LONGISSIMUS MUSCLE FATTY ACIDS PROFILE OF NELLORE BULLS ON DIFFERENT GRAZING HEIGHTS OF XARAÉS GRASS

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Abstract – Differences in fatty acid profile of *Longissimus* muscle in Nellore bulls under different grazing heights (15, 30, 45 and 60 cm) of xaraés grass were tested. Animals were kept during the experiment in paddocks with grazing under continuous variable stocking, in a completely randomized design. *Longissimus* muscle sample was collected and the composition of fatty acids was quantified. The fatty acid profiles were different for the percentages of lauric acid (12:0), heptadecanooic acid (17:1), oleic acid (18:1n9c) and eicosadienoic acid (20:2), being best in height of 30 cm grazing (0,36%, 0,85% 39,7% and 1,83%, respectively); myristic acid (14:0) and conjugated linoleic acid (C18:2,c9-t11) presenting better value for the height of 60 cm grazing (4,04% and 0,23%, respectively). The grazing height between 30 and 45 cm improves the levels of fatty acids in *Longissimus* muscle of Nellore bulls.

I. INTRODUCTION

Brazil have 170 million hectares of grasslands, 100 million are cultivated pastures [1]; 80% of cultivated pastures is formed by the genus *Brachiaria* [2].

Grazing height directly influences animal selectivity on pasture and feeding behavior [3]. Situations of low grazing (overgrazing) hamper the animal selectivity, reducing the quality of the ingested diet; high pasture (sub-grazing) disfavor forage quality, because the older the plant, the greater its lignification, and lower nutritional value[4]. As the plant reaches maturity, there is an increase in fiber content, stem elongation and a decrease in the proportion of leaves, besides the increase in the content of triacylglycerols in the seeds, and the lipid content decreases determining reduction in the content of fatty acids, mainly polyunsaturated [7]. Thus, situations of grazing height with balance between productivity and quality are necessary to sustainable production system.

The way the forage is provided to the animals (fresh, ensiled or baled) is crucial in the proportion of polyunsaturated fatty acids in meat. Bulky food contains higher levels of linolenic acid (C18:3), the precursor of the series of omega 3 (n-3) [5]. French *et al.* [6] reported that the inclusion of fresh forage in the diet of steers can provide increased deposition of Conjugated Linolenic Acid (CLA) in the tissues.

Some fatty acids, particularly polyunsaturated, are used as feedstock for substances that regulate immunity, contraction of the vessels, blood pressure, hormones production [8]. Fat of ruminant is natural source of these fatty acids. Alteration in fatty acid profile is interesting to human health from the point of view of reducing the risk of coronary heart disease, whereas saturated fatty acids are hypercholesterolemic and the less percentage is better [9].

According to FAO [10] higher proportions of omega-3 and polyunsaturated fatty acids in the diet of humans is important to prevent the onset of coronary heart disease, autoimmune diseases, breast cancer, prostate and colon cancer and rheumatoid arthritis. England Department of Health [11] recommends that the quantity consumed must be less than four parts of omega-6 to omega-3 for human consumption. However, there are few studies available that allow characterizing the beef produced on pasture and the link between grazing heights and meat's fatty acids profile.

The aim of this study was to identify the grazing height that improves the profile of *Longissimus* muscle fatty acids in Nellore bulls, from the perspective of human health.

II. MATERIALS AND METHODS

The experiment was lead in Cidade Gaúcha city, Paraná, southern Brazil, using the *Longissimus* muscle of 36 Nellore bulls with an average weight of 483±34,14 kg and slaughter age of 24±9 months, which were assigned to four treatments (15, 30, 45 and 60 cm grazing heights of *Brachiaria brizantha* cv. Xaraés – xaraés grass) with nine replications.

Extraction of total lipids was carried out using the cold technique described by Bligh and Dyer [12] and transesterification of triglycerides to the technique of Hartman and Lago [13]. The fatty acid methyl esters were analyzed by gas chromatography (Trace GC Ultra, ThermoScientific, EUA) autosampler equipped with a flame ionization detector at 240 ° C and fused silica capillary column (100 m long, 0.25 mm intern diameter and 0,20 µm, Restek 2560).

Identification of the fatty acid sample was performed by comparison with the retention time of methyl esters of fatty acids patterns of samples (Sigma, F.A.M.E. Mix, C4-C24) and the calculation of peak areas determined by Chromquest 5.0 Clarity Lite software version 2.4.1.91. The quantification of these fatty acids in mg g^{-1} of total lipids was performed in relation to the internal standard, methyl tricosanoate (Sigma).

The results were submitted to analysis of variance using the SAS software, version 9.3, and when significant were subjected to regression analysis.

III. RESULTS AND DISCUSSION

There was no effect of the heights managements on the composition of fatty acids, except for percentages of lauric acid (12:0), myristic acid (14:0), heptadecenoic acid (17:1), oleic acid (18:1n9c), conjugated linoleic acid (C18:2c9t11) and eicosadienoic acid (C20:2n6) (Table 1).

