

## TECHNOLOGICAL PARAMETERS AND SENSORY ACCEPTANCE OF BEEF BURGER WITH ADDITION OF OAT BRAN AND REDUCED FAT

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**Abstract - The aim of this study was to develop hamburgers with partial and total replacement of beef fat per oat bran (Source of Fiber) and assess the implications of this substitution on physicochemical characteristics and sensory acceptance. Three formulations were produced based on beef: A) Control, with 20.83% bovine fat and without oat bran added, B) 50% Bran/50% Fat, 10.41% bovine fat and 10, 41% oat bran and C) Source of Fiber, without beef fat addition and 20.83% oat bran (equivalent to 3% fiber). Analysis of cooking losses, diameter reduction, pH values, objective color (L\*, a\* and b\* parameters) and acceptance test using a 9-point hedonic scale with 60 burger consumers were performed. There was no significant difference among samples only for parameter cooking losses (0.081 to 0.099%). Regarding the sensory evaluation, consumers did not detect any difference (p>0.05) only for aroma attribute. The partial or total replacement of fat by the oat bran impaired the majority of technological parameters and the sensory acceptance by the consumers, but in partial replacement sensory notes were higher than 5. In conclusion, one can recommend to replace 50% of the fat by oat fiber in hamburgers, seeking a balance between healthiness and sensory quality.**

**Keyword:  $\beta$ -Glucan. Fiber. Meat Products.**

### I. INTRODUCTION

The dietary fiber is a class of compounds of plant origin, especially consisted of polysaccharides and related substances. When it is ingested it does not undergo hydrolysis, digestion and absorption in the small intestine of humans [1].

The fibers are classified according to their solubility in water and can be soluble or insoluble fibers [2]. The soluble fiber has the function to delay gastric emptying, glucose absorption and to reduce blood serum cholesterol. Forming a gel network or a viscous network in certain physicochemical conditions, and thereby bind water, which increases water holding capacity and lipid absorption [3]. Insoluble fibers accelerate intestinal transit, increase stool weight, contributing to reduce the risk of gastrointestinal diseases [4].

Oat bran is considered today as the food available on the market with the highest content of beta-glucan [5], around 9,5% [6]. The dietary fiber content in oat bran is from 15 to 19%, thus, from 34 to 48% is considered to be soluble fiber and the remainder is insoluble [7]. It is produced from the outer layers of the oat grain [8].

The importance of meat products is huge in the daily diet due to its significant protein content and amino acid balance. The burger deserves to be pointed out due to its high consumption, quick and easy preparation in households. The over consumption of this product can be harmful to human health, which may lead to chronic diseases like obesity and hypertension because it contains high levels saturated fat. Several studies have

demonstrated the possible substitution of ingredients in the formulation of burgers, with the aim of introducing substances with functional properties, for example, substances that can contribute to the health and well-being of consumers. Thus, ingredients have been added in food products providing the same functional characteristics. The increase in the number of consumers who are constantly seeking healthy food prefer certain foods such as whey protein, soy, oats, sesame seeds, chia, psyllium, quinoa [9].

The aim of this study was to develop beef hamburgers with reduced fat and addition of a source of fiber (oat bran) and to evaluate physicochemical characteristics and sensory acceptance of the products elaborated with partial and total replacement of fat by oat bran.

## II. MATERIAL AND METHODS

### A. Materials and preparation of burgers

Three different formulations of beef burger were produced, as show in Table 1: 1) Control, 2) 50% Bran/50% Fat and 3) Source of Fiber (equivalent to 3% fiber).

The raw materials used were beef *Quadriceps femoris* , beef fat, oat bran and condiment for hamburgers [10]. The meat raw materials (beef meat and fat) were weighed separately, as well as all the ingredients. The meat and fat were grinded in a meat grinder at 4 mm disc. Then the meat, the beef fat and the other ingredients were mixed until obtaining a homogeneous mass, with a suitable bind. The resulting mass from the previous step was divided into pieces of approximately 100g and subsequently shaped by placing the paper between parts. The final product was stored frozen at -18 °C until analysis performance.

### B. Physical and chemical parameters

*pH values:* pH measurements on the samples were performed using pH meter with electrode directly from the drill samples.

*Weight loss during cooking (%):* (raw weight - cooked weight) x 100 / raw weight.

