

ORIGINAL RESEARCH ARTICLE

OPEN ACCESS

## DEVELOPMENT OF SMOKED MORTADELLA PREPARED WITH SURIMI OF FLYING FISH ADDED INULIN AND WITH FAT REDUCTION

\*<sup>1</sup>Raimundo Bernadino Filho, <sup>2</sup>Solange de Sousa, <sup>2</sup>Raunira da Costa Araújo,  
<sup>3</sup>Mônica Tejo Cavalcanti, <sup>4</sup>Lucivânia Assis de Oliveira Navarro and  
<sup>5</sup>Artur Xavier Mesquita de Queiroga

<sup>1</sup>College professor at the Federal Rural University of Pernambuco, Academic Unit of Garanhuns, Garanhuns, Pernambuco, Brazil

<sup>2</sup>College professor at the Department of Management and Agroindustrial Technology, Universidade Federal da Paraíba, Bananeiras, Paraíba, Brazil

<sup>3</sup>College professor at the Academic Unit of Food Technology, Federal University of Campina Grande, Pombal, Paraíba, Brazil

<sup>4</sup>Food Laboratory Technician at the Jundiá Agricultural School, Federal University of Rio Grande do Norte, Macaíba, Rio Grande do Norte, Brazil

<sup>5</sup>Post-graduate Program in Process Engineering, Federal University of Campina Grande, Campina Grande, Paraíba, Brazil

### ARTICLE INFO

#### Article History:

Received 28<sup>th</sup> March, 2018  
Received in revised form  
19<sup>th</sup> April, 2018  
Accepted 24<sup>th</sup> May, 2018  
Published online 30<sup>th</sup> June, 2018

#### Key Words:

Mechanically separated meat (MSM).  
Surimi. Emulsion.  
Prebiotic. *Hirundichthys affinis*.

### ABSTRACT

The objective of this research was to develop and characterize the physico-chemical composition of a smoked mortadella prepared with surimi from flying fish added inulin and with reduction of fat. The experiment was planned in a factorial scheme 2<sup>2</sup> with 3 central points, to observe the influence of the independent variables (fat concentration vegetable and insulin concentration) in the variables responses that were physical and chemical analysis. Seven treatments were formulated following the experimental planning and control formulation using 15% of vegetable fat and 0% inulin. The response surface showed that the lower the concentration of fat added in the meat, the higher the response observed for the moisture and carbohydrates contents, and the higher the fat concentration added in the experiments, the higher the lipid content observed. With relation to the ash content and protein, it was observed that the models were not performed statistically significant at the 5% level of significance. This work allowed the preparation of a smoked sausage from the surimi of flying fish with good physicochemical characteristics, high nutritional value and with reduced fat content.

Copyright © 2018, Raimundo Bernadino Filho et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Raimundo Bernadino Filho, Solange de Sousa, Raunira da Costa Araújo, Monica Tejo Cavalcanti, Lucivânia Assis de Oliveira Navarro and Artur Xavier Mesquita de Queiroga. 2018. "Development of smoked mortadella prepared with surimi of flying fish added inulin and with fat reduction", *International Journal of Development Research*, 8, (06), 21374-21377.

### INTRODUCTION

Every day there is a world-wide trend of consumers in purchasing foods that some form submit health benefits. The white meats of fishes go in favor of this new reality, because are rich in lipids and proteins for high digestibility. In addition, it constitutes a food potentially accessible to low-income populations, because of the ease with which it can be cultivated.

