

Sensory Evaluation of Shrimp Flavored Nile Tilapia Mortadella

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Authors' contributions

This work was carried out in collaboration among all authors. Author RBF designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors OSS, AXMQ, MNO and SNO managed the analyses of the study. Author UAAV managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Objectives: The aim was to develop and evaluate the microbiological and sensory characteristics of a mortadella made from mechanically separated shrimp flavored Nile Tilapia.

Study Design: In the data generated in the acceptance test of the mortadellas, the averages and standard deviations were calculated and the Analysis of Variance (ANOVA) was subsequently performed, the averages were compared by the Tukey test, at the level of 5% significance.

Place and Duration of Study: Universidade Federal de Campina Grande, Department of Graduate Studies in Process Engineering, between January 2017 and May 2018.

Methodology: Three mortadellas formulations were developed with varying concentrations of shrimp flavored aromatic extract. In formulation $M_{0.5}$ 0.5% was added, in formulation $M_{0.75}$, 0.75%, and in formulation M_1 1% of aromatic extract. In the microbiological analyses, *Staphylococcus* coagulase-positive, *Salmonella* sp. and Coliforms at 45°C were determined. Acceptance and purchase intention tests were performed with 100 untrained judges.

Results: All formulations presented microbiological characteristics within the standards established by the legislation in Brazil. The sensory tests indicated a good acceptance of all mortadellas samples, achieving an acceptability rate of 85.97% for formulation M_1 , and 84.42% and 80.25% for formulations $M_{0.75}$ and $M_{0.5}$ respectively. The addition of higher concentrations of aromatic extract had a positive influence on the acceptance of the products. For the purchase intention test, $M_{0.75}$ and M_1 formulations were statistically equal ($p < 0.05$) and had a better evaluation with averages of 4.32 and 4.38 respectively, corresponding to the term "I would possibly buy".

Conclusion: It can be presumed that the formulations developed are an alternative to add value to the residues from the processing of tilapia filleting, and can be used in the elaboration of mortadella with healthier and more nutritious characteristics and with a possible acceptability for marketing.

Keywords: Meat sausages; fish; shrimp; mortadella; sensory analysis; residues.

1. INTRODUCTION

Currently, consumer demand for healthier foods has motivated the food industry to look for raw materials and ingredients for the development of new products and reformulations of traditional products. These consumers are looking for tasty, visually appealing foods, and, at the same time, aim for health and well-being. Fish meat meets this new reality, because it is rich in lipids and proteins of high digestibility and quality.

Nile Tilapia (*Oreochromis niloticus*) is the species of fish that presents the highest rates of aquaculture production in Brazil, and the main products marketed of this species are whole frozen fish and, mainly, the fillets that represent the preference for consumption of tilapia by the national and international consumer market [1]. However, in spite of the several positive aspects related to tilapia culture, one of the undesirable characteristics of this species is the low yield of fillet, which is around 32% to 35%, thus generating large quantities of waste in the fishing industries and reducing the profit margin of the production system [2].

One way of taking advantage of the solid waste from tilapia filleting that has been gaining space in the market is to obtain the Mechanically Separated Meat - MSM, which promote an appreciation and added value to this waste. MSM is the edible fraction of mechanically separated fish and its yield is higher than that of filleting. Offering greater advantage to both the producer and the consumer because it is a product of high nutritional quality. This raw material can be used for the production of surimi, kamaboko,

analogues and emulsified sausages, for which the market is being directed [3].

According to Moreira et al. [4], emulsified sausages stand out as meat products of greatest industrialization and consumption in Brazil, suggesting that they would be the most accepted and the most accessible to the population with low purchasing power. The elaboration of emulsions based on MSM produced with residues from filleting of Nile Tilapia may contribute to avoid waste, add value to the product and reduce environmental pollution, besides being able to facilitate the access of the population to food with high nutritional value and healthier characteristics.

Given the above context, this research aimed to develop and evaluate the microbiological and sensory characteristics of a mortadella made from mechanically separated meat of Nile Tilapia and added shrimp flavored aromatic extract.

2. MATERIALS AND METHODS

2.1 Raw Materials and Inputs

The raw material used to obtain the Mechanically Separated Meat (MSM) was Nile Tilapia carcasses of the species *Oreochromis niloticus*, from the manual filleting process.

The inputs used in the elaboration of mortadellas such as curing salt, antioxidant dye cochineal carmine and condiment for mortadella were donated by Duas Rodas Industrial® company, located in the state of Santa Catarina, Brazil. Sodium chloride, sugar, manioc starch, textured soy protein and the artificial casing were

purchased in local commerce in the city of Sousa, Brazil. The shrimp flavored aromatic extract powder was obtained from the cephalothorax of white shrimp (*Litopenaeus vannamei*), through lyophilization process.

