INFLUENCE OF SIRE LINE ON CARCASS AND MEAT QUALITY IN PIGS

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ABSTRACT

Investigations about the effect of paternal lines on carcass and meat quality traits are very important in order to explore the maximum potential of available breeds. To evaluate the effect of breed on carcass composition and meat quality, 109 castrated males and females from the cross between (Piétrain x Large White) x (Large White x Landrace), 120 castrated males and females from the cross between (Piétrain x German Landrace) x (Large White x Landrace), and 141 castrated males and females from the cross between (Danish Duroc) x (Large White x Landrace) were used. For all of these animals, characteristics such as pH 24 hours, drip loss (DL), water holding capacity (WHC), intramuscular fat, and color patterns of the meat were evaluated. All animals were Halothane gene free, genotyped by PCR-RFLP. No significant difference for pH 24 hours, intramuscular fat, and carcass quality were found among the three lines. However, differences related to DL, color, and WHC were found. Concluding, the inclusion of the Duroc breed in the paternal line composition improved the meat quality, and German Landrace breed is a good alternative regarding meat color.

Keywords: genetics, Halotane gene, PCR-RFLP, carcass, meat, pig.

INTRODUCTION

The swine genetic improvement is responsible for the current development of the pig industry. However, only a small proportsyon of all the swine breeds known are used in genetic improvement programs. The pig breeds which are mostly used as paternal lines by the industry are: Landrace, Large White, Duroc, Piétrain and Hampshire. Several trials have been made in order to compare the meat quality traits of the crossbreeds from these lines. Kolstad, (2000) compared three types of crossbreeds produced from the Norwegian Landrace x Duroc line, selected for high percentage of lean meat, and Norwegian Landrace selected for high backfat. This work showed that, despite no difference among them at the weaning, there was a significant variation in subcutaneous, intramuscular, and internal fat deposition at slaughter.

Another experiment with several commercial and Czechoslovakian local breeds concluded that the best parental line, regarding meat quality traits, was the Large White (ADAMEC et al., 2000). These results were corroborated by Becková; David (2000). On the other hand Nowachowicz et al. (2000) using Duroc, Poland Large White, and Hampshire, showed low capacity of water retention in Poland Large White x Hampshire pigs when compared to the other breeds. The effects of Belgian Large White and Duroc on pH, color patterns, and protein solvability showed the advantage of using the Duroc line to select some meat quality parameters (MICHALSKA et al., 2000).

The variations observed in the principal traits among distinct parental lines from several countries are probably due to the differences between breeding lines and, in a particular line, due to the selection applied. For example, Tribout; Bidanel (2000) published genetic parameters from French Landrace and Large White, showing that the genetic correlations among the growing rate and meat quality are practically inexistent. However, the meat quality traits were negatively correlated to feed conversion and lean meat percentage. On the other hand, distinct results were found with Piétrain breed (GEYSEN et al., 2000). It is very important to measure carcass performance (CP) in tests for the evaluation of male lines (FARIAS et al., 1990).

In the present study, a mating strategy was outlined to produce offspring from three different male lines, free of the Halothane gene. These paternal lines were crossed with Rezende® maternal lines, in order to determine the carcass and meat quality of their offspring.

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MATERIAL AND METHODS

To evaluate carcass and meat quality parameters, 175 and 195 animals were used, respectively. Three boar paternal lines, ½Piétrain and ½Large White - PILW; ½Piétrain and German Landrace - PIGLD; and pure Danish Duroc DD, were mated with ½Large White and ½Landrace - LWLD females (Rezende®) in order to produce the experimental animals. Sixteen matings were done for each distinct crossbreed, with eight different boars of each paternal line, and two mates per boar. At least one male and one female of each litter, were sent to slaughter by the end of the finishing phase for meat quality evaluation. The experimental animals were: 48 castrated males and females (PILW x LWLD); 62 castrated males and females (PIGLD x LWLD); 85 castrated males and females (DD x (LWLD). For carcass quality evaluation, 34 males and 27 females, 28 males and 30 females, and 28 males and 28 females from the three lines were dissected accordingly to Antunes et al. (2001). At least one animal of each litter, all of them Halothane free, were used.

The animals were slaughtered in accordance to the Brazilian legislation. The fasting period adopted was 15 hours and the resting period at the slaughter plant was 10 hours. The animals were conducted to the restrainer without the use of electric drivers. The process of insensibilization was performed manually with two points for the electric shock, being one in the chest and the other in the head. After the electric insensibilization the animals were bled in a horizontal platform, hanged by the foot, driven to the scalding tank, conducted to the depilation equipment, and then driven to the AUTOFOM to carcass evaluation. After the sniggering process, evisceration, Official Meat Inspection Services (SIF), longitudinal carcass cut, weighing (SCANVET balance), and pH measurement, the carcasses were conduced to the chilling chamber (thermal shock). The total period between electric insensibilization and carcass freezing was 48 minutes.

