SENSORY ACCEPTANCE AND TECHNOLOGICAL CHARACTERISTICS OF BEEF BURGERS WITH PARTIAL REPLACEMENT OF MEAT AND FAT BY PEA FIBER

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Abstract – The objective of this paper was to evaluate sensory acceptance and physicochemical parameters of beef burgers made with addition of pea fiber as a partial substitute of meat and fat. Three treatments were processed: Control (C) – no pea fiber addition, Less meat/Fiber (LMF) – reduction of 5% meat and addition of 1% pea fiber (plus 4% water) and Less fat/Fiber (LFF): reduction of 7% fat and addition of 1.0% fiber (6% water). Analysis of cook loss, diameter reduction, pH values, objective color (L*, a* and b* parameters) and acceptance test using a 9-point hedonic scale with 60 consumers of hamburger were carried out. There were no significant differences (p>0,05) among all three treatments for cook loss (21-23%), diameter reduction (23-24%), pH values (5,5), L* (44-46) and b* (14-15) parameters. The red color (a*) decreased (p<0,05) in LMF. Regarding the sensory evaluation, consumers detected no differences (p>0,05) among the three samples for all evaluated attributes (aroma, texture, flavor and overall acceptance) and all burgers received good scores (around 8 = like very much). One can conclude that it is possible to use pea fiber as a partial substitute to meat and fat in beef burgers, without compromising technological parameters and consumers' acceptability.

Key Words – Meat product, Healthier, Cost reduc.

I. INTRODUCTION

The market for processed meat products has shown significant expansion and high competitiveness in the last decade, since the consumption of meat products like sausages, burgers, hams and others, became part of the consumption habits of a considerable portion of Brazilian consumers [1]. The growing market for frozen products explains the increased demand for hamburger, whose consumption is 37.9% compared to other frozen meat products in Brazil [2]. Several factors contribute to the success of meat products, including the taste and convenience. The fats present in these products may be the main responsible for the aroma, flavor, texture and juiciness. However, these same fats, besides being the ingredients with higher calories, also exhibit high levels of saturated fatty acids and cholesterol.

Dietary fibers have been evaluated and are increasingly used as potential fat substitutes in the formulation of meat products, acting on the water and fat retention, allowing to obtain products of flavor, juiciness and texture similar to conventional ones [3]. The incorporation of water and fiber in equilibrium into meat products formulation can also assist in obtaining reduced final costs, in addition to commercial appeals that healthier items may present in the context of current consumption without guilt [4].

According to Giuntini et al. [5], the ideal fiber should have the following characteristics: be very concentrated, has no anti-nutritional components, not to compromise the shelf life of the products, possess good ratio between soluble and insoluble fiber, presenting smooth sensory characteristics, be accepted by the consumer as a healthy product, presenting positive physiological effects and have reasonable cost. The main fibers that could be used in meat products are from orange, sugar beet, wheat, oats and peas [6].

The pea fiber may be defined as a mixture extracted from peas, consisting essentially of fibers, starch and proteins. Using this fiber in meat products have been investigated because of the characteristics and properties that it presents as dispersibility in water and oil, high capacity for liquid absorption, easy to connect to spices and herbs, neutral taste and odorless. The use of pea fiber in ground meat was evaluated by Anderson et al. [7] at concentrations ranging from 10 to 16%.

The authors reported a higher retention of fat during cooking due to the addition of the fiber, from 33% (no fiber) to values ranging from 85-98% when the pea fiber was added.
The aim of this work was to evaluate sensory acceptance and physicochemical parameters of beef burgers made with addition of pea fiber as a partial substitute of meat and fat.

II. MATERIALS AND METHODS

A. Experimental treatments

Three different beef burger formulations were processed (Table 1) as follows: 1) Control: similar to conventional burger formulation, without pea fiber; 2) Fiber/less meat: reduction of 5% of the beef meat and addition of 1% pea fiber (plus water) e 3) Fiber/less fat: reduction of 7% of the beef fat and addition of 1% pea fiber (plus water). The experiment was replicated twice.

Table 1: Beef Burger formulations

	Control	Less meat/Fiber	Less fat/Fiber
Ingredients	%	%	%
Beef meat (front quarter)	79	74	79
Beef fat	18	18	11
Hamburger seasoning mix	1,5	1,5	1,5
Salt	0,9	0,9	0,9
Water	0,35	4,35	6,35
Pea fiber	-	1,0	1,0
Sodium tripolyphosphate	0,25	0,25	0,25

B. Materials and preparation of burgers

According to the manufacturer (Labonathus, São Paulo), the pea fiber used in this work presented the following composition: maximum of 10% moisture, maximum of 50% fiber (dry basis), maximum of 10% protein (dry basis) and approximately 35% starch (dry basis).
The raw animal materials (beef meat and fat) were ground using a 4mm grinding plate. Meat, fat and other ingredients were homogenized in a meat mixer for approximately 10 minutes, than formatted into burgers of approximately 100g. The final product was frozen and kept at -18° C until analyzes were carried out.