2.2 Elaboration of Mortadellas

Three formulations were developed with varying concentrations of shrimp flavored aromatic extract. In $M_{0.5}$ emulsion, 0.5% aromatic extract was added, in $M_{0.75}$ emulsion, 0.75%, and in M_1 emulsion, 1%. In all formulations were added the ingredients in fixed concentration, such as 1.5% salt, 0.15% curing salt, 0.2% antioxidant, 0.05% white pepper, 0.05% garlic, onion and dehydrated parsley, 0.5% mortadella condiment, 0.07% dye cochineal carmine, 3% manioc starch, 4% textured soy protein (powder) and 15% ice. The mortadellas were prepared based on the technique described by Moreira et al., [4], obeying the Technical Regulation of Quality and Identity of Mortadella [5]. Fig. 1 illustrates the explained how sausages were obtained.

Frozen MSM was homogenized in cutter, and the mixing step was performed in the sequence. Due to the different characteristics of the various ingredients, there is an order of addition to produce a better effect. The salts were added first, followed by the other ingredients, including antioxidant and aromatic extract. After obtaining

the meat emulsion, the mass was inserted in a mechanical sausage stuffer using an artificial envelope to form the product. The sausage was tied with a cotton thread every 20 cm, resulting in pieces of about 500 grams.

The emulsified parts were cooked in an oven with air circulation, performed in four stages: the first one, at a temperature of 65°C for 30 minutes; the second one, at a temperature of 70°C for 30 minutes; the third one, at a temperature of 75°C for 30 minutes; and the fourth one, at a temperature of 80°C until reaching an internal temperature of 72°C. After the cooking process was completed, the pieces were quickly cooled in a water and ice bath, vacuum packed in low-density polyethylene bags and stored in a cold room at a temperature of 6°C for further microbiological and sensory analysis.

2.3 Microbiological Analysis

All microbiological analyses were performed according to the methodologies proposed by the American Public Health Association [6]. The analyses were performed for the following microorganisms: *Staphylococcus* coagulase-positive, *Salmonella* sp. and Coliforms at 45°C, proposed by RDC n° 12, January 2, 2001, of the National Health Surveillance Agency [7].

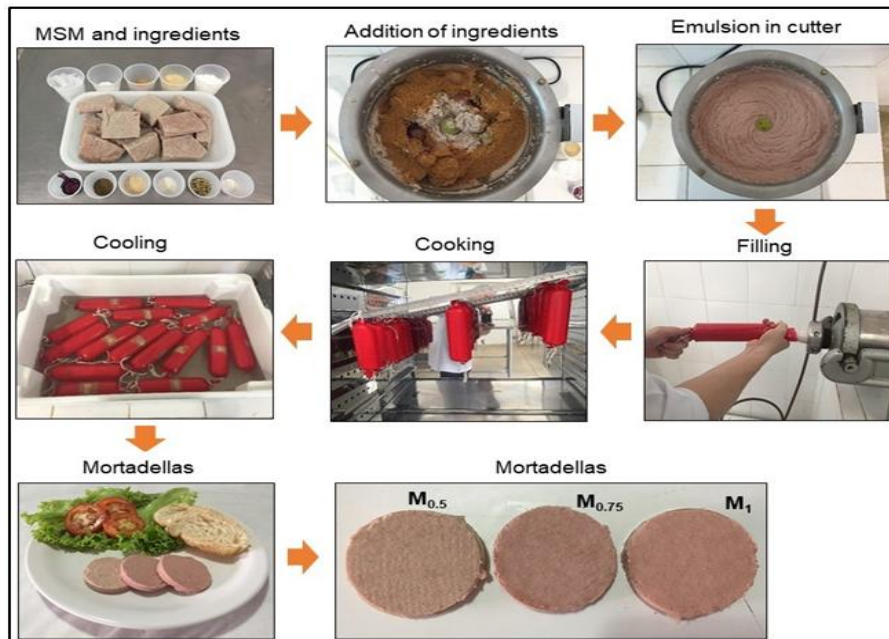


Fig. 1. Flowchart of the elaboration of MSM mortadellas of shrimp flavored Nile Tilapia

2.4 Sensory Analysis

The sensory tests were carried out with 100 untrained judges aged between 18 and 44 years, both genders, accommodated in individual cabins, chosen because they were consumers of mortadella and not allergic to shrimp. Acceptance and purchase intention tests were applied as specified by Stone and Sidel [8] and Meilgaard, Civille and Carr [9].

The acceptance test was performed with a 9-point verbal category hedonic scale (9=Like Extremely to 1=Dislike Extremely), for the attributes analyzed (color, smell, texture, flavor and overall evaluation). The test to evaluate the attitude towards purchase intention was performed using a five points mixed category scale (5= certainly I would buy to 1= certainly I would not buy).

