

## QUALITY EVALUATION OF ONION BISCUITS WITH AROMATIZED FISHMEAL FROM THE CARCASSES OF THE NILE TILAPIA

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### ABSTRACT

Current assay aims at the preparation of onion biscuits with the inclusion of different levels of aromatized fishmeal from the carcasses of the Nile tilapia (*Oreochromis niloticus*) to assess their chemical composition and analyze their sensorial and microbiological features. Carcasses (spine with ribs and adhering meat after filleting) were washed and immersed in brine 20% (2:1 - brine volume /weight) with a mixture of 50 g of dehydrated rosemary, marjoram, sage, oregano, chives and parsley. The carcasses were drained, smoked, pressed, ground, dehydrated and ground for the second time. The onion biscuits included 0%, 10%, 20% and 30% fishmeal. There was a positive linear effect for protein, ashes and minerals, but no significant difference for humidity and lipids. A negative linear effect occurred with carbohydrates, with a decrease from 53.75% to 40.56%, similar to calorie rates (from 386.30 to 356.05 kcal/100 g). There was no significant difference for sensorial attributes and purchase intention. Scores ranged between 5.08 and 7.14 for aroma, taste, texture and color (scale 1-9) and between 2.70 and 3.28 for buying intention (scale 1-5). Results show that the product lay within microbiological standards required by Brazilian sanitary law. It is concluded that owing to the sensorial analysis, up to 30% of aromatized fishmeal may be included, with an increase in the rates of protein and minerals coupled to the reduction of carbohydrate and calorie rates.

**Keywords:** chemical composition; fish carcass; microbiology; processing wastes of fish; sensorial analysis

## PALITO DE CEBOLA COM INCLUSÃO DE FARINHA AROMATIZADA A PARTIR DE CARÇAÇAS DE TILÁPIA-DO-NILO

### RESUMO

O objetivo deste trabalho foi elaborar palitos de cebola com a inclusão de diferentes níveis de farinha aromatizada a partir de carcaças de tilápia-do-nilo (*Oreochromis niloticus*) para avaliar a composição química, análise sensorial e microbiológica. As carcaças (espinhaço com as costelas e carne remanescente da filetagem) foram lavadas e imersas em salmoura a 20% (2:1 - volume da salmoura/peso) com uma mistura de 50 g de alecrim desidratado, manjerona, sálvia, orégano, cebolinha e salsa. Após, foram drenadas, submetidas à defumação, prensagem, moagem, desidratação e nova moagem. Foi incluído 0%, 10%, 20% e 30% de farinha de peixe na elaboração dos palitos. Houve efeito linear positivo para proteína, cinzas e minerais, mas não houve diferença significativa para umidade e lipídeos. Para carboidratos houve efeito linear negativo, reduzindo de 53,75% para 40,56%; o mesmo efeito ocorreu para valor calórico (386,30 a 356,05 kcal/100 g). Também não houve diferença significativa para os atributos sensoriais e intenção de compra. As notas variaram de 5,08 a 7,14 para os atributos aroma, odor, textura e cor (escala de 1 a 9), e de 2,70 a 3,28 para intenção de compra (escala de 1 a 5). Análise microbiológica mostrou que o produto estava dentro dos padrões microbiológicos exigidos pela legislação brasileira. Conclui-se que, em função das notas obtidas na análise sensorial, pode ser incluído até 30% da farinha aromatizada nos palitos de cebola, com acréscimo no teor de proteína, minerais e redução nos carboidratos e valor calórico.

**Palavras chave:** análise sensorial; carcaças de peixes; composição química; microbiologia; resíduos de beneficiamento de peixes

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**Original Article/Artigo Científico:** Recebido em 30/11/2014 - Aprovado em 11/09/2015

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## INTRODUCTION

Among animal-derived products fish meat is highly underscored and appreciated mainly due to Omega-3, a polyunsaturated fatty acid with great importance in food. Fish meat has significant rates of proteins (approximately 20%) with a balanced composition of amino acids rich in methionine and cysteine which are lacking in a great number of foods (NEIVA, 2008). Fish meat is also rich in minerals, especially calcium, phosphorus and iron (OLIVEIRA *et al.*, 2002), vitamins A, D and B complex, mostly B12, which transform the product into an excellent nutritional product (SIMÕES *et al.*, 2004; VILA NOVA, *et al.*, 2005).

