars. Barrows, immunocastrates and boars differed in water holding capacity and boar taint. Home consumer panels were conducted to evaluate palatability. The consumers did detect differences in tenderness and juiciness, but not for boar taint. The chicory feed supplemented in boar feed decreased skatole concentration in backfat, without largely influencing meat quality or palatability.
Not only boar taint, but also carcass and meat quality should be considered when evaluating alternatives for surgical castration.

1. Introduction

Vaccination of boars against GnRH (Improvac®) to avoid boar taint, an unpleasant odour released by heating the meat of intact boars, has been recently accepted for use in the European Union (European European Medicines Agency, 2013). While vaccination has been shown to be effective against boar taint, performances may differ between boars and boars vaccinated against GnRH. Boars and barrows have been shown to differ in carcass and meat quality (Lundstrom, Matthews, & Haugen, 2009). Immunocastrates physiologically turn into barrows at a later age (4–8 weeks before slaughter depending on the time of second vaccination); however, the effect of this hormonal modification on performance and carcass and meat quality remains unclear. Results vary greatly depending on genetics (D'Souza & Mullan, 2003), feeding (ad lib. vs. restricted), time of second vaccination (4 weeks or more before slaughter) or housing (group or individually housed) as described by Skrlep et al. (2010).

Boar taint is caused by skatole and androstenone, and to a lesser extent by indole. Various management strategies are currently being investigated to reduce boar taint in entire male pigs (Zamaratskaia & Squires, 2009). Skatole reduction efforts focus mainly on feeding strategies. Several feed components, e.g., raw potato starch, sugar beet pulp and lupines, have been tested in varying concentrations from 1 to several weeks before slaughter (Wesoly & Weiler, 2012). Literature also indicates reduced incidence of boar taint when boars are fed either crude/dried chicory roots or pure inulin from chicory (Hansen et al., 2006; Nielsen, Hansen, & Byrne, 2007). Byrne, Thamsborg, and Hansen (2008) suggest that the sesquiterpene lactones (bitter compounds) present in chicory also reduce skatole but to a lesser extent than inulin. In a previous study we found that supplementing feed with 5% feed grade inulin (or 3.3% pure inulin) did not significantly reduce skatole concentrations (Aluwe et al., 2009). According to Kjos, Overland, Fauske, and Sorum (2010), optimal skatole reduction results from adding 6% chicory inulin (or 4.2% pure inulin) during the last 4 weeks before slaughter. Zammerini, Whittington, & Nute (2010) evaluated the effect of 0, 3, 6 and 9% inclusion of dried chicory roots during 1 or 2 weeks on skatole reduction. Only the addition of 9% (±5.4% inulin) during 2 weeks before slaughter was effective to reduce skatole below cut-off level. To curb costs, the use of the lowest effective supplementation levels and dried chicory roots to pure inulin is preferred. Rosenvold et al. (2002) fed gilts a diet supplemented with high inulin content for 4 weeks before slaughter. This diet resulted in lower drip loss and darker but less tender meat as compared with gilts on a control diet. Ultimate pH and cooking loss were not affected. The researchers proposed that the reduced tenderness was probably due to the reduced muscle glycogen stores arising from feed that contained a low level of digestible carbohydrate and high level of fermentable carbohydrate. In general, boars have darker, less tender and less juicy meat than barrows (Bonneau & Lebret, 2010). We therefore investigated whether chicory supplementation also affects boar meat in the same way.

* Corresponding author. Tel.: +32 92722587; fax: +32 92722601.
Email Addresses: marijke.aluwe@ilvo.vlaanderen.be, marijkealuwe@hotmail.com (M. Aluwé).

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http://dx.doi.org/10.1016/j.meatsci.2013.02.015

This study was performed to compare carcass quality, meat quality and palatability characteristics of barrows, boars vaccinated against GnRH and control boars and to evaluate the effect of 5% chicory pulp + 5% dried chicory roots inclusion in boar feed during the 10 days before slaughter.

2. Materials and methods

2.1. Animals and management

On a commercial farm, 97 male piglets (hybrid sow × Pietrain boar) were surgically castrated at 4 days of age (barrows, BA), 100 male piglets were kept entire (boars, BO) and 100 male piglets were vaccinated twice against GnRH with a 2 mL dose given subcutaneously in the neck, first at 136 days of age and again at 163 days of age or 4 weeks before slaughter (boars vaccinated against GnRH, IMP).

The fattening stable was divided in 7 comparable compartments which consisted of 8 pens per compartment. Pigs were allocated to 3 of these compartments at 10 weeks of age. So barrows were kept together in one compartment and immunocastrates were kept together in a second compartment of the same stable. Boars were housed in a third compartment with 4 pens with boars fed the standard diet until slaughter and 4 pens with boars which received the chicory diet during 10 days before slaughter. Average stocking density was 12 to 13 pigs per pen.

Pigs had free access to water at all times and feed was given *ad libitum*. All BA, IMP and BO began at the same diet. Starting at 10 days before slaughter, BA, IMP and 53 boars received a standard diet (BO) and 47 boars received a mixture of 90% standard diet and 5% dried chicory pulp (1 mm) + 5% 'Fibrofos 60' (CBO). Fibrofos 60 (SOCODE, Warcoing, BE) is a chicory root dried at a low temperature, reduced to a powder (±1 mm), and supplemented with an anti-caking agent. Minimum inulin level is 60% of dry matter. The average inulin level of the dried chicory pulp is 7%.

