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SENSORY ACCEPTANCE OF SMOKED MORTADELLA PREPARED WITH SURIMI FROM FLYING FISH ADDED INULIN

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ABSTRACT

The objective of this research was to evaluate the microbiological quality, sensory acceptance and purchase intention of a smoked sausage prepared with surimi from flying fish added inulin and with reduction of fat. Seven treatments were formulated following an experimental and a control formulation using 15% of vegetable fat and 0% inulin. All treatments were within acceptable microbiological standards for human consumption, in accordance with the legislation in force in Brazil. There was no significant difference between the sensory attributes evaluated, i.e., the adjudicators found no differences between the control formulation and the treatments obtained in experimental planning. With regard to purchase intention, there was no statistically significant influence among the treatments. The increase in the concentration of inulin on mortadelas has resulted in a higher purchase intention with shades ranging from 3.82 to 4.05, corresponding to "may be buy/might not buy" and "possibly buy." The results found in the microbiological and sensory tests were satisfactory, being an alternative to add value to the species of flying fish to offer a food with low fat that may contribute to the health of the consumer in addition to being noptiontoencour age the consumption of fish by the population.

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INTRODUCTION

A healthy diet can be possible through a balanced diet with foods that somehow may bring benefits to our health. Functional foods, in addition to the nutritional function, can help in the promotion of health, through the prevention of diseases (SÁNCHEZ-ALONSO *et al*. 2007).

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The fish can be considered a food with functional properties, because it is an important source of proteins, lipids and nutraceutical compounds, such as fish oil, in addition to contain easily digested protein, ideal for people with digestive problems. The demand for healthier foods has led to meat industry to develop differentiated products. The increment of the nutritional value of meat and meat products can be obtained through the improvement of the composition and quality of meat, use of new raw materials, or through the reformulation of products, adding ingredients with functional

properties such as prebiotics and probiotics (SIRÓ *et al*., 2008; ZHANG *et al*., 2010). The production of sausages of fish, such as mortadella, represents a promising alternative to attract consumers seeking convenience foods with easy preparation and high nutritional value. The preparation of such products, because they are easy to prepare and free of pimples, you can encourage the increase of consumption of meat of fish, since the fish consumption in Brazil is considered low compared to other protein sources of animal origin (Bartholomew *et al*., 2014). The inulinis a dietary fiber, belonging to the group of fructo-oligosaccharides, found in nature in some varieties of vegetables, butmainly in the root of the chicory (*Cichoriumintybus L*.) and Jerusalemartichoke (*Helianthustuberosus*). It is considered a prebiotic by selectively stimulating the proliferation or desirable activity of beneficial bacteria in the large intestine, bringing many benefits, among them the stimulation of the immune system, increase the absorption of minerals and inhibit the growth of pathogenic bacteria intestinal anomalies (FRANCK, 2002; ROBERFROID, 2007). The use of surimi from sub species of fish usedcommercially in Brazil, such as the flying fish (Hirundicthys affinis), coupled with the addition of inulin, can facilitate the access of the population to a food with high nutritional value and functional characteristics, with the aim of providing a more healthy food consumers. In this way, the objective of this work was to evaluate the microbiological and sensory quality of a smokedmortadella type emulsified product elaborated with flying fish surimi, added inulin to replace fat.

MATERIAL AND METHODS

Obtaining of surimi from flying fish: Mechanically separated meat (MSM) was initially obtained flying fish using the following steps: desquamation, beheading, gutting and removal of the skin followed by washing of fish with chlorinated water (10 ppm). The mechanical separation of meat was performed on a machine of boning industrial with endless screw thread and with openings of 2 mm. After extraction, the CMS was washed twice with chlorinated water (5 ppm and 18 ºC) in proportion 3:1 (water:CMS), NaHCO3 (0.5%) and NaCl (0.2%), being made a refining in fabricd is infected after each wash. At the end of the second wash was added sucrose (0.2%) as CRYOPROTECTANT, in this way, obtaining the surimi (ARAUJO, 2013).

Elaboration of mortadella formulations

They were developed eight formulations, weighing 500 g each sample, there is variation in the addition of vegetable fat content (GV) and inulin. The mortadelas were drawn up according to a factorial experimental 2^2 with 3 central points, totaling 7 treatments (BARROS NETO *et al.,* 2002), in order to observe the influence of input variables (X1 = concentration of vegetable fat and X2 = concentration of inulin) in response that were the microbiological and sensory tests. The levels used varied between 5% to 15% and 3% to 9% for the variables concentration of vegetable fat and inulin respectively. The matrix of the planning of experiments are presented in Table 1. It was also developed a formulation control, using 15% of vegetable fat and 0% inulin.

