# CAN WE IMPROVE CARCASS AND MEAT QUALITY OF IMMUNOCASTRATES BY ELONGATION OF THE TIME POST SECOND INJECTION

Marijke Aluwé[1], Isabelle Degezelle[2], Dirk Fremaut[3], Lies Depuydt[2], Sam Millet[1]

[1] Institute for Agricultural and Fisheries Research (ILVO), Animal Sciences Unit, Scheldeweg 68, 9090 Melle, Belgium

[2] VIVES University College, Doorniksesteenweg 145, 8500 Kortrijk, Belgium

[3] University College Ghent, Valentin Vaerwyckweg 1, 9000 Gent, Belgium

**Abstract – Immunocastration can be used as an alternative for surgical castration of male piglets to avoid boar taint. The vaccine is administrated twice, once around 10 weeks of age and a second time about 4 to 6 weeks before slaughter. Before this second vaccination, pigs behave and perform like entire male pigs. Afterwards, feed intake increases which may result in a lower lean meat percentage. It can be expected that the timing of the second vaccination is crucial to optimise results. In total, 180 animals (hybrid sow × Piétrain): 60 gilts, 60 early vaccinated male pigs (IM-E, 79±6 kg live weight) and 60 late vaccinated male pigs (IM-L, 87±10 kg live weight) were slaughtered at an average pen weight of 119 kg. Second vaccination was performed 42±5 and 31±3 days prior to slaughter, for IM-E and IM-L respectively. Daily feed intake (DFI), daily gain (DG) and feed conversion ratio (FCR) did not differ significantly between IM-E and IM-L, while gilts had a lower DFI and DG compared to both IM groups. FCR of gilts was higher compared to IM-L, but not compared to IM-E. Gilts showed a higher lean meat content compared to both IM groups. Earlier vaccination increased dressing which could partly be explained by the lower weight of the gastrointestinal tract, but not by testes weight. For meat quality traits, intramuscular fat content (IMF) tended to increase and redness and yellowness values tended to decrease with earlier vaccination. Within the studied time frame of second injection before slaughtering, earlier vaccination improved dressing percentage and tended to increase IMF, while maintaining performances and carcass characteristics.**

**Key Words – GnRH, intramuscular fat, dressing**

## I. INTRODUCTION

Production of entire male pigs is more efficient compared to the production of surgically castrated male pig. Several studies confirm that surgical castration significantly increases feed intake, feed conversion ratio (FCR) and carcass back fat thickness, without affecting daily gain [1]. Shift towards entire male pigs is hindered by the possible presence of boar taint. Vaccination against gonadotrophin-releasing hormone (GnRH) or immunocastration, can be used as an alternative for surgical castration of male piglets. Immunocastration induces the formation of antibodies against endogenous GnRH, and thereby also the secretion of luteinizing hormone, follicle stimulating hormone and testicular steroids as well as boar taint. The vaccine is administrated twice, once around 10 weeks of age and a second time about 4 to 6 weeks before slaughter. Before this second vaccination, pigs perform and behave like entire male pigs [2]. About one week after the second vaccination, feed intake and daily gain increases [3]. Therefore, immunocastration creates opportunities to achieve similar performance results as entire males, while eliminating boar taint. Surgical castration increases FCR with +0.47 compared with entire male pigs [1]. Difference in FCR between immunocastrates and entire male pigs was only +0.11, during the period between second vaccination and slaughter. Considering the differences in performance results between entire male pigs, immunocastrates and surgically castrated male pigs, it can be expected that an optimal timing of the second vaccination can improve production results. Indeed, several studies indicate that the timing of the second vaccination can be crucial to optimise results when producing immunocastrates [4, 5]. Recently, some studies have been performed to evaluate the effect of time post second injection by varying slaughter age and thereby also weight, while age at the second vaccination was similar [6]. However, results comparing performance, carcass and meat quality at comparable slaughter weight is lacking. The aim of the present study is therefore to evaluate the effect of long (6 weeks) and short time (4 weeks) post second injection on performances, carcass and meat quality for immunocastrates at comparable slaughter weights. We hypothesized that IM-E would lead to improved results for daily gain, meat thickness, meat quality and lower testes weight, while IM-L would coincide with better feed conversion ratio, lower fat thickness and weight of the gastro intestinal tract.