The standard diet, the chicory diet, 'Fibrofos 60' and the chicory pulp were subject to proximate analysis according to EC-methods (Table 1): dry matter (EEC 1971a and 1971b), neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) (Van Soest, Robertson, & Lewis, 1991), crude fibre (EC 1992) and ash (EEC 1971a, 1971b). Sugars were determined with the Luff Schoorl reagens (ISO 71/250/EEC), crude protein level was calculated based on the nitrogen level (N × 6.25), determined following Kjeldahl (ISO 5983–2) and starch was determined by enzymatic hydrolysis (NEN 3574).

Pigs were fasted for 24 h before slaughter. All pigs were slaughtered on the same day by exsanguination after electric stunning. Warm carcass weight was determined after evisceration.

Longissimus dorsi muscle thickness and fat thickness were determined at the slaughter line with the (GIRALDA CHOIROMETER) PG 200. The apparatus is equipped with a probe (Siemens KOM 2110) 6 mm in width, a light diode (LED Siemens F 28) and a light sensor (Siemens F 232). Lean meat content in the carcass was estimated ($\hat{Y}$) based on this PG 200 measurement with the equation approved for use in Belgian abattoirs (97/107/EC):

$$\hat{Y} = 70,09860 - 0,84616 \times X_1 + 0,091860 \times X_2$$

with X_1 as the thickness of backfat (including rind) in millimetres, measured perpendicularly to the back of the carcass (70 mm off the split line on the outside and ±40 mm off the split line on the inside) between the third and the fourth last ribs, and X_2 the thickness of the dorsal muscle in millimetres, measured at the same time, in the same place and in the same way as X_1.

Feed consumption, weight at 10 weeks of age and weight at slaughter (26.5 weeks of age) were determined at compartment level. For the boars (BO and CBO together), feed consumption of the chicory feed was also recorded and taken into account to calculate daily feed intake of all the boars together. Daily feed intake, daily gain and feed conversion ratio were calculated based on this data for the group of immunocastrated male pigs, the barrows and both groups of boars together.

Table 1
Nutrient levels (g/kg) of the standard fattening diet, the chicory diet, Fibrofos and chicory pulp.

Nutrients (g/kg)	Standard diet	Chicory diet	FIBROFOS 60	Chicory pulp
Dry matter	879.6	886.3	931.1	887.2
NDF	164.8	155.7	58.6	267.9
ADF	57.7	59.4	53.4	245.6
ADLignine	9.0	5.8	0.0	11.7
Crude protein	145.7	142.8	50.2	65.9
Crude fat	51.2	50.1	5.0	14.3
Crude ash	43.9	46.3	47.9	54.0
Crude fibre	51.7	47.6	39.3	186.3
Sugars	49.7	83.0	574.0	156.0
Starch	400.6	330.3	86.3	36.1

2.2. Sampling

Dorsal neck fat samples with skin were collected on the slaughter line for all BO, CBO, the first 24 BA, and the first 48 IMP to evaluate boar taint with the hot iron method. All visible meat was trimmed from the fat samples. Neck fat samples of all BO and CBO were stored vacuum packed (without skin layer) and frozen (−20 °C) for laboratory analysis of boar taint compounds (see 3.2).

Longissimus thoracis et lumborum samples with backfat layer were taken at the slaughterhouse 24 h after slaughter, vacuum packed, and stored under refrigeration (5 °C) until analysis at day 4 or 5 after slaughter. Samples of the different groups were evenly distributed over these two days. The samples were trimmed of visible fat and cut into slices of 25 mm. For the home consumer panel, 20 samples were collected from the middle of the left and right loin. Four samples were vacuum packed per animal per package. Five packages were then prepared per animal: 4 packages for the home consumer panel and 1 package for backup. Samples used for the home consumer panel and measurement of shear force and cooking loss were stored frozen at −18 °C.

3. Measurements

3.1. Meat quality

Ultimate pH (pH_u) was measured on two freshly cut (intact) meat samples per animal at least 48 h after slaughter (Knick, Portamess, Type 911 pH with a Xerolyt puncture-type electrode (Mettler Toledo). Colour determinants (L^*, a^*, b^*) were measured using a HunterLab miniscan (45/0 geometry) on 2 meat samples per animal after 15 min of blooming. Average values of pH_u and colour determinants were used for further statistical analysis.

Drip loss was determined on meat samples of about 150 g (Honikel, 1987). Drip loss was measured using a method based on that described by Honikel (1987). Samples (109 ± 26 g) were hung by a nylon cord and placed in a plastic bag for 24 h. The percentage drip loss is calculated as follows. After wiping the sample dry, the raw meat sample was weighed. The difference in weight of the meat sample before and after 24 h was divided by the sample weight at the beginning and multiplied by 100. Initial weight of the meat samples was on average 109 ± 26 g.

To measure cooking loss and Warner–Bratzler shear force measurements (Boccard et al., 1981), meat cuts (25 mm) were placed in a closed plastic bag in a hot water bath of 75 °C for 50 min, then cooled by placing the bagged samples in a cold tap water bath for 40 min.

Cooking loss (%) is defined as the difference in weight of the meat sample (after wiping dry) before and after cooking and cooling, divided by the sample weight at the beginning and multiplied by 100. Average