Growth Potential of Immune- and Surgically Castrated Iberian Pigs Fed Diets of Different Protein Concentration

Isabel SEIQUER
Luis LARA
Patricia PALMA-GRANADOS
Noelia HERRERA
Manuel LACHICA
Ignacio FERNÁNDEZ-FÍGARES
Ana HARO
Rosa NIETO (✉)

Summary

Immunocastration is effective to prevent sexual development and boar taint in pigs of conventional genotypes. Other studies pointed out that immunocastrated (IC) pigs show better performance than surgically castrated (SC) pigs. Apart from animal welfare aspects, this fact could be of relevance for Iberian and other fatty pig types with low lean deposition capacity. The purpose of this study was to examine the effects of immunocastration on Iberian pig performance and some carcass traits under different dietary protein concentrations. Fifty-four pure Iberian pigs were used (3 sexes: IC males, IC females, SC males; 3 isoenergetic diets: 160, 140 and 120 g CP/kg DM, 6 pigs/treatment combination). Vaccination against gonadotropin releasing factor was at 4.3 (40 kg) and 6 months of age (70-80 kg). Pigs were individually housed consuming the experimental diets from 40 to 105 kg-BW. The results indicate greater growth rate and feed conversion efficiency for IC males compared to SC males and IC females, and no relevant differences in growth related to dietary protein. Further results will help to elucidate possible effects of immunocastration on lean tissue accretion in Iberian pigs.

Key words

Iberian pig, immunocastration, dietary protein, performance

CSIC, Estación Experimental del Zaidin, Camino de Jueves s/n, ES-18100 Granada, Spain
✉ e-mail: rosa.nieto@eez.csic.es

Received: April 28, 2017 | Accepted: July 27, 2017

ACKNOWLEDGEMENTS
This work has been funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No 634476 (project acronym TREASURE). The content of this paper reflects only the author's view and the European Union Agency is not responsible for any use that may be made of the information it contains. The authors are grateful to Miguel A. Liñán and Alfonso García for their valuable and skilful work.

Introduction

The vaccination against gonadotropin releasing hormone (GnRH) stimulates antibody production to neutralize GnRH. In this way, the hypothalamic-pituitary-gonadal axis is disrupted (Dunshea et al., 2001). This approach has proven to be effective to prevent sexual development and boar taint in male pigs of conventional genotypes (Batorek et al. 2012), being a feasible alternative to the practice of surgical castration, which has raised animal welfare concerns among European citizens.

Immunocastration can also be an effective strategy to avoid boar taint in the production of autochthonous pig breeds, which are usually slaughtered at heavier weights than conventional pigs. This is the case in the Iberian pig and other pig breeds raised in the Mediterranean area. Iberian female pigs are also gonadectomized to prevent unwanted oestrus or pregnancies during the finishing period, particularly when it takes place in extensive conditions (Gómez-Fernández et al. 2013, Martínez-Macipe et al., 2016). Immunocastration may also alter pig performance. The literature available on this issue indicates that immunocastrated (IC) male pigs exhibit higher performance until final (effective) vaccination compared to surgically castrated (SC) pigs (Millet et al., 2011; Batorek et al., 2012; Dunshea et al., 2013). In addition to the obvious benefits on animal welfare, this aspect could be of interest for Iberian and other autochthonous pig breeds, in which the capacity for growth and lean tissue deposition rapidly decreases as the animal go further in their productive cycle (Nieto et al. 2012). We have previously established optimal protein-to-energy ratios in the diet for SC Iberian pigs growing from 10 to 150 kg body weight (BW) (Nieto et al., 2012, 2013). There is a question on whether protein requirements might be increased in IC compared to SC Iberian pigs. Therefore, the purpose of this study was to investigate the effect of immunocastration on Iberian male and female pig performance and carcass traits, combined with the effect of feeding the animals with diets of different protein concentration. The results presented are one of the first pieces of information obtained in the study and form part of the experiments designed within the work package 2 of the TREASURE project (task 2.3, Nutritional requirements of growing pigs and reproductive sows in selected local pig breeds in different environmental conditions, and task 2.4, Innovative feeding strategies or management practices and their effects on production traits and product quality).

