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THE EFFECT OF SLAUGHTER WEIGHT AND CROSSBRED ON PIG CARCASS AND MEAT QUALITY TRAITS

A. DIESTRE[1], J.A. GARCIA-MACIAS[1], M.A. OLIVER[1], A. MIQUEL[2], E. ESTEVE[2], P. ALONSO[4], A.MUÑOZ[3] and M. GISPERT[1]

[1] IRTA, Centre de Tecnologia de la Carn, Granja Camps i Armet 17121 Monells
[2] IRTA Centre Mas Bové, 43280 Reus
[3] Universidad de Murcia, Departamento de Genética Animal, Murcia
[4] Pig Improvement Company España, Avda. Ragull, 80, 08190 St.Cugat Spain

INTRODUCTION

There is currently great interest to improve pig carcass and meat quality in Spain. Therefore, several trials have been carried out by our Institute considering that good conformation, high carcass lean content with high cutting yields are valuable characteristics for the market. On the other hand, good water holding capacity and colour is required since the meat industry is facing a high incidence of PSE meat. The aim of this trial was to study the effect of three experimental crossbreeds and two slaughter weights on carcass and meat quality.

MATERIAL AND METHODS

One hundred and sixty-two crossbred barrows separated in two fattening intakes (76 the first year and 86 the second year) were studied. The animals were grouped in pens in the first intake and fed *ad libitum* until 95kg. In the second intake they were restricted (2.5kg per animal per day) from 60kg and 57 animals were grouped in pens and 29 in individual boxes. For statistical analysis the data of the second intake was separated in two batches (B) and the first intake was considered as one batch.

The animals were slaughtered at 90kg (L) and 120kg (H) and distributed by three experimental crossbred. Two crossboars, a Pietrain x (Synthetic conformate x LW) and a Duroc x (Synthetic conformate x LW) sired (LWxLR) sows. A third crossbred (LWxLR) was also included. The conformate cross, Duroc cross and white cross will be in the following abbreviated as crossbred A, B and C respectively.

The animals were slaughtered in the Carcass Evaluation Unit (IRTA-CTC), after a standardized pre-slaughter treatment (12 hours in lairage, electrically stunned with 350V at 50Hz). The following predictor variables of the carcass lean content were recorded on the left side of cold carcasses:

Leg conformation: a visual assessment of the shape of the hind leg was made from 1 = very good conformation to 5 = very poor conformation.
Carcass length (cm): measured from the anterior edge of the *symphysis pubis* to the recess of the first rib. On the cut surface at 3/4 last rib over the *m.longissimus dorsi* at 60mm from the mid-line backfat was recorded. Also 3/4 muscle depth and eye muscle area (cm^2) in the *m.longissimus dorsi* was also taken at the same position. Lean percentage was estimated using the HGP grading probe.

The left side of the carcasses was used to measure meat quality. Muscle pH (pH45) and electrical conductivity (QM45) at 45 minutes post-mortem, ultimate pH (pHu) and electrical conductivity (QMu) at 24 hours post-mortem were measured in the *m.longissimus dorsi* (LD) at the level of last rib and *m.semimembranosus* (SM) muscles. Colour (L*, a*, b*) using Minolta reflectometer and subjective colour (Nakai *et al.*, 1975) was measured in the exposed cut surface of the LD at the level of the last rib.

After removal of flare fat and kidneys, the left side of each carcass was divided into 17 joints according to the EC-reference method for the full dissection (Scheper and Scholz, 1985). The simplified reference method, based on the dissection of the main joints of the carcass: leg, loin, shoulder, belly, tenderloin, neckfat and backfat was used (Branscheid *et al.*, 1990).

The statistical analysis was carried out with the Statistical Analysis System (SAS Institute Inc., 1985), using the following model:

$$Y_{ijkl} = \mu + W_i + C_j + B_k + (W \times C)_{ij} + (W \times B)_{ik} + (C \times B)_{jk} + b_i (W_{ijkl} - W_i) + e_{ijklm}$$

where:

Y_{ijklm} = the ijklm observation,
μ = overall mean,
W_i = effect of weight (i = L, H),
C_j = effect of crossbred (j = A, B, C),
B_k = effect of batch (k = 1, 2, 3),
$(W \times C)_{ij}$ = interaction of W and C,
$(W \times B)_{ik}$ = interaction of W and B,
$(C \times B)_{jk}$ = interaction of C and B,
b_i = coefficient of the covariable W_{ijkl} (i = 1,2),
$(W_{ijkl} - W_i)$ = bias for each slaughter weight, eijklm = residual random term, N (0, $Õ^2_e$).