Fish processing produces a great amount of wastes, which in the case of tilapia filleting may range between 60 and 72%, according to KUBITZA (2006). According to VIDOTTI (2011), the carcass, comprising spine and ribs, and meat wastes from filleting, amount to 19.23% in fish weighing 901 g and to 19.69% for fish weighing 703 g. Doubtlessly, such significant rates should be used in a healthier manner.

Owing to the quantity and quality of wastes, a methodology for a better and greater benefitting of filleting wastes should be adopted. One alternative is the production of mechanically separated meat (MSM) which is being employed by some processing industries. Another alternative would be the preparation of fishmeal from fish carcasses by the aromatization method, already patented for the State University of Maringá, Maringá, Brazil (PI0403921-1) or by cooking (similar to the preparation of flour for animal meals), even though certain precautions should be taken with regard to the preparation and the conservation of prime matter used, regardless of the process.

The preparation of fishmeal from filleting wastes of the Nile tilapia constitutes an excellent protein source with 48.13% and 46.90% of crude protein reported by HARDY (1996) and SUGIURA *et al.* (2000) respectively. GODOY *et al.* (2012) registered that aromatized fishmeal, prepared from tilapia carcasses for human consumption contained 32.82% crude protein, 21.95% lipids and 22.86% ashes. Fishmeal also contained minerals, namely, 1.78 g calcium in 100 g of fishmeal, and

2.36 mg iron and 5.47 mg phosphorus in 100 g of tilapia fishmeal. The same authors reported 23 fatty acids, among which AGPI n-3 with great relevance as eicosapentaenoic (EPA) and docosahexaenoic (DHA) acids. The inclusion of fishmeal in different food products already used but with high carbohydrate and low protein rates, coupled to other nutrients, such as minerals and fatty acids, enriches the product. It also stimulates the consumer to eat fish even though indirectly. In fact, *per capita* consumption of fish in Brazil is merely 9.75 kg per inhabitant year<sup>-1</sup> (MPA, 2012), lower than world *per capita* consumption which is approximately 18.0 kg per inhabitant year<sup>-1</sup> (MPA, 2012). Low fish consumption indexes in Brazil is probably due to lack of knowledge on the food's importance for health, cultural factors, low buying power and concern on y-shaped bones, perhaps one of the main problems for mothers in introducing fish in children's menu.

Product supply and diversification with the inclusion of fish in meals may increase this highly important prime matter in daily consumption, with an increase in consumption index, especially byproducts from industrial processing as a promising alternative for the preparation of economically feasible and nutritionally high quality food products.

Moreover, cereals are one of the most consumed types of food worldwide, with wheat flour ranking first. Biscuits made from flour are one of the products greatly consumed by children. It is also a good option for adults, especially spicy biscuits prepared from a sort of chili pepper and consumed as snacks.

Onion long biscuits are a type of biscuits composed of wheat flour which has a low nutrition rate, or rather, low protein and high carbohydrate rates. In fact, the latter are important calorie sources but insufficient for providing other macronutrients and micronutrients to the human body (GUILHERME and JOKL, 2005).

Current assay aims at enriching onion long biscuits by including different levels of aromatized fishmeal from the carcasses of the Nile tilapia (*Oreochromis niloticus*), assessing its chemical composition and analyzing its sensorial and microbiological attributes.

## MATERIAL AND METHODS

Fishmeal and onion long biscuits were prepared at the Fish Technology Laboratory of the Iguatemi Experimental Farm of the State University of Maringá, Maringá (PR), Brazil. Carcasses of the Nile tilapia (*O. niloticus*), donated by Smartfish (Rolândia (PR), Brazil) were used. They were frozen immediately after filleting and transported in isothermal boxes to the laboratory and stored in a freezer (-18 °C) till the preparation of the several types of fishmeal. While the different flours were prepared, the carcasses were thawed and fins and head were removed. The carcasses (spine with ribs and adhering meat after filleting) were washed and immersed in brine 20% (2:1 - brine volume/weight) mixed with a mixture of 50 g of dehydrated rosemary, marjoram, sage, oregano, chives and parsley, with the purpose of flavor. Next, the carcasses were hung for 1 h for draining and reduction of surface water. After that, the carcasses were placed in a smoking chamber for partial drying at 50 °C for 30 min, after which smoking was started. A

