FATTY ACID COMPOSITION AND CHOLESTEROL CONTENT OF BEEF FROM PODOLIAN AND LIMOUSINE X PODOLIAN CATTLE.

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Background

The fatty acids composition of intramuscolar fat can affect the nutritive value of beef. In recent years the fat content of foods has become more important. The consumers are aware of the relationships between dietary fat and the incidence of lifestyle diseases, notably coronary heart disease. The Department of Health (1994) recommended a reduction in the intake of saturated fatty acids and an increase in that of polyunsaturated fatty acids (PUFA). Beef contains significant levels of PUFA (Enser *et al.*, 1996) and, at present, there is considerable interest in developing production methods aimed at raising the levels of these fatty acids to improve meat nutritional quality.

Objectives

The aim of this work is to estimate the influence of genotype (Podolian and Limousine x Podolian) on fatty acids composition and cholesterol content in beef meat and to determine its influence on nutritional quality.

Methods

Data were collected on eight Podolian and eight crossbred (Limousine x Podolian) young bulls. Animals were slaughtered at 16 - 18 months of age. Mean slaughter weights were 458 and 505 kg for Podolian and crossbred, respectively. Calves were dam-reared on natural pasture until the age of 8 months and subsequently finished in a loose housing system using grain and forage ad *libitum*. Carcasses were chilled at 4° C and fatty acid and cholesterol contents determined on muscle samples. Lipid was extracted according to the method used by Folch *et al.* (1957), modified by Michealson *et al.*,(1991). Duplicates of 10 ml of chloroform extract, corresponding to 100 mg of lipid, were methylated adding 1ml of hexane and 0.05 ml of 2N methanolic KOH (I.U.P.A.C., 1987). Gas chromatograph analysis was performed on a Varian Model Star 3400 CX instrument equipped with a CP-Sil 88 capillar column (lenght 100 m, internal diameter 0.25 mm, film thickness 0.25 μm). Operating conditions were: a helium flow rate of 0.7ml/min, a FID detector at 260°C, a spli-splitless injector at 220°C at 4°C/min. Retention time and area of each peak were computed using the Varian Star 3.4.1. software. The individual fatty acid peacks were identified by comparison of retention times with those of known mixtures of standard fatty acids (FAME, Sigma) run under the same operating conditions. Fatty acids were expressed as percent total methylated fatty acids.
The determination of cholesterol was performed using the method of Ulberth and Reich (1992) with direct saponification of samples. The content of cholesterol was expressed as mg/100g of meat. Data were analysed with SAS statistical package (SAS,1990).

Results and discussion

For each genotype, Table 1 shows fatty acid composition expressed as percentage of total fatty acids. Meat from Podolian bulls had a lower concentration of saturated fatty acids and a higher concentration of unsaturated fatty acids. In particular, percentage polyunsaturated fatty acids tended to be higher in meat samples obtained by Podolian than crossbred subjects, whereas no differences were observed for monounsaturated fatty acids. In addition, meat from both genotypes had higher polyunsaturated fatty acid contents than Chianina, Marchigiana young bulls (11.52% and 11.17%, respectively; Renieri, 1997) and Charolais steers (5.3%, Mandell *et al.*,1997). Meat from Podolian animals compared with Limousine x Podolian showed a higher unsaturated fatty acid content and, as a consequence, a higher nutritional quality. The saturated lauric C12:0, myristic C14:0, pentadecanoic C15:0 and palmitic C16:0 fatty acid contents decreased in the meat of Podolian animals; conversely, the saturated behenic C22:0 and C17:0 anteiso contents increased. A reduced content of the monounsaturated C14:1 trans fatty acid was observed in samples from Podolian subjects, whereas a decreased amount of linoleic acid isomers C18:2, γ-linolenic C18:3 n-6, α-linolenic C18:3 n-3, C20:5 n-3 EPA, C22:5 n-3 and C22:6 n-3 DHA contents were detected in the meat of crossbred. The content of *iso*- and anteiso- methyl branched fatty acid C15:0 anteiso, C16:0 *iso,* C17:0 *iso* was lower in meat from Podolian animals. It's well established that the branched-chain fatty acids, particularly those of the *iso* and anteiso series, are components of rumen bacterial derivation (Harfoot *et al.*,1988). These acids are synthesised by chain elongation of branched-chain precursors generated by metabolism of branched-chain aminoacids (Garton, 1977). The low content of branched-chain fatty acids in Podolian animals could be attributed to a reduced rumen activity. Saturated myristic and palmitic fatty acids, which have been shown to be hyperlipidemic, were lower in meat from Podolian bulls. A low proportion of palmitic acid in the diet may reduce the risk of heart disease (Bonamone and Grundy, 1988). The content of stearic acid in both groups was high, although difference was observed between the two experimental groups. Bonamone and Grundy (1988) found that a higher content of stearic acid in the diet did not elevate LDL-cholesterol since it is poorly digested and can be easily desaturated to oleic acid. The monounsaturated oleic acid has been reported to be hypolipidemic, reducing cholesterol and triglyceride levels in the plasma (Mattson and Grundy, 1985), therefore, it can be considered a desiderable component of the diet. Total fat content, P/S and n-6/n-3 ratios are thought to be important in relation to the nutritional value of foods for human health. P/S ratio in ruminant meat is unfavourably low because dietary unsaturated fatty acids are hydrogenated by rumen micro-organisms (Choi, *et al.*, 2000). Nevertheless, the P/S ratio in Podolian muscles was slightly higher than in cross-breed, reflecting the higher amounts of PUFA observed in the meat of the former breed. In the human diet, the recommend value for P/S ratio is 0.45 – 0.65 (Department of Health and Social Security,1984) and lower ratios in the diet as a whole may increase the incidence of cardiovascular desease. The effect on the n-6/n-3 ratio is probably of more significance than the P/S ratio in term of human nutrition (Enser, *et al.,* 1996). Another risk factor for atherosclerosis and coronary heart disease (CHD) was found to be a high intake of cholesterol and the consequent hypercholesterolemia. In the present study the n-6/n-3 ratio is above the recommended value (10:1; Commision of European Comunities, 1993) in both groups, reflecting the high contents of C18:2 n-6 and C20:4 n-6 fatty acids. However, it is possible to modify the fatty acid composition of intramuscular fat through supplementation with essential and protected fatty acids. Mean cholesterol contents are shown in Chart 1. Podolian products had a higher cholesterol content compared with Limousine x Podolian. In this research the cholesterol content found in both groups was lower than that previously reported in Chianina breed (55.16 mg/100g; Poli *et al.,* 1996). In both groups the content of unsaturated *trans* fatty acid (TFA) was close to recommended values. We concluded that the meat from Podolian animals showed a higher percentage of polyunsaturated fatty acids good for health and nutrition of consumers, whereas, the cholesterol content was lower in the crossbred.

