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LENGTH OF THE INTERVAL BETWEEN IMMUNOCASTRATION AND SLAUGHTER IN RELATION TO BOAR TAINT AND CARCASS TRAITS

Martin ŠKRLEP [1], Marjeta ČANDEK-POTOKAR [2], Nina BATOREK [3], Blaž ŠEGULA [4], Maja PREVOLNIK [5], Carolina PUGLIESE [6], Michel BONNEAU [7]

ABSTRACT

The objective of the present study was to study the effect of the interval between effective immunisation against GnRH (immunocastration) on boar taint elimination and carcass quality and to compare meat quality of immunocastrates and entire males. Among 40 commercial fatteners, 10 animals were left entire (EM27), while the remaining (IC) were vaccinated with Improvac® at the age of 12 (V1) and 19 (V2) weeks. IC pigs were slaughtered in three batches of 10 at the age of 21 (IC21), 24 (IC24) and 27 (IC27) weeks, while EM27 were slaughtered along with the last group. After the slaughter, weight of the reproductive organs, boar taint compounds, carcass traits and meat quality (IC27 and EM27) was measured. Results show that 2-week interval from V2 to slaughter seems enough for elimination of boar taint, although firm conclusions cannot be made (uncertainty regarding sexual maturity), while boar taint does not occur with prolongation V2-slaughter interval to 8 weeks. Comparison of IC24 and IC27 showed that three weeks delay of slaughter resulted in gaining on carcass weight but loosing on meat percentage, mainly due to the increasingly high increment of fat depots in the last fattening period. Meanwhile, slaughter at earlier age (IC21) showed no important advantage in carcass meat % (beside lighter carcasses) over IC24. EM27 resembled IC27 regarding weight and muscularity traits while being significantly less fat (resembling IC24). There was no major difference in meat quality between EM27 and IC27, except the tendency ($P < 0.10$) for the tougher meat in EM27.

Key words: pigs / immunocastration / carcass traits / meat quality

1 INTRODUCTION

Immunocastration (active immunisation against GnRH) is one of the possible alternatives to surgical castration which is likely to be banned in EU by the end of 2018. The method represents welfare-friendly elimination of boar taint (Prunier *et al.*, 2006) along with advantages for production results (Millet *et al.*, 2011; Batorek *et al.*, 2012) and less aggressive behaviour (Rydhmer *et al.*, 2010) compared to entire males. To achieve effective immunisation, it takes two vaccinations administered at least four weeks apart, resulting in a disruption of hypotalamic-pituitary-gonadal axis, rapid cessation in testicular steroidogenesis (Claus *et al.*, 2007) and consequent switch to castrate-like metabolism. The vaccine producer recommends 4–6 week interval between second immunisation (V2) and slaughter in order to eliminate boar taint. However, recent research demonstrated the levels of skatole and androstenone below sensory threshold already two weeks after V2 (Lealiifano *et al.*, 2011), indicating that the interval could be shorter. Timing of the vaccination and slaughter is also important for production

1 Kmetijski inštitut Slovenije, Hacquetova ulica 17, 1000 Ljubljana, Slovenia, e-mail: martin.skrlep@kis.si
2 Same address as 1, e-mail: meta.candek-potokar@kis.si
3 Same address as 1, e-mail: nina.batorek@kis.si
4 Same address as 1, e-mail: blaz.segula@kis.si
5 Fakuleta za kmetijstvo in biosistemske vede, Univerza v Maribou, Pivola 10, 2311 Hoče, Slovenija, e-mail: maja.prevolnik@kis.si
6 Dipartimento di Scienze Zootecniche dell'Universita di Firenze, Via delle Cascine 5, 50144 Firenze, Italia, e-mail: carolina.pugliese@unifi.it
7 INRA, UMR 1348 PEGASE Physiologie, Environnement et Génétique pour l'Animal et les Systèmes d'Elevage; Agrocampus-Ouest, UMR1348 PEGASE Physiologie, Environnement et Génétique pour l'Animal et les Systèmes d'Elevage, Saint Gilles, France, e-mail: Michel.Bonneau@rennes.inra.fr

efficiency; the shorter the delay, the more benefits from boar-like performance can be expected. It is not unusual in pig industry to witness slaughter postponing due to the market situation. The effects of immunocastration are now relatively well known, in particular as regards the physiological changes (Claus *et al.*, 2007; Zamaratskaia *et al.*, 2008; Einarsson *et al.*, 2009) and performance (see reviews of Millet *et al.*, 2011 and Batorek *et al.*, 2012). On the other hand, there is a need for more information about a possibility to shorten the recommended interval between immunocastration and slaughter in terms of boar taint or how would a delayed slaughter affect carcass and meat quality. Therefore the main objective of the present research was to test the consequences of different intervals between V2 and slaughter for boar taint and carcass quality in practical conditions of fattening i.e. in case of premature or delayed selling of pigs. Additionally, meat quality of immunocastrates and entire males was compared.

