PRELIMINARY STUDY ON FATTY ACID COMPOSITION AND THE OCCURENCE OF TRANS-OCTADECENOIC ACID (TRANS-C18:1) OF ADIPOSE TISSUE OF BEEF REARED WITH TWO DIFFERENT SYSTEMS

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Background

The nutritional quality of food is receiving a determining role of conditioning the choice of consumers, nowadays aware on the importance of diet in health. Particular attention must be addressed to fat composition of meat and essentially to the rate of saturated and unsaturated fatty acids (FA) and to the presence of some trans and cis isomers (Enser,1998).
The fatty acid composition of adipose and muscular tissues is strongly different between ruminants and monogastrics. The rate polyunsaturated fatty acids (PUFA)/saturated fatty acids (SFA) is lower in ruminants since the PUFA ingested with diet undergo to à rumen bacterial biohydrogenation (Moshley et al., 2002). Meanly, the rate PUFA/SFA of meat is in a range of about 0.11 – 0.15 in ruminants (Enser et al., 1998), whereas it is highly increased in monogastrics as swine, in which the range is 0.55 – 0.60. Diets with a rate PUFA/SFA higher than 0.4, are recommended by nutritionists because a lower rates is related to the risk of the cardiovascular diseases.
The cis isomers of FA, have positive effects on coronary cardiopathy prevention while the trans isomers have a negative input on human health and their presence in food is not recommended for a good and healthy diet. The ingestion of FA trans isomers in laboratory animals increase in blood the LDL cholesterol fraction in the blood and reduce the HDL, increasing (Abbey and Nestel, 1994; Katan, 1995; Khosla et al., 1996; Khosla et al., 1997; Judd et al., 2002).A dietary intake of total trans-fatty acids is associated with a modest increase and trans isomers of linoleic acid (Trans C18:1) with a larger increase in the risk of primary cardiac arrest (Lemaitre et al., 2002). The dietary intake of trans fatty acids was also correlated to sudden cardiac deaths (Katz, 2002) and they can be carcinogenic (Slattery et al., 2001).
Besides the presence of branched chain FA and the higher quantity of SFA, high levels of FA with odd carbon atom numbers and trans isomer forms are found in ruminant fat and not in other animals. Indeed, the FA with odd carbon atom numbers originate from rumen bacterial activities and the trans isomers arise from the FA biohydrogenation process, especially in rumen (Enser et al., 1998; Moshley et al., 2002).
Studies are available on the effects of diet and production systems on the levels of trans isomers in milk but there is a lack of information on their effects on meat and adipose tissue.
The aim of this study is to give some reports on FA composition of beef fat of beef reared in various farms using two different diets and slaughtered at 18-20 months of age.

Material and methods

The study was carried out analysing the subcutaneous adipose tissue sampled between the 7th and the 9th rib of sixty beef carcasses selected *at random* and weighting 380 – 410 kg (600 – 650 kg of body weight). The fat was sampled after five days of the slaughtering time and stored at -20°C until analysis.
The animals came from 30 farms sited central Italy subdivided in two groups (1: 20 farms; 2: 10 farms) according to the farming system and the daily ration starting from 300 kg of body weight:

Group 1 –	farming system:	small extensive farms of 15-20 animal/farm;
	daily ration	*ad libitum* lucerne hay and 1 kg/100 kg of body weight/day of a home made feed composed by grains (corn, barley and 15-18 % of soybean) and a vitamin - mineral supplement, administered two times a day.
Group 2 –	farming system:	intensive farms;
	daily ration	*ad libitum* wheat straw and commercial feed until slaughtering

The FA was extracted with hexane and sodium sulphite, trans-esterificated with 2M potassium hydroxide in methanol.
The obtained fatty acid methylic esters (FAMEs) were evaluated using a gas chromatograph (FISON HRGC MEGA 2) with a split/splitness injector and a FID detector. The FA separation was achieved with a capillary column (Chrompack CIP-SIL 88, 100 meters long and 0.22 internal diameter) using a thermal program (172°C for 22 minutes increased at a rate of 4°C/minute until 220°C). The FAMEs were identified in base of external standards of FA.
The results were given as percent of FA on the total FA composition and statistically evaluated using the variance analysis.

