INTERACTION OF IMMUNOCASTRATION AND SEX ON PERFORMANCE, CARCASS AND MEAT QUALITY IN PIGS

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Abstract– This study aims to assess the effects of sex and immunocastration and their interaction on performances, carcass and meat quality of pigs at higher slaughter weights. Forty boars (BO), 40 barrows (BA) and 40 gilts (GI) were divided in 2 groups of 20 animals per sex, the control (C) and immunocastrated (IC) group. The IC group received two Improvac® injections. They were slaughtered at an average live weight of 133 kg. The experiment confirms the known effects of sex on performances. Dressing percentage of BO was lower compared to BA and GI. Meat percentage of BO and GI was higher and backfat thickness and intramuscular (IM) fat content lower compared to BA. Drip loss was higher in BO compared to BA. Meat of BA was less yellow compared to meat of GI. Immunocastration led to a higher feed intake and daily gain in BO and GI in the period after the second vaccination. In BO, the higher feed intake after IC led to higher backfat thickness resulting in a lower meat percentage, while GI showed higher IM fat content, lowering shear force. IC had minor effects in barrows.

Key Words – Barrow, Boar, Improvac, Gilt

I. INTRODUCTION

Due to the possible European ban on surgical castration in 2018, the rearing of boars (BO) and immunocastrates instead of barrows (BA) becomes more common in Belgium. This offers advantages in terms of production results (feed efficiency and meat percentage) but also disadvantages as boar taint may occur in the meat and fat of some BO. Moreover, the retail is evolving toward higher slaughter weights. Differences in performance, carcass and meat quality between different sexes of Belgian commercial growing-finishing pigs at high slaughter weights (130 kg) are not well documented. At the common slaughter weights (110-115 kg) BO are leaner and have a lower IM fat content compared to BA due to their lower daily feed intake [1,2]. Immunocastrated BO are considered as intermediates between BO and BA as they stay BO until their second vaccination, followed by a high increase of their daily feed intake [3]. Retail fears that meat of BO is dryer but no differences between different sexes could be observed for drip loss, tenderness and juiciness in the meta-analysis of Trefan *et al.* [2]. Therefore, the aim of this study was to assess the effect of sex on performances, carcass and meat quality at higher slaughter weights. In order to differentiate between the effect of GnRH vaccination (IC) and the presence of gonadal hormones, a study was designed to assess the interaction between sex and IC on the performance, carcass and meat quality of finishing BO, BA and gilts (GI).

II. MATERIALS AND METHODS

In an interventional study, 40 boars (BO), 40 barrows (BA) and 40 gilts (GI) were raised in individual pens. Each sex was divided in 2 groups of 20 animals, the control (C) and the immunocastrated (IC) group. The IC group received two times (at 70 kg and 105 kg) a dosage of Improvac®, an anti-GnRH vaccine. All pigs had free access to water and were fed *ad libitum* with the same three phase diet. At weekly intervals, all pigs were individually weighed and feed leftovers were recorded to calculate feed consumption. They were slaughtered the week after they weighed 130 kg. Average daily gain (ADG), average daily feed intake (ADFI), and gain to feed ratio (G:F) were calculated for four growth periods: from 20 to 40 kg live weight (first phase diet); from 40 to 70 kg live weight (second phase diet);

