Effects of terminal pig sire types and sex: On carcass traits, meat quality and sensory analysis of dry-cured ham.

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Background
A common practice in pig production is the use of crossbred sows, frequently Large WhitexLandrace, that are mated to different terminal sires, depending on the market requirements. When body conformation and very lean meat are needed, Belgian Landrace or Pietrain sires are used. If fast growth, feed efficiency and meat quality are required, Large White and Duroc sires are preferred, and for intermediate situations some crossbred sires among the previous types are frequently used (Oliver *et al.*, 1993). The raw material quality plays a key role in dry-curing processes. Dry-cured ham is a meat product typical in the Mediterranean area, which undergoes a long processing for a flavourful matured product, increasing its production cost. For this reason, consumers demand a high quality product determined by its sensory properties.

Objectives
The objective of this study was to determine the effect of terminal sire on carcass traits, meat quality parameters and dry-cured ham sensory qualities in order to determine the terminal sire that will be more adequate to producers or consumers requirements.

Methods
Animals: A total of 150 pigs have been used for the study. The pigs were the offspring of Large White x Landrace (LWxLR) crossbreeds sows mated to five different genetic types: Danish Duroc (DU), Dutch Large White (LW_D), English Large White (LW_E), Belgian Landrace x Landrace (BLxLR) and Belgian Landrace (BL). The number of pigs slaughtered, coming from each type of sire were respectively: 30 (15 females and 15 males), 30 (14 females and 16 males), 29 (14 females and 15 males), 35 (17 females and 18 males), and 26 (13 females and 13 males).
Carcass traits: The killing out was expressed as the ratio between carcass weight (kg) and animal liveweight (kg). Footless ham, handless shoulder, loin chops and ribs were cut out of all the carcasses at 24 hours post mortem.
Meat quality measurements: The pH and the electrical conductivity were measured in *Semimembranosus* muscle at 2 hours (pH_{2h}) and 24 hours post-mortem (QM_{24h}), respectively. Drip loss and water holding capacity (WHC) were also measured in the *Longissimus dorsi* muscle. The following chemical analyses in the *Semimembranosus* muscle were performed: moisture (ISO, 1973), protein (Kjeldahl, AOAC, 1990) and intramuscular fat (IMF) (Folch *et al.*, 1957) contents.
Sensory analysis of dry-cured ham: The study consisted in 15 sessions, with 5 hams evaluated per session. The ham samples were sliced (approximately 3 mm thickness), and 3 g rolls prepared. Each sample (2 rolls) was presented at room temperature in a petri-dish. Intensities of aromatics, tastes and feeling factors were based on unequal-interval scale (Stone *et al.*, 1974).
Statistical analysis: A mixed model methodology was used to analyse the data. The model was: $\mathbf{Y}_{ijkl} = \mu + \mathbf{g}_i + \mathbf{s}_j + \mathbf{b}^*\mathbf{d}_{ijkl} + \mathbf{A}_{ijkl} + \mathbf{L}_{ik} + \mathbf{e}_{ijkl}$, where: $\mathbf{Y}_{ijkl}$ is the data of the animal, μ stands for the overall mean; **g** for the sire type effect; **s** for the sex effects; **b** is the regression coefficient of the carcass weight or ham weight, depending the trait studied (**d** expressed in kg); **A** for the additive genetic effect of the animal; **L** for the litter of birth and **e** for the error. The genetic parameters used to solve the mixed model, heritabilities (h^2) were on the range of the estimate by Hovenier *et al.* (1992). When there is no literature concerning litter effects (c^2), we have assumed a c^2=0.1 for these traits and we have tested the robustness of the analyses.