handmade stainless steel smoking chamber with external smoke production was used. Eucalyptus awdust (*Eucalyptus globulus*) sawdust was used as a fuel and the chamber temperature was kept with a butane burner. The smoking temperature was raised from 60 to 70 °C at 10 °C h<sup>-1</sup>. Smoking lasted for 3 h. After the smoking, carcasses were pressed (10-ton capacity), ground in a meat-mincing machine, dehydrated for 24 h at 60 °C, triturated and ground once more in a knife-type mill (Willye TE-650). The flours were sieved through sieve 500 µm, resulting in a flour with particle size of 0.468 mm. Flours were vacuum packed.

The flours for samples submitted to the analysis of centesimal composition were frozen at -18 °C, whereas samples for microbiological analysis were refrigerated at 5-7 °C, for approximately 24 hours.

Onion long biscuits were prepared (Figure 1) with aromatized fishmeal from the Nile tilapia at several levels (0%, 10%, 20% and 30%) and formulated according to Table 1.



**Figure 1.** (A) Open dough of onion long biscuits with cuts; (B) rolled biscuits; (C) cooked biscuits.

**Table 1.** Ingredients in the preparation of dough of onion long biscuits with the inclusion of different levels of aromatized tilapia fishmeal.

Ingredient	Inclusion of aromatized tilapia fishmeal			
	0%	10%	20%	30%
Wheat flour (g)	490	490	490	490
Aromatized tilapia fishmeal (g)	0	49	98	147
Margarine (g)	93	93	93	93
Onion (g)	192	192	192	192
water (mL)	20	20	20	20
Grated Parmesan cheese (g)	100	100	100	100
Yeast in powder (g)	18	18	18	18
Chimichurri (g)	1.5	1.5	1.5	1.5
Chili pepper (g)	1	1	1	1

Ingredients were mixed and homogenized in a food mixer Arno and the dough opened with a rolling pin at a thickness of about 1 cm, cut in strips 4 cm long by 1 cm wide, and coiled. They were then placed in an oiled cooking pan, with enough space between the biscuits, and cooked in a heated oven (200 °C) for 20 minutes.

The product was then cooled and the samples packed and labeled at random according to inclusion level for sensorial analysis.

The microbiological analysis of the flour and onion long biscuits was performed at the Laboratory of Food Microbiology and Microscopy of the Department of Clinical Analysis in the State University of Maringá. Samples were assessed for the Most Probable Number (MPN) of coliforms at 35 °C and 45 °C and *Staphylococcus* positive coagulase in colony-forming unit (CFU) gram<sup>-1</sup> and *Salmonella* spp. were counted following APHA (1992). Microbiological protocol followed standards recommended by RDC n. 12, published on Jan. 2, 2001 by the Brazilian Sanitary Agency (BRASIL, 2001).

Humidity, crude protein and ash rates of aromatized fishmeal of the tilapia and of the onion long biscuits were calculated. Assays were performed in triplicate following methodology by AOAC (2005) and the BLIGH and DYER method (1959) was employed for the extraction of total lipids. Carbohydrate content was determined by calculating the difference between the other components (BRASIL, 2003). Total caloric value was obtained by the sum of the multiplication of protein, lipids, and carbohydrates means multiplied by the factors 4, 9, and 4 respectively (SOUCI *et al.*, 2000).

Sensorial analysis was undertaken in individual white-painted cabins, under a white light, imitating daylight. The analysis of onion long biscuits was performed 24 h after preparation. A biscuit from each treatment (corresponding to each level of fishmeal inclusion) was given to 50 non-trained tasters who assessed the sensorial attributes of its aroma, color, taste, texture, coupled to a general impression of the product.

Tasters received the samples coded randomly with three identification digits, a card for the assessment of sensorial analysis and a glass of

mineral water at room temperature to evaluate the samples. The card contained two evaluation forms of the product, comprising a 1-9 score hedonic scale (1 = I disliked it; 9 = I liked it very much) (STONE and SIDEL, 1993; DUTCOSKY, 1996) to evaluate sensorial attributes, and a 5-score buying intention scale, with 5 as maximum score (I will surely buy it) and 1 as the minimum score (I won't buy it), following procedures by MEILGAARD *et al.* (1991) and DAMÁSIO and SILVA (1996).

