

## Performance and carcass characteristics of immunocastrated and surgically castrated Iberian pigs fed diets of different protein concentration. Preliminary results

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### SUMMARY

#### ADDITIONAL KEYWORDS

Dietary protein.  
Growth.  
Carcass traits.

Immunocastration has proved to be an effective strategy to prevent sexual development and boar taint in pigs. Previous results indicate that immunocastrated (IC) pigs exhibit better performance than surgically castrated (SC) pigs. In addition to animal welfare benefits, this fact could be of interest for Iberian pigs, as their growth capacity rapidly diminishes as animal ages. The purpose of this study was to examine the effects of immunocastration on Iberian pig performance, protein utilization, and carcass traits under different dietary protein concentrations. Pure Iberian pigs (n=27) were used as follows: 3 sexes (IC males, IC females, SC males); 3 isoenergetic diets (160, 140 and 120 g CP/kg DM); 3 pigs/group. Pigs were vaccinated against Gonadotropin Releasing Hormone at 4.3 months (40 kg) and 6 months (70-80 kg) of age. Experimental diets were offered to individually-housed pigs from 40 to 100 kg BW. Digestibility and N-balance assays were performed at 50 and 90 kg BW, respectively. Pigs were slaughtered at 100 kg BW. Preliminary results indicate greater growth rate for IC males (803 vs 706 and 696 g/d, for IC males, SC males and IC females, respectively;  $P < 0.001$ ). Feed efficiency (G:F) was greater for IC males (0.289 vs 0.260 and 0.263;  $P < 0.01$ ). Moreover, IC males exhibited increased carcass length and greater relative weights for most lean cuts, but they also had smaller carcass yield and belly proportions than the rest of groups. No relevant differences related to dietary treatments were detected. Further research would help to elucidate possible effects of immunocastration on Iberian pig lean growth.

### Índices productivos y características de la canal de cerdos Ibéricos inmunocastrados o castrados quirúrgicamente y alimentados con dietas de diferente concentración proteica. Resultados preliminares.

#### RESUMEN

La inmunocastración ha resultado una estrategia útil en el cerdo para prevenir el olor sexual en la carne. En trabajos previos se indica que los cerdos inmunocastrados (IC) pueden presentar mejores índices productivos que los castrados quirúrgicamente (SC). Además de las ventajas en bienestar animal que conlleva esta práctica, la mejora en producción puede tener interés en razas como la Ibérica, con capacidad de crecimiento limitada. El objetivo de este estudio ha sido examinar los efectos de la inmunocastración sobre los índices productivos del cerdo Ibérico, el uso de la proteína en la dieta y las características de la canal, en animales alimentados con dietas de diferente concentración proteica. Se utilizaron 27 animales de tres sexos (machos IC, machos SC, y hembras IC) alimentados con 3 dietas isoenergéticas (160, 140 y 120 g PB/kg materia seca), con tres animales por cada combinación de tratamientos. Los animales se vacunaron contra la hormona liberadora de gonadotropina a los 4,3 (40 kg) y 6 meses de edad (70-80 kg). Los tratamientos se ofrecieron a los animales, que permanecieron alojados individualmente, desde los 40 a los 100 kg de peso. Se realizaron ensayos de digestibilidad y balance de N a los 50 y 90 kg de peso. A los 100 kg se sacrificaron los animales. Los resultados preliminares indican que los machos IC tuvieron un ritmo de crecimiento superior (803 vs 706 and 696 g/d, para machos IC, machos SC y hembras IC, respectivamente;  $P < 0.001$ ) y mejores índices productivos que el resto de grupos ( $P < 0.01$ ). Los machos IC presentaron mayor longitud de la canal y pesos relativos en la mayoría de los componentes magros de la canal, así como menor peso relativo de canal y panceta que el resto de grupos. No se apreciaron diferencias en los parámetros estudiados debidas a la concentración proteica de la dieta. Necesitamos profundizar en el posible papel que pueda jugar la inmunocastración en el crecimiento magro del cerdo Ibérico en futuros trabajos.

#### PALABRAS CLAVE ADICIONALES

Proteína dietética.  
Crecimiento.  
Parámetros de la canal.