Pertinent literature

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Chart 1 – Influence of genotype on cholesterol content.

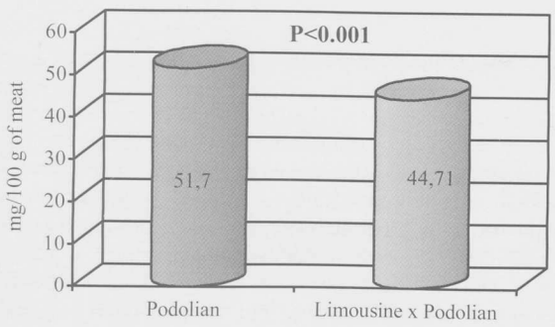

Table1 – Influence of genotype on fatty acid composition (% ± S.E.).

Fatty Acids	Genotype		Significance
	Podolian	Limousine x Podolian	
C12:0 lauric	0.044 ± 0.01	0.054± 0.01	P<0.01
C14:0 myristic	1.60 ± 0.03	1.78 ± 0.03	P<0.001
C14:1 *trans*	0.13 ± 0.01	0.16 ± 0.01	P<0.001
C15:0 anteiso	0.17 ± 0.01	0.21 ± 0.01	P<0.001
C15:0 pentadecanoic	0.32 ± 0.01	0.38 ± 0.01	P<0.001
C16:0 iso	0.18 ± 0.01	0.22 ± 0.01	P<0.001
C16:0 palmitic	21.68 ± 0.20	22.81 ± 0.20	P<0.001
C17:0 anteiso	2.61 ± 0.08	2.23 ± 0.08	P<0.01
C17:0 iso heptadecenoic	0.85 ± 0.01	0.89 ± 0.01	P<0.10
C18:0 stearic	16.93 ± 0.27	17.29 ± 0.27	NS
C18:1 n- 9 oleic	31.96 ± 0.44	31.98 ± 0.44	NS
C18:2 linoleic acids isomers	0.49 ± 0.01	0.37 ± 0.01	P<0.001
C18:2 n-6 γ-linoleic	12.21 ± 0.41	11.68 ± 0.41	NS
C18:3 n-3 α-linolenic	0.32 ± 0.01	0.29 ± 0.01	P<0.05
C20:0 arachidic	0.14 ± 0.01	0.12 ± 0.01	NS
C22:0 behenic	0.19 ± 0.01	0.09 ± 0.01	P<0.001
C20:4 n-6 arachidonic	3.78 ± 0.14	3.65 ± 0.14	NS
C20:5 n–3 EPA	0.21 ± 0.01	0.12 ± 0.01	P<0.001
C22:5 n-3	0.56 ± 0.02	0.40 ± 0.02	P<0.001
C22:6 n-3 DHA	0.08 ± 0.01	0.03 ± 0.01	P<0.001
Saturated	45.22 ± 0.32	46.66 ± 0.32	P<0.01
Unsaturated	54.78 ± 0.32	53.34 ± 0.32	P<0.01
Polyunsaturated	19.39 ± 0.63	18.10 ± 0.63	P<0.20
Monounsaturated	35.39 ± 0.47	35.24 ± 0.47	NS
Σn-6/Σn-3	15.16 ± 0.36	19.59 ± 0.36	P<0.001
P/S	0.43 ± 0.01	0.39 ± 0.01	P<0.10
Trans	2.04 ± 0.09	1.80 ± 0.09	P<0.10