

DEVELOPMENT AND CHARACTERIZATION OF A TAMBAQUI SAUSAGE

Elaboração e caracterização de embutido de tambaqui

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ABSTRACT

In Brazil, fish are sold in retail fresh or frozen, whole, or gutted. To increase consumption, convenient products with good sensory attributes should be offered. The objective of this study was to develop and characterize, through physicochemical, microbiological, and sensory traits, a fresh sausage of tambaqui fish (*Colossoma macropomum*). Three formulations, with different percentages of fat (0, 4.5, and 9%) were developed. To determine shelf life, samples of the products were refrigerated at 4 °C for 12 days and microbiological analyses were performed on days 0, 3, 7, and 12. Analyses of centesimal composition, shear force, cooking weight loss, and water-holding capacity were carried out. The shelf life of the fresh sausages was estimated at 7 days of storage. The sensory attributes evaluated were aroma, color, flavor, succulence, texture, and overall appearance. All treatments showed high acceptance rates, above 80%. The treatment with 9% fat showed the highest mean values in the evaluated attributes, with 86.6%, 83.4%, 92%, 88.2%, 87.2%, and 85.8% for aroma, color, flavor, succulence, texture and overall appearance, respectively. The centesimal composition of the treatments showed the following variations in g.100 g⁻¹: moisture, 72.73 to 68.82; protein, 18.85 to 18.90; lipids, 2.90 to 8.33; and ash, 3.86 to 4.20. Shear force varied from 5.92 to 8.14 N; water-holding capacity varied from 71.83 to 74.71% and cooking weight loss, from 24.21 to 26.59%.

Index terms: Fish; fresh sausage; shelf life; sensory.

RESUMO

No Brasil, a comercialização de peixes é realizada com o produto fresco ou congelado. Para se conseguir o aumento de consumo, se faz necessário oferecer produtos de conveniência e com valor agregado. Produtos processados possuem atributos sensoriais diferenciados além de facilidade no preparo. O objetivo deste trabalho foi elaborar e caracterizar, através de análises físico-químicas, microbiológicas e sensoriais, um embutido a base de tambaqui (*Colossoma macropomum*). Foram desenvolvidas três formulações, que distinguiram entre si com relação ao percentual de gordura: 0%, 4,5% e 9%. Para determinação da vida de prateleira, amostras dos produtos foram armazenadas sob refrigeração 4 °C por 12 dias e realizaram-se análises microbiológicas nos dias 0, 3, 7 e 12. Foram realizadas análises de composição centesimal, força de cisalhamento, perda de peso por cocção e capacidade de retenção de água. Os atributos sensoriais avaliados foram aroma, cor, sabor, suculência, textura e aparência global. Todos os tratamentos apresentaram altos índices de aceitação, acima de 80%, porém, o tratamento com 9% de gordura apresentou as maiores médias nos atributos avaliados, 86,6%, 83,4%, 92%, 88,2%, 87,2%, e 85,8% respectivamente para aroma, cor, sabor, suculência, textura e aparência global. A composição centesimal dos tratamentos apresentou as seguintes variações em g.100 g⁻¹: umidade 72,73 a 68,82; proteína 18,85 a 18,90; lipídeos 2,90 a 8,33 e cinza 3,86 a 4,20. A força de cisalhamento oscilou de 5,92 a 8,14 N; a capacidade de retenção de água variou de 71,83 a 74,71% e a perda de peso por cocção de 24,21 a 26,59%.

Termos para indexação: Pescado; linguiça; vida de prateleira; sensorial.

INTRODUCTION

The consumption of fish and derived products has significantly increased in the last few years, as these foods have been increasingly recognized as important sources of nutrients for human health (Gonçalves, 2011). According to Burger (2008), the nutritional value of fish and the dissemination of research associating it with health

improvements have increased the interest in this food. In his study conducted aiming to obtain data on consumption and awareness about fish, the author found that over 90% of the interviewees had heard about its benefits.