#### INFORMATION

Cronología del artículo.  
Recibido/Received: 17.01.2017  
Aceptado/Accepted: 29.06.2017  
On-line: 15.01.2018  
Correspondencia a los autores/Contact e-mail:  
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#### INTRODUCTION

Vaccination against Gonadotropin Releasing Hormone (GnRH) induces antibody production to neutralize GnRH, thus disrupting the hypothalamic-pituitary-gonadal axis (Dunshea et al. 2001). This

procedure has been demonstrated to be effective to prevent sexual development and boar taint in male pigs (Batorek et al. 2012) and could be a reliable alternative to surgical castration, which has raised animal

welfare concerns, particularly in European countries. Immunocastration can also be an effective strategy to avoid boar taint in production of local pig breeds, usually slaughtered at heavy weights, as for Iberian pig production. Iberian female pigs are also gonadectomized to prevent unwanted oestrus or pregnancies during the finishing period, particularly if it is performed in extensive conditions (Gómez-Fernández et al. 2013, Martínez-Macipe et al. 2016). Immunocastration may also alter pig performance. Results in the literature indicate that immunocastrated (IC) male pigs exhibit higher performance after the second vaccination compared to surgically castrated (SC) pigs (Millet et al. 2011; Batorek et al. 2012; Dunshea et al. 2013). In addition to animal welfare aspects, this latter observation could be of interest for Iberian and other autochthonous pig breeds, as their capacity for growth and lean tissue deposition rapidly decreases as the animal increases body weight (Nieto et al. 2012). We have previously defined optimal protein-to-energy ratios in the diet for SC Iberian pigs growing from 10 to 150 kg BW (Nieto et al. 2012 & 2013). We hypothesize that protein requirements might be increased in IC compared to SC animals, particularly at earlier stages of growth. Therefore, the purpose of this study is to investigate the effect of immunocastration on Iberian male and female pig performance, protein utilization and carcass traits under three dietary protein concentrations. Results presented are preliminary and comprise a part of a wider study involving additional measurements and individuals.

## MATERIALS AND METHODS

Twenty-seven pure Iberian males and gilts (Silvela strain) were used in a 3 × 3 factorial arrangement of treatments (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) with 3 pigs 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, Spain) at approximately 20 kg BW and consumed *ad libitum* a commercial diet (170 g CP, 1.1 g Lys and 13 MJME/kg diet) until they reached 4.3 months of age and approximately 40 kg BW. Entire males and females were vaccinated against GnRH with IMPROVAC™ (Zoetis, Madrid, Spain) following manufacturer recommendations and all pigs were allocated to experimental treatments and individually housed in partially slatted pens of 2 m<sup>2</sup> each, in an environmentally controlled room (21±1°C) 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 supplemented with essential amino acids to maintain an adequate amino acid profile ("ideal protein" concept). Pigs were fed twice daily (8:00 and 14:00 h) at 0.9 × *ad libitum* on a BW basis, weekly determined according to previous equations derived from SC Iberian pigs (Nieto et al., 2012). Individual actual feed intake was recorded daily for all

pigs along the experiment. Refusals were collected, weighed and dried if they occurred.

Digestibility and N-balance assays were performed at 50 and 90 kg BW, respectively. Samples of experimental diets were periodically collected for analysis of nutritive composition and stored at -20° C until analysis. During digestibility and N-balance experiments, whole faeces and urine were daily collected, weighed, and aliquots frozen at -20° C. At 100 kg BW, pigs were slaughtered by electronarcosis and exsanguination. In the left-half carcass, measurements of midline backfat (first rib, last rib and minimum fat thickness over *gluteus medius* muscle) and leanness (thickness of *L. lumborum* muscle and gluteal thickness at the cranial end of *gluteus medius* muscle) were performed. Weights and yields of prime cuts were determined 24 h post-mortem as described previously (Nieto et al. 2013).

Treatment effects were 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. The individual pig was the experimental unit. The level of significance was set to 5%.

## RESULTS AND DISCUSSION

The results indicate no relevant effect of dietary protein concentration on growth parameters and carcass traits ( $P>0.05$ ; **Table I**). There were differences in growth performance among sex groups. The IC males showed higher growth rates than SC males and IC females, which did not differ significantly between them (803 vs 706 and 696 g/d, for IC males, SC males and IC females, respectively;  $P<0.001$ ). Average individual dry matter intake for the whole study period was 2709 g/d. Feed efficiency (Gain:Feed) was significantly greater for IC males (+10%; 0.289 vs 0.260 and 0.263;  $P<0.01$ ). The response in terms of performance of the Iberian IC male pigs found in this study 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). Although there is little information on IC females, IC males seems to have greater growth potential than gilts (Elsbernd et al. 2015).