In order to obtain the acceptability rate (AR) of the product, Equation 1 was used:

$$AR (\%) = A \times 100/B \quad (1)$$

Where A = Average Score obtained for the product, and B = Maximum Score given to the product [10].

The mortadella samples, under the different aromatic extract concentrations, were served in cubes in white disposable plastic cups, coded with three-digit randomly defined numbers, accompanied by a water-salt biscuit and a glass of natural mineral water for cleaning the palate between sample exchanges (Fig. 2).



Fig. 2. Cabin prepared for sensory analysis

2.5 Statistical Analysis

In the data generated in the acceptance test of the mortadellas, the averages and standard

deviations were calculated and the Analysis of Variance (ANOVA) was subsequently performed, the averages were compared by the Tukey test, at the level of 5% significance by the software ASSISTAT, version 7.7 [11].

3. RESULTS AND DISCUSSION

3.1 Microbiological Analysis

According to the results (Table 1), all the formulations produced were within acceptable standards for human consumption, complying with Resolution RDC No. 12 of the National Health Surveillance Agency [7].

The absence of *Staphylococcus* coagulase-positive/g, *Salmonella* sp. / 25 g and Coliforms at 45°C, ensured the microbiological stability of mortadellas, indicating that the formulations were in accordance with the legislation in force in Brazil and can be used in sensory analysis [7].

Similar results to Table 1 were found by Bartolomeu et al. [12] and Oliveira et al. [13], when evaluating the microbiological quality of smoked mortadella elaborated with MSM of Nile Tilapia. The authors obtained low counts from coagulase-positive *Staphylococcus*/g (<10), absence of coliforms at 45°C and of *Salmonella* sp.

The results achieved in this work indicate that mortadella formulations have been handled and stored correctly according to the standards of good manufacturing practice and are therefore suitable for consumption.

3.2 Sensory Analysis

As can be seen in Table 2, there was no significant difference ($p < 0.05$) by Tukey test between the attributes evaluated for $M_{0.75}$ (0.75% extract) and M_1 (1% extract) formulations, while in relation to $M_{0.5}$ formulation (0.5% extract), there was a significant difference in all the attributes when comparing the M_1 sample.

In the color attribute, according to the averages obtained (Table 2), it can be observed that $M_{0.75}$ and M_1 treatments differed from $M_{0.5}$ formulation. These data can be justified by the lower addition of aromatic extract in $M_{0.5}$, which besides intensifying the taste of shrimp, contributed to the enhancement of the red color. Bartolomeu et al. [12], by evaluating the sensory acceptance of MSM mortadella of Nile Tilapia, also found

values close to those ones from this study for color. On the contrary, Lago et al. [14], obtained lower results with an average of 6.15 for the same type of product.

In the aroma attribute, it was found that formulations $M_{0.5}$ and $M_{0.75}$ did not differ statistically from each other ($p>0.05$). M_1 formulation with 1% added extract had the highest average for this attribute (7.80) and differed statistically from $M_{0.5}$ formulation (7.34), indicating that the addition of higher proportions of shrimp flavored extract positively influenced the perception of the judges.

According to Table 2, it is possible to observe that for texture parameter formulation $M_{0.5}$ differed from M_1 , being statistically equal to $M_{0.75}$. Formulation M_1 showed the highest score (7.49) in the sensory analysis. The addition of aromatic extract in different concentrations has not altered the texture of any treatment. This can be explained by the use of the same formulation for all treatments, with only a variation in the amount of aromatic extract added.

Minozzo [15] and Dallabona et al., [16] found data close to Table 2 for the texture attribute when evaluating the sensory quality of MSM mortadella of Tilapia, obtaining averages scores of 7.20 and 7.50, respectively, corresponding to the term "I liked it moderately". Evaluating the emulsified sausage texture of MSM Nile Tilapia, Lago et al. [14] obtained an average score lower than the one from this study (6.02), as well as Bernadino Filho et al., [17] who obtained an average score of 6.80 when evaluating the mortadella texture prepared with flying fish surimi.

For the flavor attribute, it is verified (Table 2) that formulations $M_{0.75}$ and M_1 are statistically equal. The concentrations between 0.75% and 1% of shrimp flavored extract could be used in the preparation of sausages without interferences in the flavor, however, the addition of 0.5% of extract may be perceptible by the judges due to the taste, since formulation $M_{0.5}$ was the only one that differed significantly from the others.

In relation to the overall evaluation (Table 2), the highest score was achieved for M_1 formulation (7.81), which did not differ statistically from $M_{0.75}$ (7.77). It was observed that formulation $M_{0.5}$ (7.25) was the one that received the lowest score for this attribute, differing from the others, however, the judges liked moderately all formulations by assigning average scores corresponding to the term "I like moderately".