Materials and methods

The experimental protocol was approved by the Bioethical Committee of the Spanish National Research Council (CSIC).

Fifty-four pure Iberian males and gilts of the Silvela strain were used in a 3 × 3 factorial arrangement of treatments with 3 sexes: IC males, IC females, SC males; and 3 isoenergetic diets containing 160, 140 and 120 g CP and 14 MJ ME/kg DM. The experiment was performed in two replicates with 27 pigs each, and three pigs per treatment combination. Therefore, a total of 6 pigs were allocated to each combination of treatments. The SC pigs were castrated within the first week of life. Pigs arrived from a commercial farm (Sánchez Romero Carvajal, Jabugo, Cádiz, Spain) at approximately 25 kg BW and had *ad libitum* access to a commercial diet (170 g CP, 1.1 g Lys and 13 MJ ME/kg) until they achieved 4.3 months of age and approximately 40 kg BW. At this moment, entire male and females were vaccinated against GnRH with IMPROVAC (Zoetis, Madrid, Spain) following manufacturer recommendations. All pigs were allocated to experimental treatments and individually housed in 2 m^2 partially slatted pens in an environmentally controlled room (21± 1ºC) until the end of the study. Seven weeks after the first vaccination, pigs received a second vaccine dose (6 months of age, 70-80 kg BW). Diets (prepared by NANTA S. A., Seville, Spain) were based on barley, maize and soybean meal and added of essential amino acids (L-Lys, L-Thr, DL-Met) to maintain an adequate amino acid profile (ideal protein, NRC 2012). Pigs were fed twice daily at 8:00 and 14:00 h at 0.9 × *ad libitum* on a BW basis determined weekly, according to previous equations derived from SC Iberian pigs (Nieto et al. 2012). Individual feed intake was recorded daily for all pigs along the experiment. When feed refusals occurred, they were collected, weighed and dried to be taken into account to calculate actual feed intake.

Aliquots of experimental diets were periodically collected for analysis of nutrient composition and stored at -20º C until analysis. At approximately 105 kg-BW pigs were slaughtered after electronarcosis by exsanguination. In the left-half carcass, measurements of midline backfat (first rib, last rib and minimum fat over *gluteus medius* muscle) and leanness (gluteal thickness at the cranial end of *gluteus medius* muscle) were performed. Weights and yields of primal cuts were determined 24 h post mortem as described previously (Nieto et al. 2013).

The statistical treatment of data was assessed by analysis of variance using the GLM procedure of SAS (SAS Inst. Inc. Carry, NC). The effects of sex, dietary protein, and their interaction were included in the statistical model, as well as the effect of trial replicate. The individual pig was the experimental unit. The level of significance was set to 5%.

Results and discussion

All pigs had normal behavior during the experiments except for two animals that stopped eating and were withdrawn from the study. Pigs initiated the experimental treatments with similar body weights: 43.1, 41.9 and 41.2 kg for IC males, SC males and IC females, respectively ($P > 0.05$), whereas mean initial BW across treatments were: 42.1, 42.2 and 41.9 kg for diets containing 160, 140 and 120 g CP/kg DM, respectively ($P > 0.05$).

The analysis of data revealed no relevant effects of dietary protein concentration on growth parameters and carcass traits ($P > 0.05$). The average slaughter weight was 106 ± 1.4 kg with no differences among the experimental groups: 109, 103 and 107 kg for IC males, SC males and IC females, respectively, while average values of 107, 108 and 105 kg for diets of high, medium and low protein content, respectively, were recorded ($P > 0.05$).

