FATTY ACID COMPOSITION OF INTRAMUSCULAR FAT OF LAMBS FED DIFFERENT LIPIDS SOURCES

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Abstract - The purpose of this study was to evaluate the effect of lipids sources in finished diets of finished lambs on the fatty acid composition of the *Longissimus* muscle. Therefore, twenty four crossbred, Dorper x Santa Inês, male, lambs (BW= 18 kg), with three months, were assigned in a completely randomized design with four treatment and six repetition. The animals were assigned to one of four dietary treatments: 1) Control diet (CD); 2) diet containing sunflower seed (SF); 3) whole cottonseed (WC); 4) soybean seed (SB). Diets were isonitrogenous and isocaloric and offered once daily to lambs in an individual pens for 84 d. At the end of the trial, lambs were slaughtered and samples of the *Longissimus* muscle were collected for fatty acid composition. Myristic, palmitic and stearic acid were not affected by lipid source (P>0.05). However, lauric acid was influenced by diets (P<0.05). For linoleic (C18:2 n6) and linolenic acids (C18:3 n3), differences between the sunflower diet, soybean and cotton seed diet were observed. The soybean seed treatment showed the highest level for linoleic acid. In addition, when compared to soybean in the diet, the inclusion of whole cotton decreases the meat CLA cis-9, trans-11, what is not desirable and beneficial for the consumer's health.

Key Words – conjugated linoleic acid, ovine, polyunsaturated fatty acid

I. INTRODUCTION

Several studies have been conducted to alter the beef fatty acid profile resulting in healthier product for human consumption. The fatty acid composition of beef is dependent of several factors like animal, breed, age, sex and diet [1].

Results from the literature have demonstrated it that is possible to change the fatty acid profile of beef by feeding animals with ingredients containing high levels of unsaturated fatty acids (UFA) that are partially or completely protected from ruminal modification [2];[3]. Previous studies have demonstrated that feeding grains rich in UFA increased their concentration on meat [4].

Therefore, the objective of this work was to evaluate the effects of lipid sources on the *Longissimus* muscle (LM) fatty acid composition of finished lambs.

II. MATERIALS AND METHODS

All animal procedures described in this study were conducted following the Institutional Animal Care and Use Committee Guidelines of University of Sao Paulo.

Twenty four crossbred, Dorper x Santa Inês, male, lambs (BW= 18 kg), with three months, were assigned in a completely randomized design with four treatments and six repetitions.

The diets were isonitrogenous and isocaloric differing in lipid source (sunflower seed, whole cottonseed or soybean grain). The animals were allotted to individual pens, with one animal per pen, and fed one of four diets: 1) Control diet (CD); 2) diet containing sunflower seed (SF); 3) whole cottonseed (WC); 4) soybean seed (SB). The diets were isonitrogenous and isocaloric differing in lipid source (sunflower seed, whole cottonseed or soybean grain), as described in Table 1.

Table 1. Ingredients and chemical composition of diets (g/kg), on a dry matter (DM) basis

Ingredients, g/kg DM	Control	Whole cottonseed	Whole Soybean	Sunflower seed
Sugarcane	23,63	23,63	23,63	23,63
Soybean hulls	15,00	15,00	15,00	15,00
Ground corn grain	50,92	32,92	40,79	42,14
Soybean meal	7,48	7,48	7,48	7,48
Limestone	1,00	1,00	1,00	1,00
Mineral salt	0,60	0,60	0,60	0,60
Urea	1,37	0,70	0,50	1,05
Whole cottonseed	--	18,00	--	--
Whole Soybean	--	--	9,00	--
Soybean oil	--	--	2,00	--
Sunflower seed	--	--	--	9,00
Nutrients, g/kg DM				
TDN	76,75	77,88	80,75	77,21
CP	14,61	14,65	14,79	14,66
RDP	9,59	9,28	9,40	9,48
EE	3,11	6,14	6,30	6,33
Ca	0,59	0,61	0,62	0,60
P	0,31	0,36	0,34	0,34

The animals were slaughtered after 84 days of feeding at the slaughter house of University of Sao Paulo, in accordance to Humanitarian Slaughter Guidelines as required by Brazilian laws. After twenty four hours of chilling at 2°C, carcasses were ribbed between 12th and 13th ribs and a 2.5 inch thick LM sample was taken from each animal, vacuum packaged and frozen at -18°C for posterior analysis.