\*Corresponding author: Raimundo Bernadino Filho

<sup>1</sup>College professor at the Federal Rural University of Pernambuco, Academic Unit of Garanhuns, Garanhuns, Pernambuco, Brazil

The flying fish (*Hirundichthys affinis*) is a species abundant and low commercial value in the region Northeastern Brazil, can be found on the coastlines of all continents (ARAÚJO et al., 2011). It is food for low-income populations, being little valued commercially. Mortadella stands out as an emulsified meat product of, low cost, intense odor with significant contents of fat and widely consumed in Brazil, mainly in the Northeast (GUIMARÃES, 2011). A recent trend in this type of emulsified is the development of differentiated products with appeals to health, with a focus on reducing or fat replacement and addition of fibers. Inulin is a non-digestible fiber with

estimated calorie 1.5 kcal/g, found and extracted from a variety of plants and produced commercially from chicory root (PARK, 2006). In products meat, inulin constitutes an ingredient with a very good potential of application, on the basis of their technological properties suitable for replacing the fat, as development agent of texture properties, with low calorie value, very useful in the reformulation of products with focus to the Health (WANG, 2009). In this research the aim is the preparation and physico-chemical evaluation of a smoked mortadella made with surimi of flying fish, added inulin as fat substitute.

## MATERIAL AND METHODS

**Obtaining of surimi:** Mechanically Separated Meat (MSM) was initially obtained from 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 MSM was washed twice with chlorinated water (5 ppm and 18 °C) in proportion 3:1 (water: MSM), with addition of sodium bicarbonate (0.5%) and sodium chloride (0.2%), being made a refining in fabric disinfected after each wash. At the end of the second wash was added sugar (0.2%) as cryoprotectant thus obtained the surimi, following the methodology proposed by Araújo et al. (2013).

**Preparation of formulations mortadella:** The mortadellas have been elaborated in accordance with a factorial experimental planning  $2^2$  with 3 central points, totaling 7 treatments (BARROS NETO et al., 2002), in order to observe the influence of input variables (X 1 = concentration of vegetable fat and X 2 = concentration of inulin) in response that were the physical and chemical analyses. 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 planning of experiments are presented in Table 1. It was also developed a formulation control, using 15% of vegetable fat and 0% inulin.

**Physical-chemical analysis:** The analyses physicochemical (moisture, ash, proteins, lipids and carbohydrates) formulations elaborated were determined in accordance with the methodology proposed by the Association of Official Analytical Chemists (AOAC, 2010).

**Statistical treatment of the data:** The results of the physico-chemical analysis of the samples formulated, 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 response surface method to evaluate the influence of input variables on the dependent variables of the experiments set through the planning experimental, using the statistical program STATISTICA 5.0 version (STATISTICA, 2004).

## RESULTS AND DISCUSSION

The moisture content presented statistically significant at the 5% level of significance. It has been observed through the response surfaces (Figure 1), that the lower the concentration of fat in mortadella, the greater was the response observed (moisture content). When evaluating the addition of fibres as replacing the fat in mortadella, Barreto (2007),

found that the greater the amount of added fat, the lower was moisture content were found, this can be proven in this research to compare the control formulation (57.42%) with F3 (69.97%) in Table 2. With respect to the ash content in mortadellas, it was observed that the model was not statistically significant at the 5% level of significance. The control formulation showed no difference in comparison with the other formulations at level of 5% of probability of the Tukey test (Table 2). Result lower than this research (3.10%) for ash content was found by Bartholomew (2011) when assessing the acceptance of smoked mortadella from fish with low fat.

