

**ARTIGO CIENTÍFICO**

**SENSORY QUALITY OF TILAPIA HAMBURGER (*OREOCHROMIS NILOTICUS*) WITH ADDITION OF SOYBEAN RESIDUE (OKARA)**

***Qualidade sensorial de hambúrguer de tilápia (*Oreochromis niloticus*) com adição de resíduo de soja (okara)***

Rafaela Bergmann Strada de OLIVEIRA<sup>1</sup>, Flávia DELLA LUCIA<sup>2</sup>, Eric Batista FERREIRA<sup>3</sup>,  
Dayana Aparecida Queiroz CASTILHO<sup>4</sup>, Estella Peixoto CARVALHO<sup>5</sup>, Isabela Garcia  
C.GUIMARÃES<sup>6</sup>

**RESUMO:** Este trabalho pretende desenvolver e avaliar a qualidade sensorial de hambúrgueres de tilápia com adição de farinha de okara, com o objetivo de desenvolver um produto de boa qualidade proteica, rico em fibras, baixo custo e fácil acesso à população. A farinha de Okara foi adicionada em diferentes concentrações (0, 5, 10, 15, 20 e 25%) aos hambúrgueres e, em seguida, estes foram submetidos à análise de aceitabilidade (escala hedônica de 9 pontos). As médias para todos os parâmetros avaliados variaram entre 5,02 e 7,5, na faixa de "indiferente" a "gostado moderadamente". As médias mais altas foram encontradas para formulações com 10 e 15% de okara, indicando a quantidade de okara que proporciona melhor qualidade sensorial do produto. Esses resultados confirmam a tendência de buscar produtos com maior valor nutricional e o hambúrguer de tilápia com quiabo adicionado como alternativa ao mercado, visando tornar o peixe e a soja cada vez mais presentes nos hábitos alimentares da população.

**Palavras-chave:** Aceitabilidade, *fishburger*, resíduos agroindustriais, novos produtos.

**ABSTRACT:** This paper intends to develop and evaluate the sensory quality of tilapia hamburgers with addition of okara flour, aiming to develop a product of good protein quality, rich in fiber, low cost and easy access to the population. Okara flour was added at different concentrations (0, 5, 10, 15, 20 and 25%) to hamburgers and then these were subjected to analysis of acceptability (9-point hedonic scale). The averages for all evaluated parameters varied between 5.02 and 7.5, within the range of "indifferent" to "liked moderately". The highest means were found for formulations with 10 and 15% of okara, indicating the okara amount that provides better sensory quality of the product. These results confirm the tendency to seek products with higher nutritional value, and tilapia hamburger with added okara as an alternative to market, aiming at making fish and soybean increasingly present in the eating habits of the population.

**Keywords:** Acceptability, fishburger, agro-industrial waste, new products.

\*Autor para correspondência

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<sup>1</sup>Rafaela Bergmann Strada de OLIVEIRA - Nutrition Faculty, University José do Rosário Vellano - Unifenas, Rodovia MG 179, Km0, Trevo, Alfenas, MG, Brazil. CEP: 37130-000. Phone: +55 35 3299 3236. E-mail: rafaela.bergmann@unifenas.br

<sup>2</sup>Flávia DELLA LUCIA - Nutrition Faculty, Federal University of Alfenas, Alfenas, MG, Brasil. CEP: 37130-000. Email: flavia@unifal-mg.edu.br

<sup>3</sup>Eric Batista FERREIRA<sup>3</sup> – Statistics Department, Federal University of Alfenas, Alfenas, MG, Brazil. CEP: 37130-000. E-mail:

eric.ferreira@unifal-mg.edu.br \*Correspondent Author

<sup>4</sup>Dayana Aparecida Queiroz CASTILHO - Nutrition Faculty, Federal University of Alfenas, Alfenas, MG, Brasil. CEP: 37130-000. Email: daynutricao@hotmail.com