2 MATERIAL AND METHODS

Forty crossbred pigs (progeny of Large White × Landrace) were selected from 10 litters farrowed within five days. At the age of 12 weeks, they were transferred to the experimental stable and individually housed. Within each litter one pig was left entire (EM), while the remaining animals were immunocastrated (IC) by the means of anti-GnRH vaccine application (Improvac®, Pfizer Animal Health) at the age of 12 and 19 weeks. Pigs were fed *ad libitum* a commercial diet containing 13.0 MJ/kg of metabolisable energy. IC pigs were slaughtered in three batches of 10 animals at 21 (IC21), 24 (IC24) or 27 (IC27) weeks of age at the average live weights of 84.8 ± 2.4, 100.9 ± 3.8 and 112.3 ± 6.6 kg, respectively. Entire males (EM27) were slaughtered in the last batch together with IC27 (i.e. aged 27 weeks) at the average weight of 118.3 ± 8.7 kg. The slaughter took place in a commercial abattoir according to standard procedure (app. 1 hour transport, 2 hours of lairage, CO_2 stunning). In order to prove the effectiveness of the immunocastration androstenone and skatole were determined in backfat tissue by HPLC according to the procedures of Hansen-Møller (1994) and Pauly *et al.* (2008) and reproductive organs weighed. At slaughter, leaf fat was removed and weighed, backfat thickness (DM_F), muscle thickness (DM_M), warm carcass weight (carc_w) and carcass meat % (method approved for Slovenia; Commission decision, 2008) were measured. Carcass dressing was calculated as a ratio between warm carcass weight and live weight before the slaughter.

A day following slaughter, the hind leg was cut off the carcass between the 6th and 7th lumbar vertebra and the shank removed. The weight of the leg (ham) was recorded before and after the removal of the skin and subcutaneous fat (ham_mb). Ratio between ham_mb and entire ham weight (ham meat, %) were calculated. Two further cross-sections were made; one at the level of the last rib and one between 3rd and 4th cervical vertebra. A digital image of each cross-section was taken using a digital photo camera (Canon PowerShot G3, Canon Inc., Tokyo, Japan). Image analysis using LUCIA.NET 1.16.5 software (Laboratory Imaging s.r.o., Prague, Czech Republic) was used for determination of the % of intermuscular fat of the neck (NIMF, %), cross-sectional area of *longissimus dorsi* (LD) muscle (LD_M, cm^2) and its corresponding fat area (LD_F, cm^2). Loin meat % was calculated from the ratio between LD_F and LD_M.

Meat quality was assessed for the last batch of pigs (EM27 and IC27). At slaughter, pH (pH_{45}) in LD was taken 45 minutes *post mortem* using a MP120 Mettler Toledo pH meter (Mettler-Toledo, GmbH, 8603 Schwarzenbach, Switzerland). Colour measurements (CIE L*, a*, b*) were taken using Minolta Chroma Meter CR-300 (Minolta Co. Ltd, Osaka, Japan). Ultimate pH (pH_{24}) was also measured in LD 24 h p.m. At the level of last rib two 2.5 cm thick slices of LD were removed; the first was used for drip loss (according to Christensen, 2003) and intramuscular fat determination using in-home NIRS calibration (Prevolnik *et al.*, 2005). The second LD slice was used for evaluation of tenderness assessed as Warner Bratzler shear force (WBSF) on cooked samples (internal T = 72 °C). After cooling to 4 °C overnight, two 2.5 cm wide cylindrical cores were excised and shear force was measured using TA Plus texture analyser (Ametek Lloyd Instruments Ltd., Fareham, UK) equipped with 60° V-shaped rectangular edged blade and a crosshead speed set at 3.3 mm/sec.

Analysis of variance vas performed using the GLM procedure of statistical software SAS (SAS Inst., Inc., Cary, NC, USA). Two independent data sets were used; the first one comprised carcass data for IC21, IC24 and IC27 and EM27 treatment groups, whereas the second one comprised meat quality data for EM27 and IC27 groups. Namely, the IC groups were slaughtered on different days, therefore meat quality could only be compared for EM27 and IC27. The model included the fixed effect of treatment group. In case of WBSF, cooking loss was included as a covariate. If a significant effect of the treatment group ($P < 0.05$) was observed, least square means were compared using Tukey adjustment.

