Natural additives on fatty acids composition of *Longissimus* muscle from bulls (Angus vs. Nellore) finished in feedlot

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Abstract – In the present study the inclusion of natural additives in the diet of 48 bulls (Angus vs Nelore) were assessed on chemical composition of Longissimus dorsi. The bulls were randomly assigned in four treatments: control (CON); addition of 4 g/animal/day of essential oils from castor bean (EOL); addition of 10 g/animal/day of a commercial product composed of a mix of essential oils from oregano, Confimax (MAX) and addition of 5 g/animal/day of yeast (YST). The fatty acids profile was assessed by a gas chromatography (Varian, USA). Most fatty acids in the Longissimus muscle were not altered by the inclusion of additives in the diet. The myristic acid was higher in the CON diet compared to the EOL diet. Palmitic acid was lower for the LEV diet. Oleic acid was higher in the LEV diet than in the MAX diet. However the essential fatty acids linoleic and linolenic were not afftecd by the diets, thus natural addtives can be used as an alternative to the conventional products to finish bulls in feedlot.

I. INTRODUCTION

When cattle are fed in feedlot, high energetic density diets are used. Highly fermentable carbohydrates can lead to a quick drop in pH and result in ruminal acidosis [1]. Thus, it is necessary to include additives in diets to modulate the ruminal fermentation and reduce methane emission [2].Essential oils are a mix of complex lipophilic, volatile and low molecular weight substances, generally with a characteristic odour. They can be extracted from all the parts of plants, i.e. leaves, flowers, stems, seeds, roots and hulls [3]. Ricinoleic acid is the major component of castor bean (Ricinus communis) oil and the hydroxyl compounds in it causes the rupture of bacterial membrane [4]. Anacardic acid, cardanol and cardol are the mains constituents of cashew (Anacardium occidentale) oil and they act especially on gram-positive bacteria by the rupture of physical membrane of bacteria and inhibition of the bacterial respiration chain [5]. Carvacrol is a compound found in oregano (Origanum vulgare) which affects gram-positive bacteria by reacting with membrane lipids and hydroxyl radicals and turning them instable [6]; and inclusion of carvacrol increase propionate proportion in ruminants [7], and antimicrobial, antiparasitic and antioxidant activity [8]. Yeast (Saccharomyces cerevisiae) has a role at rumen pH stabilization and for providing a healthier environment for cellulolytic bacteria, which in turn helps pH stabilisation [9].Microbial additives and their extracts may benefit ruminant nutrition to the same degree as ionophores, mainly by increasing feed intake [10]. The objective of this work was to evaluate the effect of the inclusion of different natural additives in the diet on fatty acids profile of Longissimus muscle of bulls (Angus vs. Nellore) finished in feedlot.

II. MATERIALS AND METHODS

Forty eight bulls (Angus vs. Nellore) with average 318±30 kg and 22 months old were used. Bulls were randomly assigned to one of the four diets: control (CON); addition of 4 g/animal/day of essential oils from castor bean (EOL); addition of 10 g/animal/day of a commercial product composed of a mix of essential oils from oregano, Confimax (MAX) and addition of 5 g/animal/day of yeast (YST). Natural additives were provided by VetScience Bio Solutions. The bulls were fed twice a day (08h00 and 15h00) and diets were formulated with a ratio of 50:50 forage and concentrate for a weight gain of 1.5 kg/day according to NRC [11]. Animals were slaughtered according to brazilian industrial practices. After 24 hours chilling Longissimus muscle were excised from carcasses and samples were thawed, ground, homogenised and analysed in triplicate.Fatty acid methyl esters (FAMEs) were prepared by triacyl glycerine methylation according to ISO [12] method and were analysed in a gas chromatograph (Varian, USA), equipped with a flame ionisation detector and a fused silica capillary column CP-7420 (100 m, 0.25

mm and 0.39 μmo.d., Varian, USA) Select Fame. The column temperature was programmed at 165°C for 10 min, 180°C (30°C min−1) for 22 min, and 240°C (15°C min−1) for 30 min with 45-psi pressure. The injector and detector were kept at 220°C and 245°C, respectively. Gas flows (White Martins, São Paulo, Brazil) were 1.4 mL min−1 for carrier gas (H2); 30 mL min−1 for make-up gas (N2); and 30 mL min−1 and 300 mL min−1 for H2 and synthetic flame gas, respectively. The sample was injected using a split mode 1/80. Fatty acids (FAs) were identified by comparing the relative retention time of FAME peaks of the samples with FAME standard 189-19 from Sigma Company, St Louis, MO, USA by spiking samples with the standard. The peak areas were determined using Star software (Varian, Walnut Creek, CA, USA). A variance analysis was performed, using the SAS (2004) software. Comparison of means was performed using Tukey test at 5% of significance.

