EFFECT OF INCLUSION OF ESSENTIAL OILS AND AGEING ON LIPID OXIDATION OF CROSSBRED YOUNG BULLS FINISHED IN A FEEDLOT

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Abstract – The objective of this study was to assess of the effects of the inclusion of essential oils (MixOil®) on lipid oxidation of meat of young bulls finished in feedlot. Twenty seven 12 month-old crossbred (Angus vs. Nellore), average weight of 243.2 ± 35.3 kg were randomly assigned to one of three finishing diets composed with MixOil®: without addition of blend (E0.0), with 3.5 g/animal/day (E3.5) and with 7 g/animal/day (E7.0) of blend. Component of blend consisted on seven plants extracts: oregano, garlic, lemon, rosemary, thyme, eucalyptus and sweet orange. Animals were slaughtered with 440.3 ± 42.7 kg and carcasses were labeled and chilled for 24 h at 4oC. *Longissimus dorsi* muscle (LM) was used to quantify the lipid oxidation (TBARS). The addition of essential oils in the diet had a significant effect (P<0.05) on lipid oxidation at the 24 hours and 14 days of ageing. The diet E3.5 had lower lipid oxidation in ageing times. E7.0 had a pro-oxidant effect with the advanced of ageing. Lipid oxidation increases with exposure time; however, only between days 7 and 14 did those variations increase significantly.

Key Words – meat quality, natural additives, time of exposure.

I. INTRODUCTION

Over the last decade, the addition of antibiotics in livestock production systems has been common, especially when animals are reared intensively in order to prevent diseases, metabolic disorders, and to improve feed efficiency. However, due to the emergence of antibiotic resistance and the possible risks to human health due to residues in the final products [1].

In this sense, plant extracts have an interesting role, as some authors have reported [2][3], due to their consideration as a safe food additive.

Several studies have reported varied activities of essential oils [4] as feed additives for livestock because they improve feed efficiency and animal productivity due to their antimicrobial, anti-inflammatory, antioxidant, and digestive modulatory effects on ruminal metabolism [5]. Although a high diversity of plants demonstrate that this effect exists, oregano and thyme are the two species with the highest antioxidant potential, thanks to the presence of phenolic terpenes such as thymol and carvacrol [5]. Due to the possible synergy that exists between the different principal components of each plant, the possible combinations between them are numerous, as are the ways to incorporate the essential oil.

This work was carried out to investigate the effect of lipid oxidation on meat of crossbreed young bulls, whose diets were or not supplemented with different levels of an essential oils blend.

II. MATERIALS AND METHODS

Twenty-seven 12 month-old crossbred (½ Angus vs. ½ Nellore) young bulls, average weight of 243.2 ± 11.7 kg, respectively, were randomly assigned to one of three finishing diets (n = nine for young bulls per treatment). The three experimental treatments were: (E0.0) diet without addition of the blend of Essential oils (EO), (E3.5) diet with 3.5 g/animal/day of the blend of EO, and (E7.0) diet with 7.0 g/animal/day of the blend of EO. The blend of EO used consisted of seven plants extracts: oregano (*Origanum vulgare*), garlic (*Allium sativum*), lemon (*Citrus limonium*), rosemary (*Rosmarinus officinalis*), thyme (*Thymus vulgaris*), eucalyptus (*Eucalyptus saligna*) and sweet orange (*Citrus aurantium*), registered as Mixoil® (Animal Wellness Products

– Oakland – Nebraska – USA). The blend of EO had powdery texture; and it was mixture directly to the concentrate each two weeks in a commercial mixer where diets were prepared during experimental period. The young bulls were finishing with their respective diets under intensive conditions (90:10; respectively concentrate and forage). The concentrate consisted of corn grain (819 g/kg of dry matter, DM), soybean meal (65 g/kg of DM), Limestone (4.6 g/kg of DM), yeast (0.5 g/kg of DM), mineral salt (4.1 g/kg of DM) and urea (6.2 g/kg of DM). Sugar-cane pellets were used as-forage. The basal diet was the same for all animals, formulated according to NRC [6] recommendations for a 1.5 kg/day average daily gain presenting dry matter intake of 7.07 kg for all the treatments. All diets were isoenergetic and isonitrogenous. The diet consisted of 125 g/kg of DM of crude protein, 22 g/kg of DM of ether extract, 303 g/kg of DM of neutral detergent fiber, 14.8 g/kg of DM of acid detergent fiber and 708 g/kg of DM of nutrient digestible total. The mineral salts consisted of (g/kg of DM) 150 Ca, 88.0 P, 0.08 Co, 1.45 Cu, 10.0 S, 1.0 Fe, 0.88 F, 0.06 I, 10.0 Mg, 1.10 Mn, 0.02 Se, 120 Na and 3.40 Zn. The bulls were finished for 4 (young bulls) months. The bulls were slaughtered with 440.3 ± 42.7 kg at a commercial slaughterhouse 20 km from Experimental Farm (Maringá, PR) according to Brazilian practices. After slaughter, the carcasses were labelled and chilled for 24 h at 4°C. After chilling, the carcass were weight and the right side of carcass was used to determine the quantitative and qualitative characteristics. The *Longissimus* muscle (LM) was excised from the left side of the carcass between the 7^{th} and the 9^{th} ribs, sliced into steaks (2.5 cm thick). weighed, vacuum-packed, and aged for either 24 h and 7 or 14 days before being frozen and stored (-20ºC) for one month for subsequent analyses. A small portion from the medial surface of the steak was cut and used to assess lipid oxidation (TBARS) through the procedure described by Pfazgraf, Frigg & Steinhart [7]. Results were expressed as mg malonaldeyde/kg meat.