## II. MATERIALS AND METHODS

Spread over two round, in total, 180 animals (Piétrain x hybrid sow) were used in this experiment: 60 gilts and 120 entire male pigs. At four weeks of age, the entire male pigs were randomly divided over two treatments, i.e. early second vaccination (IM-E) at an average pen weight of 75 kg and late second vaccination (IM-L) at an average pen weight of 85 kg live weight, thus leading to three treatment groups. Animals of the same treatment group were housed with 6 animals per pen, resulting in ten pen replicates per treatment. The pigs had free access to water and were fed *ad libitum* with a three phase (P) feeding strategy (P1, 20-40 kg: NEv 9.6 MJ/kg, ID lys 10.6 g/kg; P2, 40-70 kg: NEv 9.4 MJ/kg, ID lys 9.7 g/kg; P3, 70-110 kg: NEv 9.1 MJ/kg, ID lys 9.1 g/kg). Pigs were slaughtered per pen at an intended average live weight of 117 kg. All pigs were weighted individually and feed consumption per pen was recorded weekly to calculate average daily gain (DG), average daily feed intake (DFI) and feed conversion ratio (FCR). The pigs were fastened one day prior to slaughter and slaughtered in a commercial slaughterhouse using carbon dioxide anaesthesia followed by exsanguination. Muscle and fat thickness were measured using autoFOM III and values were converted into lean meat percentage by the equation approved by the regulation 2012/416/EU. Furthermore, ham angle and ham width were measured using a Pic2000 device (Rovi-tech, Belgium). Dressing percentage was calculated as cold carcass weight divided by live weight (recorded prior to transport to slaughterhouse). At slaughter, the weight of gastrointestinal tracts and testes were measured. At 45 minutes post mortem, electric conductivity was measured by PQM. *Musculus longissimus thoracis et lumborum* was sampled 24 hours post mortem to determine ultimate pH, drip loss, colour (L, a, b, using HunterLab Miniscan), shear force, cooking loss and intramuscular fat content. All measurements were analyzed by ANOVA (R-core), with treatment as fixed factor and carcass weight as co-variable for carcass quality.

## III. RESULTS AND DISCUSSION

***Performances***

Second vaccination was performed at 78.6±6.3 and 86.9±9.6 kg live weight or 42.0±4.5 and 30.6±3.4 days prior slaughter, for IM-E and IM-L respectively. As intended, live slaughter weight did not differ between treatment groups.

Overall, DFI and DG showed an interaction between feeding phase (P) and treatment (T) ($P<0.001$). In the first and second phase, DFI and DG did not differ between treatment groups. In the last phase of growth, DFI and DG were significantly lower for gilts compared to IM-E and IM-L ($P<0.001$). Feed conversion ratio showed no P × T interaction and was significantly higher for gilts compared to IM-E and IM-L between 20 and 115 kg ($P=0.001$). The increased feed intake of immunocastrates after the second vaccination is well reported [7, 8].

**Carcass quality and dressing**

It was suggested that fat deposition increases from four weeks after the second vaccination [5]. Some studies indeed found a lower meat percentage [9] and higher backfat thickness [1] with increasing time post second injection. However, carcass characteristics of IM-E and IM-L did not differ significantly in the present study (Table 1). Dressing percentage was lower for IM-L compared to IM-E and both were lower compared to gilts, in line with previous results [9]. However, Lealiifano et al. [10] found no significant difference in dressing percentage at slaughter between 6 to 0 weeks post second injection. The higher weight of the gastrointestinal tract of IM-L compared to IM-E and gilts partly explains the lowest dressing percentage of IM-L. The higher weight of the gastro-intestinal tract of immunocastrates compared to boars has been described in previous studies. Boler et al. [11] found 0.24% unit more gut fill and 0.20% units more intestinal mass for immunocastrates compared to barrows. Possibly, the gastro-intestinal tract normalises after a longer period post second injection. However, in contrast with literature [10, 12], testes weights were not reduced by earlier vaccination.