*Diameter reduction (%):* (raw diameter - cooked diameter) x 100 / raw diameter.

*Shear force:* After cooking, the samples were cut into 10 pieces measuring 2×2cm. The forces required to shear these cuts were determined using a Warner Bratzler texturometer.

*Instrumental colour determination:* Samples of each treatment were subjected to evaluation of color using a portable colorimeter (model MiniScan XE HunterLab mark) by L\*, a\*, b\* scale, from the CIE Lab system,

D65 illuminant observation angle 10 and opening cell with 30 mm.

### C. Sensorial evaluation

The acceptance test was applied by using a nine-point hedonic scale, evaluating the aroma, firmness, juiciness, flavor and overall quality. Panelists were recruited from the University in terms of appreciating the burgers and being regular consumers of them. The experimental design used was randomized complete blocks, where all the panelists evaluated the three products samples. The order of presentation was balanced so that each sample was submitted in an equal number of times in each position. An informed consent form was provided, which was read and signed by the judges before performing the analyzes. The experimental samples of burgers were heated on a plate at 180°C until an internal temperature of 75°C, to perform sensory evaluation with 60 panelists. The sample presentation was monadic and under red light so, that there would not be any appearance panelist judgment.

### D. Statistical analysis

The results were subjected to statistical analysis ANOVA (analysis of variance) with SAS (Statistical Analysis Software) version 9.1.3, followed by Tukey's test at a significance level of  $p = 0.05$  and were conducted using a completely randomized experimental delineation model.

Table 1. Hamburger samples of formulation

	Control	50% Bran/ 50% Fat	Source of Fiber
<b>INGREDIENTS</b>	(%)	(%)	(%)
Bovine Meat	76,17	76,17	76,17
Bovine Fat	20,83	10,41	0
Oat Bran	0	10,41	20,83

### III. RESULTS AND DISCUSSION

The results of the physicochemical analysis of the beef burgers formulated with or without added oat bran are shown in Table 2.

Differences ( $p < 0.05$ ) were detected for the parameters pH, diameter reduction, color  $L^*$ ,  $a^*$  and  $b^*$  and tenderness (shear force). The parameters of diameter reduction and  $a^*$  color for the Control treatment had the highest values and the Source of Fiber treatment had the lowest values. 50% Bran/50% Fat treatment for pH and color parameters  $L^*$  had the highest values and the Source of Fiber treatment had the lowest values. Finally, the Source of Fiber treatment to  $b^*$  color and texture parameters obtained the highest values and the Control treatment obtained the lowest values.

There was no significant difference ( $p > 0.05$ ) for the cooking losses parameter probably due to the capacity of oat fiber ( $\beta$ -glucan) to create a three dimensional matrix, sustaining not only the water but also the fat added to formulas avoiding fat and water loss during cooking (Piñero et.al, 2005).

The comparison of the evaluated attributes on sensory acceptance test is described in Table 3.

Table 3. Results of sensory evaluation of acceptance (mean  $\pm$  standard deviation) of beef burgers formulated with added oat bran.

	Control	50% Bran/ 50% Fat	Source of Fiber
<b>Aroma</b>	7,1 $\pm$ 1,5 <sup>a</sup>	6,6 $\pm$ 1,5 <sup>a</sup>	6,0 $\pm$ 1,8 <sup>b</sup>
<b>Texture</b>	7,2 $\pm$ 1,6 <sup>a</sup>	6,1 $\pm$ 1,5 <sup>b</sup>	4,3 $\pm$ 1,9 <sup>c</sup>
<b>Succulence</b>	7,4 $\pm$ 1,4 <sup>a</sup>	5,3 $\pm$ 1,6 <sup>b</sup>	3,9 $\pm$ 1,8 <sup>c</sup>
<b>Flavor</b>	7,7 $\pm$ 1,3 <sup>a</sup>	6,5 $\pm$ 1,5 <sup>b</sup>	4,7 $\pm$ 2,1 <sup>c</sup>
<b>Overall Acceptability</b>	7,7 $\pm$ 1,1 <sup>a</sup>	6,1 $\pm$ 1,4 <sup>b</sup>	4,5 $\pm$ 1,9 <sup>c</sup>

Values refer to the mean  $\pm$  standard deviation of scores of attributes and different superscript letters in the same column determine significant differences ( $p < 0.05$ ) by Tukey test.

