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THE EFFECT OF OUTDOOR-REARING ON CARCASS COMPOSITION, TECHNOLOGICAL AND SENSORY MEAT QUALITY IN CROSS-BRED PIGS WITH YORKSHIRE OR DUROC AS TERMINAL SIRE

ANN-CHARLOTTE ENFÄLT[1], KERSTIN LUNDSTRÖM[1], INGEMAR HANSSON[1], NILS LUNDEHEIM[2] AND PER-ERIK NYSTRÖM[2]

[1]Dept. of Food Science, [2]Dept. of Animal Breeding and Genetics, Swedish Univ. of Agric. Sci., Box 7051, S-750 07 Uppsala, Sweden.

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BACKGROUND AND OBJECTIVES

The quality of pig meat, expressed as either carcass composition, technological quality or sensory quality, is determined by both the genetic background of the animals, and the environmental factors during rearing. The increased interest for meat from a more ethical animal production has led to an increased number of farms which raise the pigs outdoors. So far, little research has been carried out concerning the effects of outdoor-rearing. Barton-Gade & Blaabjerg (1989) observed a calmer behaviour for pigs raised outdoors, and a lower frequency of DFD. The purpose of the present investigation was to study the effect of outdoor-rearing and sire breed on carcass composition and technological and sesory meat quality.

METHODS

Animals: The animals used were 102 cross-bred slaughter-pigs with Duroc or Yorkshire as terminal sire and Yorkshire or Yorkshire x Landrace sows. Each litter was split into two, and one half was reared outdoors in a 5 km^2 area, and the other half was reared indoors, in pens with 4 pigs in each pen. Both groups were fed *ad libitum*, using a feedstuff with a normal energy- and protein level. The pigs were slaughtered and graded in a commercial slaughterhouse, at a weight of 100 kg.

Carcass composition: The carcasses were cut in ham, back, shoulder and belly according to Andersson (1980). The ham and back were defatted and the weights of meat+bone and fat were recorded. In addition, the loin and ham were dissected into the following muscles: *M. longissimus dorsi* (LD), *M. biceps femoris* (BF), *M. semimembranosus et adductor* (SMA), *M. quadriceps femoris* (QF), *M. semitendinosus* (ST) and *M. gluteus* (GLU).

Technological meat quality: These measurements were carried out at cutting, at the last rib in LD, in the central part of the SMA, BF and GLU, in the rectus part of QF and in the light and dark parts of ST. Meat colour, ultimate pH (pH_u) and waterholding capacity were measured according to Enfält et al. (1994). A subjective scoring for the intramuscular fat content (IMF) was carried out, using the levels from 1 (no marbling) to 5 (high marbling).

Sensory analysis: The sensory analysis was carried out by a trained panel on *M.longissimus* samples from 32 animals, equally divided between the two sire breeds and the two rearing forms. The meat was scored for overall-acceptance, tenderness, chewing time, biting resistance, acidity, juiciness, meat taste intensity and off-flavour taste.

Statistical analysis: The statistical analysis was carried out with the Statistical Analysis System (SAS Institute, 1989), using the GLM-procedure.

RESULTS AND DISCUSSION

The results from the present study are presented in Table 1. They showed that Yorkshire as terminal sire in comparison with Duroc gave carcasses with a significantly higher meat content. This difference was registered as percentage meat at grading, the sum of meat and bone in back and ham and proportion of the individual muscles. The carcasses from the Yorkshire-sired pigs also had a significantly lower proportion of fat in ham and loin, a thinner backfat, but no difference in the proportion of back. Edwards et al. (1992) also found thinner backfat in Yorkshire carcasses compared with Duroc, and a higher killingout-percent for the former, while they did not find any difference between the breeds in the proportion of back. In accordance to this, Cameron (1990) found that British Landrace was leaner than Duroc.

The carcass composition was also influenced by raising form, where animals reared outdoors produced leaner carcasses with a higher percent meat+bone in ham and in ham and back, and a lower proportion of fat in both back and ham. The indoor-reared pigs also had a tendency to thicker backfat. The outdoor-rearing influenced the carcass composition to the same extent in both breeds. Concerning the fat content in the loin, the difference between rearing forms was significant only for the Duroc breed-cross. The size of individual muscles seems to be difficult to influence by environmental factors, since the rearing forms did not differ in the proportions of individual muscles. Also Enfält et al. (1993) could not find any effect of moderate indoor exercise on muscle size. By giving the pigs the possibility to exercise and move during the fattening period, it seems to be possible to change the total proportion of meat and fat but not the size of individual muscles. The latter is probably more genetically steered.

Meat from Duroc-crosses had a better sensory quality than Yorkshire-crosses, shown as significantly higher scores for overall-acceptance and tenderness. This is in accordance with English results, where a higher proportion of Duroc in the animal material had a positive influence on taste and juiciness (Meat & Livestock Commission, 1992). In contrast, Edwards et al. (1992) found no differences in sensory quality in the loin between the Duroc and Large White breeds. Yorkshire had higher scores for acidity in the present study, even though the pH-value did not differ.