Since the main objective of the meat processing sector of Rezende Alimentos® was the production of ham, all the meat quality measurements were applied to the *semimembranosus* muscle, which was collected from the shank 24 hours after the slaughter. The following meat quality parameters were determined: pH 24 hours, using an industrial pHmeter (pH-star™, SFK); Drip Loss (DL) according to Honikel (1987); and Water Holding Capacity (WHC), by the method of compression (GRAU and HAMM, 1953). The color pattern was evaluated in a subjective way, using the Japanese Standard for the Swine Meat (JSSM) as wax standard, varying from 1 to 6 (being 1 the clearest, 6 the darkest), and the intramuscular fat (IMF) was evaluated accordingly to Franco, (1999).

The DNA extraction was carried out by the salting out method (BIASE et al., 2002), and the samples were stocked at –20 °C. The *Hal* gene genotyping was conducted under the following conditions: 2mM of $MgCl_2$, 1 U of Taq DNA polymerase, 8 nmoles of dNTPs, 10 pmoles of each primer, 50-150 ng of DNA, in a final volume of 20 µl, using a PCR program with: 95°C for 5 minutes; 35 cycles at 94°C for 30 seconds; 56°C for 35 seconds; 72°C for 30 seconds; and a final extension at 72°C for 4 minutes.

The amplicons were submitted to an enzymatic digestion using Hha I or BsiHka I enzymes. After digestion, the products were verified in agarose gel (2%) electrophoresis stained with ethidium bromide (0.5 µg/ml) and visualized under UV light.

The experiment outline was entirely casual. The sex effect was not considered in the analysis of meat quality or carcass composition. The data were analyzed through the method of minimum squares, using the GLM (General Linear Models) procedures of the computer software SAS (1985), according to the following model:

$$Y_{ij} = \mu + l_i + bz_{ij} + e_{ij}$$

where:

Y_{ij} is the observed value of the j^{th} animal, that belongs to the i^{th} male genetic line (i = 1, 2, 3);

μ is the general mean;

l_i is the effect of the i^{th} male genetic line;

b is the coefficient of the linear regression for the covariable weight of hot carcass;

z_{ij} is the observed carcass weight for each animal; and

e_{ij} is the residual effect associated to the j^{th} animal (repetition).

To analyze the percentage of lean meat, we consider the effects of sex and its interaction with line.

The data were analyzed according to the following model:

$$Y_{ijk} = \mu + l_i + S_j + ls_{ij} + bz_{ijk} + e_{ijk}$$

where:

Y_{ijk} is the observed value of the k^{th} animal, that belongs to the i^{th} line (i=1,2, 3), and to the j^{th} sex (j=1, 2);

μ is the general mean;

l_i is the effect of the i^{th} line;

s_j is the effect of the i^{th} sex;

ls_{ij} is the effect of the interaction between line and sex;

b is the coefficient of the linear regression for the covariable weight of carcass;

z_{ijk} is the observed carcass weight for each animal; and

e_{ijk} is the residual effect associated to the j^{th} animal (repetition).

The carcass weight was used as covariable for all traits analyzed and the comparison between the means was obtained through the Tukey test.

RESULTS AND DISCUSSION

It is important to comment that the current study have used a paternal line developed by the Rezende® Company, consisting in a crossbreed from Piétrain and Landrace, which is distinct from the current commercial lines. This crossbreed was outlined in 1998, after the conclusion of a study where the purebred Landrace animals showed very good lean meat production in the shank, despite of its lower total lean meat in the carcass. When compared to Large White, the Rezende line had high production of lean meat in pestle (ANTUNES et al., 1998; FRANCO et al., 1998). Another relevant aspect is the lack of consideration of the sex effect on meat quality in the statistic model; this strategy was taken based on the results obtained by Pommier et al. (1998). Their evaluation has considered only the meat quality of Halothane free animals. Originally, the genetic improvement program of Rezende Alimentos® aimed the replacement of Halothane positive animals for Halothane free pigs. Much has been discussed about the eradication or not of the Halothane gene from the swine herds (IRGANG, 2001). Gibson et al. (2001), as well as Nurnberg et al. (2000) recommended its elimination from the swine population of Canada and Germany, respectively. In Brazil, some trials were conducted showing the benefits of the Halothane gene for lean meat production (ANTUNES, 1997; FÁVERO et al., 1997). Recent studies showed that the Halothane free Piétrain, under selection for lean meat, presented a good carcass performance and matched the actual yearnings of the pig industry (LEROY; VERLEYEN, 2000; KORTZ et al., 2000).

There were no significant differences for pH 24 hours ($P>0.05$) among the crossbreeds, as shown in Table 1. However, despite not being significant, this result is consistent with the results of color pattern and DL. The DD x LWLD showed higher DL than the PILW x LWLD and PIGLD x LWLD ($P < 0.01$), the same color parameter of PILW x LWLD, but worse than the PIGLD x LWLD ($P < 0.05$). Our results present consistence regarding pH data, but not color data, when compared to the results obtained by Nowachowicz et al. (2000), even though the latter researchers did not find differences in color for the lines using Duroc.