between the first (70 kg) and the second (105 kg) vaccination (third phase diet); and between the second vaccination (105 kg) and slaughter (third phase diet). The pigs were fastened one day prior to slaughtering, which was performed in a commercial slaughterhouse using carbon dioxide stunning followed by exsanguination, after a 1 hour lairage time. Slaughter weight was recorded prior to transport to the slaughterhouse. Dressing percentage was calculated as cold carcass weight, recorded in the slaughterhouse, divided by slaughter weight. Muscle thickness and fat thickness were measured using a Capteur Gras-Maigre (CGM)-device and converted into meat percentage by the equation approved for use in Belgian abattoirs by the regulation 2012/416/EU [4]. At 45 minutes post mortem the pH was measured in the *musculus longissimus thoracis et lumborum* (mLT) around the 13th rib of the right carcass side. The mLT was sampled 24 hours post mortem to determine drip loss, ultimate pH (pH_u), color (L*a*b* using HunterLab Miniscan) and IM fat content. A meat slice was cooked at 75 °C for 60 minutes to record cooking loss and evaluate shear force (triangular Warner-Bratzler). The meat sensory attributes were evaluated by an expert panel, consisting of 6 out of 8 trained experts, at the sensory laboratory of the Food Pilot (Melle, Belgium). The pork was grilled in an electric grill (Tefal, model GC3060, Rumilly, France) for approximately 5 minutes until a core temperature of 75°C was reached. Each grilled pork slice was cut into 6 pieces and tasted by 6 panelists. The panelist evaluated 9 attributes, on an unstructured 10 cm line scale with low and high intensity marked on the ends of the scale. In each session, 12 pork samples (2 per treatment group) were tasted and a Williams design [5] was used to determine the order of the samples so that the study was balanced for first-order carry-over effects. Between each sample, the panelists cleaned their mouths with water and a cracker.

For statistical analysis, animal was considered as experimental unit. All parameters were analyzed by ANOVA [6]. Differences were considered significant if $P<0.05$. Tukey's post hoc test was used to compare treatment means. Performance parameters (ADFI, ADG, and G:F) were analyzed using a longitudinal model that included sex, IC, growth period, the interaction terms sex x IC, sex x growth period, IC x growth period and sex x IC x growth period. The effect of IC was assessed by comparing the contrasts between C and IC animals within a certain sex and growth period. The effect of sex was assessed by comparing the contrasts between BO, BA and GI within the C group and growth period. Carcass quality parameters were analyzed with sex, IC, the interaction term sex x IC and cold carcass weight as fixed factors and round as random effect. Meat quality parameters were analyzed with sex, IC and the interaction term sex x IC as fixed factors and round and slaughter date as random effects. The effect of IC was assessed by comparing the contrasts between C and IC animals within a certain sex. The effect of sex was assessed by comparing the contrasts between BO, BA and GI within the C group. The sensory attributes of pork were analyzed with sex, IC and the interaction term sex x IC as fixed factors and animal and assessor as random effects. Because the boar taint related attributes (boar taint odour and flavour, manure flavour and sweat flavour), were not normally distributed with a majority of samples scored 0, the attributes were treated as binomial distributed data with a cutoff of 1. Logistic regression was used to assess that binomial distributed data.

III. RESULTS AND DISCUSSION

Between 40 and 70 kg, the ADFI of BO and GI and the ADG of GI were lower compared to BA (Table 1). Between 70 and 105 kg, the ADFI of BO and GI were lower compared to BA, the ADG of GI was lower compared to BO and BA and the G:F of BO was higher compared to BA and GI. Between 105 and 133 kg, the ADFI of GI was lower compared to BO and BA, the ADG and the G:F of BO was higher compared to BA and GI. Immunocastration led to higher ADFI and ADG in BO and GI but not in BA in the growth period after the second vaccination (105-133 kg) whereas the G:F ratio was not affected in that growth period. Pigs were randomly assigned to treatments at the start of the experiment. However, BA of the IC group had a significantly lower G:F ratio in the first period (20-40 kg) compared to the BA of the C group, making comparisons between the two barrow groups difficult.