<sup>5</sup>Estella Peixoto CARVALHO - Nutrition Faculty, Federal University of Alfenas, Alfenas, MG, Brasil. CEP: 37130-000. Email: estellapeixoto@hotmail.com

<sup>6</sup>Isabela Garcia da Cunha GUIMARÃES - Nutrition Faculty, Federal University of Alfenas, Alfenas, MG, Brasil. CEP: 37130-000. Email: isaguimaraes2010@hotmail.com

## INTRODUCTION

The development of new products has been occurring with higher intensity in the different segments of the Brazilian and worldwide farming sector due to the great variety of raw material available. The success of developing new products, especially the innovative ones, has contributed significantly to competition between many enterprises. There is plenty of literature available referring to the process of creating new products at industrial scale (OLIVEIRA et al., 2008).

The world production of fish was about 158 million tons in 2012 (FAO, 2014). Brazil still presents low consumption of fish, due to little knowledge about its importance in nourishment and by the way, in which it is offered. An interesting alternative to increase the consumption of fish would be through the diversification of the processing line, through the elaboration of new products and byproducts that offer wider choice options to the consumers (BORDIGNON, et al., 2010). The Nile Tilapia (*Oreochromis niloticus*) is one of the species most commonly raised in Brazil (MONTEIRO et al., 2012). The national preference for the meat from tilapia is in the form of fillets, and in the process of obtaining them, residues are generated, usually not used and discarded, polluting the environment (STEVANATO, 2007). Arvanitoyannis and Kassaveti (2008) highlight that the byproducts from the fish fillet obtainment are generating low commercial value products such as silage and fish flour.

Soybean is considered a great ally for healthier diets. According to a survey done by Bowles and Demiate (2006), soybean presents highly beneficial components to human health. Isoflavones, proteins, phospholipids, antioxidants, vitamins and fibres stand out. So, the consumption of soybean products in the diet contributes to improve life quality, preventing against chronic degenerative diseases (RIBEIRO et al., 2007) and some types of cancer (AZEVEDO, 2011). The production and utilization of soybean have increased in the last decades due to its nutritional properties (RIBEIRO et al., 2007; ACHOURI et al., 2008) and low cost (ACOURI et al., 2008). The processing of soybean originates different raw materials such as soybean flour; hydrosoluble extracts and texturized protein, which may be used in the production of foods that take part in western diet (GENOVESE; LAJOLO, 2002; WANG; MURPHY, 1994). The aqueous extract of soybean (soybean milk) generates a byproduct named Okara in its processing (BOWLES; DEMIATE, 2006). It is noted that most times this residue is rejected. This discarding includes its dispatching to animal feed industries and it is directly discharged in the natural environment. Okara contains high percentage of protein (40% dry weight) with good profile of essential amino acids and it has good digestibility. About one third of the isoflavones present in

soy remain in the okara, suggesting that this is a good source of low cost nutrients. Other components of soybean present in okara include lignines, phytosterols, saponins and phytates. Despite its excellent nutritional and functional properties, okara is rarely used in food products. The most common utilization of this byproduct is in the making of animal feeds. Its exploitation, besides improving the nutritional quality of alimentary products and adding value to soybean products, it reduces loss of food and minimizes the generation of industrial residues (TIE SU ET AL., 2013; SILVA ET AL., 2007).

A possible way of profiting from this residue would be to process it in the form of hamburger. The hamburger is an industrialized product made of minced meat, with or without tissue, with addition or not of fatty tissue and other ingredients, modelled and submitted to an adequate technological process (BRASIL, 2013). This process permits the incorporation of residues from industrial byproducts. Byproducts generated by alimentary industries are promising sources of compounds available due to their technological, nutritional and functional properties (TIE SU et al., 2013).

The present work aimed at elaborating and evaluating the sensory quality of tilapia hamburgers with addition of okara flour intending to take advantage of this residue, which contains nutritional and functional properties.

