LONGISSIMUS DORSI FATTY ACIDS COMPOSITION OF *BOS INDICUS* AND *BOS INDICUS* X *BOS TAURUS* CROSSBRED STEERS FINISHED IN PASTURE SYSTEMS

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Background

Bovine meat fat presents approximately 48% of saturated fat and 52% of unsaturated fat. (Jiménez-Colmenero *et al.*, 2001). Since saturated fatty acids are not essential and have been associated to health problems (Jiménez-Colmenero *et al.*, 2001) bovine meat consumption may be prejudiced due to the search for healthier diets. According to this, many studies have been made in order to decrease the saturated fatty acids proportion and increase the polyunsaturated fatty acids of the meat. Once forage is rich in polyunsaturated fatty acids (French *et al.*, 2000), steers fed only forages could result in a fat production with a higher amount of these fatty acids, which would led to a healthier aliment, with lower saturated fat contents.

Objectives

The aim of this research was to evaluate the bovine meat fatty acids composition of *Bos indicus* and *Bos indicus* x *Bos taurus* crossbred steers finished in different pasture systems. The pasture systems evaluated were the millet and star grass pasture associated with mineral or protein and mineral supplements.

Methods

The experiment was carried out in a private farm located in Centenário do Sul, Paraná State, Brazil (22°51'south latitude, 51°33'longitude W-GR). Seventeen steers were used, 7 *Bos indicus* (Nelore) and 10 *Bos indicus* x *Bos taurus* crossbred assigned to 3 finishing pasture systems: millet (*Pennisetum americanum* L.) + mineral salt supplementation (1 ½ Nelore x ½ Limousin, 3 ½ Nelore x ½ Girolando and 2 Nelore); star grass (*Cynodon plectostachyus* Pilger) + mineral salt supplementation (2 ½ Nelore x ½ Limousin, 1 ½ Nelore x ½ Girolando and 2 Nelore) and star grass + protein mineral salt supplementation (2 ½ Nelore x ½ Limousin, 1 ½ Nelore x ½ Girolando and 3 Nelore). The protein and mineral supplement was made of soybean meal, cracked corn, urea and mineral premix. The intake of protein mineral salt supplement was 0.2 kg per animal a day. During grazing time, ten forage samples were collected from each pasture, each 28 days, being further homogenised for each treatment, for future analysis. The animals were kept in this management for 70 days (1st slaughter) or 83 days (2nd slaughter). The slaughter occurred when the animals achieved 450 kg (Nelore) or 470 kg (crossbred) of body weight, approximately. Shortly after the slaughter, the carcasses were identified and chilled for 24 hr at 2°C, before the *Longissimus dorsi* muscle samples were collected from the area between the 12th and 13th rib, and then immediately taken to the laboratory and frozen for future analysis. Two months later, these samples were thawed at ambient temperature and separated in two portions in order to analyse the fatty acids composition. All fat thickness was removed from one of the samples, and only the *Longissimus dorsi* muscle had the amount of fatty acids analysed. The fat thickness of the other sample was maintained and analysed along with the muscle portion. These two cuts and the forage samples were ground and homogenised, the total fat matter was separated (Bligh and Dyer, 1959) and the lipids were transesterified to form fatty acids methyl esters (ISO, 1978). The fatty acids were analysed on a Shimadzu 14A gas chromatograph equipped with flame ionisation detector and fused silica capillary column (25 cm x 0.25 mm and 0.20 µm of Carbowax 20M). The temperatures of the injector and detector were of 220 and 245°C, respectively. The gas fluxes were of: 1.2mL/min for the carrier gas (H_2), 30mL/min for the make-up gas (N_2); 300 mL/min and 30 mL/min for the flame gases, synthetic air and H_2, respectively. The split used was of 1/100. The peak areas were determined by the CG-300 Computing Integrator. The identification of the main peaks was made according to the patterns determined by Sigma (USA). The statistical analysis was made using the Statistical and Genetic Analysis System (SAEG, 1983).

Results and discussions

The fatty acids compositions of the millet and star grass forage were similar, however, protein mineral salt presented some differences in comparison to forages (Table 1). The majority of fatty acids of protein mineral salt were MUFA and for forages were PUFA. Diets with high PUFA levels could lead to an increase in these fatty acids in the meat. However, concerning ruminants, during the passage of fatty acids through the rumen, hydrogenation will occur, that is, hydrogen ions will be added to the polyunsaturated fatty acids, mainly forming C18:0 and C18:1 acids (Tamminga and Doreau, 1991). In conclusion, the increase in PUFA in the diet will not have a direct relation to an increase in these fatty acids in the ruminant meat.

The PUFA, MUFA, SFA, n-6 and n-3 proportions of meat without fat thickness did not differ between treatment or genetic group. Despite the difference observed on fatty acids composition of protein mineral salt compared to forages, a difference on meat fatty acids composition was not observed. This is a result of the low protein and mineral supplement consumption (200g/animal/day). So, the main component of the diet was the forage, and not the supplement. The average PUFA content was of 11%. Inferior values were obtained by French *et al.* (2000) - 5.35% - and superior values were obtained by Mitchell *et al.* (1991) - 16.7% of PUFA. These authors worked with castrated animals kept exclusively in pasture. The average SFA proportion was of 45%; similar to the value obtained by Mitchell *et al.* (1991). The average PUFA:SFA ratio was of 0.25. Mitchell *et al.* (1991) obtained a value of 0.40 and French *et al.* (2000) obtained a value of 0.13. These differences found in literature can be a result of the type of forage used, breed or finishing score of the animals.