C. Physicochemical parameters

pH values: a pH meter (HANNA, HI 99163) with a combined electrode was used for performing readings in triplicate with perforation of the samples.
Objective color analyses: a portable colorimeter (HunterLab, MiniScan XE) was used to measure L^*, a^* and b^* parameters of the CIELab evaluation system. A D_{65} illuminant was used at an observation angle of 10º and with a cell opening of 30 mm.
Cooking Measurements: Beef burgers from three treatments were cooked in the same way, using an electric griddle at 180°C for 8 min. They were turned over every 2 min interval to ensure uniform cooking until 72°C internal temperature. The weight and diameter of three beef burgers from each batch were measured at room temperature before and after cooking to calculate cook loss and diameter reduction, according to following equations:

- Cook loss (%): (raw weight – cooked weight) X 100 / cooked weight
- Diameter reduction (%): (raw diameter – cooked diameter) X 100 / cooked diameter

D. Sensory evaluation

Sixty consumers were recruited among the University's students, staff and faculty; enjoying beef burger was the only selection criterion. The recruited consumers were given a free and informed consent form to be read and signed prior to performing samples evaluation. An acceptance test using a 9-point hedonic scale was conducted in individual booths. Samples

were cooked in a similar manner to that described for Cooking Measurements and were stored in an oven at 60 °C for a maximum of 30 minutes. A randomized complete block design was used, and the samples were served to the participants individually in disposable plastic plates that were coded by three-digit numbers. The panelists assessed aroma, texture, flavor and overall quality attributes.

E. Statistical Analysis

All results were analyzed using analysis of variance (ANOVA) with SAS (Statistical Analysis Software) version 9.1.3. The means were compared using Tukey's test at 5% significance level. The acceptance responses of the evaluated attributes were also analyzed by ANOVA, considering the effects of consumers in the statistical model.

III. RESULTS AND DISCUSSION

The results of physicochemical analysis of beef burgers from different treatments are presented in Table 2. Differences ($p < 0.05$) were detected only for the a* parameter (redness), being the treatment with less meat the one which showed the lower a*. This result was expected because the reduction of 5% meat caused a consequent reduction in the myoglobin (meat red pigment) amount present in this formulation. For all other physicochemical parameters evaluated no differences ($p > 0.05$) were detected. In other words, the replacement of 5% meat or 7% fat with 1% pea fiber + water did not significantly affect most of the technological parameters of hamburgers. Differently, Besbes et al. (2008) [8] added pea fiber (0,5%) and wheat fiber (0,5 a 1,5%) plus water to beef burgers, replacing approximately 4 to 8% of the meat in the formulations, and found higher ($p<0,05$) cook loss and diameter reduction in the control sample (no fiber added) than in the burgers with added fibers.

Table 2: Physicochemical parameters (means ± standard error) of beef burgers formulated with or without pea fiber.

	Control	Fiber/less meat[1]	Fiber/less fat[2]
pH vales	5,48 ± 0,05	5,55±0,005	5,43±0,09
Cook loss (%)	21,16 ±1,88	23,01±1,01	19,91±1,02
Diameter reduction (%)	22,84 ±1,29	24,35±2,58	23,07±0,38
L*	46,49±0,33	44,07±1,46	44,91±0,10
a*	11,51±0,11[a]	10,18±0,04[b]	11,62±0,10[a]
b*	14,19 ±0,66	15,31 ±0,26	15,58 ±0,72

[1]Fiber/less meat: reduction of 5% of the beef meat and addition of 1% pea fiber plus 4% water
[2]Fiber/less fat: reduction of 7% of the beef fat and addition of 1% pea fiber plus 6% water

Table 3 shows the results of sensory acceptance test of hamburger samples from the three different treatments. No differences were detected ($p > 0.05$) in sensory acceptance of all of attributes, which means that the partial replacement of meat (5%) and fat (7%) by 1% pea fiber plus water did not negatively affect consumer acceptance of burger samples. In the same way, Pietrasik et al. (2010) [9] found similar consumer's overall acceptance when comparing bologna sausage with high fat content (22%) and low fat bologna (10%) with 4% pea fiber. Besbes et al. (2008) [8] also did not find differences in the sensory acceptance of the flavor attribute when comparing beef burgers with or without added pea and wheat fibers.

IV. CONCLUSION

One can conclude that it is possible to add 1% of pea fiber (plus water) to beef burgers with partial substitution of 5% meat (cost reduction) or 7% fat (caloric reduction), without compromising most of technological parameters and consumers' acceptability

Table 3: Sensory acceptance of beef burgers formulated with or without pea fiber.

	Control	Fiber/less meat[1]	Fiber/less fat[2]
Aroma	7,64	7,66	7,52
Texture	7,60	7,85	7,90
Flavor	7,99	8,07	7,87
Overall quality	7,73	7,88	7,82

[1]Fiber/less meat: reduction of 5% of the beef meat and addition of 1% pea fiber plus 4% water
[2]Fiber/less fat: reduction of 7% of the beef fat and addition of 1% pea fiber plus 6% water
9 = like very much, 5 = neither like/nor dislike, dislike very much
n = 60 consumers

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