University staff and students were invited to be tasters through advertisement fixed on the university premises. The first 50 people who declared they had no health problems with fish were enrolled. The effects of inclusion levels of tilapia aromatized fishmeal were evaluated by SAS program (PROC GENMOD). Sensorial results were analyzed taking into consideration the distribution of variables as a parameter with an inverse bond function. Effect of treatment and tasters was evaluated by comparing inclusion levels with control through tests of averages and behavior of tasters' scores according to levels of inclusion of aromatized fishmeal by regression analysis.

The results of variables analyzed by centesimal composition underwent analysis of variance with 5% probability (SAS, 2000). Since microbiological tests merely characterized the onion long biscuits, or rather, to verify whether they were fit for human consumption, statistical analysis was not performed.

## RESULTS

Microbiological analysis showed that fishmeal and onion long biscuits (Table 2) complied with standards established by the Brazilian Sanitary Agency (Agência Nacional de Vigilância Sanitária - ANVISA), which determines for fish and fish products 10<sup>2</sup> MPN g<sup>-1</sup> for coliforms at 45 °C, absent of *Salmonella* sp./25 g and counts lower of 5x10<sup>2</sup> CFU g<sup>-1</sup> for *Staphylococcus* coagulase positive (BRASIL, 2001).

Aromatized tilapia fishmeal included in onion long biscuits contained 4.94% humidity; 45.84% crude protein; 18.31% total lipids; 32.24% ashes. Since fishmeal was used at different levels in the onion long biscuits, there was an increase of nutrients in the final product, regardless of the inclusion level, as Table 3 shows.

**Table 2.** Microbiological analysis of aromatized fishmeal and onion long biscuits with the inclusion of aromatized tilapia fishmeal at different levels.

Treatment	Microbiological analyses			
	Coliforms at 35 °C (MPN g <sup>-1</sup> )	Coliforms at 45 °C (MPN g <sup>-1</sup> )	<i>Staphylococcus</i> coagulase positive (CFU g <sup>-1</sup> )	<i>Salmonella</i> ssp. 25g
1 = 0%	< 3	< 3	< 1x10 <sup>2</sup>	Absent
2 = 10%	< 3	< 3	< 1x10 <sup>2</sup>	Absent
3 = 20%	< 3	< 3	< 1x10 <sup>2</sup>	Absent
4 = 30%	< 3	< 3	< 1x10 <sup>2</sup>	Absent
Aromatized fishmeal	< 3	< 3	< 1x10 <sup>2</sup>	Absent

MPN = Most Probable Number; CFU = Colony-forming unit.

Although there was no significant difference for humidity and lipids (Table 3), significant difference was reported for crude protein, ashes and carbohydrate rates. Crude protein and ashes increased as inclusion levels of tilapia fishmeal in onion long biscuits were raised. Positive

linear equations ( $y = 15.255 + 0.257xi$ ;  $R^2 = 0.99$  and  $y = 3.419 + 0.153xi$ ;  $R^2 = 0.98$ , respectively) explained the results. Carbohydrate rates decreased according to increase in the inclusion of tilapia fishmeal levels, with a negative linear equation ( $y = 62.192 - 0.368xi$ ;  $R^2 = 0.98$ ).

**Table 3.** Analysis of the centesimal composition of onion long biscuits with the inclusion of aromatized tilapia fishmeal.

Parameter	Inclusion level (%)				P rate	CV <sup>a</sup> (%)
	0	10	20	30		
<b>Centesimal composition (%)</b>						
Humidity	6.15 ± 0.29	7.22 ± 1.47	6.20 ± 0.18	6.03 ± 0.31	NS	12.01
Crude protein	15.34 ± 0.65	17.57 ± 0.22	20.70 ± 0.92	22.95 ± 1.89	<0.001	5.78
Lipids	12.21 ± 0.96	12.60 ± 0.21	12.14 ± 1.47	11.33 ± 1.24	NS	8.95
Ashes	3.64 ± 1.19	4.69 ± 0.08	6.32 ± 0.34	8.18 ± 0.51	<0.001	11.77
Carbohydrates	62.65 ± 1.18	57.92 ± 1.33	54.65 ± 1.35	51.50 ± 2.48	<0.01	2.94
<b>Minerals</b>						
Calcium (%)	0.30 ± 0.05	0.57 ± 0.03	0.74 ± 0.07	1.03 ± 0.20	<0.001	16.48
Phosphorus (%)	0.39 ± 0.04	0.57 ± 0.01	0.71 ± 0.03	0.97 ± 0.08	<0.001	7.53
Iron (mg/100 g)	56.16 ± 21.85	62.20 ± 13.37	62.25 ± 5.65	73.24 ± 6.52	0.0361	23.12
Calorie rate <sup>b</sup> (kcal/100 g)	421.91 ± 9.33	415.36 ± 5.25	410.60 ± 8.57	399.81 ± 7.84	0.0017	1.92