**Meat quality and palatability**

Ultimate pH was higher for IM-E and IM-L compared to gilts, in line with previous studies [11] Redness (Color a) and yellowness (Color b) tended to be lower for IM-E compared to gilts and IM-L. The meat quality measurements of PQM, lightness (L value), drip loss and shear force were not significantly different between gilts, IM-E and IM-L. Results for the meat colour determinants are inconsistent in the literature. In a previous study [13], barrows and boars tended to have lighter meat (L*) than immunocastrates, while others found that boars had darker meat than barrows, with immunocastrates intermediate. In line with current results, yellowness was lower in boars compared to barrows. Cooking loss was higher for IM-L compared to gilts, both not significantly differing from IM-E. Most studies indeed indicate higher cooking losses for boars compared to immunocastrates [6, 14]. Overall, time post-second injection had little effect on meat quality. This is in line with the results from Boler et al. [11], who found increased carcass weights at 6 weeks versus 4 weeks post-second injection, but little effect of time post-second injection on carcass and meat quality. Nevertheless, intramuscular fat (IMF) content tended to increase in IM-E compared to IM-L. This is in line with the differences seen between boars and immunocastrates, with the latter having higher IMF content [15].

**Table 1 Carcass and meat quality traits of gilts, early immunocastrated male pigs (IM-E) and late immunocastrated male pigs (IM-L)**

| | Gilts | IM-E | IM-L | SEM | P-treatment |
|---|---|---|---|---|---|
| N | 60 | 58 | 56 | | |
| **Carcass quality** | | | | | |
| Slaughter weight, kg | 117.7 | 119.7 | 119.8 | 0.6 | 0.164 |
| Cold carcass weight, kg | 93.8 | 93.4 | 92.8 | 0.5 | 0.753 |
| Dressing percentage, % | $79.7^{c}$ | $78.0^{b}$ | $77.4^{a}$ | 0.1 | <0.001 |
| Gastrointestinal tract, kg | $6.9^{a}$ | $7.9^{b}$ | $8.2^{c}$ | 0.1 | <0.001 |
| Testes weight, g | | 278 | 260 | 11 | 0.421 |
| Lean meat, % | $65.6^{a}$ | $64.0^{b}$ | $63.5^{b}$ | 0.2 | <0.001 |
| Fat thickness, mm | $6.8^{a}$ | $8.5^{b}$ | $8.7^{b}$ | 0.2 | <0.001 |
| Muscle thickness, mm | $68.6^{a}$ | $67.1^{b}$ | $67.5^{ab}$ | 0.4 | 0.030 |
| **Meat quality** | | | | | |
| PQM 45', mS [1] | 4.06 | 4.06 | 4.01 | *0.04* | 0.164 |
| $pH_u$ | $5.30^{a}$ | $5.37^{b}$ | $5.37^{b}$ | *0.01* | 0.010 |
| L | 55.03 | 55.40 | 55.67 | *0.28* | 0.375 |
| a | 8.04 | 7.60 | 7.74 | *0.10* | 0.051 |
| b | 15.92 | 15.83 | 15.92 | *0.09* | 0.088 |
| Drip loss, % | 6.41 | 5.71 | 6.13 | *0.14* | 0.115 |
| Cooking loss, % | $32.9^{a}$ | $34.4^{ab}$ | $34.8^{b}$ | *0.16* | 0.014 |
| Shear force, N | 35.4 | 34.4 | 33.5 | *0.46* | 0.457 |
| IMF (%) [2] | $1.67^{a}$ | $2.10^{b}$ | $1.84^{ab}$ | *0.05* | 0.002 |

[1] higher values are associated with paler, wetter meat

[2] Intramuscular fat content (%) was measured on 20 animals per treatment

IV. CONCLUSION

Within the studied time frame of second injection before slaughtering, earlier vaccination improved dressing percentage which could partly be explained by the lower weight of the gastrointestinal tract, but not by testes weight. For meat quality traits, redness and yellowness values tended to reduce and intramuscular fat content tended to improve with earlier vaccination. Performances and carcass characteristics were not significantly affected.