There were differences in growth performance among sex groups. The overall daily feed intake of IC males was slightly greater than that of IC females and SC males ($P < 0.05$; Figure 1), although all groups were slightly restricted in feed intake (by 10% of the theoretical *ad libitum* level). At this respect, higher intakes of IC compared to SC males have been described in the

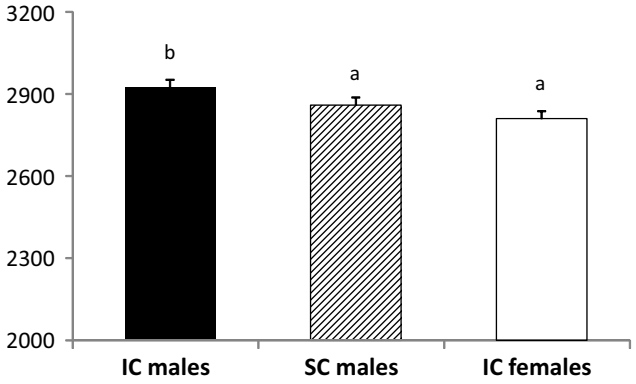

Figure 1. Average daily feed intake of the experimental groups of Iberian pigs. Columns with different letters differ significantly (P < 0.05). IC and SC refer to immune- or surgically castrated pigs, respectively.

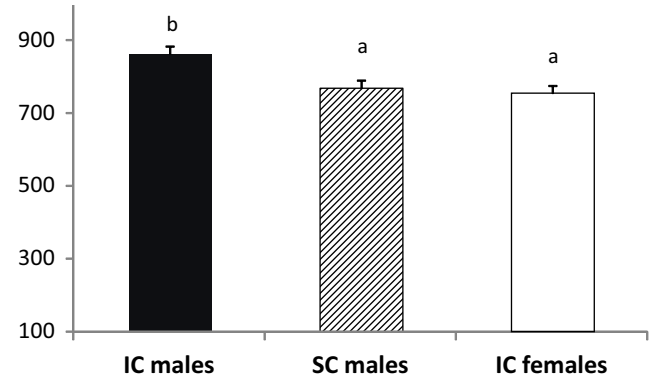

Figure 2. Average weight gain of Iberian pigs through the experimental period. Columns with different letters differ significantly (P < 0.001). IC and SC refer to immune- or surgically castrated pigs, respectively.

available literature (Candek-Potokar et al. 2015). The IC males showed also higher growth rate than SC males and IC female (Figure 2; P < 0.001). Feed efficiency, expressed as g of weight gain per g feed intake, was significantly greater for IC males (Figure 3; P < 0.001). The response in performance of the Iberian IC male pig found in this experiment is in line with studies performed in conventional pig breeds, in which IC males showed higher growth rates and better feed utilization than SC males (Millet et al. 2011, Batorek et al., 2012, Dunshea et al., 2013). In this sense, it seems that the greater growth potential of immunocastrated compared to surgically castrated pigs could be a common response for both conventional and fatty type pigs. There is little information on performance of IC females in the literature available, although IC males seem to have greater growth potential than IC gilts (Elsbernd, et al., 2015).

There were no differences in carcass weight among groups (85.5 ± 0.5 kg), although IC males showed less carcass yield than SC males and IC females (77.0, 79.2 and 78.8 %, respectively, P<

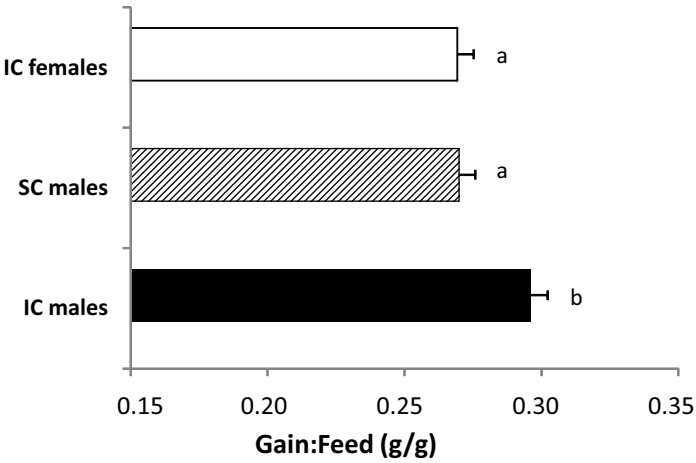

Figure 3. Mean feed efficiency values obtained for the experimental groups of Iberian pigs. Columns with different letters differ significantly (P< 0.001). IC and SC refer to immune- or surgically castrated pigs, respectively.