A sample of LM was used for ether extract [5] and fatty acid composition determinations. The extracted lipids were hydrolyzed and methylated and fatty acids methyl esters were [6] and determined by gas chromatograph (Shimadzu) equipped with a flame ionization detector and a 100-m Supelco SP-2560 (Supelco Inc., PA, USA) fused silica capillary column (100 m, 0.25mm and 0.2 µm film thickness). Column oven temperature was programmed at 70°C for 4 min, 170°C (13ºC min^{-1}), and 250°C (35ºC min^{-1}) for 5 min. The gas fluxes were 1.2mL min^{-1} for carrier gas (He); 45mL min^{-1} for make-up gas (N_2); 40 mL min^{-1} for hydrogen and 450 mL min^{-1} for synthetic flame gas. One µL sample was injected in split mode at 1/21. Injector and detector temperatures were 250 and 300ºC, respectively.

Fatty acids were identified by comparing the relative retention times of fatty acid methyl esters peaks with a internal standard (vaccenic C18:1 trans-11 (V038-1G, Sigma®), C18 CLA:2 trans-10, cis-12 (UC-61M 100mg), CLA e C18:2 cis-9, trans-11 (UC-60M 100mg), (NU-CHEK-PREP EUA ®).

Effects of lipid sources on fatty acid muscle composition were evaluated by analysis of variance using the PROC MIXED of SAS (*Statistical Analysis System*, version 9.1).

III. RESULTS AND DISCUSSION

The majority of the individual fatty acids were not affected by either lipid (Table 2).

Table 2. Least squares means, standard error of mean (SE) and significant level of *Longissimus* muscle from feedlot finished lams fed different lipid sources.

