FATTY ACIDS PROFILE IN *LONGISSIMUS LUMBORUM* MUSCLE OF FEEDLOT FATTENED LAMBS WITH DIETS CONTAINING DIFFERENT SOURCES OF VEGETABLE OIL[1]

Francisco de Assis Fonseca de Macedo[2], Sandra Mari Yamamoto[1], Makoto Matsushita[2], Guilherme Bareia Liberato da Rocha[4], Alexandre Agostinho Mexia[3], Marilice Zundt[3], Rosa Maria Gomes de Macedo[2], Eduardo Shiguero Sakaguti[2]

[1] Parte da dissertação de mestrado do segundo autor, financiada pela Fundação Araucária-PR

[2] Professores doutores do Programa de pós graduação em Zootecnia, UEM, Maringá-PR. E-mail: fafmacedo@uem.br

[3] Alunos do programa de pós graduação em Zootecnia - UEM, Maringá-PR

[4] Aluno do curso de Zootecnia - UEM, Maringá-PR, Bolsista PIBIC.

Introduction

The meat can be defined as the resulting product of the continuing transformations that the muscle suffers after animal death. The concept of equivalency between meat and muscular tissue is not valid, because the meat is constituted by the arrangement of muscular, adipose, conjunctive, a little part of epithelial and nervous tissues, beyond ligaments and tendons (Sañudo, 1992). The most found saturated fatty acids in ovine specie are miristic, palmitic and estearic; the monounsaturated are palmitoleic and oleic and the polyunsaturated are the linoleic, linolenic and arachidonic (Monteiro, 1998). However, it's possible increase the unsaturation and decrease the relative level of saturated fatty acids and *trans*-monounsaturated in ruminant meats, increasing the polyunsaturated fatty acids proportion in these animal diets (Geay et al., 2001).

Objective

The objective of this work was to evaluate the fatty acids profile in *Longissimus lumborum* muscle of pure Santa Inês lambs and ½ Dorset x ½ Santa Inês, feedlot fattened, consuming diets containing different sources of vegetable oil.

Materials and Methods

The experiment was carried out on Maringá State University ovine sector. Twenty-four lambs weaned with 60 days, with 75 days old on average and 17.75 kg of live weight were used. The treatments were: ration without oil addition (control); with soybean oil addition (soybean); with rapeseed addition (rapeseed); and with linseed oil addition (linseed). The treatments were isoproteic (17% of PB with basis on DM on average) and isoenergetic (76.6% of total digestible nutrients (TDN) on average). Table 1 shows the composition of the principal fatty acids of the treatments used. The animals remained in individual cover cage, with wood floor suspended, equipped with individual feeding place and collective watering-place, for each two animals, receiving water to the will, during all the experimental period.

At reaching the band of 30 kg of live weight on origin, the animals were slaughtered. After *rigor mortis* establishment, was done the transversal cut of *Longissimus lumborum* muscle samples (between 12ª and 13ª ribs), together with a portion of fat covering, which had been conditioned in polyethylene packing and stored at –18ºC until analyses beginning, when they were defrosted, until reach the ambient temperature, and them, triturated in food processor and duly homogenized. All the analyses were made in triplicate, using *Longissimus lumborum* muscle *in natura*. For total lipids extraction, was used the technique in cold (Foch et al., 1957) with chloroform/methanol (2:1 v/v) solution. The 5509 of ISO (1978) method was used for triglycerides transesterification, in *n*-heptane and KOH/methanol solution. The fatty acids esters were isolated and analyzed by a Shimadzu 14^A gas chromatography, equipped with a flame ionization detector and fused silica capillary column (50m of length, 0.25 mm of internal diameter and 0.20 µm of Carbowax 20M). The gases fluxes were of 1.2 ml min^{-1} for the carrier gas (H_2); 30 ml min^{-1} for the make-up gas (N_2) and 30 and 300 ml min^{-1} of H_2 and synthetic air, respectively. The initial temperature for the column flame was established in 150ºC, kept for 3 minutes, being them raised to 240ºC in a rate of 10ºC min^{-1}. The division reason was of 1:100. The peak areas were determinate by the Integrator-Processor CG-300. The peaks were identified comparing the retention times with Sigma standards fatty acids methyl esters.The experimental design was entirely randomized. The statistical analysis of the variables studied was interpreted for the variance analysis, using the Statistical Analyses System.

