MEAT QUALITY OF RESTRUCTURED BEEF STEAK WITH ADDED CANOLA OIL WITH ANTIOXIDANT

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Abstract – The preference for meat is more affected for changes in appearance, especially in color and texture, and less by changes in flavor. The objective of this study was to evaluate the qualitative characteristics of restructured beef developed with *Triceps brachii* muscle, using transglutaminase enzyme and antioxidant and/or canola oil, by evaluating color, objective texture and sensorial analysis. Adding oil, there were brighter (L*) and more yellow (b*) color, but was not observed more red (a*) steaks. The treatments with canola oil showed lower values of hardness. The steaks with canola oil and sodium erythorbate had good consumer acceptance.

Key Words – Color, Consumer, Texture, Omega 3

I. INTRODUCTION

With an increasing consumer market, the meat industries try to develop new products that can add value to meat cuts with lower quality. The restructured meat is an alternative technology to create products with quality and standardization, trying to bring convenience to consumers.

Experiments using conventional meat, by restructuring system (including NaCl and phosphate), with added oil to restructured beef production (precooked and frozen) have results in products with acceptable physical chemistry and sensory properties [1].

Several oil plant species have a good potential and value for food industry. Canola oil is one of the healthiest oils, because it has high levels of Omega-3, vitamin E, mono-unsaturated fats and lower saturated fat of all vegetables oils. The canola oil is recognized as excellent source of linolenic acid [2]. The preference for meat is more affected for changes in appearance, especially in color and texture, and less by changes in flavor [3]. Affective tests are an important tool because it directly accesses the opinion (preference or acceptability) of already established or potential consumer of a specific product. Affective tests are mainly used by manufacturers of direct selling products to consumers, but they can also be an important strategy to ingredients manufacturers such as fragrances, dyes, additives, prepared mixtures of food among others [4].

The subjective evaluation of texture of meat is accompanied simultaneously characteristics including tenderness, juiciness and residual fibers. Of those, the tenderness is more important to the consumer and strong influence on the acceptability of these products [5].

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 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 instrumental texture, instrumental color and sensorial analysis.

For color evaluation was used portable spectrophotometer MINOLTA, operating in the CIE (Commission Internationale d ' le Ecleraige) L* a* b* (L * lightness, a * red color intensity, b * yellow intensity).

The texture of the restructured meat was evaluated using the technique called TPA (Texture Profile Analysis), which was calculated parameters of hardness, elasticity, cohesiveness, and chewiness [6].

Sensorial analysis was performed using quantitative affective tests of acceptability [7]. For this, the samples were encoded with three-digit number and provided one at a time to the tasters in accordance with the balancing of the samples [4]. Consumers rated the samples and recorded their notes in chips using nine-point hedonic scale (9 = liked very much, 5 = not liked or disliked and 1 = disliked very much).

III. RESULTS AND DISCUSSION

For the results of instrumental color analysis there was no effect (P>0.05) of interaction of the factors (storage time X treatment) in relation to color parameters evaluated (L *, a * and b*) (table 1).

Table 1 Means and standard errors means of the results of the profile instrumental colorimetric of the restructured beef.

	L*	a*	b*
Treatments			
Control	25.76 [b] ± 1.42	17.70 [a] ± 1.23	14.98 [b] ± 0.66
Canola	37.60 [a] ± 1.35	14.99 [a] ± 1.17	19.70 [a] ± 0.63
Antioxidant	26.06 [b] ± 1.42	19.68 [a] ± 1.23	15.92 [b] ± 0.66
Canola + Antioxidant	33.65 [a] ± 1.42	18.35 [a] ± 1.23	18.59 [a] ± 0.66
Days			
0	36.30 [a] ± 1.28	15.47 [a] ± 1.11	20.88 [a] ± 0.59
60	28.38 [b] ± 1.32	19.09 [a] ± 1.15	16.22 [b] ± 0.61
120	27.62 [b] ± 1.02	18.48 [a] ± 0.89	14.79 [b] ± 0.48

[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).

The values of luminosity (L*) and intensity of yellow (b*) were different (P<0.05) among the treatments (table 1). The restructured meat with canola oil added (treatments 2 and 4) presented the highest values of L* (37.60 and 33.65) and b* (19.70 and 18.59). The treatments without canola oil (1 and 3) presented (P<0.05) the lowest values of L* (25.76 and 26.06) and b* (14.98 and 15.92). In the present study, the increase of the luminosity (L*) in the restructured products with canola oil is probably related with the fact the fat globules of the canola oil are much smaller and thus reflect more light (more surface area), compared to bovine fat globules, that are bigger. The sharper tone of b* in restructures steaks with canola oil probably occurred to the more yellowish color of canola oil.

There were no differences (P<0.05) in the evaluation of intensity of red and the results varied between 14.99 to 19.68. According to the data from the literature the red intensity for the *Triceps brachii* muscle range from 16.6 to 20.0 [8], which is in accordance with the results of this experiment, except for the treatment 2, containing only canola oil.

Also, Youssef & Barbut [9] used 25% of canola oil in the preparation of meat products in comparison with the use of 25% bovine fat and b * values were highest for canola oil treatments (14.81) in relation to bovine fat (13.68).

Serrano, Cofrades and Jiménez-Colmenero [10] found similar results when testing different nuts levels in restructured steaks, where the treatment containing nuts increased brightness and yellowing, but decreased the redness, a fact that was not observed in the present work.

