Rhomboideus muscle fatty acid profile in advancing age of zebu cattle (*Bos indicus*)

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Abstract— The lipid content in muscle tissue confers flavor and other sensory attributes affecting meat tenderness. In this study, we evaluated the changes of fatty acids profile in the Nelore *Rhomboideus* m. (RB) having *Longissimus dorsi* (LD) of the same animal for comparison. We used muscle samples in triplicate of three male animals (n=9), aged 18, 24, 36 and 48 months. Whilst for RH, the changes in the lipid content were completely random varying from 3.76% to 50.39% irrespective of animal age, for LD, the lipid amount decreased proportionally with ageing of 3.28<2.83<2.08<1.75, respectively. This result for RH reflects the variability of the muscle in relation to season and management of the animals while in the farm. In relation to n-6/n-3 ratio the RH samples presented values ranging from 7.40 at 18mo of age to 1.52 at 48mo of age while LD samples changed from 1.68 at 24mo of age to 10.74 at 36mo, being the exception of the animals 18mo of age for RB and 36mo for LD, this ratio is lower than 3:1. The MUFA for both RB and LD presented a range of 37 to 50%. The ratio PUFA/SFA, ranged from 0.050 and 0.080 for both muscles irrespective of ageing. We concluded that *Rhomboideus* m. presented similar fatty acids nutritional quality of *Longissimus dorsi* m.

Keywords, rhomboideus muscle, nelore catle, fatty matter

I. INTRODUCTION

The Brazilian Association of Meat Exporting Industries [1] show the Brazilian cattle herd is the largest commercial herd in the world, beating the Indian and Chinese. It comprises about 80% of animals of zebu (*Bos indicus*) and 20% of taurine breeds (*Bos taurus*). In 2009, the effective national cattle increased at 205.292 million head, an increase of 1.5% compared with the previous year, this data are Brazilian Institute of Geography and Statistics [2]. The developed humpback muscle, popularly known as cupim in Brazil, is unique to the nelore breed (Fig 1).

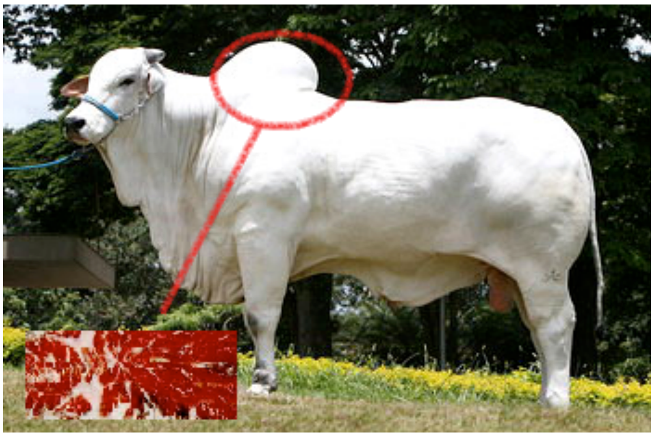

Figure 1 - Typical zebu nelore (*Bos indicus*) and the location of *Rhomboideus* m. Great Champion - Touro_Serro FIV da Bacaray-Brazil. [5]

It can be approx. 1.0% of the total cold carcass in weight and is much appreciated grilled as barbecue by Brazilians. It is believed that its biological origin was the necessity of the animal to have a supply of nutrients in order to resist long warm and dry season [3]. Recently we have reported that RH presented at 24 mo of animal age an astonishing amount of about 50.0% in fat fraction, the highest quantity in a tissue so far reported (Pedrao et al., 2009). One example relating the relative excess of fat and meat taste is the abundant marbled intramuscular fat of Japanese Black cattle as reported by Nishimura et al [6]. However the fatty acid profile of this kind of tissues is scarce therefore the aim of this work was report the RB m quantity and nutritive value to lipid fraction having LD m for comparison.

II. MATERIAL AND METHODS

Animals: Twelve male zebus breed (*Bos indicus*) of 18, 24, 36 and 48 months old grown in a free range farm system and fed under native grasses raised at Paraná state region, Brazil, and slaughtered in a commercial abattoir (Jataizinho, PR, Brazil) were studied. The carcasses were kept refrigerated for 24 hours prior to analysis. Six samples of both *Rhomboideus* m. (RB) and *Longissimus dorsi* m. (LD) were excised from each carcass. Aponevrosis tissues were carefully removed by dissection and intramuscular samples were analysed.

Lipids were extracted from the muscle tissues using the Bligh and Dyer (1959) method, and fatty acid methyl esters (FAME) were prepared by methylation of the the triacylglycerols, as described by method 5509 of ISO (1978). The FAME were analyzed using a Shimadzu 14A (Japan) gas chromatograph equipped with flame ionization detector and fused silica capillary column (50 m x 0.25 mm and 0.20 mm of Carbowax 20M). The column temperature was programmed at 2°C/min from 150 to 240°C. The injection port and detector were maintained at 220 °C and 245 °C, respectively. The column temperature was programmed to 150°C for 5 min, followed by a ramp of 2°C /min up to 240°C. The carrier gas was hydrogen (1.2 ml/min), the make-up gas was nitrogen (30 ml/min) and the split used was 1:100. The identification of normal fatty acids was carried out by comparing the relative retention times of FAME peaks from samples with standards from SIGMA.

III. RESULTS

The contents of total lipids are shown in Table 1. The termite has higher proportions of fatty matter when compared with *L. dorsi*. For analysis of the total lipid content found for *L. dorsi*, the values obtained are in agreement with the averages reported in the literature. [9], obtained values of 2.27%, [10] obtained 1.86%. [11] obtained for *L. dorsi* Nelore, values ranging from 1.05 to 2.60%.