Table 1 Effect of sex and IC on ADFI, ADG and G:F ratio (means). BO= boars, BA= barrows, GI= gilts, C= control group, IC= immunocastrated group, ADG= average daily gain, ADFI=average daily feed intake, G:F = gain to feed ratio

		Means						SEM	P-value[1]		
		BO		BA		GI			IC		
		C	IC	C	IC	C	IC		BO	BA	GI
ADFI, kg	20-40, kg	1.36	1.36	1.45	1.46	1.36	1.41	0.13	0.996	0.837	0.579
	40–70, kg	1.95[a]	1.93	2.26[b]	2.23	1.90[a]	1.95	0.19	0.772	0.653	0.529
	70–105, kg	2.28[a]	2.30	2.55[b]	2.46	2.18[a]	2.18	0.22	0.801	0.243	0.999
	105-133, kg	2.77[b]	3.26	2.76[b]	2.69	2.55[a]	3.09	0.27	**<0.001**	0.342	**<0.001**
ADG, kg	20-40, kg	0.66	0.64	0.71	0.65	0.63	0.65	0.06	0.784	0.197	0.649
	40–70, kg	0.89[ab]	0.86	0.98[b]	0.91	0.81[a]	0.81	0.08	0.517	0.131	0.971
	70–105, kg	0.94[b]	0.91	0.88[b]	0.83	0.77[a]	0.75	0.08	0.519	0.314	0.530
	105-133, kg	0.88[b]	0.99	0.75[a]	0.72	0.66[a]	0.86	0.08	**0.013**	0.387	<**0.001**
G:F, kg/kg	20-40, kg	0.48	0.47	0.49	0.45	0.46	0.46	0.04	0.555	**0.001**	0.950
	40–70, kg	0.45	0.45	0.43	0.41	0.42	0.41	0.04	0.474	*0.074*	0.429
	70–105, kg	0.41[b]	0.39	0.34[a]	0.34	0.35[a]	0.34	0.03	0.207	0.741	0.313
	105-133, kg	0.31[b]	0.30	0.27[a]	0.26	0.25[a]	0.28	0.03	0.362	0.654	0.133

[1]P-values are determined by comparing the contrasts between C and IC animals within a certain sex

[a,b] Within a row, means of different sexes without a common superscript differ within the control group (P<0.05)

Slaughter weight differed between the sexes and between the two treatment groups of gilts (Table 2). This is probably due to the higher daily gain of IC GI compared to C GI in the last week before slaughter. In line with literature, dressing percentage of BO was lower compared to BA and GI [7]. Meat percentage of BO and GI was higher and backfat thickness and IM fat content lower compared to BA. Drip loss was higher in BO compared to BA. Meat of BA was less yellow compared to meat of GI. Backfat thickness was higher, meat percentage lower and IM fat content tended to be higher in IC BO compared to C BO. The meat of IC BO was paler and less red compared to C BO and tended to have higher cooking loss and a lower pH_u. IC BA tended to have more yellow meat compared to C BA. IM fat content was higher and shear force was lower in IC GI compared to C GI.

Table 2 Effect of sex and IC on carcass and meat quality in pigs (means). BO= boars, BA= barrows, GI= gilts, C= control group, IC= immunocastrated group, pH_{45} = the pH measured at 45 min postmortem, pH_u = the ultimate pH, measured at 24 h postmortem.