The kind of treatment affected (P<0.05) the hardness, elasticity, cohesiveness and chewiness (Table 2).

Table 2 Means and standard errors means of the results of the texture parameters of the restructured beef.

Treatments	Hardness (N)	Elasticity (cm)	Cohesiveness **	Chewiness (N.cm)
Control	$306.41^a \pm$ 7.84	$0.84^b \pm$ 0.01	$0.52^a \pm 0.01$	$133.75^a \pm$ 5.50
Canola	$267.41^b \pm$ 7.84	$O.84^b \pm$ 0.01	$0.46^b \pm 0.01$	$104.75^b \pm$ 5.50
Antioxidant	$312.29^a \pm$ 7.84	$0.82^b \pm$ 0.01	$0.46^b \pm 0.01$	$120.65^{ab} \pm$ 5.50
Canola + Antioxidant	$257.10^b \pm$ 7.84	$0.88^a \pm$ 0.01	$0.49^{ab} \pm 0.01$	$112.36^{ab} \pm$ 5.50

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

The treatments with addition of canola oil (treatments 2 and 4) presented the lowest values of hardness (267, 41N and 257, 10N) (P<0.05) and the treatments control and with antioxidant only presented the highest values (306, and 312 41N, 29N).

Alvarez et al. [11] studied the textural properties of pork sausages containing canola and olive oils, nuts and rice bran and observed that the hardness was higher in sausages made with lard in comparison with sausages made with canola oil or olive oil. This increase in soft consistency observed in sausages containing vegetable oils has also been reported by Özvural and Vural [12], when bacon was fully replaced by different oils and oil mixtures for the production of sausages.

Similar hardness reduction has also been reported in burgers formulated with avocado oil, sunflower and olive in place when the bacon fat has been reduced to 50% [13]. However, Youssef and Barbut [14] found that the replacement of beef fat for canola oil increased the hardness values as a result of the creation of much smaller fat globules in the treatments with canola oil, concluding that the reduction of fat content decreased the toughness of the meat products, because there is more moisture content in these treatments and the water provides a lower compressive strength.

There were no differences (P<0.05) between treatments in function of the three frozen storage times and for the attributes of aroma, tenderness and juiciness for sensorial analysis (table 3).

Table 3 Means and standard errors means of the results of sensory evaluation of restructured beef for aroma, tenderness and juiciness.

	Aroma	Tenderness	Juiciness
Treatments			
Control	$7.65^a \pm 0.11$	$7.17^a \pm 0.12$	$7.24^a \pm 0.13$
Canola	$7.64^a \pm 0.11$	$7.35^a \pm 0.12$	$7.21^a \pm 0.12$
Antioxidant	$7.63^a \pm 0.11$	$7.23^a \pm 0.12$	$7.37^a \pm 0.11$
Canola + Antioxidant	$7.45^a \pm 0.11$	$7.20^a \pm 0.12$	$7.00^a \pm 0.14$
Days			
0	$7.60^a \pm 0.13$	$7.42^a \pm 0.15$	$7.37^a \pm 0.15$
60	$7.64^a \pm 0.13$	$7.19^a \pm 0.16$	$7.13^a \pm 0.16$
120	$7.53^a \pm 0.14$	$7.11^a \pm 0.17$	$7.12^a \pm 0.17$
Interactions	Ns	Ns	Ns

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

It was observed that for all attributes there was an acceptance average, around 7 (liked moderately) to 8 (liked a lot) on hedonic scale. Therefore, the restructured steaks with canola oil and sodium erythorbate had good acceptance among consumers who evaluated the products. According to the agreement, it is suggested that the restructured steaks can be kept in frozen storage, without any adverse effect on the main features of quality. In relation to results found for tenderness, it is observed that the effect of canola was not perceived by consumers.

There was interaction (P<0.05) between treatments and frozen storage time to the average values of acceptance of sensory flavor (table 4).

Table 4 Means and standard errors means of the results of sensory evaluation of restructured beef for flavor attribute.

Days	Treatments			
	Control	Canola	Antioxidant	Canola + Antioxidant
0	$7.72^{af} \pm$ 0.21	$7.33^{af} \pm$ 0.19	$7.41^{af} \pm$ 0.20	$6.80^{ag} \pm$ 0.24
60	$7.71^{af} \pm$ 0.22	$7,43^{af} \pm$ 0.21	$7.54^{af} \pm$ 0.22	$7.30^{af} \pm$ 0.25
120	$7.06^{af} \pm$ 0.24	$7.65^{af} \pm$ 0.22	$7.04^{af} \pm$ 0.23	$7.24^{af} \pm$ 0.27

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

It was observed that only restructured meat with canola oil and antioxidant in day zero of storage presented lower average (P<0.05) for flavor, compared to other groups. However, this difference in flavor was not observed (P>0.05) for the 60 and 120 days of storage.

We also observed that there was no difference (P>0.05) in average value of acceptance of flavor, as has the storage of frozen meat products, regardless of the treatments tested. The antioxidant sodium erythorbate did not influence the taste of restructured steaks, according to consumers over time. According to Stika et al. [15], there was loss of flavor and appearance of "off flavor", became more intense, as restructured steaks were frozen for 6 months.

On the other hand, Serrano et al. [10] reported no difference to the flavor in restructured meat with added nuts frozen (-18°C) for up to 92 days.

IV.   CONCLUSION

The restructured steaks with canola oil and sodium erythorbate have physical-chemical and sensory acceptable and can be marketed as a product of fast preparation and possibly with greater added value.

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