Table 1. Fatty acids profile (g $100g^{-1}$) of *Longissimus* muscle of Nellore bulls in different grazing heights of xaraés grass.

	Grazing Height (cm)				
	15	30	45	60	P-value
Fatty Acids[1]					
C12:0	0,68	0,36	0,39	0,67	<0.05[2]
C14:0	4,98	4,40	4,16	4,04	<0.05[3]
C16:0	25,76	24,97	26,21	25,4	0.38
C17:0	0,42	1,06	0,98	1,17	0.33
C18:0	18,92	17,63	19,27	18,69	0.11
C20:0	0,3	0,24	0,3	0,3	0.23
C21:0	0,21	0,14	0,16	0,08	0.35
C22:0	0,07	0,09	0,12	0,16	0,23
C23:0	1,61	1,58	1,79	0,57	0.35
C14:1	0,45	0,58	0,42	1,43	0.29
C16:1	1,47	2,14	2,89	2,66	0.30
C17:1	1,21ab	0,85b	1,23ab	1,31a	<0.05
C18:1n9c	37,95ab	39,71a	36,04b	38,29ab	<0,05
C20:1	0,47	0,74	1,73	0,9	0.29
C22:1n9	0,11	0,07	0,06	0,09	0.35
C18:2c9t11	0,20	0,15	0,15	0,23	<0.05[4]
C18:2n6c	0,3	0,11	0,13	0,16	0.23
C18:3n3	0,11	0,1	0,11	0,11	0.23
C18:3n6	5,36	5,87	5,26	6,07	0.21
C20:2n6	0,36	1,83	0,89	0,89	<0.05[5]
C20:3n3	0,01	0,01	0,01	0,01	0.23
C20:3n6	0,2	0,27	0,36	0,22	0.21
C20:4n6	0,02	0,02	0,01	0,02	0.35
C20:5n3	0,01	0,11	0,07	0,06	0.45
C22:2n6	0,61	0,3	0,45	0,24	0.36
C22:6n3	0,2	0,24	0,24	0,42	0.29

[1] C12:0 = Lauric Acid; C14:0 = Myristic Acid; C16:0 = Palmitic Acid; C17:0 = Heptadecanoic Acid; C18:0 = Stearic Acid; C20:0 = Arachidic Acid; C21:0 = Heneicosanoic Acid; C22:0 = Behenic Acid; C23:0 = Tricosanoic Acid; C14:1 = Myristoleic Acid; C16:1 = Palmitoleic Acid; C17:1 = Heptadecenoic Acid; C18:1n9c = Oleic Acid; C20:1 = Gadoleic Acid; C22:1n9 = Erucic Acid; C18:2c9t11 = Conjugated Linoleic Acid; C18:2n6c = Linoleic Acid; C18:3n3 = λ-linolenic Acid; C18:3n6 = γ-linolenic Acid; C20:2n6 = Eicosadienoic Acid; C20:3n3 = Eicosatrienoic Acid; C20:3n6 = Di-homo-γ-linolenic Acid; C20:4n6 = Arachidonic Acid; C20:5n3 = Eicosapentaneoic Acid; C22:2n6 = Docosadienoic Acid; C22:6n3 = Docosahexaenoic Acid.

[2] $\hat{Y}=1,26671-0,0498067x+0,000666608x^2$ ($r^2=0.87$; $p=0.0455$);

[3] $\hat{Y}=5,24039-0,0212554x$ 9 ($r^2= 0.95$; $p=0.0461$);

[4] $\hat{Y}=0,326938-0,0106259x+0,000150079x^2$ ($r^2=0.89$; $p=0.04614$);

[5] $\hat{Y}=0,0633049+0,0857213x-0,00138714x^2$ ($r^2=0.92$; $p=0,213$).

Means followed by different letters, in the same row, differ according to Tukey's test at 5% probability.

The lauric acid (Figure 1) showed a quadratic effect (minimum point, 0.34% at 37.36 cm grazing height) and myristic acid (Figure 2) had a negative linear effect. Lauric (C12:0), myristic (C14:0) and palmitic acid (C16:0), are undesirable for the reason that they induce the increase of cholesterol [14], being appointed as the main responsible for the hypercholesterolemic effect of saturated fatty acids and increased low density lipoprotein (LDL, or bad cholesterol) which are responsible for coronary heart disease. Conjugated linoleic acid (C18:2c9t11) (Figure 3) showed a quadratic effect (minimum point of 0.13% and grazing height of 35.40 cm).

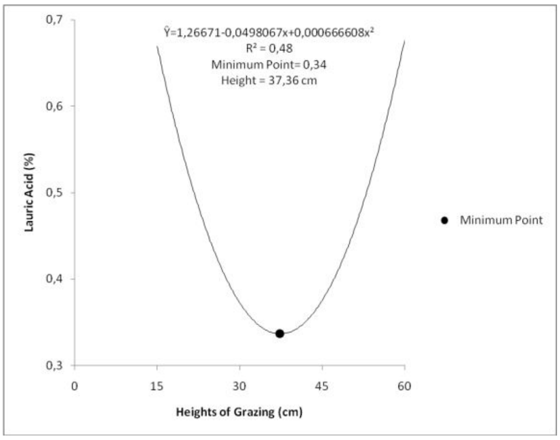

Figure 1. Quadratic effect of Lauric Acid’s profile of *Longissimus* muscle of Nellore bulls in different grazing heights of xaraés grass.