Fatty Acid (%)	Diets[1]			
	Control	Whole cottonseed	Sunflower seed	Whole soybean
C8:0	0,0097 ± 0,0006	0,0118 ± 0,0006	0,0118 ± 0,0006	0,0103 ± 0,0007
C10:0	0,0988 ± 0,0084	0,0989 ± 0,0084	0,1085 ± 0,0084	0,1051 ± 0,0092
C11:0	0,0017 ± 0,0004	0,0020 ± 0,0042	0,0024 ± 0,0004	0,0029 ± 0,0042
C12:0	$0,0696^{a}$ ± 0,0078	$0,0593^{ab}$ ± 0,0078	$0,0943^{b}$ ± 0,0078	$0,0793^{ab}$ ± 0,0085
C13:0	0,0030 ± 0,0076	0,0040 ± 0,0076	0,0030 ± 0,0007	0,0042 ± 0,0076
C14:0	2,0357 ± 0,1600	1,9601 ± 0,1600	2,2024 ± 0,1600	2,1480 ± 0,1753
C14:1	0,0167 ± 0,0110	0,0348 ± 0,0110	0,1900 ± 0,0110	0,0147 ± 0,0120
C15:0	0,0430 ± 0,0067	0,0523 ± 0,0067	0,0523 ± 0,0067	0,0479 ± 0,0073
C15:1	$0,0146^{ab}$ ± 0,0032	$0,0126^{ab}$ ± 0,0032	$0,0243^{b}$ ± 0,0032	$0,0102^{a}$ ± 0,0036
C16:0	25,0366 ± 0,6965	24,2291 ± 0,6965	23,8834 ± 0,6965	23,8648 ± 0,7630
C16:1	1,8030 ± 0,1134	1,4494 ± 0,1134	1,8960 ± 0,1134	1,6826 ± 0,1242
C17:0	0,5213 ± 0,0418	0,5251 ± 0,0418	0,4869 ± 0,0418	0,5935 ± 0,0458
C17:1	0,5462 ± 0,0549	0,4138 ± 0,0549	0,6301 ± 0,0549	0,5560 ± 0,0601
C18:0	16,5051 ± 0,8356	19,2654 ± 0,8356	16,3700 ± 0,8356	17,3048 ± 0,9153
C18:1 t11	0,1920 ± 0,3160	1,1982 ± 0,3160	0,2873 ± 0,3870	0,9850 ± 0,3461
C18:1 n9,c	44,1242 ± 1,2543	41,0338 ± 1,2543	42,0186 ± 1,2543	41,2056 ± 1,3740
C18:2 n6,c	$3,8038^{a}$ ± 0,5292	$4,6104^{ab}$ ± 0,5292	$4,6932^{ab}$ ± 0,5292	$6,3672^{b}$ ± 0,5797
C20:0	0,0510 ± 0,0080	0,0634 ± 0,0072	0,0578 ± 0,0072	0,0448 ± 0,0080
C18:3 n3	$0,1181^{a}$ ± 0,0209	$0,0812^{a}$ ± 0,0170	$0,1590^{a}$ ± 0,0186	$0,2585^{b}$ ± 0,0186
C21:0	0,0172 ± 0,0189	0,0577 ± 0,0212	0,0153 ± 0,0300	0,0251 ± 0,0212
CLA c9 t11	$0,6784^{ab}$ ± 0,1094	$0,4589^{a}$ ± 0,1094	$0,6629^{ab}$ ± 0,1094	$0,8734^{b}$ ± 0,1198
C20:2	0,1898 ± 0,0701	0,2730 ± 0,0701	0,2550 ± 0,0701	0,1334 ± 0,0768
C22:0	0,0870 ± 0,0135	0,0840 ± 0,0135	0,1105 ± 0,0135	0,0921 ± 0,0149
C20:4 n6	1,3955 ± 0,2163	1,2678 ± 0,2163	1,8067 ± 0,2163	1,3028 ± 0,2370
C23:0	0,0401 ± 0,0602	0,1621 ± 0,0602	0,0697 ± 0,0602	0,0491 ± 0,0737

[a,b] Means in the same row within lipid source are different according to significance level by Tukey test (P<0.05).

Myristic, palmitic and stearic acid were not affected by lipid source (P>0.05). However, lauric acid was influenced by diets (P<0.05). Saturated fatty acids C12:0 and C14:0 are considered hyperlipidemic [8]. SFA are most abundant in intramuscular fat, corresponding to 45 to 48% of the total fatty acids, whose main representatives are C14:0, C16:0 and C18:0 [7]. In the present study, the values were considered appropriate, with 43%, approximately.

For linoleic (C18:2 n6) and linolenic acids (C18:3 n3), differences between the sunflower diet, soybean and cotton seed diet were observed. The soybean seed treatment showed the highest level for linoleic acid. In addition, when compared to soybean in the diet, the inclusion of whole cotton decreases the meat CLA cis-9, trans-11.

CLA is a combination of the two main isomers of CLA including c9, t11-18:2 and t7,c9-18:2. The cis-9, trans-11 (CLA isomer) has anticarcinogenic activities, however other isomers can also offer benefits through the modulation of fat metabolism [8].

CLA cis-9, trans-11 corresponds to 57 to 85% of the total value of CLA [9] and can be absorbed or formed by incomplete biohydrogenation to acid (trans-11 octadecenoic acid). After absorption, this acid can be converted to CLA cis-9, trans-11 by stearyl-CoA desaturase enzyme (SCD) or delta-9 desaturase [10].

IV. CONCLUSION

The inclusion of whole soybean seed to finished crossbred lambs modified fatty acid profile of *Longissimus* muscle, increasing linoleic acid (C18:2), linolenic acid (C18:3).

In addition, when compared to soybean in the diet, the inclusion of whole cotton decreases the meat CLA cis-9, trans-11, what is not desirable and beneficial for the consumer's health.

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