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

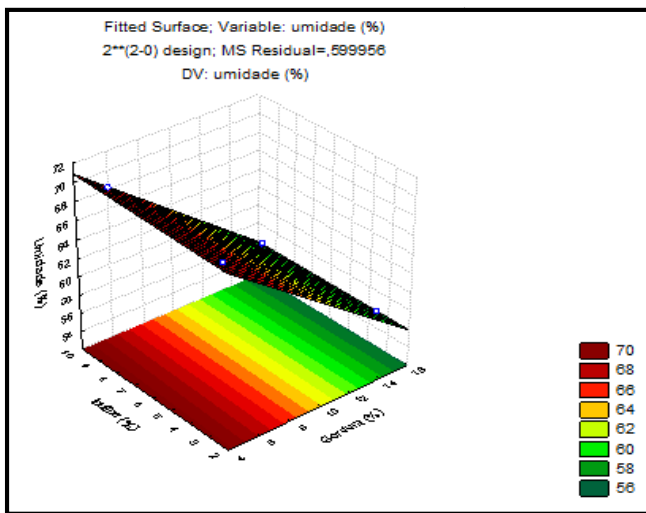
Experiments	Variables	
	Concentration of vegetable fat (%)	Concentration of inulin content (%)
	X1	X2
1	(-1) 5	(-1) 3
2	(+1) 15	(-1) 3
3	(-1) 5	(+1) 9
4	(+1) 15	(+1) 9
5	(0) 10	(0) 6
6	(0) 10	(0) 6
7	(0) 10	(0) 6

It was also found that there was no influence of independent variables on the response variable protein. When comparing the average of the control formulation with the other treatments, also there was no statistical difference at the 5% level of probability of the Tukey test (Table 2). When assessing the physico-chemical composition of mortadella made with MSM of Tilapia, obtained higher result (17%) of protein compared to this study (Table 2). The smaller quantities of proteins in the analyzed formulations are related to the use of surimi as raw material, as that for obtaining same was done two washes with water and this process has caused a reduction in the protein content when confronted with the MSM that doesn't pass through this process. In relation to the lipid content of the samples, it was observed that the model proved to be statistically significant at the 5% level of probability of the Tukey test. Analyzing the response surface (Figure 2) has the increased concentration of vegetable fat in the experiments caused an increase in lipid content in samples evaluated and that there was no influence of inulin concentration for this response variable. Moreira et al., (2008) obtained a variation of lipid between 1.24 to 17.09% when evaluating the addition of isolated soy protein in physico-chemical quality of fish mortadella. Bartholomew (2011), evaluating mortadella prepared with MSM of Tilapia and wheat fiber, obtained a result (1.9%) lower than this research. As for the carbohydrate content of the samples, it was observed that the vegetable fat and inulin variables statistically influenced the level of 5% probability of this parameter. It was observed in Figure 3, which the higher the concentration of fat in mortadella elaborated, the lower was the response observed (carbohydrate content). By increasing the concentration of vegetable fat had a reduction in inulin content, which is a carbohydrate, thereby providing a reduction of that component in the formulations that had higher contents of lipids. The oscillations between carbohydrate contents were expected due to the variation in the content of inulin added. Studying the effect of addition of fibers in the centesimal composition of mortadella produced with beef, Guimarães (2011) obtained superior results (4.26 to 4.94%) than reported in this study (Table 2).

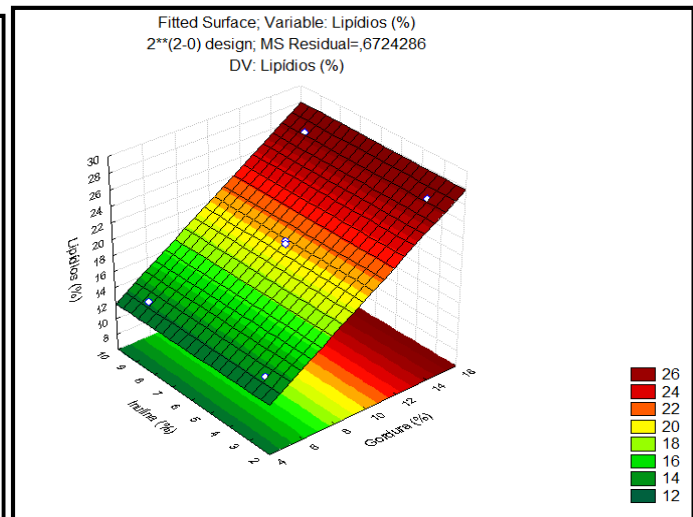
**Tabela 2. Averages and standard deviations of physico-chemical characteristics of the emulsified "mortadella type" of flying fish added inulin**

