EFFECT OF DUROC GENES PROPORTION ON IODINE NUMBER AND FATTY ACID CONTENT OF BACKFAT AND SEASONED PARMA HAM SUBCUTANEOUS FAT

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Background

Pig industry in Italy has been based largely on selection within Large White and Landrace breeds and subsequent back-cross of purebred boars on crossbred sows. More recently the Duroc has been used as terminal sire breed for increasing heterosis and trait complementariety (Bonomi et al., 1991, Franci et al., 1994). Several studies have been carried out in other Countries to assess the effect of Duroc genes proportion on productivity and carcass, meat and fat quality; yet, comparisons are difficult because of the different situation in Italy, particularly the need to achieve high slaughtering weights, maintaining a correct adiposity. In a previous study, we investigated the performance in vivo and the carcass and meat quality of pigs with increasing percentages of Duroc breed genes (Sabbioni et al., 2002) and concluded that crosses with the Duroc breed can be positively included in Italian heavy pig production, because of an enhancement of the growth and of the efficiency of food transformation in the fattening phase, the production of carcasses with correct ratios between lean and adipose cuts and an action on meat quality not in contrast with the requirements of the transformation into high quality typical products.

Objectives

Fat quality is important especially for long time seasoned products, as Parma ham is, but also for human health, as a means to influence the incidence of coronary hearth disease (Ulbricht and Southgate, 1991). The study has then been conducted with the aim to assess, by means of covariance analysis, the effect of Duroc genes percentage increasing on some quality parameters of backfat and seasoned Parma ham subcutaneous fat.

Methods

167 heavy pigs, 87 castrated males and 80 females, from different crosses, between Duroc (D), Large White (LW) and Landrace (L) breeds, bred from 26 sows mated to 15 unrelated boars were used. The percentage of the Duroc breed was equal to 0% (LWxL; no. 33), to 25% [(LWx(DxL); no. 31 and Lx(DxLW); no. 35)] and to 50% [Dx(LWx(LWxL)); no. 68]. In vivo performances, carcass and meat quality data have been already published (Sabbioni et al., 2002). Pigs were reared under the same conditions from weaning and were slaughtered at 298 ± 6 d of age and 171 ± 17 kg live-weight, during three different sessions, each with a representative number of animals from the four genetic types. At slaughtering fat samples (50-100 g) from 72 carcasses of the four genetic types have been withdrawn, at loin level, then frozen until analysis, without separation of the two layers. Carcass right side was dissected and hams submitted to seasoning, according to Parma ham production. At the end of the seasoning period (382 d), subcutaneous fat samples at the external face of hams from the same 72 pigs were taken, then frozen until analysis. Iodine number (IN) was determined according to Wijs method after cold extraction with chloroform (Dieffenbacher and Pocklington, 1992); fatty acid content was determined by a capillary gas-chromatograph (PERKIN-ELMER mod.8420) after cold extraction with chloroform/methanol 2/1 v/v, under the following conditions: capillary column: MEGAWAX 30m x 0.25mm ID x 0.25 μ thickness; carrier: Helium, 1.08 ml/min; detector: FID (Flame Ionization Detector), 300°C; injection: split, 70:1, 220°C; oven: 120°C (8 min) to 200°C at 5°C/min (7 min), to 250°C at 10°C/min (5 min); aterogenicity and trombogenicity indexes were calculated according to Ulbricht and Southgate (1991). Raw data were elaborated according to the least squares method (SPSS, v.10.0.6, 1999), using a model of covariance analysis with sex and slaughtering session as fixed effects and percentage of Duroc breed genes (the regression coefficient was expressed as the variation of the dependent each 10% more genes of the Duroc breed) and carcass or ham weight (kg), resp. for backfat or ham fat, as covariates.

Results and discussion

Duroc genes percentage linearly affected IN both in backfat ($P=0.06$) (table 1) and in ham subcutaneous fat ($P<0.01$) (table 2). The increase of IN as Duroc genes percentage increases could have a negative technological impact, mainly at ham level. In fact, as reported by Skelley et al. (1973) IN is negatively related to carcass firmness. Yet, mean values in the present study are far from the maximum accepted for Parma ham production (IN=70) (Corino et al., 1997).

The variations of fatty acids content in backfat (table 1) have shown a significative ($P<0.10$) linear effect of Duroc genes percentage, except for C18:3. The increase of the percentage of the Duroc breed was positively related with variations of C14 ($P=0.07$), C16 ($P=0.02$), C16:1, C18:1 ($P<0.01$) and negatively related with variations of C18 ($P<0.01$), C18:2 ($P=0.03$), C20 ($P=0.07$) and C20:1 ($P=0.01$) content. Saturated fatty acids, as well as PUFA and saturated/unsaturated ratio were reduced with increasing Duroc inclusion (resp., $P<0.01$, $P=0.03$ and $P<0.01$), as unsaturated fatty acids and MUFA increased ($P<0.01$). Thrombogenicity index was significantly ($P<0.01$) reduced by Duroc breed inclusion.

C20:1 in seasoned ham subcutaneous fat (table 2) was not detected; the variations of fatty acids content have shown a significative linear effect of Duroc breed only for C18:1, C18:2 and C18:3 (resp. $P<0.01$, $P=0.02$, $P<0.01$), the first in a positive way, the second and third in a negative way. As Duroc genes percentage rose, saturated fatty acids ($P=0.07$), PUFA ($P=0.01$) and saturated/unsaturated ratio ($P=0.05$) decreased, MUFA ($P<0.01$) and unsaturated fatty acids ($P=0.07$) increased. Both atherogenicity and thrombogenicity indexes have been reduced ($P=0.10$) by the increase of Duroc breed genes.

