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

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Background

Bovine meat has excellent nutritional quality as its protein present high biological value associated to rich vitamins contents. Bovine meat contains all the essential amino acids in the right ratio to maintain the needs of the human organism (Pensel, 1998). By other side bovine meat has been mentioned as one of the factor that may lead to the development of human cardiovascular diseases, obesity, hypertension and cancer, specially due to the presence of saturated fat and cholesterol. However, low fat and cholesterol contents has been obtained in bovine meat chemical analyses. Less than 5% of fat and less than 75 mg of cholesterol/100 g of muscle has been associated with bovine meat. This is sufficient to achieve from one third to one half of the daily recommended cholesterol intake (Jiménez Colmenero et al., 2001).

Objectives

The aim of this research was to evaluate the contents of moisture, ash, protein, fat and cholesterol of the *Longissimus dorsi* muscle with and without fat thickness of *Bos indicus* and *Bos indicus x Bos taurus* 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 between the months of November and February, 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* crossbreed assigned to 3 finishing pasture systems: millet (*Pennisetum americanum* L.) + mineral salt supplementation – MMS (1 ½ Nelore x ½ Limousin, 3 ½ Nelore x ½ Girolando and 2 Nelore); star grass (*Cynodon plectostachyus* Pilger) + mineral salt supplementation – GMS (2 ½ Nelore x ½ Limousin, 1 ½ Nelore x ½ Girolando and 2 Nelore) and star grass + protein mineral salt supplementation – GPS (2 ½ Nelore x ½ Limousin, 1 ½ Nelore x ½ Girolando and 3 Nelore). The intake of protein mineral salt supplement was 0.2 kg per animal a day. The chemical composition of forages and supplement is shown in Table 1. The initial average weight of animals was 413 kg. 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 (*Bos indicus*) or 470 kg (crossbreed) of body weight, approximately. After the slaughter of the animals the carcasses were 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 were frozen for future chemical analysis. Two months later, the samples were thawed at ambient temperature and separated in two portions. All fat thickness was removed from one of the samples, and only the *Longissimus dorsi* muscle was analysed. The fat thickness of the other sample was maintained and analysed along with the muscle portion. These two cuts were ground and the moisture, ash, crude protein and fat contents were analysed according to the AOAC methodology (1980). The cholesterol extraction was made according to the method described by Al-Hasani *et al.* (1993). The cholesterol quantification was made by a Shimadzu 14A chromatograph, equipped with flame ionisation detector and fused silica capillary column (25 cm x 0.25 mm and 0.20 µm of SE-30). The temperatures of the injector, column and detector were of 260, 300 and 300°C, respectively. The gas fluxes were 1.5mL/min for the carrier gas (H_2), 25mL/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 1/150. The peak areas were determined by the CG-300 Computing Integrator and the cholesterol identification 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 animals submitted to the MMS treatment present lower moisture and ash contents ($P<0.05$) in muscle without thickness when compared with animals submitted to the GPS treatment, and GMS treatment presented intermediate values. Crude protein, fat and cholesterol contents were similar ($P>0.05$) for 3 treatments (Table 2). The animals submitted to the MMS treatment presented lower moisture contents on meat with fat thickness ($P<0.05$) when compared with animals submitted to the GPS treatment, and the ones submitted to GMS treatment achieved intermediate values. In addiction, fat content was higher ($P<0.05$) for animals submitted to MMS treatment when compared with both other treatments. Differences were not observed ($P>0.05$) among the animals submitted to the GMS and GPS treatments. The treatment did not effect ($P>0.05$) ash, crude protein and cholesterol contents of the cuts with fat thickness (Table 2). Millet pasture presented the highest energy value (Table 1), which made the performance of the animals better, favouring the fat deposition on the meat. In the same way, the higher fat proportion favoured smaller moisture content.

A higher moisture content ($P<0.05$) and a smaller total fat matter content ($p=0.07$) were observed on meat without fat thickness of the crossbred steers. Ash, crude protein and cholesterol contents did not present differences ($P>0.05$) among the two genetic groups (Table 2). Intramuscular fat is the last one to be deposited, according to animal growth (Owens *et al.*, 1993). In growth scale, Nelore steers probably were more advanced in maturity than crossbred steers, which can be confirmed by the fat thickness of Nelore animals. Nelore animals had higher fat thickness (4,88 mm) than crossbred animals (3.05 mm). At more advanced maturity stages, a higher deposition of intramuscular fat will occur, which explains the higher proportion of fat for Nelore steers meat. The higher proportion of adipose tissue determined the lower moisture content, once the adipose tissue presents hydrophobic characteristic. Crossbred steers probably did not achieve mature weight and therefore did not complete the intramuscular deposition. Nelore animals, even presenting approximately 5mm of fat thickness, achieved 1.86% of intramuscular fat. This value was inferior to 2.72%, which was found by Mandell *et al.* (1998) analysing *Bos taurus* animals in pasture, with finishing of 4mm of fat thickness. This data suggests that *Bos indicus* animals present lower intramuscular fat deposition when compared to *Bos taurus* with the same carcass finishing score, but more researches need to be done to confirm this suggestion. The moisture, ash, crude protein, fat and cholesterol contents of meat with the presence of fat thickness, did not present differences ($P>0.05$) among genetic groups (Table 2).