III. RESULTS AND DISCUSSION

Few fatty acids in Longissimus muscles were affected by the inclusion of natural additives (Table 1). However, C14:0 (myristic acid), C14:1 n-9 (fiseteric acid), C16:0 (palmitic acid), C17:1 n-9 (oleic acid), C18:1 n-7 (vacenic acid), C18:3 n-6 (γ-linolenic acid) were different among treatments (P < 0.10). Fatty acids composition is multifactorial affected, i.e. breed, age, gender and diet composition [13]. The fatty acids with higher content were palmitic acid (C16:0), stearic (C18:0) and oleic (C18:1 n-9), representing 80% of total identified fatty acids, which is corroborates other studies; [13]). Myristic fatty acid (C14:0) was higher for CON (*P* < 0.10) and lower for EOL. Palmitic fatty acid (C16:0) was lower (*P* < 0.10) for YST, with an average of 25.02%. Maggioni [14] found no differences when yeast was added to the diets of crossbred bulls finished in feedlot. Stearic fatty acid (C18:0) has a high content in beef cattle muscle. This fatty acid was similar among treatments. Observed average was 16.7%, which is lower than what Zawadzki, [15] found when evaluating functional oils and/or glycerine in the diet of young bulls finished in feedlot. Oleic fatty acids (C18:1 n-9) where higher (*P* < 0.10) for YST treatment (41.4%) compared to MAX treatment (39.0%), and similar among CON and EOL and other treatments. Maggioni, [14] found no differences for these fatty acids in the meat of crossbred beef cattle fed sorghum silage or hay with the inclusion of yeast. Percentages of vaccenic acid (C18:1 n-7) were higher (*P* < 0.10) for MAX compared to EOL, with 1.41 and 1.08%, respectively, and 1.18% and 1.21% for the CON and YST treatments, respectively.

Table 1 Fatty acids composition of *Longissimus* muscle from bulls (Angus *vs.* Nellore) finished in feedlot fed different natural additives

Fatty acid	Treatments				*P* < F
	CON[1]	EOL[2]	MAX[3]	YST[4]	
N	12	12	12	12	
12:0	0.06	0.06	0.06	0.06	Ns
13:0	0.04	0.03	0.03	0.04	Ns
14:0	3.27[a]	2.83[b]	3.12[ab]	2.87[ab]	T
14:1 *n*-9	0.81[a]	0.55[b]	0.69[ab]	0.59[b]	T
15:0	0.28	0.27	0.28	0.26	Ns
15:1 *n*-9	0.13	0.13	0.13	0.14	Ns
16:0	26.30[a]	26.33[a]	26.49[a]	25.02[b]	T
16:1 *n*-9	0.25	0.24	0.24	0.25	Ns
16:1 *n*-7	3.28	2.93	3.24	3.02	Ns
16:1 *n*-5	0.46	0.44	0.43	0.44	Ns
17:0	0.78	0.83	0.81	0.81	Ns
17:1 *n*-9	0.58	0.55	0.59	0.59	Ns
18:0	16.21	17.37	16.50	16.88	Ns
18:1 *n*-9t	1.13	1.20	1.18	1.17	Ns
18:1 *n*-9	39.61[ab]	39.70[ab]	39.03[b]	41.40[a]	T
18:1 *n*-7	1.18[ab]	1.08[b]	1.41[a]	1.21[ab]	T
18:2 *n*-6	2.89	2.84	2.98	2.70	Ns
18:3 *n*-6	0.14[a]	0.12[ab]	0.12[ab]	0.10[b]	T
18:3 *n*-3	0.27	0.26	0.26	0.25	Ns
20:0	0.36	0.37	0.38	0.38	Ns
20:1 *n*-9	0.25	0.26	0.26	0.29	Ns
22:0	0.12	0.11	0.11	0.11	Ns
20:4 *n*-6	0.80	0.70	0.83	0.70	Ns
20:5 *n*-3	0.17	0.15	0.18	0.16	Ns
22:4 *n*-6	0.11	0.11	0.11	0.09	Ns
22:5 *n*-3	0.02	0.06	0.02	0.01	Ns
22:6 *n*-3	0.08	0.05	0.06	0.06	Ns
24:0	0.46	0.43	0.47	0.42	Ns

1Control; 2Essential oils; 3Confimax; 4Yeast; Means within a row lacking a common superscript letter differ significantly (P < 0.10).

Among the quantified fatty acids, linoleic acid (C18:2 n-6) and α-linolenic (C18:3 n-3) are some of the fatty acids classified as strictly essential for health. These fatty acids must be present in our daily meals, as mammals cells cannot synthetize these fatty acids. Also, these fatty acids enter a metabolic pathway to be transformed in other essential fatty acids [16], like n-3 fatty acids family, which have α-linolenic fatty acid as precursor, and n-6 fatty acids family, which have linoleic acid as precursor [17] Mean values quantified for linoleic and α-linolenic were 2.85 and 0.26%, respectively. Maggioni, [14] quantified superior values from these fatty acids. Long chain fatty acids are biohydrogenated in rumen to stearic fatty acid [18].

IV. CONCLUSION

The inclusion of different natural additives in the diets, presented few changes in the fatty acids profile of beef cattle finished in feedlot. However the essential fatty acids linoleic and α-linolenic, were not affected by the treatments, thus these natural additives can be used as an alternative for the substitution of conventional antimicrobial products.

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