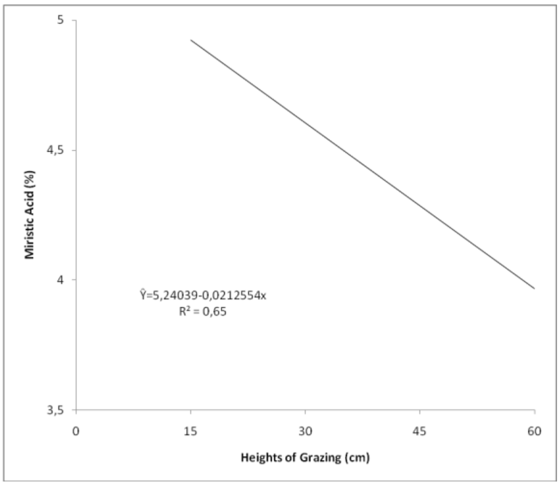

Figure 2. Linear effect of Myristic Acid’s profile of *Longissimus* muscle of Nellore bulls in different grazing heights of xaraés grass.

Oleic acid (C18:1n9c) had a higher percentage than other fatty acids (38.00% ± 1.51) and its highest values occurred in the treatment with 30 cm of grazing height (39.71%). Diets with high percentage of oleic acid provide reduction in the percentage of LDL, the ratio LDL:HDL and total plasma cholesterol levels, showing a positive effect for human health. The consumption by humans of oleic acid has anticarcinogenic effect reduces atherosclerosis in restoration of insulin sensitivity, modulation of the immune response and inhibition of tumor growth [10].

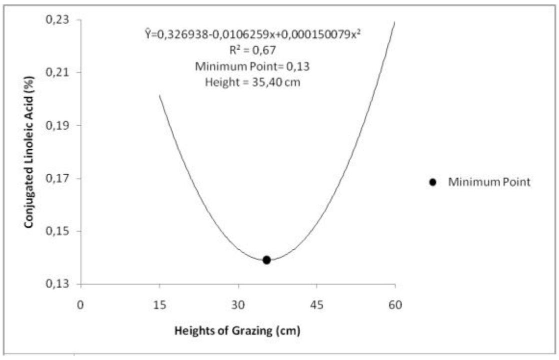

Figure 3. Quadratic effect of Conjugated Linoleic Acid’s profile of *Longissimus* muscle of Nellore bulls in different grazing heights of xaraés grass.

Eicosadienoic acid (C22:2n6) (Figure 4) had a quadratic effect with maximum point 1.39% at 30.90 cm grazing height. Probably, the increase in plant height is related to age and may confer a decrease in cellular contents, in order to decrease the thickness of the cell wall, causing thus a decrease of the acid’s content.

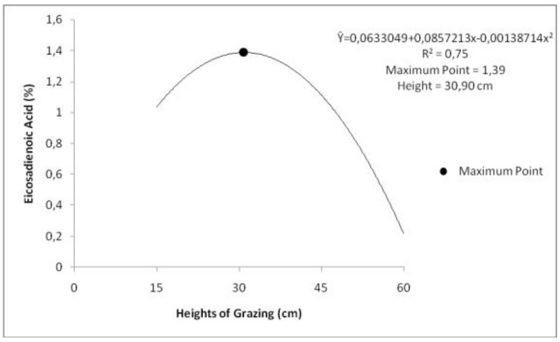

Figure 1. Quadratic effect of Eicosadienoic Acid’s profile of *Longissimus* muscle of Nellore bulls in different grazing heights of xaraés grass.

This profile of fatty acids, in general, may have occurred due to the fact that, at the height between 30 and 45 cm, animals had better availability of food, and consequently better-quality leaves, performing grazing when the plant is more productive than what occurred at the heights of 15 (overgrazing) and 60 cm (sub-grazing). Thus, the animal selectivity may have contributed to the better quality diet, because the leaves have greater amounts of fatty acids, and lipids are predominantly in fodder leaves.

IV. CONCLUSION

Data show that, for the percentage of fatty acids, the height of 30 cm was best, considering the best values for unsaturated fatty acids.

The grazing management in heights between 30 and 45 cm, positively alter the levels of fatty acids, important to human health, in *Longissimus* muscle of Nellore bulls.

The management of pasture appears to provide additional advantages to productive systems based on pasture, considering that the use of pasture is interesting to minimize production costs, higher production stability, reduced dependency external factors, greater use of natural conditions of climate and soil, promoting a sustainable production system.

More research is needed to find the actual meat's fatty acids effect of Nellore bulls grazing xaraés grass on human health, as to the relation between xaraés grass fatty acids and Nellore bulls fatty acids.

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