Fish is still sold in its entirety (whole body) cooled or frozen, with no previous processes included to add value to the product. In addition to the use of refrigeration, other forms of processing can be used on fish. Processed

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products have differentiated sensory traits such as flavor, texture, and ease of preparation (Lara; Garbelini; Delbem, 2007).

Although fish has adequate nutritional properties and its consumption is associated with a healthy lifestyle, some restrictions to its consumption exist, justified by the following aspects: versatility, situational relevance, negative properties (bones and odor), economic factors, and convenience (Leek; Maddock; Foxall, 2000). The authors suggest that marketing actions and further research for the development of new products are necessary.

Food products that spare time and that are prepared with practicality are present in supermarkets and homes because of the contemporary lifestyle. People need products of easy and fast preparation and sometimes in smaller portions (Brunner; Horst; Siegrist, 2010). Scholderer and Trondsen (2008) report that fish in its fresh form, recently captured, cooled or frozen in its entirety, is cited as an inconvenient food. However, fish-based products are not considered to be so, as they feature practicality and convenience. Those authors indicated an inverse relationship between the consumption of fish products and the consumption of fresh fish. These negative evaluations are responsible for the substitution of the way traditional fish is supplied to the consumer for processed products.

Given the foregoing, and considering the need for the development of new fish-derived products, the objective of this study was to develop and characterize a fresh sausage of tambaqui (*Colossoma macropomum*) through physicochemical, microbiological and sensory analyses.

MATERIAL AND METHODS

The raw material utilized in this study was 64 fish of the tambaqui species (*Colossoma macropomum*), originating from the Fish Farming Section of the Experimental Farm (15°51'06.0"S; 56°04'13.9"W) at Federal University of Mato Grosso (UFMT), in Mato Grosso State, center of Brazil. After the capture, the fish were slaughtered by immersion in ice slurry (ice:fish ratio of 1:1, for 5 min). After slaughter, they were washed with chlorinated water (5 ppm) and eviscerated, and their meat portion was removed.

To measure the freshness of the raw material, analyses of potential hydrogen (pH), in pH meter (Tekna T-1000, Brazil) (Pregnotatto; Pregnotatto, 1985), and total volatile base nitrogen (TVBN) were performed (Brasil, 1981).

Development of the sausage

To develop the sausage, the meat portion was ground in an 8-mm-diameter grinder (*Poli equipment*, PCP22L model, Brazil) generating a homogeneous dough. After grinding, the other ingredients were mixed with the dough and subsequently homogenized until they were completely incorporated. The ingredients are listed in Table 1. Three sausage-formulations were developed, changing only their fat concentration. In the control (C) formulation, no fat (pig lard) was added. In the other formulations, fat was added at the concentrations of 4.5% (F1) and 9% (F2). The following ingredients were utilized: common salt, onion, garlic, parsley, basil, black pepper, oregano, monosodium glutamate, citric acid, curing salts, emulsifier, and stabilizer.

Table 1: Ingredients (%) used in the development of the fresh sausage.

Ingredient	Formulation (%)		
	C	F1	F2
Tambaqui meat	95.5	91	86.5
Fat	0	4.5	9
Salt	1.7	1.7	1.7
Dry onion	0.2	0.2	0.2
Dry garlic	0.2	0.2	0.2
Dry parsley	0.1	0.1	0.1
Basil	0.1	0.1	0.1
Black pepper	0.1	0.1	0.1
Oregano	0.05	0.05	0.05
Sugar	0.05	0.05	0.05
Monosodium glutamate	0.1	0.1	0.1
Antioxidant (citric acid)	0.3	0.3	0.3
Carrageenan	0.25	0.25	0.25
Curing salt	0.15	0.15	0.15
Sodium tripolyphosphate	1.2	1.2	1.2

Natural pig gut with 36 mm caliber was used as casing. The sausage was conditioned in low-density polyethylene according to each treatment and stored in a refrigerator (4 °C ± 0.5 °C – *Incoterm Thermometer* L-178/05 model, Brazil) until the moment of the physicochemical, microbiological, and sensory analyses.

