PHYSICAL CHEMICAL CHARACTERISTICS OF BEEF RESTRUCTURED WITH ANTIOXIDANT AND CANOLA OIL

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Abstract – Restructures steaks are a technology alternative to meat cuts, to provide convenience to the consumer. The objective of this study was evaluate physic-chemical characteristics of steaks made from muscle *Triceps brachii*, using the enzyme transglutaminase and antioxidant and/or canola oil, by evaluating pH, centesimal composition, ash content, losses by cooking and cholesterol content. The results obtained for pH were higher (P<0.05) to 120 days of freezing, regardless of treatment. The addition of canola oil changed (P<0.05) the centesimal composition of the steaks. The ash contet did not change (P>0.05) when canola oil was added. The bigger cooking loss (P<0.05) was observed in the restructured meat formulated with antioxidant plus canola oil, differing (P<0.05) of the meat only with antioxidant, which presented the smallest loss. The addition of canola oil and oxidant affected (P<0.05) the cholesterol content in the restructured meat. The steaks are a good alternative to add value to the product and bring convenience to the consumer.

Key Words – Omega-3, Cholesterol, Centesimal composition

I. INTRODUCTION

The meat sector industries have sought ways to add value to smaller cuts. Restructured meat are technological alternatives to cuts with lower demand, creating more uniform products in relation to the shape, color and texture [1], especially those of the front. Trying to meet the consumer in terms of convenience, portion size, composition and easy preparation, by changing the ingredients used in its preparation [2].

The link between meat fragments is often obtained by solubilization of proteins on the surface of these fragments, which are modeled by compression into the desired shape and then united in one piece [3]. To a better linkage between meat fragments, different systems have been studied. Among the commercial products, is the transglutaminase enzyme (Activa TG-EB®).

Several oil plant species have a good potential and value for food industry. The canola oil is one of the most healthy, because it has high amount of Omega-3 (reduces triglycerides and controls arteriosclerosis), vitamin E (antioxidant that reduces free radicals), monounsaturated fats (reduce LDL) and lower saturated fat (cholesterol control) of all vegetable oils.

Canola oil has been recognized as excellent source of linolenic acid [4]. According Corner et al. [5] the use of canola oil in food provides beneficial effects on blood lipid composition, with significant increase in α-linolenic acid and EPA in the plasma, as well as increased levels of EPA and DHA in platelets.

Experiments using conventional meat, by restructuring system (precooked and frozen), including NaCl, phosphate and with addition of oil have resulted in products with acceptable physic-chemical and sensory properties [6].

The objective of this study was evaluate physic-chemical characteristics of steaks made from muscle *Triceps brachii*, using the enzyme transglutaminase and antioxidant and/or canola oil, by evaluating pH, centesimal composition, ash content, losses by cooking and cholesterol content.

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 6h. 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 evaluate the meat physic-chemical characteristics, as humidity, protein content (Kjeldahl method), ash, pH, cooking loss, exudation loss and cholesterol content [7].

III. RESULTS AND DISCUSSION

The final pH of the meat can influence the softness, the product shelf life and meat color [8].

Table 1 shows the pH in the treatments in different storage times.

Table 1 Means and standard errors means of the results of the pH of the restructured beef.

Time (days)	Treatments			
	Control	Canola	Antiox.	Canola + Antiox.
0	5.67 ± 0.03 $^{b\,f}$	5.62 ± 0.03 $^{b\,f}$	5.55 ± 0.03 $^{b\,f}$	5.56 ± 0.03 $^{b\,f}$
60	5.69 ± 0.03 $^{b\,f}$	5.57 ± 0.03 $^{b\,g}$	5.59 ± 0.03 $^{b\,fg}$	5.51 ± 0.04 $^{b\,g}$
120	5.87 ± 0.03 $^{a\,f}$	5.94 ± 0.03 $^{a\,f}$	5.99 ± 0.03 $^{a\,f}$	5.91 ± 0.03 $^{a\,f}$

$^{a-d}$ 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).

In analyzing the results of Table 1 in the columns can be seen that for all treatments there were difference (P<0.05) in function storage time, where after 120 days of storage was observed higher values of pH (5.99).