Data are in agreement with those reported by Bout et al. (1990), who noted backfat from Duroc pigs having less saturated fatty acids than backfat from LW pigs, and with those by Edwards et al. (1992), who reported lower fat firmness in Duroc sired pigs, and, as a consequence, a higher proportion of unsaturated fatty acids (Piedrafita et al., 2001). Csapo et al. (1999) reported no significant effect of genotype on fatty acids content of backfat, as Blanchard et al. (1999) have shown higher subjective fat firmness as Duroc breed percentage increased. Franci et al. (1996) observed in 6-8 months seasoned hams fatty acids content variations in agreement with those of the present study (reduction of C18:2 and PUFA in DxLW compared to LW pigs). Aterogenicity and thrombogenicity indexes are in agreement with those calculated from data reported by Geri et al. (1988) for backfat of heavy pigs; both must be considered as important to assess the dietary risk for coronary hearth disease in man and their reduction could have positive effects on health status (Ulbricht and Southgate, 1991).

Conclusions

The study has shown that IN and fatty acids content of both backfat and seasoned ham subcutaneous fat are significantly affected by pig genotype and that Duroc breed percentage must be monitored, mainly for the production of long-term high quality seasoned hams, as Parma

ham is, to avoid the increase of unsaturated fatty acids, that could have a negative impact with the processing technologies and quality. With reference to man health, an increase of Duroc genes proportion could be, on the contrary, of great interest, because of the reduction of atherogenicity and thrombogenicity indexes.

Pertinent literature

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Table 1 - Iodine number and fatty acid content of backfat (least-squares means ± SE). Linear effect of Duroc genes percentage increase by 10% (regression coefficients, b_1 ± SE).

		Overall mean	±	SE	b_1	±	SE	P	RSD
Iodine number		60.87	±	0.14	0.181	±	0.096	0.06	1.129
C14	%	1.45	±	0.01	0.014	±	0.007	0.07	0.087
C16	%	24.21	±	0.08	0.142	±	0.058	0.02	0.676
C16:1	%	1.63	±	0.02	0.090	±	0.012	0.00	0.141
C18	%	12.77	±	0.13	-0.475	±	0.093	0.00	1.090
C18:1	%	46.86	±	0.17	0.592	±	0.118	0.00	1.388
C18:2	%	11.50	±	0.20	-0.325	±	0.143	0.03	1.675
C18:3	%	0.65	±	0.01	0.003	±	0.008	NS	0.091
C20	%	0.18	±	0.01	-0.012	±	0.005	0.07	0.059
C20:1	%	0.76	±	0.01	-0.029	±	0.008	0.01	0.097
Saturated	%	38.61	±	0.14	-0.331	±	0.101	0.00	1.184
MUFA	%	49.25	±	0.18	0.653	±	0.127	0.00	1.488
PUFA	%	12.14	±	0.20	-0.322	±	0.143	0.03	1.674
Unsaturated	%	61.39	±	0.14	0.331	±	0.101	0.00	1.184
Sat./unsat. ratio		0.630	±	0.004	-0.009	±	0.003	0.00	0.031
Index of atherogenicity		0.489	±	0.003	0.001	±	0.002	NS	0.021
Index of thrombogenicity		1.189	±	0.007	-0.016	±	0.005	0.00	0.061

NS: P>0.10.

Table 2 - Iodine number and fatty acid content of seasoned Parma ham subcutaneous fat (least-squares means ± SE). Linear effect of Duroc genes percentage increase by 10% (regression coefficients, b_1 ± SE).

		Overall mean	±	SE	b_1	±	SE	P	RSD
Iodine number		62.98	±	0.11	0.307	±	0.076	0.00	0.853
C14	%	1.45	±	0.01	-0.003	±	0.009	NS	0.105
C16	%	22.81	±	0.11	-0.101	±	0.074	NS	0.828
C16:1	%	2.72	±	0.06	0.006	±	0.041	NS	0.462
C18	%	11.52	±	0.11	-0.082	±	0.072	NS	0.812
C18:1	%	51.48	±	0.17	0.349	±	0.113	0.00	1.258
C18:2	%	9.39	±	0.10	-0.154	±	0.065	0.02	0.723
C18:3	%	0.44	±	0.01	-0.016	±	0.005	0.00	0.059
C20	%	0.19	±	0.00	0.000	±	0.002	NS	0.026
Saturated	%	35.97	±	0.15	-0.186	±	0.101	0.07	1.122
MUFA	%	54.20	±	0.18	0.355	±	0.119	0.00	1.329
PUFA	%	9.83	±	0.10	-0.169	±	0.066	0.01	0.737
Unsaturated	%	64.03	±	0.15	0.186	±	0.101	0.07	1.122
Sat./unsat. ratio		0.563	±	0.004	-0.005	±	0.002	0.05	0.027
Index of atherogenicity		0.448	±	0.003	-0.003	±	0.002	0.10	0.022
Index of thrombogenicity		1.081	±	0.007	-0.008	±	0.005	0.10	0.052

NS: P>0.10.