Microbiological analysis: All microbiological analyzes were carried out in accordance with the methodologies proposed by the American Public Health Association (APHA, 2001). The analyzes were performed for the following microorganisms: *Staphylococcus* coagulase positive, *Salmonella sp.* and coliforms at 45 °C, proposed by the DRC n° 12, from 2 January 2001, the National Agency of Sanitary Surveillance (BRAZIL, 2001).

Table 1. Matrix of factorial 2^2 + 3 central points

Experiments	Variables	
	Concentration of vegetable fat (%) X1	Concentration of inulin content (%) X2
1	(-1) 5	(-1) 3
2	(+1)15	(-1) 3
3	(-1) 5	(+1) 9
4	(+1) 15	(+1) 9
5	(0) 10	(0) 6
6	(0) 10	(0) 6
7	(0) 10	(0) 6

Sensory analysis

The tests were applied to 80 untrainedadjudicators, aged 18 to 40 years, of both genders, chosen on the basis of being frequent consumers of Mortadella. The tests were applied for acceptance and purchaseintention as specified by Stone and Sidel (1985) and Meilgaard et al. (1991). The samples of mortadelas smoked, were served in cubes in disposableplates, coded with three-digit numbers defined in a randommanner, accompanied by water and salt biscuit and a glass with natural mineral water. The acceptance test was performed with a hedonicscale of nine points verbal category (9=I liked very much 1= disliked extremely), to the attributes color, aroma, texture, flavor and overall acceptability. The assessment test of attitude regarding the intention to purchase was performed using the scale of mixed category with five points (5= certainly buy the 1= certainly not buy).

Statistical treatment of the data

The results of the sensory tests of samples drawn through the experimental planning, were statistically analyzed by ANOVA (analysis of variance) comparing the averages with the control formulation through the Tukey test at 5% probability. We also used the method of surface response to evaluate the influence of input variables on the dependent variables of the treatments defined through the experimental planning, using the statistical program STATISTICA® version 5.0 (STATISTICA, 2004).

RESULTS AND DISCUSSION

Microbiological evaluation: All formulations had absence of *Staphylococcus* coagulase positive/g, *Salmonella sp*. / 25 g and thermotolerant coliforms (45 °C), ensuring the microbiological stability of mortadelas, indicating that the formulations were within acceptable standards for human consumption, in accordance with the legislation in Brazil (BRAZIL, 2001). These results demonstrate the effective hygienic and sanitary control during production, as well as the performance of the use of the curing salt and heat treatment applied during cooking.

Sensory evaluation: As can be observed in Table 2, there was no significant difference between the attributes evaluated, i.e., the adjudicators found no differences between the control formulation and the treatments obtained in experimental planning.

Table 2. Averages and standard deviations of the testresults of acceptance of emulsified"mortadella type" of flyingfish addedinulin

Treatments	Color	Aroma	Texture	Taste	Global Acceptance	Purchase intent *
Control	6.83 ± 1.32 [a]	6.92 ± 1.39 [a]	6.80 ± 1.65 [a]	6.95 ± 1.42 [a]	7.10 ± 1.32 [a]	3.90 ± 0.80 [a]
F1	6.48 ± 1.35 [a]	7.12 ± 1.33 [a]	7.03 ± 1.54 [a]	7.35 ± 1.33 [a]	7.23 ± 1.35 [a]	3.82 ± 0.75 [a]
F2	6.50 ± 1.42 [a]	6.75 ± 1.55 [a]	6.98 ± 1.56 [a]	6.95 ± 1.40 [a]	7.28 ± 1.21 [a]	3.85 ± 0.84 [a]
F3	6.57 ± 1.48 [a]	7.03 ± 1.30 [a]	6.97 ± 1.52 [a]	7.18 ± 1.46 [a]	7.40 ± 1.26 [a]	4.00 ± 0.82 [a]
F4	6.63 ± 1.25 [a]	6.75 ± 1.35 [a]	6.85 ± 1.34 [a]	6.90 ± 1.49 [a]	7.15 ± 1.38 [a]	4.05 ± 0.85 [a]
F5	6.48 ± 1.28 [a]	6.80 ± 1.38 [a]	6.68 ± 1.51 [a]	6.92 ± 1.53 [a]	7.13 ± 1.35 [a]	3.97 ± 0.76 [a]
F6	6.40 ± 1.39 [a]	6.83 ± 1.46 [a]	7.12 ± 1.22 [a]	6.90 ± 1.30 [a]	7.32 ± 1.14 [a]	3.93 ± 0.86 [a]
F7	6.47 ± 1.33 [a]	6.78 ± 1.28 [a]	6.70 ± 1.44 [a]	6.85 ± 1.39 [a]	7.12 ± 1.46 [a]	3.95 ± 0.77 [a]

* Averagesobtainedthroughscale of five points.
Different letters in the same column differ significantly from the control formulation by Tukey test at 5% level of significance.