Treatments	Moisture (%)	Ashes (%)	Proteins (%)	Lipids (%)	Carbohydrates (%)
Control	57,42 ± 0,13 <sup>c</sup>	4,03 ± 0,09 <sup>a</sup>	11,98 ± 0,34 <sup>a</sup>	26,23 ± 0,26 <sup>a</sup>	0,34 ± 0,14 <sup>c</sup>
F1	69,59 ± 0,28 <sup>a</sup>	4,04 ± 0,32 <sup>a</sup>	12,08 ± 0,78 <sup>a</sup>	12,96 ± 0,38 <sup>c</sup>	1,33 ± 0,22 <sup>a</sup>
F2	57,52 ± 0,22 <sup>c</sup>	4,00 ± 0,04 <sup>a</sup>	11,61 ± 0,25 <sup>a</sup>	26,09 ± 0,63 <sup>a</sup>	0,78 ± 0,09 <sup>c</sup>
F3	69,97 ± 0,63 <sup>a</sup>	4,07 ± 0,03 <sup>a</sup>	11,69 ± 0,32 <sup>a</sup>	12,82 ± 0,29 <sup>c</sup>	1,45 ± 0,08 <sup>a</sup>
F4	57,53 ± 0,21 <sup>c</sup>	3,98 ± 0,07 <sup>a</sup>	11,60 ± 0,53 <sup>a</sup>	26,17 ± 0,69 <sup>a</sup>	0,72 ± 0,10 <sup>c</sup>
F5	62,56 ± 0,54 <sup>b</sup>	4,03 ± 0,23 <sup>a</sup>	11,66 ± 0,67 <sup>a</sup>	20,66 ± 0,34 <sup>b</sup>	1,09 ± 0,20 <sup>b</sup>
F6	62,57 ± 0,40 <sup>b</sup>	4,08 ± 0,06 <sup>a</sup>	11,64 ± 0,23 <sup>a</sup>	20,69 ± 0,67 <sup>b</sup>	1,02 ± 0,18 <sup>b</sup>
F7	62,78 ± 0,38 <sup>b</sup>	4,07 ± 0,05 <sup>a</sup>	11,72 ± 0,38 <sup>a</sup>	20,39 ± 0,33 <sup>b</sup>	1,04 ± 0,17 <sup>b</sup>

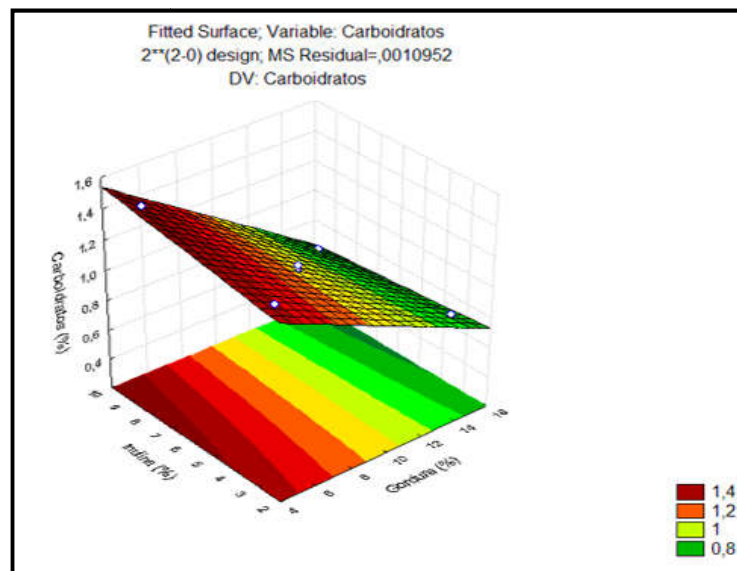
Different letters in the same column differ significantly from the control formulation by Tukey test at 5% level of significance.



