EFFECT OF ANIMAL FATNESS ON MEAT FATTY ACIDS COMPOSITION AND ITS RELATION WITH THE SATURATED FATTY ACID/POLYUNSATURATED FATTY ACID RATIO AS A NUTRITIVE PARAMETER OF BEEF QUALITY

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BACKGROUND

Lipid composition of adipose and muscular tissues interest in cattle is a consecuence of consumers asking for lean meat due to the relationship between cholesterol and fatty acids and coronary heart diseases. In order to this, sanitary organism and current dietary recommendations are positioned towards a lower consume of beef perhaps due to diet/health issues. Red meats are considered to have a bad saturated fatty acid/polyunsaturated fatty acid (SFA/PUFA) ratio from a view-point of health. In relation to the decrease of red meat consumption, the industry has changed the meat procedures methods in butcher´s as well as in animal farming.

It would be account that the present parameters to evaluate beef quality and so its comercial value are referred to carcass parameters (weight, conformation and fatness, EEC 1026/91). All these parameters are easy to measure in the slaughter process but highly subjetives. For instance, these reference parameters would be completed with others as the intramuscular fat content which is relationated with the organoleptic characteristics of meat and its eating value (Wood, 1990; Gandemer, 1998).

The intramuscular fat value varies with the animal fatness grading which depends on breed, sex, age and farming systems between others factors (Marmer, 1984; Webb et al., 1998). Fatness influences on the fat composition due to the triacylglicerides/phospholipids (TG/PL) increase with the increase of intramuscular lipid content, and in consecuence decrease the PUFA/SFA ratio (Eichhorn *et al.*, 1985).

Differences between countries in the carcass fatness and so in the fatty acids composition and fat content in beef are due to breed effect and differences between farming systems. In USA animals are fattening until 2 years old and these carcasses have around 7 g lipids per 100 g meat (USDA, 1990). However in South America, the age of slaughter is also 2 years old but the farming system is more extensive, the lipid content of beef is around 2 g per 100 g of meat (Huerta-Leindez, 1998). In the North of Spain the slaughter age is 1 year old ("añojo") and the lipid content observed is around 1-3 g per 100 g of meat (Lizaso, 1998). So that in the food composition tables would be reflected the total lipid content of the differents cuts of the carcass according to pre-slaughtering factors (breed, sex, farming system).

So that would be interesant to know the lipid composition of the North of Spain beef with the aim to evaluate and compare with the beef produced in other countries. All this information should be known by the consumers which could evaluate the nutritive fat quality of beef in the North of Spain.

OBJETIVES

The overall objetives of this study were to analize the variation in lipid composition at different meat fat contents. For that different methods of lipid content quantification in meat and their relationship with fatty acid composition are compared. In addition, results obtained will be compared with results observed in other countries.

MATERIAL AND METHODS

In the present work, thirthy Pirenaica animals (average carcass weight 340.9 ± 6.4 kg and 380 days old) were used. The animals were fed with mother´s milk and pre-calving concentrate until weaning (5 months old) and then concentrated commercial fodder and barley straw *ad libitum* until slaughtering. *Longissimus dorsi* muscle was removed from the left carcass side 48 hours *postmortem*. The samples were aged 7 days at 1-2 ºC. Intramuscular fat of meat was extracted by the Bligh and Dyer method (1959).

Lipid classes: Fat samples were applied to the TLC plates with a quantitative applicator Linomat IV (CAMAG). The lipid classes were identified by comparing Rf values with those of the standard mixtures. Each lipid spot was integrated using a GS-700 densitometer (BIORAD). The lectures of the densitometer were expressed in units of optic density (O. D. * mm).

Fatty acids quantification: The analysis of 28 fatty acids as methil esters (FAMEs) was carried out by GC (ISO 5508). A column (60m x 0.25 mm I.D.) (HP 19091N-136) coated with crosslinked polyethilene glycol (0.25µm) was used to separate FAMEs under the following conditions: temperature, programmed from 150ºC to 210ºC at 10ºC/min, from 210ºC to 240ºC at 4ºC/min, held at 240ºC for 25 min; detector temperature, 240ºC and inyector temperature 255ºC; carrier gas helium at 1 ml/min; splitless inyection mode and gas chromatograph, Hewlett-Packard 5890 series II.

Fat/lean ratio: It was determined by the dissection of the 10th rib. Fat content: The technique of cuantitative extraction of fat with diethil ether was the Soxhlet's method according to international standard ISO 1443-1973.

Statistical analysis: Stepwise multiple regression were applied to the data, using the SPSS7.5 (1999) program.