## MATERIAL AND METHODS

### Acquisition of raw material

Soybean (Glycine Max) (Natudday®) was obtained from a single lot. The tilapia (*Oreochromis niloticus*) (Francisco®) was purchased frozen in the form of fillets and the rest of the ingredients, garlic and salt seasoning (Arisco®), soy oil (Soya®), grounded pepper (Hikari®) and fresh lemon, were acquired at the local market in the city of Alfenas, MG.

### Acquisition of okara

One liter of water was heated at 98° C and 200g of soybean were added until the mixture reached 98°C. After a 5-minute period, the water was thrown away and the grains were submitted to a thermal shock for 5 min in a container with ice. Next, the soybean grains were grounded in a blender with addition of 500 mL of water for approximately 2 minutes. This content was boiled in 1.5 L of water at 98°C for 10 min and finally filtered through organza tissue. The filtered (aqueous extract of soybean) was separated and the residual mass – okara flour (OF) - was submitted to drying in a muffle with air circulation (Solab®) for about 6 hours at 60°C until the drying was complete.

## Elaboration of the hamburgers

The hamburgers were elaborated in the Dietetic Technical Laboratory at UNIFAL MG, according to proper manufacturing practices, being mixed in a bowl and

modelled in a hamburger plastic shape. The test formulations are presented on table 1. The hamburgers were grilled on a frying pan with 2 mL of oil per unit, maintained for 5 min. on each side, during a total of 10 min over moderate fire (200°C).

**Table 1** - Formulations of Tilápia hamburger under different concentrations of okara flour (FO)

Formulations % FO	Tilápia (g)	Wheat flour (g)	Garlic and salt (g)	Chili (g)	Lemon (ml)
Standard (0%)	95	5	1,8	0,4	1,7
5%	90	5	1,8	0,4	1,7
10%	85	5	1,8	0,4	1,7
15%	80	5	1,8	0,4	1,7
20%	75	5	1,8	0,4	1,7
25%	70	5	1,8	0,4	1,7

## Sensory analysis

The study was performed at the Laboratory of Sensory Analysis of the Nutrition College at the Federal University of Alfenas. The subjects were totally elucidated in a simple language about the protocol of the research. The consent to participate was confirmed with the signature on the term of free and clarified consent approved by the Ethics Committee on Research from UNIFAL MG (approval protocol n° 722.174).

The sensory tests were performed in individual cabinets by 100 subjects to whom an acceptability evaluation was requested for appearance, aroma, flavour texture and overall liking, through the use of the hedonic scale of 9 points (1- extremely disliked, 9- extremely liked). The samples (17g) were served on dischargeable plates codified with three digit numbers, in a complete manner and in one single session. A glass of water was offered to wash the testers' mouths between the analyses as well as apple cubes were given to minimize the possible interferences between the samples (SCHLICH, 1995).

## Statistical analysis

The design utilized was in complete blocks and the data were analysed by means of the variance analysis, the comparison of the means were through the Tukey test (5% significance), besides external preference mapping (R CORE TEAM, 2020).

## RESULTS AND DISCUSSION

It is remarked that the sensory analysis is by far the most important dimension for the evaluation of quality by consumers (SHEPHERD, 1988; ZANDSTRA ET AL., 2001; TUORILA; CARDELL O, 2002; LUCKOW; DELAHUNTY, 2004). The acceptability of the consumers of meat products is intrinsically related to their attributes such as colour (appearance), texture, flavour and succulence (VENTURINI ET AL., 2011).

Table 2 represents the acceptability of the tilapia hamburger with different concentrations of okara. The means for the parameters flavour, aroma, texture, appearance and overall liking varied between 5.02 and 7.5, therefore they were within the range "indifferent to "moderately liked" according to the subjects.