Cholesterol concentration obtained was inferior to the values observed by Rule *et al.* (1997) (approximately 54mg/100g of *Longissimus dorsi* muscle). The same authors did not observe any effect of breed, nutritional planning or sex of the animal on the cholesterol concentration of the *Longissimus dorsi* muscle, suggesting that a modification of the phospholipid distribution needs to be made. It is possible to observe that studies comparing different breeds are limited to the comparison of *Bos taurus*, and not *Bos indicus* animals. The results obtained suggest that *Bos indicus* animals present a lower cholesterol distribution on the skeletal musculature when compared to *Bos taurus*, even so, more research needs to be done in order to confirm such supposition.

By the comparative analysis of the cholesterol present in bovine, ovine, swine and chicken meat, it is possible to observe that bovine meat, with or without fat thickness, presented the lowest muscle cholesterol contents (34 mg/100 g of *Longissimus dorsi* muscle). Swine meat presents values close to 45 mg/100 g of *Longissimus dorsi* muscle, ovine meat has values of 50 mg/100 g of *semimembranosus* muscle and chicken meat has values of 43 mg/100g of breast without skin (Chizzolini *et al.*, 1999). These values confirm that bovine meat has excellent nutritional quality and low cholesterol contents when compared to other types of meat.

Conclusions

Feeding the animals with millet pasture resulted in higher fat deposition in meat without fat thickness than feeding them with star grass pasture. The meat without fat thickness of steers fed forages had low fat and cholesterol contents. *Bos indicus* steers could present lower fat and cholesterol concentration on meat *Bos taurus* but more researches need to be done to confirm this suggestion.

Pertinent literature

Al-Hasani, S. M., Hlavac, J., Carpenter, M. W. (1993), Rapid determination of cholesterol in single and multi-component prepared foods. *Journal of Association of Official Analytical Chemists International*, **76**, 902-906

AOAC - Association of Official Analitical Chemists (1980), *Official methods of analysis.* 14 ed. Arlington, V.A.

Chizzolini, R., Zanardi, E., Dorigoni, V. *et al.* (1999), Calorific value and cholesterol content of normal and low-fat meat and meat products. *Trends in food science Technology,* **10**, 119-128

Jiménez-Colmenero, F., Carballo, J. e Cofrades, S. (2001), Healthier meat and meat products: their role as functional foods. *Meat science.*, **59,** 5-13

Mandell, I. B., Buchanan.Smith, J. G. and Campbell, C. P. (1998), Effects of forage vs. grain feeding on carcass characteristics, fatty acid composition, and beef quality in Limousin-cross steers when time on feed is controlled. *J. Anim. Sci.*, **76,** 2619-2630

Owens, F. N., Dubeski, P. and Hanson, C. F. (1993), Factors that alter growth and development of ruminants. *J. Anim. Sci.*, **73**, 3138-3150

Pensel, N. (1998), The future of red meat in human diets. *Nutrition abstracts and reviews (Series A)*, **68,** 1-4

Rule, D. C., Macneil, M. D. and Short, R. E. (1997), Influence of sire growth potential, time on feed, and growing-finishing strategy on cholesterol and fatty

SAEG – Sistema para Análise Estatística e Genética (1983), Central de Processamento de Dados. UFV, Viçosa

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Table 1 – Crude protein (CP), ethereal extract (EE), *in vitro* dry matter digestibility (IVDMD), total digestible nutrients (TDN) and metabolizable energy (ME) of dry matter of grass and supplement used in different treatments.

Food	CP (%/DM)	EE (%/DM)	IVDMD (%/DM)	TDN (%/DM)	ME (Mcal/kg DM)
Millet	12.41	0.54	72	74	2.68
Star grass	7.41	0.87	47	48	1.74
Protein supplement[1]	38.00	5.27	-	53	1.83

[1]soybean meal, cracked corn, urea and mineral premix

Table 2 – Moisture, ash, crude protein (CP) and fat percentages and cholesterol concentration (mg/100g muscle) of fresh meat with or without fat thickness of steers finished in different pasture systems.

Treatments	Meat without fat thickness					Meat with fat thickness				
	Moisture	Ash	CP	Fat	Cholesterol	Moisture	Ash	CP	Fat	Cholesterol
MMS[1]	74.38b	0.99b	21.14	1.61	37.17	64.17b	0.87	18.43	15.22a	30.26
GMS[2]	74.71ab	1.03ab	20.79	1.87	39.24	67.58ab	0.92	20.07	7.83b	33.72
GPS[3]	75.42a	1.11a	20.58	1.36	35.99	69.29a	0.97	19.18	6.29b	30.24
SE (%)	0.59	5.04	7.70	37.87	16.79	3.77	11.86	10.87	34.91	22.40
Bos indicus	74.28b	1.04	20.94	1.86a	35.16	65.90	0.88	18.75	11.11	28.77
Bos indicus x *Bos taurus*	75.34a	1.05	20.76	1.37b	39.64	67.94	0.96	19.55	8.81	33.72
SE (%)	0.98	7.17	6.85	33.37	15.20	4.96	8.96	11.05	49.38	19.61

[1]Millet + mineral salt; [2]Star grass + mineral salt; [3]Star grass + protein and mineral salt; [4]Means in the same column followed by different letters are different by Tukey test ($P<0.05$).