Values expressed as the mean ± standard deviation. NS = Non-significant. <sup>a</sup>Coefficient of variation. <sup>b</sup>Calorie rate = (Crude protein x 4) + (Lipids x 9) + (Carbohydrates x 4).

Calcium, phosphorus and iron rates increased according to increasing inclusion of tilapia aromatized fishmeal in onion long biscuit. Rates increased according to inclusion levels of fishmeal (Table 3). The positive linear equations for these minerals were:  $y = 0.3061 + 0.024xi$  ( $R^2 = 0.99$ ) for calcium;  $(0.378 + 0.019xi)$  ( $R^2 = 0.98$ ) for phosphorus;  $47.766 + 0.713xi$  ( $R^2 = 0.51$ ) for iron.

Table 3 shows that there was a decrease in the calorie rate of onion long biscuits according to increase in the inclusion levels of aromatized tilapia fishmeal, with equation  $y = 422.581 - 0.711xi$  ( $R^2 = 0.97$ ) for these results.

No significant difference was observed for results obtained for the attributes evaluated in the sensorial analysis (Table 4). Scores in Table 4

varied between 5.08 and 7.14 for sensorial analysis attributes, with 9-score hedonic scale

and between 2.70 and 3.28 for buying intention, with a 5-score scale.

**Table 4.** Sensorial analysis of onion long biscuits with inclusion of aromatized tilapia fishmeal.

Inclusion level	Aroma <sup>a</sup>	Taste <sup>a</sup>	Texture <sup>a</sup>	Color <sup>a</sup>	Purchase intention <sup>b</sup>
0%	6.12 ± 2.07	5.98 ± 2.11	6.02 ± 1.82	7.14 ± 1.78	3.28 ± 1.21
10%	6.02 ± 1.92	5.76 ± 1.78	5.84 ± 1.90	6.80 ± 1.74	3.06 ± 1.15
20%	5.86 ± 2.18	5.52 ± 2.20	5.80 ± 1.94	6.32 ± 1.77	2.82 ± 1.14
30%	6.38 ± 1.98	5.08 ± 2.16	5.76 ± 2.06	6.46 ± 2.13	2.70 ± 1.23
<b>P rate</b>	0.497 <sup>NS</sup>	0.206 <sup>NS</sup>	0.501 <sup>NS</sup>	0.050 <sup>NS</sup>	0.119 <sup>NS</sup>

Values expressed as the mean ± standard deviation. NS = Non-significant. <sup>a</sup>Hedonic scale between 1 (I disliked it) and 9 (I liked it very much). <sup>b</sup>Hedonic scale between 1 (I won't buy it), and 5 (I will surely buy it).

## DISCUSSION

Results of the microbiological analysis showed that fishmeal and onion long biscuits with inclusion of tilapia fishmeal were proper for human consumption. In fact, coliforms *Staphylococcus* and *Salmonella* did not increase at 35 °C and 45 °C, or rather, the prime matter was microbiologically proper and handling during the preparation of the onion long biscuits was adequate. Aromatized tilapia fishmeal and onion long biscuits have shown good hygiene and sanitary scores following requirements by ANVISA, and thus good for human consumption.

Microbiological results coupled to low humidity rates of fishmeal and of onion long biscuits may favor the products' shelf life. According to HAJ-ISA and CARVALHO (2011), the above also requires conditioning in proper packages, or rather, impermeable to humidity, gases and light.

Aromatized tilapia fishmeal is a high protein product coupled to high amounts of minerals evidenced by ash rate (32.24%). Rate of ether extract was also high since its decrease was difficult during the pressing of carcasses. This fact was due to the carcasses remaining entire after the smoking process and the need of an over-15-ton press for a greater extraction of fats.