There was a significant difference ( $p < 0.05$ ) between Control sample and samples with oat bran for attributes texture, juiciness, flavor and overall acceptability, except for the attribute aroma where control sample was similar to 50% Bran/50% Fat sample and different from Source of Fiber sample. The panelists attributed to Control and 50% Bran/50% Fat samples the highest values between 5 and 7 ("neither liked / disliked or" and "like regular") observing that in Control sample had lower flavor attribute value of 7.10 and flavor attribute obtained higher value of 7.67. The 50% Bran/50% Fat sample had lower juiciness attribute value of 5.30 and aroma attribute obtained greater value of 6.63. Finally, the Source of Fiber sample presented the lowest values assigned by the judges between 3:05 ("dislike moderately" and "not liked / disliked or") where the juiciness attribute obtained the lowest value of 3.88 and aroma attribute got the highest value of 5.98.

According to Piñero et.al (2005) who evaluated hamburgers with different oat bran levels (9.58%, 13.45% and 17.35%) as a fat substitute, there was no difference between the attributes color, appearance, juiciness and softness from the formulations of 9.58% and 13.45%. Based on these sensory characteristics, the formulation of 13.45% resulted in the most suitable for the preparation of this type of burger with low fat.

Table 2. Physico-chemical parameters (mean  $\pm$  standard deviation) of beef burgers formulated with added oat bran.

	Control	50% Bran / 50% Fat <sup>1</sup>	Source of Fiber
Values pH	5,9 $\pm$ 0,1 <sup>a</sup>	6,0 $\pm$ 0,2 <sup>b</sup>	5,9 $\pm$ 0,1 <sup>c</sup>
Cooking Losses (%)	9,9 $\pm$ 0,8 <sup>a</sup>	8,1 $\pm$ 1,3 <sup>a</sup>	8,2 $\pm$ 0,5 <sup>a</sup>
Reduction Diameter (%)	14,1 $\pm$ 2,4 <sup>a</sup>	8,5 $\pm$ 2,1 <sup>b</sup>	7,3 $\pm$ 2,0 <sup>b</sup>
$L^*$	54,1 $\pm$ 1,8 <sup>a</sup>	54,4 $\pm$ 1,3 <sup>a</sup>	51,0 $\pm$ 0,8 <sup>b</sup>
$a^*$	14,5 $\pm$ 0,6 <sup>a</sup>	13,8 $\pm$ 0,6 <sup>b</sup>	13,3 $\pm$ 0,2 <sup>b</sup>
$b^*$	19,4 $\pm$ 1,1 <sup>a</sup>	20,3 $\pm$ 1,7 <sup>a</sup>	22,5 $\pm$ 0,6 <sup>b</sup>
Texture (kgf)	6,6 $\pm$ 0,6 <sup>a</sup>	9,6 $\pm$ 1,4 <sup>b</sup>	19,0 $\pm$ 1,9 <sup>c</sup>

<sup>1</sup>50% Bran/50% Fat: burger with at least 25% reduction of total cattle fat

<sup>2</sup>Source of Fiber: burger without adding beef tallow

However, this result does not corroborate with those obtained in this study, since increased fiber levels and decreased fat content was sensory unfavorable.

Still, according to Piñero et.al (2008) who evaluated the effect of addition of oat fiber (13.45%) in the sensory characteristics of breaded meat with low-fat (<10%) compared to breaded meat with 20% fat (control), the breaded meat with low fat showed significant differences in taste and juiciness attributes when compared to control. Unlike the attributes of appearance, hardness and color were not significantly different with the addition of soluble fiber from oats. Likewise, these results do not corroborate with those obtained in this study, since increased fiber levels and decreased fat content was sensory unfavorable.

#### IV. CONCLUSION

The fat replacement by oat bran compromises most of the technological and sensory parameters of burgers. Considering the total replacement of the fat by the oat bran, the sensory grades were very poor (below 5), but in contrast to the partial substitution (50%) the sensory notes were above the indifference (above 5). In other words, the products can still be acceptable, and the replacement of 50% of fat by oat fiber can be recommended, seeking a balance between the aspects of healthiness and sensory quality.

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