The omega-6 fatty acid deposition was close to the omega-3 deposition (Table 1). Therefore, the n-6:n-3 ratio was close to 1. Similar values were obtained by Enser *et al.* (1998) with values of 1.32 for animals maintained in pasture. The linoleic (n-6) and the linolenic (n-3) acids develop vital functions in organism and, since the animal or human cannot synthesise them, they need to be supplemented by diet. These acids are converted in intermediate metabolites in order to develop their functions. However, for some metabolic passages of the n-6 and n-3 derivatives, some of the utilised enzymes are the same, so that the excess of n-6 derivative may lead to a deficiency of n-3 derivatives (Ewin, 1997). In this context, it has been advised that the n-6:n-3 ratio must be around 4-10:1 (Krummel, 1998). In spite of the importance of these fatty acids for the human health, an exact relation has not been established yet (Hu, 2001).

When comparing fatty acids proportion of the cuts with or without fat thickness, it is possible to observe that intramuscular fat presents a higher polyunsaturated fatty acids proportion and a lower saturated fatty acids proportion, which results on a higher PUFA:SFA ratio for the cut without fat thickness (Table 1) The higher PUFA:SFA ratio for the intramuscular fat was also obtained by Webb *et al.* (1998). Intramuscular fat is formed by marbling fat and lipids present in the cellular membrane. The cellular membrane is basically made up of phospholipids. Subcutaneous fat is made up of adipose tissue, and its main energy source is in the triacylglycerols form. Once the saturation

degree of triacylglycerols is higher than phospolipids (De Smet *et al.*, 2000), the adipose tissue will have the higher saturated fatty acids proportion, which explains the results that were obtained in this experiment.
A higher proportion of n-6 and n-3 fatty acids can be observed for the cut without fat thickness. Since n-6 and n-3 are polyunsaturated fatty acids, the factor described above can be the reason of the higher n-6 and n-3 fatty acids proportion in intramuscular fat.

Conclusions

There was no difference in fatty acids proportion of meat from steers feed different tropical forages with mineral or protein and mineral supplements. The fatty acids proportion of meat from *Bos indicus* steers or *Bos indicus* x *Bos taurus* crossbred steers were similar. The meat with fat thickness had higher SFA proportion and lower PUFA then meat without fat thickness. The n-6 and n-3 proportion of meat without fat thickness were higher then of meat with fat thickness.

Pertinent literature

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Table 1 – Percentage of: polyunsaturated fatty acids (PUFA), monounsaturated fatty acids (MUFA), saturated fatty acids (SFA), n-6 and n-3 fatty acids, PUFA/SFA and n-6/n-3 ratios in forages, supplement and cuts evaluated

Treatments	PUFA	MUFA	SFA	PUFA/SFA	n-6	n-3	n-6/n-3
				Forage and supplement			
Millet	65.81	14.15	20.03	3.28	22.78	42.28	0.54
Star grass	68.09	10.41	21.50	3.17	22.97	43.62	0.53
Protein and mineral supplement	25.20	52.41	22.39	1.13	21.73	1.87	11.64
				Meat without fat thickness			
MMS[1]	11.69	43.34	43.72	0.27	5.67	5.11	1.15
GMS[2]	9.90	43.78	44.80	0.22	5.24	3.96	1.29
GPS[3]	11.72	41.53	45.22	0.26	6.16	4.79	1.39
Bos indicus	12.08	42.33	43.93	0.28	5.62	5.39	1.09
Bos indicus x *Bos taurus*	10.40	43.27	44.99	0.23	5.74	4.08	1.40
SE	25.97	5.40	4.08	28.86	30.05	27.66	25.19
				Meat with fat thickness			
MMS[1]	4.45	44.22	49.50	0.09	1.45	2.45	0.62
GMS[2]	5.35	44.87	48.00	0.11	2.19	2.52	0.87
GPS[3]	5.63	41.73	50.73	0.11	2.41	2.56	0.93
Bos indicus	5.19	43.27	49.64	0.10	1.85	2.34	0.69
Bos indicus x *Bos taurus*	5.08	43.76	49.37	0.10	2.14	2.69	0.91
SE	25.46	8.07	5.63	24.75	38.34	23.68	26.72
				Cuts			
Meat without fat thickness	10.94a	42.83	44.83b	0.25a	5.60a	4.56a	1.27a
Meat with fat thickness	5.13b	43.53	49.49a	0.10b	2.00b	2.51b	0.80b
SE	27.00	6.93	5.43	30.61	32.41	30.28	28.51

[1]Millet with mineral supplementation; [2]Star grass with mineral supplementation; [3]Star grass with protein and mineral supplementation.