Table 1. Least square means (LSMEANS) and standard deviations (S.D) observed for the evaluated traits, related to the different variables considered, Uberlândia-MG, 2001.

		PILW x LWLD		PIGLD x LWLD		DD x LWLD	
Traits	*N*[1]	LSMEANS	S.D	LSMEANS	S.D	LSMEANS	S.D
pH 24 hours	113	5.78[a]	0.12	5.80[a]	0.09	5.69[a]	0.17
Drip loss (DL)	195	2.15[a]	1.04	1.82[a]	0.42	3.11[b]	1.78
Color (Japanese method)	195	2.84[a,b]	0.54	3.05[b]	0.82	2.71[a]	0.68
Water holding capacity (WHC)	195	0.41[a]	0.05	0.42[a]	0.05	0.45[b]	0.05
Intramuscular fat (IMF)	104	2.11[a]	0.96	1.98[a]	1.08	2.5[a]	0.91
Carcass yeld (%)	195	75.1[a]	1.99	74.7[a]	3.22	74.1[a]	3.09
Lean meat percentage (LM%)	175	56.6[a]	3.3	56.4[a]	3.5	56.0[a]	3.0

* Means in the line that do not have a common superscript differ, $P < 0.05$.

[1]*N* - number of animals evaluated

Regarding the discrepancy observed between WHC, and DL in DD x LWLD, it can be explained by the differences in the parameters evaluated by each methodological approach. While the DL measures only the free water lost spontaneously by gravity, the WHC measures all loss, including the water associated to the myofibers and sarcoplasmic proteins. Although the positive correlation between the WHC and DL is the standard expectation, discrepancies between both methodologies is not uncommonly found in the pig industry evaluations. For intramuscular fat it is interesting to observe that the frequent use of the same male lines is responsible for better meat quality (BAULAIN et al., 2000; BLANCHARD et al., 1999; HERMESH et al., 2000; SCHWORER et al., 2000), moreover, Puigvert et al. (2000) found higher levels of intramuscular fat in the offspring of Duroc compared to Landrace and Large White. However, in the present research we did not find any significant difference for these characteristics ($P>0.05$). Regarding the carcass quality, there were no statistically significant differences among the three lines considering carcass performance and lean meat percentage ($P>0.05$), corroborating the results obtained by Irgang et al. (1997a). Cardoso et al. (1990) observed superior carcass quality in crossbreeds without the presence of Duroc. However, in another trial with these same lines, the crossbreeds with Duroc components showed better growing rates (SOUZA et al., 1990). As to the lean meat percentage, Fávero et al. (1990a,b) showed that Duroc animals with 90 kg and 20.7 mm of backfat, had the worst lean meat percentage compared to Large White and Landrace animals. Some trials in the USA evaluated nine paternal lines showed that the Duroc breeders were the worst in terms of lean meat percentage compared to other meat production lines (JONES, 1998). Furthermore, there was no advantage in including Duroc in the composition of paternal lines (BUSK et al., 2000; IRGANG et al., 1997b; SOUZA et al., 1997). In our experiment the use of Duroc in the finishing crossbreed improved the meat quality in terms of water retention capacity, but showed unsatisfactory results regarding water loss by dripping, which is an undesirable trait in pig industry. However, the carcass performance and lean meat percentage observed in this study were compatible with the demand of pig industry.

CONCLUSIONS

The inclusion of Duroc in the paternal line improved water holding capacity, but worsen drip loss and color the meat. And it did not negatively affect the carcass performance or lean meat percentage. The use of German Landrace breed has proven also to be a good alternative for the paternal line composition, particularly regarding meat color.

Influência da linhagem paterna nas qualidades da carcaça e carne de suínos

RESUMO

As investigações sobre o efeito de linhas paternas em características de qualidade da carcaça e de carne são muito importantes no intuito de explorar o potencial máximo das raças disponíveis. Para avaliar o efeito da raça na qualidade da carcaça e da carne, foram comparadas as características de 109 machos castrados e fêmeas do cruzamento entre (Piétrain x Large White) x (Large White x Landrace), 120 machos castrados e fêmeas do cruzamento entre (Piétrain x German Landrace) x (Large White x Landrace) e 141 machos castrados e as fêmeas do cruzamento entre (Danish Duroc) x (Large White x Landrace). Foram analisados: pH 24 horas após abate, a perda por gotejamento (PG), a capacidade de retenção de líquido (CRL), gordura intramuscular e cor da carne. Todos os animais eram livres do gene Halotano, genotipados por PCR-RFLP. Nenhuma diferença significativa para pH 24 horas, gordura intramuscular e qualidade de carcaça foi encontrada entre as três linhas. Entretanto, observou-se diferenças relacionadas à PG, cor, e CRL. Pode-se perceber que a inclusão da raça Duroc na composição da linha paternal melhorou a qualidade da carne e a raça German Landrace mostrou-se como uma alternativa favorável em relação à cor da carne.

Palavras-chave:genética, gene Halotano, PCR-RFLP, carcaça, carne, suíno.

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