## ACKNOWLEDGEMENTS

The authors thank ADLO (Demonstration project) for funding this study.

## REFERENCES

1. Dunshea FR, Colantoni C, Howard K, McCauley I, Jackson P, Long KA, Lopaticki S, Nugent EA, Simons JA, Walker J & Hennessy DP 2001. Vaccination of boars with a GnRH vaccine (Improvac) eliminates boar taint and increases growth performance. Journal of Animal Science 79, 2524-2535.
2. Rydhmer L, Lundstrom K & Andersson K 2010. lmmunocastration reduces aggressive and sexual behaviour in male pigs. Animal 4, 965-972.
3. Weiler U, Gotz M, Schmidt A, Otto M & Muller S 2013. Influence of sex and immunocastration on feed intake behavior, skatole and indole concentrations in adipose tissue of pigs. Animal 7, 300-308.
4. Bonneau M & Enright WJ 1995. Immunocastration in Cattle and Pigs. Livestock Production Science 42, 193-200.
5. Dunshea FR, Allison JRD, Bertram M, Boler DD, Brossard L, Campbell R, Crane JP, Hennessy DP, Huber L, de Lange C, Ferguson N, Matzat P, McKeith F, Moraes PJU, Mullan BP, Noblet J, Quiniou N & Tokach M 2013. The effect of immunization against GnRF on nutrient requirements of male pigs: a review. Animal 7, 1769-1778.
6. Skrlep M, Segula B, Prevolnik M, Kirbis A, Fazarinc G & Candek-Potokar M 2010. Effect of Immunocastration (Improvac (R)) in Fattening Pigs Ii: Carcass Traits and Meat Quality. Slovenian Veterinary Research 47, 65-72.
7. Batorek N, Candek-Potokar M, Bonneau M & Van Milgen J 2012. Meta-analysis of the effect of immunocastration on production performance, reproductive organs and boar taint compounds in pigs. Animal 6, 1330-1338.
8. Millet S, Gielkens K, De Brabander D & Janssens GPJ 2011. Considerations on the performance of immunocastrated male pigs. Animal 5, 1119-1123.
9. Andersson K, Brunius C, Zamaratskaia G & Lundstrom K 2012. Early vaccination with Improvac (R): effects on performance and behaviour of male pigs. Animal 6, 87-95.
10. Lealiifano AK, Pluske JR, Nicholls RR, Dunshea FR, Campbell RG, Hennessy DP, Miller DW, Hansen CF & Mullan BP 2011. Reducing the length of time between slaughter and the secondary gonadotropin-releasing factor immunization improves growth performance and clears boar taint compounds in male finishing pigs. Journal of Animal Science 89, 2782-2792.
11. Boler DD, Killefer J, Meeuwse DM, King VL, McKeith FK & Dilger AC 2012. Effects of slaughter time post-second injection on carcass cutting yields and bacon characteristics of immunologically castrated male pigs. Journal of Animal Science 90, 334-344.
12. Brunius C, Zamaratskaia G, Andersson K, Chen G, Norrby M, Madej A & Lundstrom K 28-11-2011. Early immunocastration of male pigs with Improvac (R) - Effect on boar taint, hormones and reproductive organs. Vaccine 29, 9514-9520.
13. Aluwé M., Langendries KCM, Bekaert KM, Tuyttens FAM, De Brabander DL, De Smet S & Millet S 2013. Effect of surgical castration, immunocastration and chicory-diet on the meat quality and palatability of boars. Meat Science 94, 402-407.
14. Pauly C, Spring P, O'Doherty JV, Kragten SA & Bee G 2009. Growth performance, carcass characteristics and meat quality of group-penned surgically castrated, immunocastrated (Improvac (R)) and entire male pigs and individually penned entire male pigs. Animal 3, 1057-1066.
15. Pauly C, Luginbuhl W, Ampuero S & Bee G 2012. Expected effects on carcass and pork quality when surgical castration is omitted - Results of a meta-analysis study. Meat Science 92, 858-862.