The indoor-rearing gave better sensory quality, shown as higher overall-acceptance, juiciness and tenderness. The juiciness was higher for the indoor-reared pigs independent of breed-cross. Yorkshire-crosses seem to be less suitable for outdoor-rearing, since these pigs had significantly lower overall-acceptance and tenderness than the other subgroups, while the Duroc-crosses differed less between rearing forms. The lower tenderness in Yorkshire-crosses reared outdoors may be due to a lower fat content, indicated by the lower percentage fat in ham. This is in agreement with results by Andersson et al. (1990) who found lower IMF content in loins from outdoor-reared pigs. Enfält et al. (1993) also found lower IMF in BF for exercised pigs, compared to non-exercised pigs.

Pigs from the two sire-breeds did not differ in any of the technological parameters, except for the subjective scores for IMF

marbling, where Duroc-crosses had higher marbling. Edwards et al. (1992) also found higher marbling-scores for Duroc pigs compared to Large White. McGloughlin et al. (1987) found that Duroc had paler meat in LD than Large White, but found no difference in pH and drip loss. The lack of difference in pH_u between pigs from the two sire-breeds in the present study is in some contrast to earlier Swedish and German results (Lundström et al., 1989; Maassen-Francke et al., 1991), where purebred Duroc pigs had higher pH_u than Large White.

Outdoor-rearing gave lower pH_u in all muscles, higher drip loss in LD and higher internal reflectance values in all muscles, except ST. The higher drip loss as a consequence of outdoor-rearing was seen in both breed-crosses. This is in agreement with the findings from Enfält et al. (1993), where moderate indoor exercise gave somewhat lower pH_u and a significantly higher surface reflectance at 680 nm. The lower pH_u following outdoor-rearing may be due to a better capacity to utilize other substrates than glycogen during the transport to the slaughterhouse, thus providing more glycogen when the *post-mortem* glycolysis is carried out.

CONCLUSIONS

Outdoor-rearing produced leaner carcasses within both Duroc- and Yorkshire crosses. Pigs with a Yorkshire sire had leaner carcasses than the Duroc-crosses, while the sensory quality was better in the latter.

The effects of rearing form on technological meat quality and carcass composition were independent of sire breed. Concerning the effects on sensory quality, the Duroc-sired pigs seem to be more suitable for outdoor-rearing than the Yorshire-crosses. Outdoor-rearing gave lower pH_u in all muscles.

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Table 1. Least-squares means for carcass composition and sensory and technological meat quality in *M. longissimus dorsi*, in outdoor- or indoor-reared pigs with either Yorkshire or Duroc as terminal sire

Variable	Yorkshire sire		Duroc sire		Level of significance	
	Outdoor	Indoor	Outdoor	Indoor	Breed	Rearing form
Sidefat thickness, mm	13.8^{a}	16.1^{b}	18.9^{c}	22.8^{d}	***	n.s.
% meat+bone in back and ham[1]	38.3^{a}	37.3^{a}	36.0^{b}	34.3^{c}	***	**
% fat in ham[1]	6.5^{a}	7.1^{b}	7.8^{c}	8.3^{d}	**	***
% fat in back[1]	3.7^{a}	4.0^{a}	4.6^{b}	5.4^{c}	***	***
% Back[1]	15.8^{a}	16.0^{ab}	16.0^{ab}	16.5^{b}	n.s.	n.s.
% Ham[1]	32.6^{a}	32.5^{a}	32.4^{a}	31.4^{b}	***	***
% Meat , grading	59.4^{a}	59.2^{a}	56.2^{b}	55.4^{b}	*	n.s.
Biting resistance	4.86^{a}	4.26^{b}	3.94^{bc}	3.88^{c}	***	*
Tenderness	4.63^{a}	5.37	5.63	5.76	***	***
Chewing time	5.36^{a}	4.75	4.45	4.40	***	**
Juiciness	4.73^{a}	5.14	4.65^{a}	5.24	n.s.	*
Meat teast intensity	4.65	4.59	4.75	4.78	n.s.	n.s.
Acidity	3.63^{a}	2.97^{b}	2.81^{bc}	2.55^{c}	**	n.s.
Off-flavour teast	1.39	1.53	1.39	1.40	n.s.	n.s.
Overall-acceptance	4.26^{a}	4.66	4.86	4.98	*	*
LD, pH_u	5.42	5.46	5.44	5.48	n.s.	*
FOP	38.6	36.5	38.4	36.4	n.s.	#
Drip loss (%)	4.18^{a}	3.35^{bc}	3.81^{ab}	2.97^{c}	n.s.	**
Filter paper wetness	1.7	1.3	1.8	1.2	n.s.	#
EEL-Y	21.4	21.6	21.2	20.9	n.s.	n.s.
IMF, Subjective score	1.27	1.32	2.45	2.10	***	n.s.

[1]In percentage of carcass weight. Means with the same letter are not significantly different ($p>0.05$).
Level of significance: n.s. $p>0.05$; * $p<0.05$; ** $p<0.01$; *** $p<0.001$.