The experimental design was completely randomized with three treatments and nine replications. The characteristics that were under study were tested for normality. Those that showed a normal distribution were analyzed through analysis of variance by using the procedure proc MIXED with SAS (2004)[8] statistical package (Statistical Analysis System, version 8.1). Differences between group means were assessed by using the Tukey Test (p<0.05).

III. RESULTS AND DISCUSSION

The addition of essential oils in the diet had a significant effect (P<0.05) on lipid oxidation (Table 1) at the first stages (one day) and the third stages (14 days) of ageing. The diet E7.0 at 24 hours of ageing presented with intermediate values, at the same level of significance as the other two diets (E0.0 and E3.5) and at 14 days of ageing higher values that E3.5 and same level of significances as the diet E0.0.

Meat from animals that were supplemented with 3.5 g/animal/day of essential oils showed the smallest values in lipid oxidation at short and long periods of exposure (P<0.05). With 7 days of ageing, differences among the three diets were not significant (P>0.05). However, the addition of 3.5 g/day of essential oils in the diet seems to be more favorable than 7 g/day, based on the smallest results in lipid oxidation from 0 and 14 days of aging.

Table 1 Effect of essential oils inclusion and display time on lipid oxidation (mg malonaldehyde/kg of meat) of crossbred young bull meat

Tbars	Essential oils			SEM[4]	*P*[5]
	E0.0[1]	E3.5[2]	E7.0[3]		
0 days	0.10Bw	0.07Aw	0.08ABw	0.01	0.04
7 days	0.15w	0.14w	0.12w	0.01	0.24
14 days	0.60ABz	0.47Az	1.0Bz	0.12	0.01
SEM	0.05	0.03	0.09		
P[5]	0.01	0.01	0.01		

[1]Without essential oils; [2]3.5 g essential oils/animal/day; [3]7.0 g essential oils/animal/day. SEM: Standard error of mean. ns: not significant. [5]Probability, n = nine bulls per treatment;

A, B: different superscripts represent significant differences inside the row, between treatments (p≤0.05).

w, z: different superscripts represent significant differences during display time

Animals were fed with an inclusion of 7g/day of essential blend in the diet and had lipid oxidation values that increased with the length of ageing.

These results can be explained because depending on the active ingredient of each essential oil and its dosage, they can become toxic to the cells and the membrane having an accustomed pro-oxidant [5].

Our findings are globally in agreement other studies [9]. They evaluated the antioxidant effects of the inclusion of essential oils from oregano and sage in raw and cooked beef meat at a 3% weight of the sample. Fasseas. [9] reported statistical differences between the control meat and the meat with essential oils. Samples with oils showed a lower oxidation for all days of exposure; however, in the raw meat, those differences, as in our study, were not maintained during the entire period that was studied (12 days), as there was an irregular kinetic that erased the differences at day 4 of aging but started again at 8 days.

Lipid oxidation increases with exposure time; however, only between days 7 and 14 did those variations increase significantly ($P<0.05$).

Values that were obtained from this crossbreed agree with those findings of Fassesas [9]; however, for them, statistical differences were seen earlier between days 4 and 8 of exposure.

IV. CONCLUSION

The addition of essential oils has an antioxidant effect by decreasing lipid oxidation in a significant way with respect to diet without essential oil. The best results and the highest effect of antioxidant compounds were obtained with the addition of 3.5 g/animal/day and on the first day of ageing. The inclusion of 7.0 g/animal/day of a blend of essential oils had pro-oxidant effects on the meat.

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