3 RESULTS AND DISCUSSION

3.1 EFFECTIVNESS OF IMMUNOCASTRATION.

The success of the vaccination was evaluated by the regression of reproductive organs and elimination of boar taint compounds. The weight of reproductive organs was statistically similar in IC21, IC24 and IC27 pigs and lower than in EM27. However compared to EM27, the regression was the most pronounced for IC27 (and the least for IC21) indicating time related involution of reproductive organs in immunocastrates. The highest involution was observed for the seminal vesicles (87, 93 and 94% for IC21, IC24 and IC27, respectively), followed by bulbourethral glands (62, 72 and 79% for IC21, IC24 and IC27, respectively) and testes (62, 67 and 68% for IC21, IC24 and IC27, respectively). As shown by meta-analysis (Batorek *et al.*, 2012), a drastic involution of reproductive organs follows immunocastration, which was confirmed in the present study. Regarding boar taint compounds, concentrations of skatole (0.04, 0.04, 0.03 µg/g liquid fat for IC21, IC 24 and IC27, respectively) and androstenone (0.25, 0.24, 0.24 µg/g liquid fat for IC21, IC 24 and IC27, respectively) in immunocastrates barely exceeded the detection limit of the methods, regardless of the delay between V2 and slaughter, which agrees with the results of Lealiifano *et al.* (2011), observing no boar taint two weeks after V2. These results demonstrate effective immunocastration; however, we cannot make any firm conclusions on the sufficiency of two weeks for the clearance of boar taint compounds, since IC21 pigs were slaughtered at a relatively low body weight causing uncertainty regarding their sexual maturity *i.e.* levels of gonadal steroids.

3.2 CARCASS TRAITS.

The comparison of carcass traits in relation to carcass weight between different groups of immunocastrates and EM27 are presented in Fig. 1.

As could be expected, the length of the interval

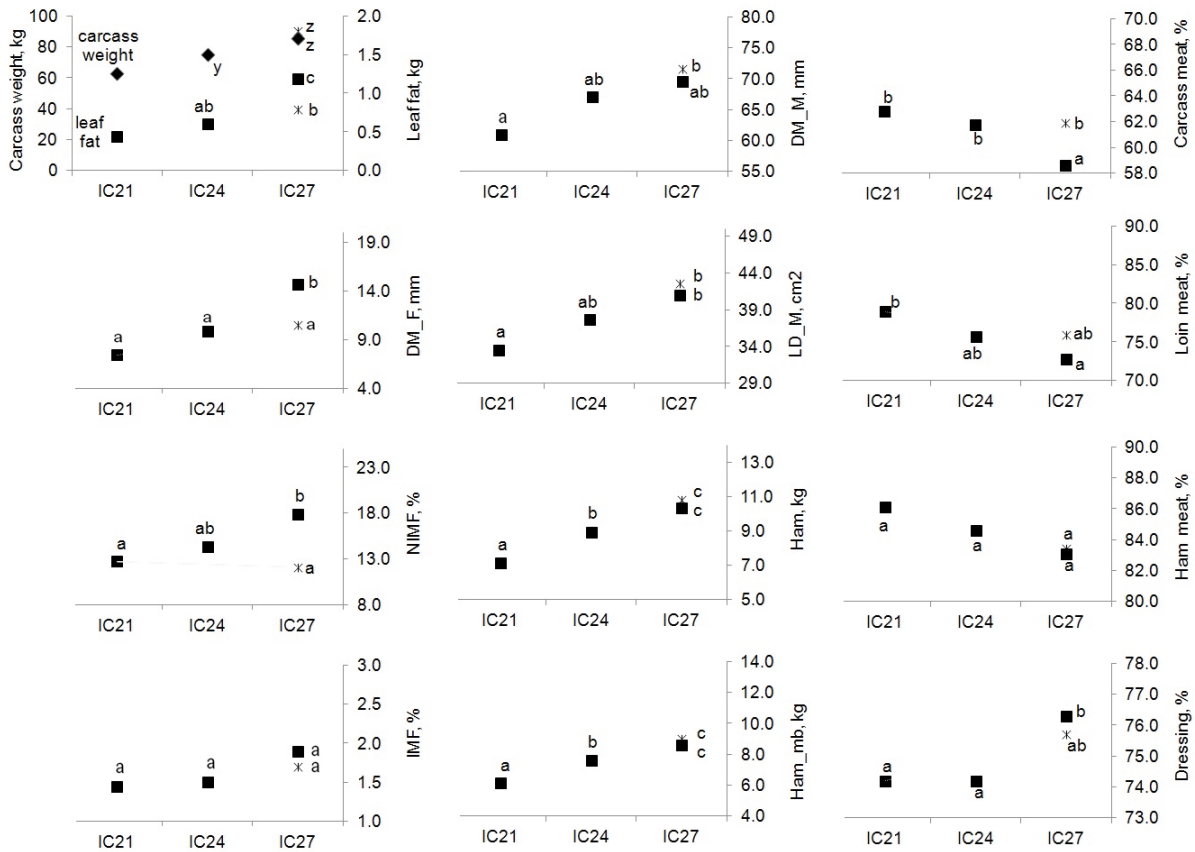

Figure 1: *Comparison of carcass traits between immunocastrates slaughtered at the age of 21 (IC21), 24 (IC24) and 27 (IC27) weeks (i.e. 3, 5 and 8 weeks after second vaccination) and entire males (EM27, ✳) slaughtered at the age of 27 weeks.*
Values within a trait with a different letter are significantly (P < 0.05) different. DM_F = backfat thickness; DM_M = muscle thickness; LD_M = loin eye area; NIMF = neck intermuscular fat; IMF = intramuscular fat of LD; Ham_mb = ham muscles and bones.