According Terra and Brum [9], pH between 5.8 to 6.2 suggested that the meat are acceptable for consumption, pH 6.4 indicate that the meat is only recommended for immediate consumption and above pH 6.4 indicates that the meat in the beginning of decomposition. The restructured steaks showed pH respecting this limit of normality.

Serrano et al. [10] did not observe the effect of frozen storage under the pH in samples of restructured steak. However, Esguerra [11] reported that in restructured steak pH increased with the frozen storage of steak.

Table 2 Means and standard errors means of the results of the centesimal composition of the raw restructured beef.

Treatments	Moisture (g/100g)	Protein (g/100g)	Ash (g/100g)
Control	68.43^{bc}± 0.83	15.65^{a}±0.23	2.71^{a}±0.04
Canola	62.88^{a}± 0.83	14.32^{b}±0.23	2.68^{a}±0.04
Antioxidant	69.31^{c}± 0.83	15.74^{a}±0.23	2.77 ^{a}±0.04
Canola + Antioxidant	65.04^{ab}± 0.83	14.48^{b}±0.23	2.74 ^{a}±0.04

$^{a-d}$ 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).

It was observed that the addition of canola oil affected the centesimal composition of restructured steaks (table 2). Adding canola oil reduced (p<0.05) values of moisture and protein content. The ash content was not influenced (p<0.05) by the addition of canola oil. The same results were found by Serrano et al. [10] [12].

Losses during defrosting (loss by exudation) in this study were less than 1% (P<0.05). Regardless of its composition, restructured steaks showed low levels of loss to defrosting (1%), similar results were found by other authors for similar products [13].

The control of these losses is important due to the changes in the results of cooking performance by affecting the centesimal composition of the product, and these changes are directly correlated to the sensorial characteristics of the final product grilled. Moisture is lost during and after the thermal process, the product yield and other

quality attributes such as softness, texture, and taste, are affected negatively [14].
There was influence of treatments and freeze time (P<0.05) on cooking losses (Table 3).

Table 3. Means and standard errors means of the results of the cooking losses of the restructured beef.

	Cooking losses (%)
Treatments	
Control	21.45 [ab] ± 1.42
Canola	18.54 [ab] ± 1.48
Antioxidant	16.34 [b] ± 1.42
Canola + Antioxidant	23.66 [a] ± 1.54
Days	
0	13.44 [b] ± 1.24
60	24.35 [a] ± 1.43
120	22.21 [a] ± 1.11
Interations	Ns

[a-d] Means in the same column followed by same letter do not differ significantly (P> 0.05)

The average values for cooking loss shown in table 3 were lower than those observed in the literature, ranging from 31% to 35% [15], showing that the level of 1% of transglutaminase was effective on the product water. According to Lee et al. [16], meat treated with sodium tripolyphosphate has superior bonding strength, cooking yield and moisture.
In the present study, in the treatments without canola oil the highest protein level seems to have helped stabilize the product, occurring less cooking loss. This may have been due to the presence of some non-stop fat cells, which allowed other muscle proteins retain the water and provided greater immobilization of fat [17].
On the other hand, Reverts et al. [18] reported that the cooking income of restructured steaks was not changed during 6 months of storage.

Table 4. Means and standard errors means of the results of the cholesterol content of the restructured beef.

Treatments	**Cholesterol content (mg/100g)**
Control	47.21 [bc] ± 0.85
Canola	50.44 [ab] ± 0.85
Antioxidant	53.97 [a] ± 0.85
Canola + Antioxidant	46.36 [c] ± 0.85

[a-d] Means in the same column followed by same letter do not differ significantly (P> 0.05)

With respect to cholesterol, can be observed in table 4 that the addition of the canola oil and antioxidant affected (P<0.05) the cholesterol content in restructured meat raw. The addition of sodium erythorbate plus 5% canola oil resulted in meats with a slightly reduced cholesterol content (46, 36mg/100 g), when compared with the treatment containing only antioxidant (53.97 mg/100 g). The results were close to the values of raw beef (45 to 62 mg/100 g).
In the present study, the levels of cholesterol have acceptable values (46.36-53, cholesterol 97mg) since Ramires [19] has recommended a daily intake of 180 mg of cholesterol and by comparison with other meat products.

IV. CONCLUSION

The restructured steaks with canola oil and sodium erythorbate have physico-chemical properties as well as acceptable cholesterol levels, and may be marketed as a product of fast preparation and possibly with greater added value.

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