Carcass weight did not differ among groups, although IC males showed less carcass yield than SC males and IC females ( $P<0.001$ , **Table I**). The IC males were superior in carcass length (92.8 vs 88.5 and 88.0 cm, for IC males, SC males and IC females, respectively,  $P<0.01$ ), and in relative weight of loin ( $P<0.01$ ), sirloin ( $P<0.05$ ), and butt lean ( $P<0.01$ ), and they showed a strong trend to increased proportions of shoulder ( $P=0.053$ ). There were no differences in ham and backfat proportions among groups ( $P>0.05$ ). For IC females, there was a strong trend for higher muscle thickness measured at the cranial end of the *gluteus medius* muscle ( $P=0.05$ ). The IC females showed the higher belly fat proportions, and IC males the lower one, while SC males were intermediate between them ( $P<0.05$ ). Measurements of backfat thickness at the

**Table I.** Carcass traits of immunocastrated (IC) male, surgically castrated (SC) male and immunocastrated female Iberian pigs fed 3 isoenergetic diets differing in protein concentration (160, 140 and 120 CP/kg dry matter; n=3/treatment combination) (Caracteres de la canal de machos inmunocastrados (IC), castrados quirúrgicamente (SC) y cerdas ibéricas inmunocastradas alimentadas a base de 3 dietas isoenergéticas con una concentración variable de proteína (160, 140 y 120 Proteína cruda/kg de materia seca; n=3/combinación de tratamiento).

	Sex			SEM	P-value		
	IC males	SC males	IC females		Sex	Diet	Sex × Diet
Slaughter weight, kg	102 <sup>b</sup>	96.1 <sup>a</sup>	97.6 <sup>ab</sup>	1.4	<0.05	NS	NS
Hot carcass weight, kg	74.6	73.0	73.1	1.07	NS	NS	NS
Carcass yield, %	73.4 <sup>a</sup>	75.9 <sup>b</sup>	75.0 <sup>b</sup>	0.35	<0.001	0.09	NS
Carcass length, cm	92.8 <sup>a</sup>	88.5 <sup>b</sup>	88.0 <sup>b</sup>	0.81	<0.001	NS	NS
Gluteal muscle thickness <sup>1</sup> , cm	5.5	5.5	6.1	0.2	0.050	NS	NS
Loin, g/kg half-carcass	46.0 <sup>a</sup>	38.5 <sup>b</sup>	40.0 <sup>b</sup>	1.0	<0.001	NS	NS
Sirloin, g/kg half-carcass	6.20 <sup>a</sup>	5.33 <sup>b</sup>	5.12 <sup>b</sup>	0.28	<0.05	NS	NS
Butt lean, g/kg half-carcass	37.7 <sup>a</sup>	32.9 <sup>b</sup>	31.5 <sup>b</sup>	1.0	<0.01	NS	NS
Ham, g/kg half-carcass	322	315	317	4.6	NS	NS	NS
Shoulder, g/kg half-carcass	200	193	187	3.6	0.053	NS	NS
Backfat, g/kg half-carcass	94.7	105	97.9	3.6	NS	0.052	NS
Belly, g/kg half-carcass	157 <sup>a</sup>	167 <sup>ab</sup>	177 <sup>b</sup>	4.2	<0.05	NS	NS
Backfat thickness at first rib, cm	5.3 <sup>ab</sup>	4.9 <sup>a</sup>	5.9 <sup>b</sup>	0.3	<0.05	NS	NS
Backfat thickness at last rib, cm	4.3 <sup>a</sup>	5.0 <sup>b</sup>	4.7 <sup>ab</sup>	0.2	<0.05	NS	NS
Backfat thickness at Gm <sup>2</sup> , cm	3.8	4.4	4.3	0.2	NS	NS	NS

<sup>1</sup> Measured on Gluteus profundus muscle at the cranial end of Gluteus medius muscle.

<sup>2</sup> Minimum thickness at Gluteus medius (Gm) muscle.

first rib were greater for IC females ( $P < 0.05$ ), while SC males showed the larger backfat thickness at the last rib ( $P < 0.05$ ), with no significant differences among groups for minimum backfat at the *gluteus medius* muscle ( $P > 0.05$ ). In general, 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, higher lean cuts and lower fat depots 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 (Valdesequera line) of approximately 150 kg BW of five sexes, 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 clearly different from IC males, in line with our results.

The effect of dietary protein concentration on carcass traits was rather modest. In the case of the diet providing the lower protein content, there was a trend for higher carcass yield ( $P = 0.09$ , Table I), and also for higher backfat/carcass ratio (+11%;  $P = 0.052$ , Table I).

The results obtained so far do not reveal a significant effect of increasing protein concentrations on growth or carcass traits of IC male and female Iberian pigs. Further experiments involving more pigs and metabolic determinations will help to elucidate possible effects of immunocastration on Iberian pig lean growth.

#### ACKNOWLEDGEMENTS

Funded by EU Horizon 2020 Research and Innovation Programme, 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.

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