Table 1 - Content of total lipids (g / 100g sample) in the muscles *L. dorsi* and *Rhomboideus* of male animals of different ages.

Age (months)	Total lipids (g/100g sample)			
	L.dorsi		*Rhomboideus*	
	Média	CV	Média	CV
18	3,29 (±0,94) ^{Aa}	28,6	16,77 (±5,98) ^{Ab}	35,6
24	2,83 (±1,47) ^{Aa}	51,9	50,39 (±8,50) ^{Bc}	16,9
36	2,08 (±1,20) ^{Aa}	57,7	3,76 (±1,58) ^{Ca}	42,6
48	1,74 (±0,19) ^{Ba}	10,9	14,22 (±6,13) ^{Ab}	43,1

Different letters indicate significant difference between samples at 5% significance; Lowercase letters indicate differences between the two muscles (rows), capital letters indicate difference between the same muscles (columns). CV is the coefficient of variation between samples. The result is the mean and standard deviation of triplicate analysis of three animals (n = 9).

To *Rhomboideus* muscle, the contents of fatty matter varied significantly ($p < 0.05$) between the ages analyzed and even for animals of the same age, so the standard deviation obtained was high, the same as the coefficient of variation. This may be due to problems during the mixing of samples, since the muscle *Rhomboideus* presents greater difficulty for homogenization due to the high content of collagenous material in its constitution, hindering the release of fatty matter throughout its structure.

To explain the variation in lipid content between the muscles, you should first verify that the function of each, the highest concentration of fat in the hump is easily understood, on the other hand, animals with 36 months of age had low fat content, which may be due to the nutritional conditions that these animals were compared to the other.

Therefore, it is assumed that the environment can interfere with the increased fat content of termites, as well as whole carcass, since the type of diet and climate have a direct influence on weight gain of animals.

According to Table 2, note that the amount SFA and MUFA are higher than the PUFA and the ratio PUFA/SFA is not in accordance with the

recommendations, which should be around 0.11 for beef, because the values obtained in this work indicate that both *L. dorsi* and *Rhomboideus*, the values are lower than recommended. We also observe that there is a significant difference (p> 0.05) for MUFA, PUFA and SFA in all ages
Authors [12] indicate that the composition of fatty acids present in animal fat, can be altered through diet. Thus, the increase in the amounts of polyunsaturated fatty acids can be obtained from the slaughter of animals with lower fat deposition [13].

These differences were also observed [14] with different types of forage and protein and mineral. In this study, it appears that the types of fatty acids found in the samples, as well as their amounts were statistically different (p <0.05) (Table 2).

Results are averages of the analysis of muscles in triplicate for each of the ages, with standard deviation in parentheses. Means with different letters in the same row differ significantly at 5%.

Table 2 - Fatty acids (g/100g) for *L. dorsi* e *Rhomboideus* de *Bos indicus* muscles with 18, 24, 36 e 48 months of age

Fatty Acids	***18 months***		***24 months***		***36 months***		***48 months***	
	LD	RB	LD	RB	LD	RB	LD	RB
PUFA	3.03^{e}	3.92^{a}	4.36^{a}	2.77^{c}	3.23^{d}	4.45^{f}	3.91^{a}	2.76^{c}
MUFA	46.44^{a}	46.79^{a}	40.10^{b}	56.67^{c}	45.85^{a}	38.96^{d}	40.38^{b}	37.51^{d}
SFA	50.53^{a}	49.29^{a}	55.53^{b}	40.56^{c}	50.62^{a}	56.58^{b}	55.70^{b}	59.73^{d}
n-6	2.19	3.26	2.36	1.54	2.79	3.18	2.51	1.58
n-3	0.83	0.44	1.99	1.23	0.,26	1.26	1.15	0,93
PUFA/MUFA	0.06	0.08	0.08	0.07	0.064	0.08	0.07	0.05
n-6/n-3	2.63	7.40	1.20	1.25	10.73	2.52	2.18	1.70

Results are averages of the analysis of muscles in triplicate for each of the ages, with standard deviation in parentheses. Means with different letters in the same row differ significantly at 5%.

IV. DISCUSSION

High values in the coefficient of variation was observed in Table 1 demonstrating the difficulties to carry out this analysis. Nevertheless the changes observed were the proportional decrease in fat fraction in LD m. throughout advance in age of the animal. The same cannot be said for the RB m. where this variability was enormous and for instance at 24 mo this amount was the astonishing value of over 50.0% and decreasing suddenly to around 3.0% at 48 mo of age. This variability seemed to have an explanation on the physiological role of fat fraction in the Nelore RB m. and goes back to its origin from those early times in India when it was used for nutrition since when the foods were scarce, this lipid fraction was used to be a energy source of the animal while starving (Jardim, 1972). This fact would explain the possibility to increase/decrease this intramuscular fact fraction depending on the animal physiological status. Having this unique property, it should be necessary to clarify how this muscle evolves because the production of collagen is also quantitatively abnormal since its amount is 10-15.0% higher in RB m in comparison to LD m irrespective of the age of the animal (Pedrao, et 2009).

Several authors also discussed that tgere was difference in fatty acid composition depending on the animal feed throughout his life span and the fatty acid profile is changeable according to this diet (FRENCH, 2000). Thus the amount of PUFA could be higher or lower or even with less deposition of intramuscular fat (DE SMET et al. 2000). This condition was observed by MOREIRA (2002) feeding with different sources of forage grass. Thus it is not surprising as we obtained these highly variability in the fatty acid profile for RB m. (Table 2).

V. CONCLUSIONS

Nelore *Rhomboideus* m. presented similar fatty acids profile to *Longissimus dorsi* m. irrespective of advancing in age of the animal although its quantity in total fat is higher.

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