Results and discussion

The results are reported in tables 1 and 2.
There are sensible differences of the FA content between the two groups according to a previous study in ovine meat.
The samples show a quantity of SFA higher in group 1 than in group 2. The differences were however significant only for the FA present at low levels: lauric acid (C12:0) and miristic acid (C14:0) with a total of 4.5%.
Palmitic acid (C16:0) and stearic acid (C18:0) represent almost the half of the total FA; the differences are not significant between the two groups. These FA are among the major responsible in human of cardiopathy cases.
The SFA with odd carbon atom numbers (C15:0 and C17:0) are slightly but significantly higher in group 1 than in group 2 as results also the arachidonic acid (C20:0) which is 3 times higher in the first group.
As for the unsaturated FA, the group 2 shows the highest values with exception of linoleic acid (C18:2) which is slightly lower than in group 1 (2.20 % vs. 2.55 %). Highly significant are the differences between the two groups for the isomers of oleic acid (C18:1), especially for trans-C18:1 acid of which the value is about three times higher in group 2 than in group 1.Trans monounsaturated fatty acids as well as all the trans isomers are not present in vegetables but are highly represented in ruminant products (meat and milk) and in foods receiving a technological treatment (e.g. margarine) (Larque et. al, 2001). The trans isomers origin from the rumen bacterial hydrogenation of feed PUFA. As shown in other studies on trans isomer levels in milk (Ledoux et al., 2002), the composition of animal diet and therefore the chemical and bacterial composition of rumen content are significantly effective on FA production, included FA trans isomers. The found

levels of elaidinic acid are similar in group 1 and about two times in group 2 to those reported previously in goat milk (1.21 – 2.02 %) (Ledoux et al., 2002).
There are no significant differences between the two groups for the miristoleic acid (C14:1) and the palmitoleic acid (C16:1).

Table 1 - Saturated fatty acid composition of subcutaneous adipose tissue (% of total fatty acids) (mean ± E.S.)

	C12:0	C14:0	C15:0	C:16:0	C17:0	C18:0	C20:0	Total
GROUP 1	0.12 a ± 0.006	4.29 a ± 0.15	0.91 a ± 0.06	29.86 ± 1.12	1.59 ± 0.11	18.07 ± 1.27	0.67 A ± 0.043	55.51
GROUP 2	0.07 b ± 0.005	3.39 b ± 0.08	0.51 b ± 0.018	26.75 ± 0.39	1.26 ± 0.047	15.06 ± 0.87	0.25 B ± 0.019	47.29

a, b = P ≤ 0,05
A, B = P ≤ 0.01

Table 2 - Unsaturated fatty acid composition of subcutaneous adipose tissue (% of total fatty acids) (media ± E.S.)

	C14:1	C16:1	C18:1 n-9	C18:1 n-7	Trans C18:1	C18:2	C18:3	Total
GROUP 1	0.91 ± 0.087	3.47 ± 0.29	33.53 a ± 1.11	0.93 a ± 0.051	1.46 A ± 0.081	2.55 ± 0.11	0.38 ± 0.025	55.51
GROUP 2	1.03 ± 0.21	3.93 ± 0.18	39.04 b ± 0.96	1.51 b ± 0.076	4.44 B ± 0.25	2.20 ± 0.107	0.47 ± 0.036	47.29

a, b = P ≤ 0,05
A, B = P ≤ 0.01

Conclusion
The results show a strong relationship between animal diet and quality of fat, especially for FA trans isomers among which elaidinic acid (Trans C18:1) content is one of the most important nutritional parameter for health consumer. It will be of interest to evaluate other trans isomers of unsaturated fatty acids as, for example, those of linoleic acid.
These results can represent a contribution for the studies on nutritional quality of meat fat in relation to farming systems and animal diet.

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