	Means						SEM	P-value[1]		
	BO		BA		GI			IC		
	C	IC	C	IC	C	IC		BO	BA	GI
Carcass traits										
Slaughter weight, kg	136[b]	137	135[ab]	134	133[a]	136	0.36	0.364	0.286	**0.010**
Cold carcass weight, kg	107	107	109	108	107	109	0.29	0.851	0.284	**0.002**
Dressing percentage, %	79[a]	78	81[b]	80	81[b]	80	0.15	0.232	0.724	0.843
Meat percentage, %	63[b]	62	60[a]	61	63[b]	62	0.23	**0.025**	0.456	0.118
Backfat thickness, mm	13[a]	15	16[b]	16	14[a]	15	0.28	**0.013**	0.407	0.112
Muscle thickness, mm	70	71	73	73	74	75	0.62	0.403	0.910	0.897
Meat traits										
pH_{45}	6.2	6.2	6.1	6.1	6.2	6.0	0.03	0.892	0.773	0.244
pH_u	5.5	5.4	5.5	5.5	5.4	5.5	0.02	*0.084*	0.479	0.258
Color L*	55	57	55	55	56	56	0.42	**0.021**	0.970	0.812
Color a*	7.4	6.3	6.4	7.3	7.4	7.5	0.15	**0.007**	0.124	0.544
Color b*	15.4[ab]	15.2	14.8[a]	15.5	15.8[b]	15.9	0.12	0.393	*0.073*	0.855
Drip loss, %	6.5[b]	6.1	4.6[a]	4.8	5.0[ab]	4.6	0.19	0.498	0.786	0.448
Cooking loss, %	32.6	33.6	31.7	31.6	32.0	31.4	1.32	*0.058*	0.919	0.324
Shear force, N	35.5	35.8	34.3	34.7	38.4	32.9	1.35	0.885	0.873	**<0.001**
Intramuscular fat content, %	1.70[a]	1.77	2.05[b]	2.01	1.61[a]	1.85	1.47	*0.087*	0.590	**0.038**

[1]P-values are determined by comparing the contrasts between C and IC animals within a certain sex

[a,b] Within a row, means of different sexes without a common superscript differ within the control group (P<0.05)

Table 3 Effect of sex and IC on sensory attributes of pork (means). BO= boars, BA= barrows, GI= gilts, C= control group, IC= immunocastrated group

	Means						SEM	P-value[1]		
	BO		BA		GI			IC		
	C	IC	C	IC	C	IC		BO	BA	GI
Percentage of animals										
Boar taint odour, %	41.5[b]	5.4	2.8[a]	7.6	2.7[a]	7.1		**<0.001**	0.124	0.155
Boar taint flavour, %	50.0[b]	2.7	9.4[a]	11.9	7.1[a]	9.8		**<0.001**	0.524	0.510
Manure flavour, %	33.9[b]	13.4	17.0[a]	11.0	13.4[a]	12.5		**<0.001**	0.141	0.785
Sweat flavour, %	31.4[b]	10.7	14.2[a]	16.1	11.6[a]	11.6		**<0.001**	0.594	0.993
Mean scores (0-10)										
Fried flavour	2.6	2.9	2.6	3.0	2.6	2.8	0.100	0.572	0.332	0.704
Piggy flavour	3.7	3.8	4.2	3.9	3.8	3.8	0.095	0.877	0.283	0.983
Tenderness	5.1	4.2	4.3	4.6	5.1	4.5	0.101	*0.055*	0.399	0.225
Juiciness	3.8	4.2	4.0	3.8	3.7	4.0	0.012	0.319	0.727	0.607
Overall tastiness	1.7[a]	3.5	3.0[b]	3.3	3.2[b]	3.2	0.090	**<0.001**	0.505	0.907

[1]P-values are determined by comparing the contrasts between C and IC animals within a certain sex

[a,b] Within a row, means of different sexes without a common superscript differ within the control group (P<0.05)

The percentage of pigs with boar taint odour and flavour, manure flavour and sweat flavour was higher and the overall tastiness score was lower in BO compared to BA and GI of the C group (Table 3). Immunocastration of boars led to a lower percentage of pigs with boar taint odour and flavour, manure flavour and sweat flavour and an increase in overall tastiness score and a tendency to a decrease of the tenderness. This was not observed in BA or GI. Immunocastration of BA or GI did not result in significant sensory differences.

IV. CONCLUSION

The experiment confirms that the known sex differences are also valid at higher slaughter weights. In BO and GI, the higher feed intake after IC led to faster growth. In BO, this resulted in higher backfat thickness and lower meat percentage, while GI showed higher IM fat content, lowering the shear force of the meat. In BO, IC led to lower boar taint related sensory attribute scores similar to the levels of BA and GI. In GI, meat quality differences did not result in significant differences in sensory profile. In barrows, IC had minor effects.

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