Results and discussion
Carcass traits: The killing out proportion was the same for all pigs except for BL sired (see table 1), which was the highest one. Blasco *et al.* (1994) did not find any difference in killing out when comparing similar sires, while Edwards *et al.* (1992) found a higher effect for DU sire as compared to LW sire. BL sired pigs had a good proportion of main carcass cuts, especially ham, which is in agreement with Blasco *et al.* (1994). When the sex effect was analysed, females had higher killing out proportion and percentage of ham and lower of shoulder and chops than males.
Meat quality measurements: The pH_{2h} in DU sired pigs was higher than in BLxLR or BL sired pigs, being the lowest ($P < .01$) in BL sired pigs (see table 1), in accordance with Oliver *et al.* (1993, 1994). Terminal sire had a significant ($P < .05$) effect for QM_{24h}, being BL sire effect higher than LW_E, in agreement with Oliver *et al.* (1993, 1994). Meat of DU and BLxLR sired pigs had higher WHC than BL sired, in accordance with Oliver *et al.* (1993) who measured muscle protein solubility (MPS) as an index of WHC. DU sired pigs were characterised by high IMF and low moisture and protein content, while BLxLR and BL had the opposite evolution. No differences between sexes were found on meat quality measurements, except in drip loss which was higher in the males.
Sensory analysis: Probably, the differences on "fat complex" aroma, highest in BLxLR sired pigs (see figure 1), are due to the lipid composition which it is affected by the genetic type (Cameron and Enser, 1991). The "rancidity" and "barnyard" aromatics, slightly high in BL sired pigs, could be explained by the intramuscular fat (IMF) content and its relationship with lipid composition (Cameron and Enser, 1991). There was not any significant genetic type effect on taste descriptors (see figure 2), as Oliver *et al.* (1994) reported. In appearance descriptors (see figure 3), DU sire effect was higher than BL sire effect in "marbling", in accordance with Gou *et al.* (1995). The content of "tyrosine crystals" was higher for DU and LW_D sires than for BLxLR sire, in agreement with Guerrero *et al.* (1996), who reported lower tyrosine contents in BL and Pietrain lines than in DU line. Females had the highest effect in "fat

complex" and the lowest in "salty" and "sour". Gou *et al.* (1995) did not find significant differences between gilts and barrows on quality properties of dry-cured ham.

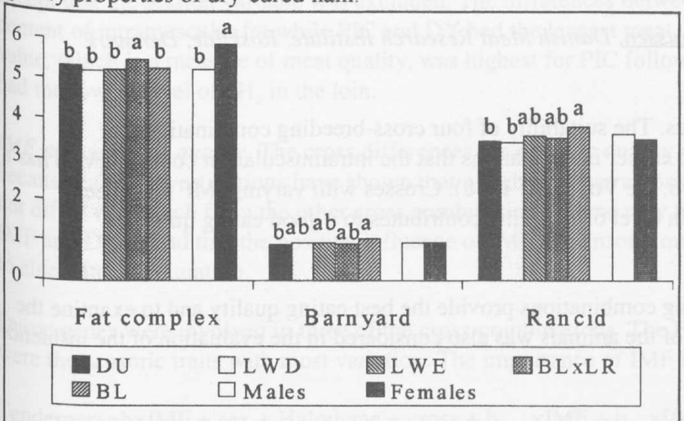

Figure 1. Aromatic descriptors by genetic type and sex.

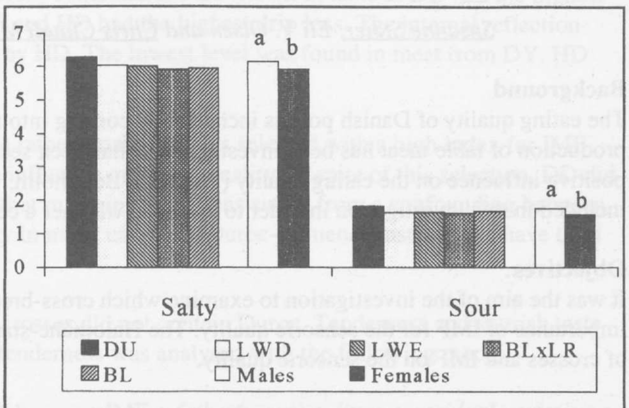

Figure 2. Taste descriptors by genetic type and sex.