RESULTS AND DISCUSSION

In Table 1 it can be observed the regression equations that relate fat content and fatty acid composition of beef. The determination of intramuscular fat content by the Soxhlet method or by fat/lean ratio obtained for the 10th rib dissection allow to estimate the fatty acid composition of beef. So the intramuscular fat content of the muscle *Longissimus dorsi* allow to study the content of SFA and MUFA beef (r^2=0.86; p<0.05), and the fat/lean ratio determines the TG/PL proportion in beef (r^2=0.58; p<0.05). It would be neccesary to use both parameters to estimate the PUFA content (r^2=0.52; p<0.05). These parameters of fat quality could be conected with the carcass fatness at slaughtered point.

In Table 2 the amount of PUFA, SFA and monounsaturated fatty acids (MUFA) estimated at differents animal fatness grading are shown. The content of SFA (133.43 mg/100 g beef), MUFA (106.74 mg/100 g beef) and PUFA (56.26 mg/100 g beef)

corresponding to intramuscular fat content around 1%, characteristic in beef that is consumed in the North of Spain. The SFA/PUFA ratio of this beef is 0.42, which is included into the current dietary recommendations (Departament of Health, UK, 1994). In the same table it can be observed a greater increase in SFA (674.68mg/100 g beef) than in PUFA (101.16mg/100 g beef) when the lipid content is 5%. In this case the SFA/PUFA ratio is 0.14, far from dietary recommendations. So it is demostrated that an increase in total lipid content in beef (g/100 g of tissue) suposses changes in the fatty acids composition from 18.97% PUFA in a lean meat with 1% of fat until 7.26% of PUFA in a meat with 5% of total fat. However results from others countries as UK (Enser et al., 1996) are differents with 1574 mg of SFA, 1.765 mg of MUFA, and 177 mg of PUFA per 100 g of beef. The PUFA/SFA ratio is around 0.11. The last value could be became in ours meats when the intramuscular fat content would be 10 g per 100 g of beef, which is not common in the habitual beef that is consumed in the North of Spain.

These variations in the fat composition in relation to the increase of total lipids could influence negatively on the consumers´ health. So the increase of SFA influence on the lipoproteins increasing LDL-cholesterol concentration (Mattson and Grundy, 1985). On the other hand, the decrease in PUFA has a harmful effect due to its function as enhancers of HDL-cholesterol (Sanders, 1987). In order to this, the beef consumed in the North of Spain could be considered as an equilibrate food for an everyday meal, with a good nutritive quality due to its adecuate provide of fatty acids. So it is neccesary look for an agreement between the enough amount of fat for good sensory characteristic and without decrease eating quality of beef fat.

CONCLUSSIONS

The content and composition fat of Pirenaica breed in the North of Spain are clearly different than other countries as anglosaxones countries where the animals fattening is a longer period. The lower age and fattening period of the animals slaughtered in the North of Spain is accompained with a lower fat deposition with a favourable PUFA/SFA ratio and so a better composition since dietary view-point. However, it is necessary a mimimun amount of fat to develop the characterisitics flavour of beef. So that it would became a compromise between the nutritive and sensoryal quality of beef. For instance, it would be typified the content and composition of fat in the different countries to the consumer would have a real information on the eating quality of the meat.

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Table 1.- Estimation of polyunsaturated fatty acid (PUFA), saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), triacylglycerides/phospholipids ratio and throug Soxhlet fat (fat) and fat/lean ratio (fat/lean), and the determination coefficient (r^2).

Variables	Regression equations	r^2
PUFA	y = 27.50 **fat**- 101.71 **fat/lean** + 85.71	0.52
SFA	y = 127.28 **fat** - 20.54	0.86
MUFA	y = 135.29 **fat** -1.77	0.86
TG/PL	y= 8.15 **fat/lean** + 0.51	0.58

Table 2.- Amount of (mg/100 g of meat) polyunsaturated fatty acid (PUFA), saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), triacylglycerides/phospholipids (TG/PL) ratio, PUFA/SFA (PUFA/SFA) ratio and relation linoleic acid/linolenic acid (C18:2ω6/C18:3ω3) ratio, at different intramuscular fat content (dates from regression equations of Table 1).

Total lipids (g)/100 g of meat	PUFA	SFA	MUFA	TG/PL	PUFA/SFA	C18:2ω6/C18:3ω3
1	56.26	133.43	106.74	5.07	0.42	26.20
2	67.47	268.81	234.02	6.37	0.25	23.99
3	78.71	404.10	361.30	7.68	0.19	21.78
4	89.95	539.39	488.58	8.98	0.16	19.57
5	101.16	674.68	615.86	10.28	0.14	17.37
8	134.84	997.70	1080.55	14.20	0.13	10.74
10	157.29	1252.26	1351.13	16.81	0.11	6.33