Physicochemical analyses

The centesimal composition of the following components was determined in samples of the meat portion of the tambaqui and in the developed sausages: moisture, crude protein, ash, and total lipids, according to Brasil (2011). The carbohydrate content was obtained by calculating the difference, and the caloric value was determined by multiplying the lipid content by 9 and the protein and carbohydrate content by 4 (Brasil, 2003).

A texturometer (*Stable Micro System*, TA.XT/Plus model, England) was used for the instrumental assessment of texture. The sausages were baked at a temperature of 170 °C until the internal temperature reached 70 °C in an electric oven (*Fischer* model *Grill 16*, Brazil), for 40 minutes, in the laboratory of the Nutrition College. A digital thermometer was used (*Incoterm* modelo ST-9227B, Brazil) to measure the temperature. Afterwards, sausages were cooled at room temperature and cut into 20 mm-length cylinders, and their shear force (SF) was determined with a probe (*Warner-Bratzler*), moving at a pre-test speed of 1.0 mm/s; test speed of 2.0 mm.s⁻¹; post-test speed 10.0 of mm.s⁻¹; and sample distance of 65 mm (Bressan et al., 2011). Five measurements were taken per treatment. Results were expressed in Newton (N) for the maximum force necessary to cut the samples.

The water-holding capacity (WHC) was measured by employing the methodology described by Ramos and Gomide (2009). The methodology described by Koohmaraie, Wheeler and Shackelford (1998) was utilized to calculate the cooking weight loss (CWL).

Microbiological analyses of the sausage

The microbiological analyses were performed in the meat portion to determine the hygienic-sanitary conditions of the raw material and in samples of the three sausage formulations on days 0, 3, 7, and 12 of cold storage at 4 °C to monitor the microbiological growth. The analyses comprised the count of total and thermo-tolerant coliforms, detection of *Salmonella* spp., counts of mesophilic aerobic heterotrophic and psychrotrophic aerobic heterotrophic bacteria, and detection and identification of coagulase-positive staphylococci. The American Public Health Association methodologies described in the 3rd edition of Compendium of Methods for the Microbiological Examination of Foods (Downes; Ito, 1992) were adopted.

Sensory analyses of the sausage

The sensory evaluation of the sausage samples was accomplished by an affective acceptance test using a structured five-point hedonic scale varying from “really

liked it” (score 5) to “really disliked it” (score 1). The evaluated attributes were: aroma, color, flavor, juiciness, texture, and overall appearance (Faria; Yotsuyanagi, 2008).

The samples were previously baked in a gas oven that was kept heated until the moment of the sensory analyses and presented to the evaluators in disposable plastic cups identified with random three-digit figures. The purchase intention of the tasters was also evaluated, aiming to determine if they would buy the products. The participants consisted of 84 untrained volunteers of both genders among students, professors, and workers at UFMT. This study was approved by the Ethics Committee on Research with Human Beings of UFMT (protocol CAAE 36002614.0.0000.5541).

Statistical analysis

For the physicochemical analyses, the experiment was conducted in a Completely Randomized Design (CRD), in which the treatments consisted of three levels of fat with six replicates, totaling 18 observations. Analysis of variance (ANOVA) was performed and means were compared by the Scott-Knott test.

A completely randomized design was used for the microbiological analyses, in which the factors consisted of four shelf-life times and three levels of fat concentration. The ANOVA and the comparison of means were calculated. To check the ANOVA's assumptions, the Shapiro-Wilk test was performed for error normality, and the Barlett test for homogeneity of variance. After the difference between the times was detected, a regression analysis was carried out.

In the sensory analysis, a randomized block design was established, in which the treatments consisted of three levels of fat. Eighty-four (84) blocks (untrained tasters) were used per treatment, thus totaling 252 observations. The measured variables were: color, flavor, juiciness, texture, aroma and overall appearance. The statistical analysis was performed using a nonparametric ANOVA by the Friedman test.