0.001). The IC males had higher proportions of loin, sirloin, and butt lean; these lean cuts together amounted 8.5, 7.4 and 7.5% of carcass weight, respectively, for IC males, SC males, and IC females (P < 0.001). There were no differences in ham, shoulder and backfat proportions among groups (P > 0.05). In general terms, the responses described for the Iberian IC male pigs are in agreement with the available information describing comparisons between carcass traits of IC and SC male conventional pigs; IC showed lower carcass yield and higher lean than SC pigs (Batorek et al., 2012, Dunshea et al., 2013). Our results are in line with a recent study reporting carcass traits in Iberian pig of the Valdesequera line, slaughtered at approximately 150 kg BW, including IC females, IC males and SC males (Martínez-Macipe et al. 2016). Despite differences in BW and vaccination protocol among studies, these authors found greater similarities among carcass traits of SC males and IC females, both of them different from IC males, in line with our results.

The effect of dietary protein concentration on carcass traits was rather moderate. Higher carcass yield (P < 0.05) and a trend for lower ham proportion (P=0.07) was found in pigs receiving the lower protein content diet.

The results obtained so far do not point out relevant effects of increasing dietary protein concentrations on growth or carcass traits of IC male and female Iberian pigs. Further results involving metabolic determinations will help to elucidate possible effects of immunocastration on Iberian pig lean growth.

References

Candek-Potokar M, Batorek, N, Labussiere, E (2015). Immunocastration in pigs. Proceedings of the 4th International Congress on New Perspectives and Challenges of Sustainable Livestock Production (ed. Milan M. Petrovic, Institute for Animal Husbandry, Belgrade-Zemun, Serbia), pp. 324-335.

Batorek, N, Candek-Potokar, M, Bonneanu, 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.

Dunshea, F R,. 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, PJ, 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.

Dunshea, F R,. 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.

Elsbernd, AJ, Stalder KJ, Karriker, LA Patience, JF (2015). Comparison among gilts, physical castrated, entire males, and immunologically castrated in terms of growth performance, nitrogen and phosphorous retention, and carcass fat iodine values. Journal of Animal Science, 99: 5702-5710.

Gómez-Fernández, J, Hocajada, S, Tomás, C, Gómez-Izquierdo, E de Mercado, E (2013). Efecto de la immunocastración y de la castración quírúgica sobre los rendimientos productivos y la calidad de la canal en cerdas Ibéricas y de cebo. Información Técnica Económica Agraria, 109: 33-48.

Martínez-Macipe, M, Rodríguez, P, Izquierdo, M, Gispert, M, Manteca, X, Mainau, E, Hernández, FJ, Claret, A, Guerrero, L, Dalmau, A (2016). Comparison of meat quality parameters in surgical castrated versus vaccinated against gonadotrophin-releasing factor male and female Iberian pigs reared in free-ranging conditions. Meat Science, 111: 116-121.

Millet, S, Kwinten, G, De Brabander, D, & Janssens GPJ (2011). Considerations on the performance of immunocastrated male pigs. Animal, 5: 1119-1123.

National Research Council, NRC (2012). Nutrient Requirements of Swine. 11th rev. ed. Natl. Acad. Press, Washington, DC, USA.

Nieto R., Lara L., Barea R., García-Valverde R., Aguinaga M. A., Conde-Aguilera J. A., Aguilera J. F. (2012). Response analysis of the pig growing from birth to 150 kg body weight to changes in protein and energy supply. Journal of Animal Science 90: 3809-3820.

Nieto, R, Lara, L, Barea, R, García-Valverde, R, Conde-Aguilera, JA, Aguilera, JF (2013). Growth of body components and carcass composition of Iberian pigs of 10 to 150 kg body weight as affected by the level of feeding and dietary protein concentration. Journal of Animal Science 91: 4197-4207.

acs82_26