CHARACTERISTICS OF BEEF RESTRUCTURED WITH ANTIOXIDANT AND CANOLA OIL DURING STORAGE

Lopes, M. R. F.[1], Pereira, A. S. C.[1], Hajaj, S. H.[1], Mazalli, M. R.[2], Belo. M. D.[2], Balieiro, J. C. C.[3]

[1]Department of Nutrition and Production Animal, University of Sao Paulo, Pirassununga, Brazil; [2]Department of Food Engineering, University of Sao Paulo, Pirassununga, Brazil; [3]Department of Basic Sciences, University of Sao Paulo, Pirassununga, Brazil.

Abstract - The meat sector industries are seeking ways to add value to lower acceptance cuts. Restructured meats are a technological alternative to the cuts intact, as convenience products for the consumer. The objective of this study was to evaluate the quantitative and qualitative characteristics and shelf life of the restructured beef developed with *Triceps brachii* muscle, using transglutaminase enzyme and antioxidant and/or canola oil. The results obtained for fat content were greater (P<0.05) for treatments with canola oil. The antioxidant sodium erythorbate effectively reduced (P<0.05) lipid oxidation compared with control. There were a significant difference (P <0.05) for texture, where the restructured steaks with canola oil had the lowest shear force values.

Key Words – shear force, sodium erythorbate and transglutaminase.

I. INTRODUCTION

The meat sector industries are seeking ways to add value to lower acceptance cuts. Restructured meats is a technological alternative to the cuts intact, creating more uniform products form, color and texture [1], especially those from the beef forequarter. Thus seeking to appeal to consumers in terms of convenience, the portion size, composition and ease preparation, by changing the ingredients used in their formulation [2].

The connection between the meat pieces is often achieved by solubilization of the proteins on the surface there of, which are compression molded into the desired shape and then joined in one piece [3 and 4]. For best occurring the connection between the meat pieces different binder systems have been studied among the commercial products is the enzyme transglutaminase (Activate ® EB-TG).

Several oleaginous species have promising potential value for food industry. Canola oil is one of the healthiest because it has high amount of Omega-3 (reduces triglycerides and control atherosclerosis), vitamin E (antioxidant that reduces free radicals), monounsaturated fats (reduce LDL) and lower saturated fat (control cholesterol) of all vegetable oils. Canola oil has been recognized as an excellent source of linolenic acid [5]. According Corner *et al.* [6] the use of canola oil in feed provide beneficial effects on blood lipid composition, with significant increase of a-linolenic acid and EPA in plasma as well as increased levels of EPA and DHA in platelets.

Experiments using conventional meat, by system restructuring (including NaCl and phosphate), with addition of oil to produce restructured beef (pre-cooked and frozen) have results in products with acceptable physicochemical and sensory properties [7].

Thus, the objective of this study was to evaluate the quantitative and qualitative characteristics and shelf life of the restructured beef developed with *Triceps brachii* muscle, using transglutaminase enzyme, antioxidant and addition of canola oil.

II. MATERIALS AND METHODS

The study was conducted at the Faculty of Veterinary Medicine, University of São Paulo, Campus of Pirassununga.

The restructured beef was prepared from the *Triceps brachii* muscle. The treatments were: (1) control (2) adding 5% canola oil, (3) addition of sodium erythorbate, (4) addition of 5% Canola oil + sodium erythorbate.

In each treatment the meat is cut and processed with 1% NaCl and 0.3% sodium tripolyphosphate, 1% transglutaminase enzyme and 10% beef fat. Still in the mixer was added 5% canola oil (treatments 2 and 4) and finally were added to dry 1% transglutaminase and 0.05% of antioxidant (groups 3 and 4).

The mixture obtained through the processing was placed in the square shapes and pressed, left under refrigeration at a temperature of about 0°C for the enzyme activity for 6 h. After this period the blocks were frozen. Once frozen, the blocks were removed the square shapes and frozen cut in saw with 2 cm thick, the samples were packed individually in vacuum packaged, identified and maintained under refrigeration at a temperature of about -18°C for 30 days, 60 days, 90 days and 120 days, with the objective of evaluating the shelf life of steaks through the assessment of lipid oxidation by the method of Sorensen & Jorgense [8]. We also evaluated the ether extract content by the method of Bligh & Dyer [9] in the raw samples and shear force in cooked samples. These samples were thawed under refrigeration and baked on a hot plate at 180°C until internal temperature of 71°C [10] for analyzing with cell the cutting plane, using methodology described, Shackelford, Koohmarae & Wheeler [11].

III. RESULTS AND DISCUSSION

The lipid oxidation is one of the mechanisms of quality deterioration especially in meat products. Changes in quality are manifested by unfavorable changes in flavor, color, texture and nutritional value, and possible production of toxic compounds. Disruption of muscle membrane integrity by mechanisms such as cutting and mixing, alter the cellular compartmentalization, facilitating the interaction of agents pro-oxidants with unsaturated fatty acids, resulting in the generation of free fatty acids and the propagation of oxidative reactions [12].