**Figure 1. Response surface concerning the moisture of the mortadella of flying fish added inulin**



**Figura 2. Response surface concerning the lipid content of the mortadella of flying fish added inulin**



**Figura 3. Response surface concerning the carbohydrate content of the mortadella of flying fish added inulin**

## Conclusion

With the results of this research, it has been showed up that it is possible to elaborate a mortadella from flying fish surimi, obtaining a food with good physical and chemical characteristics, high nutritional value, with reduced fat content associated with the addition of inulin, which is considered a functional prebiotic ingredient. The developed formulations are an alternative to adding value to a species of fish in little appreciated and the mortadella which is widely consumed in Brazil, besides being an option to the diet of consumers,

favoring a possible increase in the consumption of fish and providing profit to fishing industries.

## REFERENCES

- AOAC. Association of Official Analytical Chemists. Official Methods of Analysis, 18<sup>a</sup> ed. 3<sup>a</sup> rev. 194p. Washington, 2010.
- Araújo, A. S; Oliveira, M. R; Campos, C. E. C; Yamamoto, M. E. 2011. Características morfológicas-merísticas, peso-comprimento e maturação gonadal do peixe voador,

- Hirundichthys affinis*. Biota Amazônia. Macapá, v. 1, n. 2, p. 29-35.
- Araújo, S; Ruegg, R.A.B; Bernadino Filho, R; Damasceno, K. S. F. S. C; Carvalho R. A. P. L. F. 2013. Elaboração do surimi a partir da carne Mecanicamente separada do peixe voador (*Hirundichthys affinis*) 2013. In: 10º Simpósio Latino Americano de Ciência de Alimentos, 2013, Campinas/SP. Anais. Universidade Estadual de Campinas. p 1509.
- Barreto, A. C. S. 2007. Efeito da adição de fibras como substitutos de gordura em mortadela. 2007. 189p. Tese (Doutorado em Tecnologia de Alimentos). Faculdade de Engenharia de Alimentos, Unicamp, Campinas, São Paulo.
- Barros Neto, B.; Scarminio, I. S.; Bruns, R. E. C. 1996. Como fazer experimentos. Campinas: Editora da UNICAMP. 401 p.
- Bartolomeu, D. A. F.S. 2011. Desenvolvimento e avaliação da aceitação de embutido defumado “tipo mortadela” elaborado com CMS de Tilápia do Nilo (*Oreochromis niloticus*) e fibra de trigo. Dissertação (Mestrado em Tecnologia de Alimentos). Universidade Federal do Paraná, Curitiba, Paraná.
- Guimarães, C. F. 2011. Formulação e caracterização de mortadelas com adição de fibras funcionais e redução de gordura. 130p. Dissertação (Mestrado em Ciência e Tecnologia de Alimentos). Universidade Federal de Viçosa, Viçosa, Minas Gerais.
- Moreira, R. T; Lemos A. L. S. C; Harada, M. M; Cipolli, K; Mendes, E. S; Guimarães, J. L; Cristianini, M. 2008. Desenvolvimento e aceitação de embutido emulsionado tipo mortadela elaborado com tilápia (*Oreochromis niloticus* L.) / Development and acceptance of embedded emulsified type Mortadella prepared with tilapia (*Oreochromis niloticus* L.). Higiene Alimentar, v. 22, n.159, p. 47-52.
- Park, N. 2006. La inulina y fructooligosacáridos: propiedades nutricionales y funcionales. In: LAJOLO, F.M.; MENEZES, E.W. Los carbohidratos en los alimentos regionales iberoamericanos. São Paulo: Edusp. Cap.14. p.335-356.
- Statistica. 2004. Versão 5.0 for windows [Computer program]. StatSoft® Company. 2004
- Wang, Y. 2009. “Prebiotics: present and future in food science and technology.” Food Research International, v.42, p.8-12.

\*\*\*\*\*