**Table 2.** Comparison of means for sensory attributes for all formulations\*.

Attributes	Okara concentration (%)					
	0	5	10	15	20	25
Flavour	6,27 <sup>cd</sup>	6,81 <sup>abc</sup>	7,2 <sup>a</sup>	7,1 <sup>ab</sup>	6,47 <sup>bcd</sup>	5,93 <sup>d</sup>
Aroma	6,23 <sup>c</sup>	6,69 <sup>abc</sup>	7,0 <sup>a</sup>	6,71 <sup>abc</sup>	6,79 <sup>ab</sup>	6,49 <sup>bc</sup>
Texture	5,4 <sup>d</sup>	6,5 <sup>b</sup>	7,18 <sup>a</sup>	7,23 <sup>a</sup>	6,42 <sup>bc</sup>	5,83 <sup>cd</sup>
Appearance	5,02 <sup>c</sup>	6,6 <sup>b</sup>	7,36 <sup>a</sup>	7,43 <sup>a</sup>	7,5 <sup>a</sup>	7,12 <sup>ab</sup>
Overall liking	5,79 <sup>c</sup>	6,75 <sup>ab</sup>	7,09 <sup>a</sup>	7,15 <sup>a</sup>	6,65 <sup>ab</sup>	6,26 <sup>bc</sup>

\*Means followed by different letters in the same row differ at 5% significance by Tukey test.

Concerning the acceptability of the attribute flavour, samples containing 5%, 10%, and 15% OF did not significantly differ from one another, presenting the sample containing 10% OF with the best score (7.2 – liked moderately). However, there was significant difference ( $p > 0.05$ ) between the 10% OF sample and the samples with 0%, 20% and 25% OF which did not differ among themselves, with the 25% OF sample obtaining the lowest score for this attribute (5.93 – between “indifferent” and “liked slightly”).

As to the attribute aroma, the samples 0% and 25% OF presented the lowest scores, they did not differ between each other and both differed from the 10% OF sample ( $p > 0.05$ ) which got the highest score (7.0 – liked moderately).

This suggests that the amount of OF may interfere in the formation of the mass of hamburgers, turning them more compact or fibrous, reflecting on its acceptability.

About the attribute texture, the concentrations of OF which showed the best scores for acceptability were the 10% and 15% OF not differing between each other ( $p > 0.05$ ). The okara concentrations of 0% and 25% obtained the lowest scores for acceptability among all concentrations; they did not differ between each other but differed from the rest.

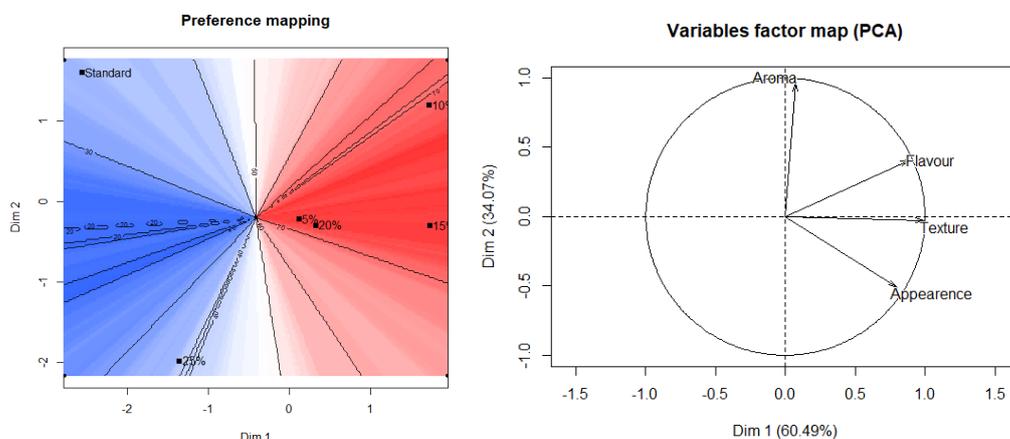
Su et al. (2013) studying beef hamburgers with addition of okara observed significantly lower sensorial scores ( $p < 0.05$ ) for flavour in burgers containing 25% humid okara. However, the results of the sensory analysis showed that succulence, appearance, softness and general acceptability of the hamburgers formulated with okara did not differ statistically from the control (0% okara).