There was significant interaction (P<0.05) between treatments depending on the storage time for TBARS values as Table 1.

Table 1. Means and standard errors means of the results of the TBARS value (mg malonaldehyde / kg of sample) of the restructured beef.

Time (days)	Treatments			
	Control	Canola	Antiox.	Canola + Antiox.
0	0.044 ± 0.2 $^{c\ f}$	0.087 ± 0.2 $^{d\ f}$	0.060 ± 0.2 $^{b\ f}$	0.094 ± 0.2 $^{b\ f}$
30	0.059 ± 0.2 $^{c\ f}$	0.053 ± 0.2 $^{d\ f}$	0.049 ± 0.2 $^{b\ f}$	0.076 ± 0.2 $^{b\ f}$
60	4.517 ± 0.2 $^{b\ f}$	4.104 ± 0.2 $^{a\ f}$	0.680 ± 0.2 $^{a\ g}$	0.838 ± 0.2 $^{a\ g}$
90	5.587 ± 0.2 $^{a\ f}$	2.992 ± 0.2 $^{b\ g}$	1.056 ± 0.2 $^{a\ h}$	1.053 ± 0.2 $^{a\ h}$
120	4.838 ± 0.2 $^{b\ f}$	2.387 ± 0.2 $^{c\ g}$	0.946 ± 0.2 $^{a\ h}$	1.066 ± 0.2 $^{a\ h}$

$^{a-d}$ Means in the same column followed by same letter do not differ significantly (P> 0.05)
$^{f-h}$ Means in the same line followed by same letter do not differ significantly (P> 0.05).

Analyzing the results in Table 1 lines can be seen that for times 0 and 30 days there was no significant difference (P>0.05) between treatments. Already at 30, 60 and 90 days, there was a significant difference (P>0.05) between treatments, where no antioxidant treatments had higher values for TBARS. Treatment with Canola also differed from treatment Control, showing that the canola oil has an antioxidant effect.

The columns results analyzed show that lipid oxidation increases as the frozen storage progresses, but was effectively delayed by the addition of the antioxidant sodium erythorbate in the restructured beef. The antioxidant effect explains the significant interaction (P<0.05) between treatment x storage time in restructured steaks [13]. Reverte *et al.* [14] observed similar effect using antioxidant propyl gallate in beef steers.

Serrano *et al.* [15] tested at different levels of walnut in restructured beef and observed that the oxidation was higher in restructured beef with walnut than the control samples, an effect that may have been related to the fat and nut content. The graph that represents this interaction for the value of TBARS is shown in Figure 1.

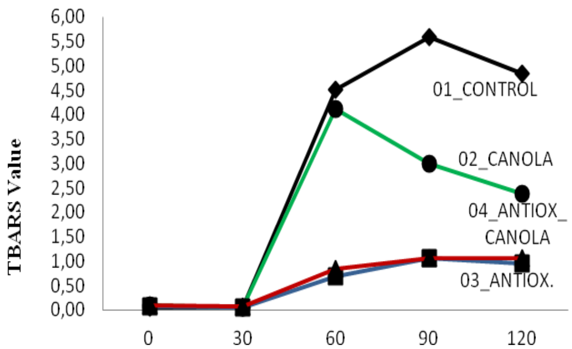

Figure 1. Treatment x storage time interaction on TBARS value (mg malonaldehyde / kg of sample) of raw restructured beef.

Canola oil changed as expected (P <0.05) the fat content of raw restructured beef, according to Table 2.

Table 2. Means and standard errors mean of the value of ether extract in *Triceps brachii* muscle.

Treatments	Ether extract **(g/100g)**
Control	10.42 ± 0.60 [b]
Canola	13.05 ± 0.60 [a]
Antioxidant	9.89 ± 0.60 [b]
Canola + Antioxidant	13.97 ± 0.60 [a]

[ab] Means in the same column followed by same letter do not differ significantly (P> 0.05).

The results for shear strength are presented in Table 3.

Table 3. Means and standard errors of the texture parameters of restructured beef assessed by shear force.

Treatments	Force (N)
Control	125.76 ± 4.26 [a]
Canola	96.10 ± 4.26 [b]
Antioxidante	123.64 ± 4.26 [a]
Canola + Antioxidant	109.62 ± 4.26 [ab]

[ab] Means in the same column followed by same letter do not differ significantly (P> 0.05).

The addition of canola oil had a significant effect (P<0.05), giving a softer compared to treatments without canola oil. Cestari *et al.* [16] used the same technology shear force of restructured beef and obtained similar values from 107.65 to 136.07N.

In a study by Serrano *et al.* [17] the lowest values of texture were found in steaks restructured with addition of walnut.

IV. CONCLUSION

Treatments with added antioxidant sodium erythorbate in this study had characteristics of lipid oxidation enhanced, resulting in longer shelf life for restructured steaks. Canola oil is effective in softening the meat, resulting in restructured beef grilled with lower values of shear force, thus providing sensory characteristics valued by consumers.

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