Results and Discussions

In Table 2 is the fatty acids composition on lambs *Longissimus lumborum* muscle, according to treatment and genetic group, respectively. Between the saturated acids, those with higher concentration were the palmitic (C16:0) and the stearic (C18:0). In relation to monounsaturated fatty acids, oleic acid (C18:1ω9) presented higher percentage. These results are in accordance with Martins Júnior (2000) that founded values of 19.27% for palmitic, 22.89% for stearic and 35.87% for oleic acids, working with lambs slaughtered in different weights, feedlot fattened. The highest amounts of oleic (C18:1ω9) are in the muscle of lambs that received rapeseed oil and linoleic acids (C18:2ω6), in lambs that received soybean oil treatment, although these didn't differed ($p>0.05$) of the treatments without oil addition and with rapessed oil, they suggest highest influence of the feeding (Table 1), because the rapessed oil presents a high acid oleic concentration (approximately 60%) and the soybean oil, a high acid linoleic concentration (about 55%). Rizzi et al. (2002), working with diets containing different proportions of soybean extruded and sunflower seeds (riches in linoleic acid), founded greater quantities of this acid in the lambs muscle, when the proportion of theses ingredients were increased in the ration.The lipid synthesis in ruminants can occur by two biochemical ways: *de novo synthesis* and the re-esterification of fatty acids absorbed in the intestine (Van Soest, 1994). On the *de novo synthesis* , the fatty acids are synthesized from acetil CoA and later estereficated to glycerol, mono or diglycerides. As the mammals can not synthesize the essential fatty acids, C18:2 and C18:3, the biggest concentration of these was not deriving of the *de novo syntheses* in the sheep.

The oil vegetable addition (soybean, rapeseed or linseed) resulted in lesser concentration of medium- chain fatty acids (C15:0, C16:0, C17:0), these are intermediate of *de novo syntheses* of the long-chain fatty acids (Lehninger, 1995), therefore, the oils vegetables supply had a inhibitory effect on fatty acids *de novo syntheses*. It is observed in Table 2, that the sheep had showed high levels of saturated fatty acids (45.32%) and monounsaturated (41.80%) and small amounts of polyunsaturated fatty acids (4.64%). The ratio polyunsaturated fatty acids/ saturated (PUFA/SFA) was 0.10, don't presenting differences between the treatments and genetic groups. This value is sufficiently below of the minimum recommended for The Department of Health (Ludovico, 2002), of 0.45, for a respected diet healthful.

The ratio ω6/ω3 varied from 5.91 for rapeseed oil treatment to 10.77 for soybean oil treatment. The superiors values of ω6/ω3 in the lambs muscles treated with soybean oil addition can be attributed, mainly, to highest levels of linoleic acid in the treatment containing this oil (50.03%). The Department of Health (Ludovico, 2002) recommends for this relation a maximum value of 4.0%, for a healthful diet.

CLA concentration of lambs fed diets supplemented with soybean, canola or flaxseed oils, and among genetic groups (SI and DS), showed no difference when expressed on a per gram of fat basis. Levels of CLA differed in several when compared different treatments with control treatment.

Conclusions

It can be evaluated that the inclusion of vegetable oils in the diets did not modified the profile of fatty acids of desirable form on the nutritional indices (PUFA/SFA and ω6/ω3) for the consumer health.

The total amounts of polyunsaturated, monounsaturated and saturated fatty acids in *Longissimus lumborum* muscle were not influenced by the treatments or genetic groups.