RESULTS AND DISCUSSION

Least squares means (LSM) of the carcass quality characteristics are given in Table 1. A significant effect of slaughter weight and crossbred was obtained. Increasing slaughter weight increased all the traits studied with the exception of the percentage of lean which decreased. Every 10kg of increase in slaughter weight means that killing out percentage increased 0.86%. Similar results were obtained by Hansson *et al.* (1975) in Swedish Yorkshire barrows. However, these authors found higher increase of fat thickness every 10kg of increase of slaughter weight (2.2mm) than the present trial. We have found the same increase (1.4mm per 10kg) in fat thickness found by several French trials (Albar *et al.*, 1990). Also, we have described a higher increase in loin area (2.8cm² vs 2.1cm²) and a lower decrease in carcass lean percentage (-0.5% vs -1.0%) compared with the Swedish trial. These results should be expected because there is a difference of at least two decades between these experiments. However, Albar *et al.* (1990) obtained a reduction of 0.7% lean every 10kg of increase in slaughter weight. The crossbred A has better conformation, higher loin area, more loin depth and higher lean percentage than crossbred B; crossbred C was the longest and worst conformation genotype studied. However, crossbred B was not different from A in killing out percentage and carcass length. In previous trials we observed higher conformation in carcass sired from blocky purebred boars compared with crossbred A (Blasco *et al.*, 1993). Not very important differences were observed in the distribution of carcass weight with increasing slaughter weight (Table 2). The crossbred B had the same percentage of ham and loin than A, having both higher percentage of ham and loin than crossbred C. When comparing with previous trials differences between Belgian Landrace sired carcasses had better distribution than crossbred A carcasses; similar results were obtained for the distribution of the lean tissue in the carcass.

Table 3 shows LSM of the meat quality characteristics we studied. Slaughter weight did not significantly affect meat quality. Only Minolta values (L, a and b) and the subjective colour evaluation were affected. According to these characteristics meat colour was less pale in heavier carcasses. This phenomenon is described as more mature meat by the industry. Surprisingly, the best conformation crossbred A had no differences in meat quality with respect to the white crossbred C, with crossbred B being intermediate. In general, meat quality of the crossbreeds studied in this trial breed was superior than previous one especially when are compared with the pure breed blocky sired carcasses (Oliver *et al.*, 1993). However, the inclusion of the Duroc line in crossbred B was not as favourable as including more stress susceptible lines in crossbred A.

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Table 1. Least squares means of carcass quality traits by slaughter weight and by crossbred.

	Weight		Cross			Rsd
	L	H	A	B	C	
Killing out (%)	79.7	82.3	81.3a	81.6a	80.2b	1.37
Carcass length (cm)	80.8	83.3	83.4b	85.8b	83.6a	2.15
Leg conformation	2.8	2.6	2.4c	2.6b	3.0a	0.46
Area LD (cm^2)	33.3	41.6	39.7a	36.9b	35.7b	4.08
3/4 backfat (mm)	15.6	19.8	16.5	18.8	17.9	3.27
3/4 muscle depth (mm)	49.2	57.4	56.4a	53.7b	49.9c	5.20
Simplified lean (%)	37.7	36.8	38.3a	37.3b	36.1c	2.13
Estimated lean (%)	53.4	51.9	53.6a	51.9b	52.4ab	3.12

Table 1(cont). Least squares means of carcass quality traits by slaughter weight and by crossbred.

	W	C	B	WxC	WxB	CxB
Killing out (%)	***	***	*	*	NS	+
Carcass length (cm)	***	***	+	NS	NS	NS
Leg conformation	**	***	+	NS	*	**
Area LD (cm^2)	***	***	*	NS	NS	NS
3/4 backfat (mm)	***	+	NS	NS	NS	+
3/4 muscle depth (mm)	***	***	NS	NS	NS	NS
Simplified lean (%)	*	***	NS	NS	NS	+
Estimated lean (%)	**	*	NS	NS	NS	+

*** = P<0.001 ; ** = P<0.01; * = P<0.05; + = P<0.1
NS = No significance.
Means with different letters are significantly different (P<0.05).