In a study performed with addition of OF in chicken hamburgers it was demonstrated that the amount of fat of the product is directly related to the texture and that the increase of the concentration of okara reduces the

quantity of fat in the product. The addition of OF in superior amounts than 10% reduces the acceptability of hamburgers (BOMDESPACHO et al., 2011). It may be observed that the addition of quantities above 20% OF and below 5% OF may impair the acceptability of the texture of fish formulations, as seen in chicken hamburgers with addition of OF superior to 10% where acceptability was impaired.

OF has enabled better appearance to the formulations when compared to the standard. It was observed that the best scores were obtained by the samples with 20%, 15% and 10% OF respectively, not differing between one another. The sample without addition of okara (0% OF) presented the lowest sensorial score and differs significantly from all the other concentrations. The addition of OF to the hamburgers improved their appearance, resulting in a more homogenous and consistent mixture now of the preparation, besides interfering positively with the colour turning the product more appealing. Referring to the attribute overall liking, the samples with 0% and 25% obtained the lowest means, not differing between themselves and differing from the samples with 10% and 15% OF ( $p > 0.05$ ) which have gotten the highest means. Besides the nutritional aspects, okara confers improvement to all the items evaluated, but its addition in small or big quantities (0% or 25% OF) interfere negatively in the acceptability of hamburgers.

The external preference mapping (Figure 14) was adjusted with the intention of explaining the overall liking and the results were confirmed through the Tukey test in relation to the acceptability of tilapia hamburgers with addition of different concentrations of OF. The analysis explains 60.49% in dimension 1 and 39.5% in dimension 2. It is observed that the preference of the consumers tends towards the 10% and 15% OF concentrations, being all sensory attributes correlated to them.



**Figure 1** - External preference map for Tilapia hamburger under formulations with different concentrations okara flour.

The highest acceptability was found in the samples with 10% and 15% OF, while the 5% and the 20% OF samples had intermediate acceptability. The samples containing 0% and 25% showed low acceptability and are in the opposite quadrant to that indicated by the vectors of the sensory attributes, which means, they correlate negatively to all of them, corroborating the results from the Tukey test (5% significance).

One can conclude that products enriched with 10% and 15% OF obtained the best acceptance when compared to the other formulations.

Grizzoto et al. (2012), in his study found that sausages type Frankfurter enriched with okara flour in the concentrations 1,5% (soy with peel) and 4% (soy without peel) were equally accepted by the subjects when compared to the standard (0% okara).

Marengoni et al. (2009) verified that there were no significant differences between the means attributed to flavour, aroma, softness, overall liking and intension to purchase hamburgers of mechanically separated tilapia meat with addition of oat flour, vegetable grease or corn starch.

According to Bowles and Demiate (2006), the content of isoflanones present in okara is 35.7 mg/100g. Therefore, it is estimated that the hamburgers with 10% and 15% OF would contain 3.57mg and 5.35 mg respectively. In the last decades, the interest for isoflavones, also known as phytoestrogens, has grown due to the potential beneficial effects that diets enriched with these compounds may confer to the control of many chronic diseases (PERON et al., 2008).

According to the external preference mapping (Figure 1), it may be observed that the vectors aroma and texture are forming a 90° angle, which indicates that they are independent attributes, which means, the evaluation of the aroma did not interfere with the texture of the product. Besides the benefits of the inclusion of fiber, the decreasing of the amount of lipids and the inclusion of isoflavones, the addition of OF in hamburger formulations contributes to the increase of the shelf-life of these products, since it reduces the amount of water, preponderant factor to the shelf-life of products.

## CONCLUSIONS

The formulations of tilapia hamburger with concentrations higher than 10% and 15% OF impair the sensory characteristic of this product.

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