between V2 and slaughter affected the majority of the measured traits. With the increased delay between V2 and slaughter, there was a persistent linear increase of carcass weight (growth) and muscularity traits in IC pigs, whereas the effect of prolonged delay between V2 and slaughter on fatness traits was exponential. Namely the differential increase of fatness in IC pigs following V2 was lesser in the first three weeks (IC24 vs. IC21) than in the second three weeks (IC27 vs. IC24). As regards the entire males, they were similar to immunocastrates of the same age in case of the weight of carcass/cuts and muscularity traits. On the other hand, they were significantly less fat as the immunocastrates of the same age i.e. IC27 (and resembled IC24). In accordance with the differences in fatness traits, three weeks of slaughter delay significantly decreased carcass meat % (IC24 and IC27 differing by 3.2% points) whereas a preliminary slaughter (i.e. IC21) showed no significant advantage in carcass meat % over IC24 (despite lower carcass weight). Timing of the slaughter had no effect on ham leanness and intramuscular fat depot (in LD muscle).

Increasing carcass fatness in immunocastrates in relation to a delay between V2 and slaughter was firstly pointed out by Turkstra *et al.* (2002) indicating that immunocastrates with early biological response to the vaccination exhibited higher backfat thickness and lower carcass leanness than their late-responding counterparts. Increase in backfat with an increase of time elapsed from V2 was confirmed by Lealiifano *et al.* (2011), but they compared pigs at similar carcass weight. Recently, Andersson *et al.* (2012) indicated higher abdominal fat deposition in pigs vaccinated earlier in life (5 vs. 11 weeks post V2), although they did not report any significant improvement of carcass leanness. Our results cannot be directly compared to the mentioned ones since in the present study we simulated practical conditions in which carcass weight and fat are simultaneously increased with the time elapsed between V2 and slaughter, whereas in the reported studies the pigs were slaughtered at similar weight with vaccination protocols adapted to each group. However, in the present study the observed fat increment was superior to overall body growth (in particular with the longer delay of slaughter) supporting the published results.

3.3 MEAT QUALITY

The comparison of meat quality from IC27 and EM27 did not show any significant differences, despite the eight weeks interval from V2. The only exception was WBSF (Fig. 2), where the EM27 tended to have tougher meat than IC27 (128 vs. 151 N, $P < 0.10$, respectively).

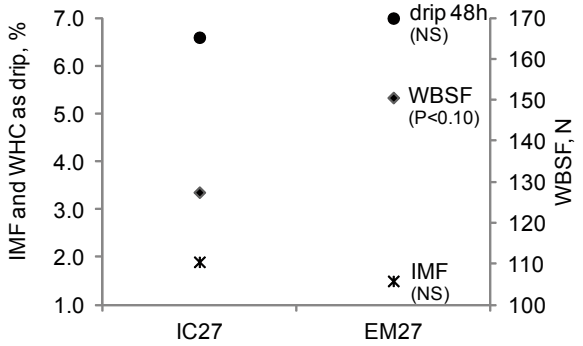

Figure 2: *Differences in meat tenderness (WBSF), intramuscular fat (IMF) and water holding capacity (drip 48h) between IC27 and EM27*

The explanatory factors could be higher drip loss or lower intramuscular fat content (however both insignificant), known to affect meat tenderness. Similar conclusion was made in a recently published meta-analysis of immunocastration effect (Batorek *et al.*, 2012) pointing out lower shear force (meat toughness) of immunocastrates than entire males.

4 CONCLUSIONS

Results of the present study, which aimed to evaluate the consequences of practically encountered situation *i.e.* dealing with premature or delayed slaughter of immunocastrated pigs, demonstrated that by slaughtering immunocastrates few weeks later, we gain in carcass weight but loose in lean meat percentage. With a delay in slaughter the increment of fatness traits was relatively more important than the increase of carcass weight. Prolonging slaughter for several weeks presents no danger for boar taint. A shorter delay (2 weeks post V2) seems unproblematic, but the results are not conclusive and would merit further confirmation. Comparison of meat quality between entire males and immunocastrates showed no major difference, however there was a tendency of lower meat tenderness in entire males.

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