LIPOGENIC ACTIVITY AND FATTY ACID COMPOSITION OF 3 DIFFERENT IBERIAN X DUROC PIG GENOTYPES

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Keywords: lipogenic enzymes, glucose-6-phosphate dehydrogenase, malic enzyme, Duroc, Iberian

Introduction

Iberian is a rustic breed with a high adipogenic potential. Endogenous synthesis of fatty acids mainly takes place *in situ*, in the adipose tissue, from acetyl CoA and malonyl CoA to produce palmitic acid (C16:0), from which can be synthesized stearic acid (C18:0) by elongation. Malic enzyme (ME) and glucose-6-phosphate dehydrogenase (G6PDH) are the main enzymes involved in supplying NADPH for these reactions (Wise and Ball, 1964).On the other hand, one of the alternatives more often applied to improve productive parameters of Iberian pigs is the cross with Duroc at 50%. A specific law for Iberian products passed in 2001 in Spain (B.O.E., 15th October 2001). It regulates the genotype for the elaboration of dry-cured meat products labelled as "Iberian" being allowed the use of pure Iberian pigs as well as Iberian x Duroc crosses, but in the crosses obliges producers always to employ Iberian females. Therefore, it is of prime importance to assess the consequences of the use of different Duroc paternal lines in Iberian x Duroc crosses as well as the differences between Iberian x Duroc reciprocal crosses on the adipogenic character and fatty acid composition of subcutaneous and intramuscular fat (IMF).

Materials and Methods

Animals. Three groups of 10 pigs each were studied (5 males and 5 females) from the genotypes: GEN1: ♂ Iberian x ♀ Duroc1, GEN2: ♂ Duroc1 x ♀ Iberian; GEN3: ♂ Duroc2 x ♀ Iberian. GEN1 and GEN2 are reciprocal crosses, while the difference between GEN2 and GEN3 is the Duroc sire line. Duroc1 corresponded to pigs selected for the production of dry-cured meat products, while Duroc2 corresponded to animals selected for meat production. Pigs were slaughtered after 316 days at 150-165Kg. Backfat thickness (BFT) and ham fat thickness (HFT) were measured in the 5th rib and in the *Biceps femoris* muscle in the carcass and ham, respectively. *Longissimus dorsi* (LD) muscles were dissected and stored at -80°C until their analyses.

Methods. Intramuscular lipids were extracted according to Bligh and Dyer (1959), fractionated by SPE (Monin *et al.*, 2003) Fatty acid methyl esters (FAMEs) from IMF and subcutaneous fat (SCF) were prepared by acidic esterification in presence of sulphuric acid. Fatty acids (g/100g) were analysed using a Hewlett-Packard model HP-5890A gas chromatograph. Lipogenic enzyme activity was measured spectrophotometrically and expressed on the basis of nmol NADP reduced to NADPH per min per mg protein, using the extinction coefficient of NADPH at 340 nm of 6.22×10^6 M^{-1} cm^{-1} following the method of Bautista *et al.,* (1988) for the determination of G6PDH activity and the method described by Spina *et al.* (1970) for the determination of ME activity. The protein content was determined by Bradford method (1976).

Results and Discussion

GEN2 had significantly higher BFT and HFT than GEN3, while the level of fatness of GEN1 was intermediate (Table 1). The fatty acid composition of subcutaneous fat showed the highest levels of PUFA in the GEN3.

Table 1: Fat depths and fatty acid composition of subcutaneous fat.

		Genotype			Sex			Probability		
		GEN1	GEN2	GEN3	♂	♀	sem	gen	sex	Interaction
Fat depths(cm)	BFT	6.3ab	6.4a	5.3b	5.9	6.1	0.18	*	ns	Ns
	HFT	3.1ab	3.4a	2.7b	3.2	2.9	0.11	**	ns	Ns
Fatty acids (FA) (g/100g FA)	ΣSFA	38.05	39.00	37.68	38.33	38.18	0.22	ns	ns	Ns
	ΣMUFA	50.90	49.65	50.30	50.24	50.29	0.25	ns	ns	Ns
	ΣPUFA	11.05b	11.34ab	12.01a	11.44	11.53	0.14	*	ns	Ns

a,b: Different letters in the same row indicate significant statistical differences (Tukey Test, $p<0.05$). ns: non significant. SFA: saturated fatty acids, MUFA: monounsaturated fatty acids, PUFA: polyunsaturated fatty acids. * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