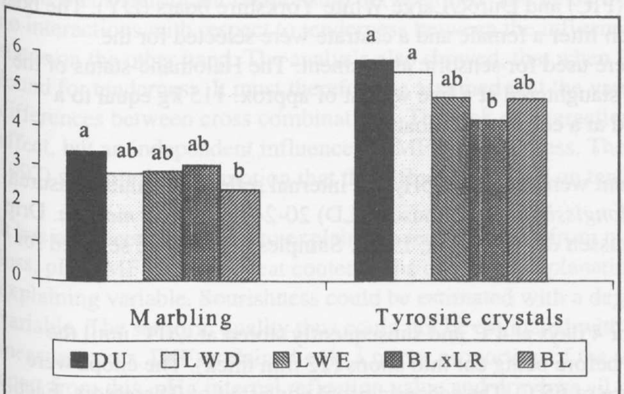

Figure 3. Appearance descriptors by genetic type.

Conclusions

On meat quality BL sired pigs had the worst score although they had the highest killing out proportion and the best carcass conformation. On the other hand, DU sired pigs had a good score in meat quality measurements. LW sired pigs were intermediate in meat quality measurements and carcass conformation. BL sire effect provided bad sensory properties, being DU effect in the opposite extreme, except on "fat complex" descriptor. LW sired pigs had intermediate scores on sensory descriptors.

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Table 1. – Least squares means (LSM) and standard errors (SE) of carcass traits and meat quality measurements at constant carcass weight (C. Wt. = 73kg) by terminal sire and by sex. Effect of the carcass weight (regression coefficient) and standard error (SE).

	Sire type										Sex				Covariate	
	DU		LW_D		LW_E		BL x LR		BL		Males		Females		C. Wt.	
	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	Effect	SE
Carcass traits: (in %)																
Killing out	75.22^{b}	.409	75.18^{b}	.436	74.85^{b}	.474	75.86^{b}	.416	77.16^{a}	.441	74.91^{b}	.239	76.41^{a}	.238	.0507*	.0197
Ham	27.14^{b}	.220	27.24^{b}	.224	26.97^{b}	.238	26.99^{b}	.213	27.85^{a}	.233	26.95^{b}	.119	27.52^{a}	.122	-. 0172	.0091
Shoulder	13.19^{ab}	.147	13.25^{ab}	.150	12.90^{bc}	.160	12.76^{c}	.143	13.39^{a}	.156	13.39^{a}	.080	12.80^{b}	.082	-.0163**	.0061
Chops	19.92^{ab}	.225	20.45^{a}	.229	19.49^{b}	.244	19.68^{b}	.218	20.15^{ab}	.239	20.09^{a}	.122	19.78^{b}	.125	-. 0192*	.0093
Ribs	4.69^{ab}	.091	4.73^{a}	.092	4.61^{ab}	.098	4.46^{b}	.088	4.49^{ab}	.096	4.61	.049	4.58	.050	-.0124**	.0038
Meat quality measurements:																
pH_{2h}	6.21^{a}	.082	6.01^{ab}	.083	6.15^{ab}	.088	5.96^{b}	.078	5.62^{c}	.087	6.02	.046	5.95	.046	.0036	.0036
QM_{24h}	6.62^{ab}	.417	6.79^{ab}	.421	6.41^{b}	.449	6.72^{ab}	.398	7.69^{a}	.444	6.64	.233	7.05	.235	.0021	.0181
WHC	.28^{a}	.009	.28^{ab}	.009	.26^{ab}	.010	.29^{a}	.009	.26^{b}	.010	.27	.005	.28	.005	.0009*	.0004
Drip loss	5.57	.559	6.46	.566	6.58	.602	5.67	.537	5.75	.592	6.35^{a}	.304	5.66^{b}	.307	-.0661**	.0227
Moisture	74.53^{b}	.188	75.42^{a}	.185	75.23^{a}	.192	75.40^{a}	.173	74.96^{ab}	.187	75.18	.099	75.04	.100	.0009	.0052
Protein	19.98^{c}	.562	20.81^{bc}	.553	20.17^{c}	.570	22.84^{a}	.517	22.20^{ab}	.559	21.30	.297	21.09	.298	.0034	.0156
IMF	3.42^{a}	.180	2.63^{bc}	.179	2.98^{ab}	.186	2.19^{c}	.168	2.30^{c}	.180	2.71	.092	2.70	.092	.0047	.0044

^{a,b,c} Means within a row and effect lacking a common superscript letter differ (P< .05). *: Significant (P<.05) or ** very significant (P<.01) effect.

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