Table 2. Least squares means of the distribution of carcass weight and carcass lean in the main joints by slaughter weight and by crossbreed.

	Weight		Cross		
	L	H	A	B	C
Distribution of the main cuts in the carcass (%):					
Ham	23.9	23.9	24.2^{b}	24.1^{b}	23.4^{a}
Hind Shank	3.7	3.5	3.6	3.6	3.6
Loin	11.2	11.2	11.4^{a}	11.3^{b}	11.0^{b}
Back-neckfat	6.9	7.0	6.4^{b}	7.1^{a}	7.3^{a}
Shoulder	14.5	14.5	14.6	14.5	14.4
Belly	9.7	9.8	9.8^{a}	9.5^{b}	10.0^{a}
Distribution of the lean in the carcass (%):					
Ham	28.7	28.8	29.3^{a}	29.5^{a}	27.5^{b}
Loin	14.6	14.9	14.8^{a}	15.0^{a}	14.4^{b}
Shoulder	15.9	16.3	16.1	16.3	16.0
Belly	8.3	8.1	8.3	8.2	8.2

	Rsd	W	C	B	WxC	WxB	CxB
Distribution of the main cuts in the carcass (%):							
Ham	0.82	NS	***	**	NS	NS	+
Hind Shank	0.30	**	NS	**	NS	NS	*
Loin	0.73	NS	*	*	*	NS	**
Back-neckfat	1.01	NS	***	*	NS	NS	NS
Shoulder	0.66	NS	NS	NS	NS	+	NS
Belly	0.67	NS	*	NS	+	NS	NS
Distribution of the lean in the carcass (%):							
Ham	1.56	NS	***	+	NS	NS	**
Loin	1.01	+	*	*	NS	NS	NS
Shoulder	0.99	*	NS	NS	NS	*	*
Belly	0.71	+	NS	NS	+	NS	NS

*** $P<0.001$; ** $P<0.01$; * $P<0.05$; + $P<0.1$; NS = no significative.
Means with different letters are significantly different.

Table 3. Least squares means of meat quality characteristics of *m.longissimus dorsi* (LD) and *m.semimembranosus* (SM) by slaughter weight crossbreed.

	Weight		Cross		
	L	H	A	B	C
pH45 LD	6.12	6.07	6.10^{ab}	3.99^{b}	6.20^{a}
pH45 SM	6.04	6.08	6.06	5.98	6.14
QM45 LD	3.67	3.99	3.83	4.13	3.52
QM45 SM	4.08	4.33	4.05	4.50	4.07
pHu LD	5.65	5.65	5.62	5.67	5.65
pHu SM	5.59	5.58	5.56	5.62	5.58
QMu LD	3.60	3.85	3.26^{b}	4.71^{a}	3.22^{b}
QMu SM	5.27	5.33	4.81^{b}	6.26^{a}	4.84^{b}
L-value	53.12	52.31	52.7^{ab}	53.58^{a}	51.89^{b}
a-value	6.85	8.63	7.70	8.00	7.52
b-value	5.69	6.67	6.17	6.52	6.85
Sub. colour	2.56	2.82	2.62	2.63	2.80

	Rsd	W	C	B	WxC	WxB	CxB
pH45 LD	0.30	NS	**	NS	NS	NS	NS
pH45 SM	0.32	NS	+	NS	NS	NS	+
QM45 LD	1.28	NS	+	+	NS	NS	*
QM45 SM	1.86	NS	NS	NS	NS	NS	NS
pHu LD	0.11	NS	+	***	NS	NS	+
pHu SM	0.12	NS	+	***	NS	NS	NS
QMu LD	1.75	NS	***	NS	NS	NS	**
QMu SM	2.39	NS	**	NS	NS	+	NS
L-value	3.10	NS	*	NS	NS	+	+
a-value	1.86	***	NS	**	NS	+	NS
b-value	1.39	***	+	***	**	**	+
Sub. colour	0.56	**	NS	+	+	**	NS

*** $P<0.001$; ** $P<0.01$; * $P<0.05$; + $P<0.1$; NS = no significance.
Means with different letters are significantly different ($P<0.05$).
QM = electrical conductivity.
L, a, b = Minolta values.