The IMF content of LD was significantly affected by the genotype (Table 2); GEN2 had significantly higher IMF content than GEN1 and GEN3. An adequate level of IMF is a determinant factor for the elaboration of dry cured meat products (Gandemer, 2002), so GEN2 would be more suitable for the production of meat products. In the IMF of the LD muscle, PUFA level was significantly higher in GEN1 and GEN3 than in GEN2. The differences between reciprocal crosses (GEN1 vs. GEN2) are caused by the lowest IMF content of GEN1, which should have increased the relative proportion of unsaturated fatty acids in this genotype, since neutral lipids –NL- did not showed differences in the fatty acid composition between reciprocal crosses. However, GEN3 showed the highest percentages of unsaturated

fatty acids, which could cause undesirable technological and sensory consequences, since PUFA are extremely sensitive to oxidation, leading to meat texture, flavour and colour alterations (Morrissey *et al.*, 1998).

Table 2: IMF content and fatty acid composition of IMF and NL of ***Longissimus*** *dorsi* muscle.

	Genotype			Sex			Probability		
	GEN1	GEN2	GEN3	♂	♀	sem	gen	sex	Interaction
IMF (g/100g)	3,84b	5,87a	3,32b	4,39	4,33	0,28	***	ns	Ns
FA imf (g/100g FA)									
ΣSFA	38,27b	40,60a	36,97b	38,33	38,90	0,40	***	ns	**
ΣMUFA	53,64ab	53,03b	54,41a	53,82	53,57	0,23	*	ns	Ns
ΣPUFA	8,09a	6,37b	8,63a	7,85	7,52	0,27	***	ns	Ns
FA NL (g/100g FA)									
ΣSFA	40,16a	41,54a	38,10b	39,40	40,41	0,38	***	*	*
ΣMUFA	54,58b	53,57b	55,98a	54,99	54,45	0,28	***	ns	*
ΣPUFA	5,25ab	4,89b	5,93a	5,60	5,13	0,18	*	ns	Ns

a,b: Different letters in the same row indicate significant statistical differences (Tukey Test, $p<0,05$). IMF: intramuscular fat. NL: neutral lipids. ns: non significant. SFA: saturated fatty acids, MUFA: monounsaturated fatty acids, PUFA: polyunsaturated fatty acids. * $p<0,05$, ** $p<0,01$, *** $p<0,001$.

The lipogenic enzyme activity of subcutaneous fat and LD muscle showed similar results between reciprocal crosses (GEN1 vs. GEN2) whereas it was strongly influenced by the Duroc sire genotype, as GEN3 showed lower enzyme activity of G6PDH and ME than GEN1 and GEN2 in both locations (Figure 1 and 2). The higher lipogenic activity of GEN1 and GEN2 is in accordance to the higher SFA levels in these genotypes, since ME and G6PDH the main enzymes involved in supplying NADPH for the endogenous synthesis of fatty acids.

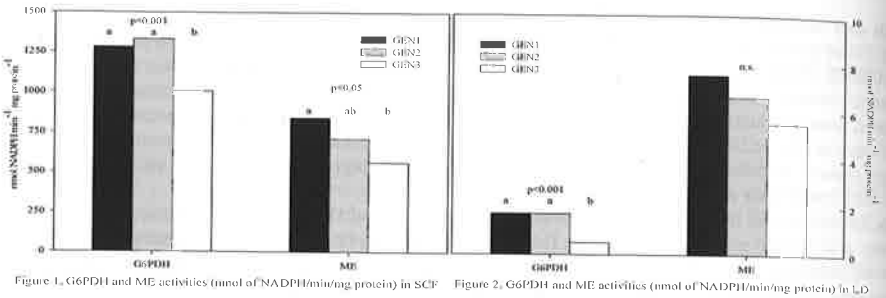

Figure 1. G6PDH and ME activities (nmol of NADPH/min/mg protein) in SCF. Figure 2. G6PDH and ME activities (nmol of NADPH/min/mg protein) in LD.

Conclusions

Iberian x Duroc reciprocal crosses (GEN1 vs. GEN2) showed a similar adipogenic character. Nonetheless, the differences found between the genotypes from the 2 paternal lines of Duroc (GEN2 vs. GEN3) indicate that crossing a selected Duroc genotype (Duroc2) with Iberian pigs reduces the adipogenic level and as consequence IMF level and it also modifies fatty acid profile, increasing unsaturated fatty acids, which could have negative effects on the production of fresh meat and dry-cured meat products.

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