According to FRANCO *et al.* (2013), crude protein and ashes of fishmeal vary according to the origin of the prime matter (fish carcass) which is due to the type of rations supplied to fish and to the filleting method employed and thus the amount of meat remaining on the spine.

According to the same authors, the methodology in the product's processing is another factor that may interfere in the chemical composition of the fishmeal. Certain factors may be observed when the results in the literature are investigated.

According to FRANCO *et al.* (2013), cooked fishmeal from tilapia carcasses (spine without head and fins) provided 2.15% humidity, 45.32% crude protein, 6.93% ether extract and 38.03% ashes. On the other hand, PETENUCCI *et al.* (2010) reported that fishmeal from the tilapia spine provided 14.2% humidity, 40.8% crude protein, 18.3% ashes and 25.3% total lipids, considered to be a product with high mineral levels and an excellent calorie and protein source. Methodologies for obtaining fishmeals were different from that of current assay. The methodology by PETENUCCI *et al.* (2010) followed the normal cooking pattern for the preparation of fishmeal, whereas the methodology used in current assay employed the smoking or aromatization method. Method by FRANCO *et al.* (2013) comprised cooking and pressing, with a further decrease in humidity and fat rates.

Aromatized tilapia fishmeal had the lowest humidity (4.94%) and total lipid (18.31%) rates when compared with fishmeal assessed by PETENUCCI *et al.* (2010), albeit with higher rates of crude protein (45.84%) and ashes (32.24%).

Results shows that onion long biscuits had low humidity rates (between 6.03 and 7.22%), with no significant difference for this parameter, and demonstrates that the product was cooked in a uniform manner for all treatments. Since the

product is a type of biscuit which, according to ANVISA (1978), must have a maximum of 14% humidity, the onion long biscuits with the inclusion of aromatized tilapia fishmeal had a low humidity rate.

According to EL-DASH and GERMANI (1994), meals with over 14% humidity are liable to goats which damage the production of the dough where flour and water should flow uniformly to maintain the proportion of the ingredients in the bread dough mixture. Moreover, according to SGARBIERI (1987), meals with over 14% humidity tend to develop microorganisms such as fungus and yeasts, with a decrease in stability and shelf-life

When compared with other meals that may be included in biscuits for the product's enrichment, fishmeals have a high nutritional value with high protein and mineral rates, reduction of carbohydrates and calorie rates. In fact, onion long biscuits were nutritionally enriched with fishmeal.

Results demonstrate that there was a 12.69–33.16% protein increase when 10 to 30% of aromatized tilapia fishmeal were added, coupled to 22.39–55.50% ash increase with the same inclusion levels, whereas carbohydrates and calorie rates decreased with the addition of fishmeal ranging between 10.52% and 24.54% and between 2.65% and 7.83%, respectively. Currently a trend exists for products with high protein rates and low carbohydrate and calorie ones. These are precisely the characteristics found in onion long biscuits with fishmeal.

Increase in mineral contents and lipid composition of aromatized tilapia fishmeal in onion long biscuits is a nutritional asset for school meals. The low energy component of onion long biscuits with the inclusion of tilapia fishmeal should also be emphasized when compared to those without the fishmeal. In fact, it is the concern of many consumers to have less energetic food but high nutritional values.

FRANCO *et al.* (2013) evaluated home-made biscuits with the inclusion of tilapia fishmeal at different levels (0%, 6%, 12%, 18%, 24% and 30%). They obtained a product with 10.00%-10.99% humidity; 9.95%-17.71% crude protein; 9.27%-10.15% ether extract; 0.76%-6.56% ashes and a carbohydrate decrease from 69.68% to 55.58%

due to the several inclusions of fishmeal in the biscuits. Results showed that the biscuits provided an increase in protein and mineral rates and a decrease in carbohydrates. HAJ-ISA and CARVALHO (2011) also assessed salty biscuits with a replacement of wheat flour by hake meat. They reported an increase in mineral and protein rates in the biscuits. Results by HAJ-ISA and CARVALHO (2011) and FRANCO *et al.* (2013) corroborate current results.