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Table 1- Main fatty acids composition of the treatments

Fatty acids	Treatments			
	Control	Soybean	Rapessed	Linseed
C14:0	0.37	0.12	0.14	0.37
C16:0	19.27	17.88	14.94	18.59
C18:0	3.51	3.71	3.18	3.98
C18:1ω9	25.33	24.36	37.44	25.90
C18:2ω6	48.11	50.03	39.30	47.18
C18:3ω3	3.40	3.90	5.00	3.96

Table 2- Fatty acids composition of Longissimus lumborum muscle of lambs, according to the treatments and genetic groups

Fatty acid	Treatments					
	Control	Soybean	Rapesseed	Linseed	Santa Inês	½ Dorset x ½ Santa Inês
C16:0	22.64±0.84^{a}	19.85±0.79^{ab}	18.38±0.79^{b}	20.48±0.79^{ab}	20.57±0.54^{a}	20.11±0.59^{a}
C17:0	2.07±0.12^{a}	1.17±0.11^{b}	1.57±0.11^{b}	1.39±0.11^{b}	1.68±0.08^{a}	1.42±0.08^{a}
C18:0	17.42±1.36^{a}	21.90±1.28^{a}	22.79±1.28^{a}	22.68±1.28^{a}	20.32±0.88^{a}	22.34±0.96^{a}
C18:1ω9c	39.41±1.09^{ab}	35.30±1.03^{b}	39.92±1.03^{a}	38.42±1.03^{ab}	39.19±0.71^{a}	37.17±0.78^{a}
C18:2ω6c	4.15±0.55^{ab}	5.02±0.52^{a}	3.52±0.52^{ab}	3.18±0.52^{b}	3.89±0.35^{a}	4.05±0.39^{a}
C18:3 ω3	0.13±0.03^{b}	0.22±0.03^{ab}	0.34±0.03^{a}	0.15±0.03^{b}	0.21±0.02^{a}	0.21±0.02^{a}
C20:0	0.19±0.03^{a}	0.29±0.03^{a}	0.29±0.03^{a}	0.19±0.03^{a}	0.24±0.02^{a}	0.25±0.02^{a}
C20:1ω9	0.59±0.16^{b}	1.41±0.15^{a}	1.00±0.15^{ab}	1.30±0.15^{a}	1.05±0.11^{a}	1.09±0.12^{a}
C20:3ω3	0.29±0.04^{a}	0.28±0.04^{a}	0.26±0.04^{a}	0.25±0.04^{a}	0.26±0.03^{a}	0.29±0.03^{a}
PUFA	4.70±0.62^{a}	5.77±0.58^{a}	4.34±0.58^{a}	3.76±0.58^{a}	4.54±0.40^{a}	4.74±0.43^{a}
MUFA	42.99±1.17^{a}	39.07±1.10^{a}	43.34±1.10^{a}	42.18±1.10^{a}	42.95±0.75^{a}	40.84±0.83^{a}
SFA	44.47±1.49^{a}	45.08±1.41^{a}	45.00±1.41^{a}	46.71±1.41^{a}	45.06±0.96^{a}	45.58±1.06^{a}
ω6	4.15±0.55^{a}	5.02±0.52^{a}	3.52±0.52^{a}	3.19±0.52^{a}	3.89±0.35^{a}	4.05±0.39^{a}
ω3	0.42±0.06^{a}	0.50±0.06^{a}	0.60±0.06^{a}	0.40±0.06^{a}	0.47±0.04^{a}	0.49±0.04^{a}
PUFA/SFA	0.11±0.02^{a}	0.13±0.02^{a}	0.10±0.02^{a}	0.08±0.06^{a}	0.10±0.01^{a}	0.10±0.01^{a}
ω6/ω3	9.75±0.49^{ab}	10.77±0.46^{a}	5.91±0.46^{c}	8.28±0.46^{b}	8.66±0.32^{a}	8.70±0.35^{a}
CLA (9c,11t-18:2)	0,86±0,12	1,61±0,37	1,36±0,21	1,44±0,11	1,23±0,39	1,38±0,25

PUFA= polyunsaturated fatty acids; MUFA = monounsaturated fatty acids; SFA= saturated fatty acids
CLA = conjugated linoleic acid = 9cis,11tans-octadecadienoic acid = 9c,11t-18:2
Means followed by the same letters, within a row, are not different by the Tukey's test ($p<0.05$)