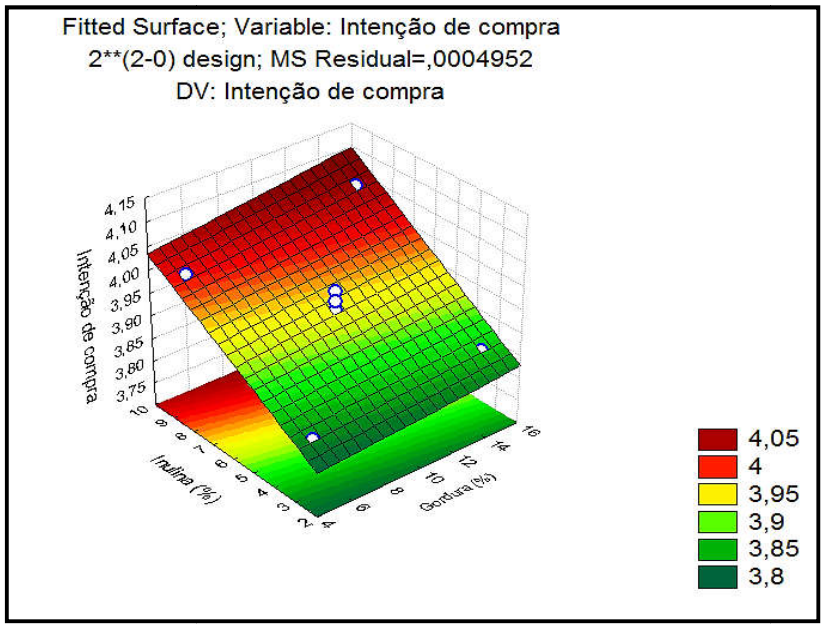

Figure 1. Surface response concerning the purchaseintention of mortadella of flyingfish addedinulin

There was also no statistical influence of independent variables vegetable fat (GV) and inulin on the response variables (color, aroma, texture, flavor and overall acceptability) among the seven treatments defined through the experimental planning. The averages for the attributes evaluated and global acceptance in the smoked sausage of flying fish ranged between values 6 (liked slightly) and 7 (liked moderately) of the hedonic scale used, indicating a possible acceptance of the product. These results are close to those reported by Bartholomew *et al*. (2014) who evaluated the acceptance of mortadella prepared with CMS of Nile tilapia. The values found in this study are similar to those found by Araújo (2013), that when assessing the acceptability of the nuggets prepared with fish surimi albacore obtained a variation between 7.72 to 8.17 proving good acceptance by the panelists. The treatments evaluated presented a good overall acceptability with a variation between 7.10 to 7.40 for the formulations control and F3 respectively, this shows that in a general way the adjudicators liked moderately from the product. The good sensory acceptance of all of the attributes studied, are similar to those found by Araújo (2013) to evaluate seven formulations of nuggets prepared with surimi from flying fish presented good acceptance by the adjudicators. In relation to purchase intention of mortadelas flying fish, there was statistical influence of independent variables for the response variable (purchase intention). Analyzing the response surface and contour (Figure 1) is that the increase in the concentration of inulin on mortadelas has resulted in a higher purchase intention and that there was no influence of concentration of vegetable fat for this response variable. Scores (Table 2) to purchase intent ranged from 3.82 to 4.05 corresponding to "maybe buy/might not buy" and "possibly buy." These results prove a good purchase intention of mortadelas flying fish by adjudicators, being quite satisfactory in view of the use of a raw material is little known and a formulation with reduced fat content.

Conclusion

The addition of inulin on smoked sausage of flying fish, has the potential to be an alternative in the reduction of fat, without harming its microbiological and sensory characteristics. The results found in the sensory tests were satisfactory, since the introduction of new products on the market, mainly from raw materials little known, stumbles on distrust on the part of consumers to the flavors and strange appearances. In this way, the formulations developed are an alternative to add value to the species of fish albacore and offer a food with functional properties, which can contribute to the health of the consumer, in addition to being an option to encourage the consumption of fish by the population.

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