A product's sensorial analysis is highly relevant since it reveals the liking and disliking degree of a determined product. According to STONE and SIDEL (1993), it should be performed in a Sensorial Analysis laboratory by a team of 25 to 50 persons which represent the target population. The fifty non-trained tasters' scores with regard to the onion long biscuit with the inclusion of different levels of aromatized tilapia fishmeal revealed certain likeliness in scores on inclusion levels. The product was moderately accepted by the tasters, with scores ranging between 5.08 (I disliked it/ I did not dislike it) and 7.14 (I liked it somewhat), following STONE and SIDEL (1993) and DUTCOSKY (1996). Further, low scores for the attribute taste may have been improved in the manufacture of the product through the addition of herbs, chili pepper or by adding onion cream instead of crushed onions so that the tastiness of the biscuit could be improved.

Scores given by the tasters suggest that the aroma, texture and color of the product are the main properties that determine a good acceptance and consumption by consumers. In fact, scores ranged between 6 and 7 which correspond to liking the product moderately to liking the product somewhat.

The purchase intention of the product analyzed by the tasters showed scores very close to 3 which, according to MEILGAARD *et al.* (1991) and DAMÁSIO and SILVA (1996), corresponded to 'Perhaps I'll buy it/Perhaps I won't buy it', regardless of the level of inclusion of aromatized tilapia fishmeal in onion long biscuits.

When purchase intention of onion long biscuits without the inclusion of aromatized tilapia fishmeal was assessed, the score represented 34% of those who would possibly buy the product. If only the purchase intention were

analyzed, there would only be a higher purchase intention (approximately 22%) when 10% of aromatized tilapia fishmeal were added to the biscuits. However, when the three inclusion levels (10%, 20% and 30%) were assessed, the purchase intention would be close to the same percentage (close to 12%) for 10 and 30% of fishmeal inclusion. A 30% inclusion of aromatized tilapia fishmeal in the product may be an option, taking into account the absence of significance in the results of sensory analysis and improved nutritional characteristics shown in this study.

A decrease in the scores of tasters occurred in taste, texture and purchase intention, albeit not significant, in proportion to the increase in the inclusion level of aromatized tilapia fishmeal. Since, according to tasters' scores, the inclusion of different levels of tilapia fishmeal did not have any significant effect, it is possible to add up to 30% of fishmeal to onion long biscuits, even with a decrease in scores as shown in this study.

The product did not reach high scores in the evaluation perhaps due to the type of evaluating population and directly reflected in the purchase intention. Other type of target population may be selected to assess the product with further alterations in the preparation of the onion biscuits as suggested above. Due to the results of sensorial analysis, an improvement in sensorial features is required if the product is commercially produced on a large scale.

Several sweet and salty products have been prepared with the inclusion of fishmeal, such as extruded snacks (JUSTEN *et al.*, 2011), cookies and biscuits (FRANCO *et al.*, 2013), honey bread (VIEIRA *et al.*, 2013) and salty biscuits prepared with hake meat (HAJ-ISA and CARVALHO, 2011), with good acceptance in sensorial analyses.

Onion long biscuits with aromatized tilapia fishmeal for the enrichment of their nutritional qualities have been considered technologically feasible at cottage-industry level. Current assay demonstrated their satisfactory chemical, microbiological and sensorial characteristics too. Besides these aspects, since biscuits are consumed daily, adults, young people and children may also acquire the habit of eating fish indirectly, benefitting mainly the lipids of the prime matter mainly composed of polyunsaturated fatty acids.

Feasible quality alternatives for wastes produced by fish filleting are mandatory to avoid wastes and decrease their impact on the environment. Further studies will be undertaken to compare and deepen results in current experiment, including people from different age-brackets for the products' assessment.

## CONCLUSIONS

Aromatized tilapia fishmeal proved to have low humidity rates and high rates of crude protein, lipids and ashes when the fishmeal is included in the biscuits. Higher inclusion levels increased rates of crude protein, ashes and minerals (calcium, phosphorus and iron) and decreased rates of carbohydrates and calories in onion long biscuits.

There were no great differences in preference for onion long biscuits with different inclusions of aromatized fishmeal. In fact, up to 30% of aromatized tilapia fishmeal may be included in onion long biscuits as a result of the scores obtained in sensorial analyses.

## ACKNOWLEDGEMENTS

The authors would like to thank Smart Fish for the donation of tilapia carcasses used in the preparation of aromatized tilapia fishmeal. Thanks are also due to GDC Alimentos S.A. for its support in current research.

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