According to the averages for the purchase intention test (Table 2), formulations $M_{0.75}$ and M_1 are statistically equal and had a better score with averages of 4.32 and 4.38 respectively, corresponding to the term "I possibly would buy". $M_{0.5}$ formulation differed statistically from the other formulations, obtaining an average purchase intention of 3.76, corresponding to the term "maybe I would buy/maybe I wouldn't buy". Color may have been one of the factors that influenced the purchase intention of formulation $M_{0.5}$, because according to Resurreccion [18], the aspect of the meat product determines how consumers perceive the quality and significantly influences the purchase behavior.

Regarding the acceptability rate (Fig. 3), all formulations had a good acceptance of all attributes, with a variation of 77.78% for the color of formulation $M_{0.5}$ to 87.67% for the color of formulation M_1 . According to Teixeira et al. [10], for a product to be considered as accepted, in terms of its sensory properties, it is necessary to obtain an acceptability rate of, at least, 70%.

The highest acceptability rates were for formulation M_1 which contained 1% shrimp flavored extract, achieving an average acceptability of all attributes of 85.97%, followed by formulation $M_{0.75}$ with 84.42% and formulation $M_{0.5}$ with 80.25%. Color may have influenced this acceptance as the carotenoid pigments in the aromatic extracts intensified the pink color in the product and may have positively interfered with the preference. However, all formulations had great acceptance, as they reached acceptability rates higher than 70%. These data again reinforce the feasibility of the elaboration of a shrimp flavored tilapia mortadella.

Table 1. Microbiological characterization of MSM mortadellas of shrimp flavored Nile Tilapia

Analysis	$M_{0.5}$	$M_{0.75}$	M_1
<i>Salmonella sp.</i> / 25 g	Absent	Absent	Absent
<i>Staphylococcus</i> coagulase-positive/g (UFC/g)	0	0	0
Coliforms at 45 °C/g (NMP/g)	0	0	0

M_{0.5} (0.5% aromatic extract); *M_{0.75}* (0.75% aromatic extract); *M₁* (1% aromatic extract)

Table 2. Acceptance test of MSM mortadellas of shrimp flavored Nile Tilapia

Treatments	Color	Aroma	Texture	Taste	Overall evaluation	Purchase intent *
M _{0,5}	7.00 ± 0.92 ^b	7.34 ± 0.98 ^b	7.18 ± 0.92 ^b	7.34 ± 0.95 ^b	7.25 ± 0.93 ^b	3.76 ± 0.74 ^b
M _{0,75}	7.72 ± 0.88 ^a	7.62 ± 0.89 ^{ab}	7.35 ± 0.88 ^{ab}	7.70 ± 0.92 ^a	7.77 ± 0.94 ^a	4.32 ± 0.76 ^a
M ₁	7.89 ± 0.89 ^a	7.80 ± 0.91 ^a	7.49 ± 0.88 ^a	7.77 ± 0.91 ^a	7.81 ± 0.89 ^a	4.38 ± 0.73 ^a

*M_{0,5} (0.5% extract); M_{0,75} (0.75% extract); M₁ (1% extract). * Averages obtained by means of a five-point scale. Different letters in the same column differ significantly from the control formulation by Tukey test at 5% level of significance*

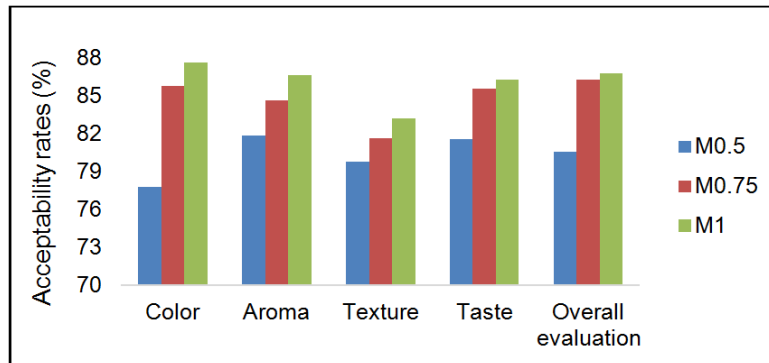


Fig. 3. Acceptability rate of shrimp flavored mortadellas

4. CONCLUSION

Sensory tests have indicated a good acceptance of all shrimp flavored mortadella formulations. The addition of higher concentrations of aromatic extract had a positive influence on the acceptance of the products. The high purchase intention rates for $M_{0.75}$ and M_1 formulations reinforce the feasibility of elaboration of shrimp flavored mortadella. Thus, formulations developed are an alternative to add value to the residues from the processing of tilapia filleting, and can be used in the elaboration of a popularly known product, such as mortadella, with healthier and more nutritious characteristics, which can be an option to encourage the consumption of fish by the population and reduce environmental contamination by avoiding the disposal of these residues in an inappropriate manner.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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