Statistical analyses were carried out on the R Development Core Team (2013) statistical package.

RESULTS AND DISCUSSION

Evaluation of raw-material quality

The results of the microbiological analyses performed in the meat portion utilized in the preparation of the sausages showed its good hygienic-sanitary quality. The fecal coliforms and coagulase-positive *Staphylococcus* were < 1 log CFU g⁻¹, and detection of *Salmonella* spp. indicated absence in 25 g; these values are in line with

the limits tolerated by the current legislation (fecal coliforms 10^2 ; coagulase positive *Staphylococcus* 5×10^2 and negative *Salmonella* spp) (Brasil, 2001). For the heterotrophic aerobic mesophilic and psychrotrophic bacteria, however, mean values were 3.3 and 1.5 log CFU g^{-1} , respectively. These results indicate a good quality of the fish farmed in water tanks. There are no standards in Brazil for the count of mesophilic and psychrotrophic bacteria in fish; however, the International Commission on Microbiological Specifications for Foods (ICMSF, 1986) recommends that the population of these bacteria in food intended for human consumption not exceed 7.0 log CFU g^{-1} . Studying the quality and formulation of fresh sausage of Indian sardines (*Sardinella longiceps*), Ravishankar, Setty and Shetty (1992) found similar results, with 3.99 log CFU g^{-1} mesophilic on day zero. In the same way, studying the microorganisms of fresh sausage of tilapia, (*Oreochromis niloticus*), Oliveira Filho et al (2010) observed psychrotrophs during storage, and the initial results were ≤ 2 log CFU g^{-1} . These results show that low contamination of fish post-capture is of fundamental importance to generate fish products of high quality.

The average BNVT for the evaluated samples of the meat portion was 13.02 mg N.100 g^{-1} . Quantifying the BNVT is recommended in the procedures of fish-quality inspection by several official agencies such as the Regulation of Industrial and Sanitary Inspection of Animal Products (AOAC, 2012). For the Brazilian legislation, the maximum tolerated limit for fish to be marketed is 30 mg N.100 g^{-1} (Brasil, 1997).

Concerning the pH, the raw material conformed to RIISPOA (Brasil, 1952), in which fish can be considered fresh when its pH varies from 6.8 to 6.5. The average pH of each meat portion was 6.6, demonstrating their quality.

Regarding the centesimal composition of the tambaqui meat portion, the average results were 77.65 g.100 g^{-1} moisture, 18.81 g.100 g^{-1} protein, 2.16 g.100 g^{-1} fat, and 1.25 g.100 g^{-1} ash, comprising a caloric value of 95.2 Kcal.100 g^{-1} . The obtained results are in agreement with those found by Cartonilho and Jesus (2011), who studied the proximate composition of frozen cuts of farmed tambaqui.

Physicochemical analyses of the sausage

Based on the results shown in Table 2, the carbohydrate, protein, and ash values found in the three sausage formulations varied little between each other, and no significant statistical difference occurred ($p < 0.05$) between their means for the different treatments. However, a significant difference ($p > 0.05$) was observed in the average lipid contents and caloric value as the added fat content was increased. Treatment F2 displayed the highest lipid content and consequently the highest caloric value.

A statistically significant difference was also observed between the average moisture values of the samples from the different treatments. The moisture values were inversely proportional to the lipid content. With an increase in the concentration of the fat added to the formulations, the amount of meat was reduced, which would possibly explain the reduced moisture content, because the average moisture result of the meat portion used in the formulations was 77.65 g.100 g^{-1} .

There is no specific legislation for fish sausages in Brazil, but the legislation for fresh sausages (raw, desiccated sausages) requires a maximum amount of 70% moisture and 30% fat, and a minimum of 12% protein (Brasil, 2000). The results found in this study show that the moisture contents of treatments C and F1 were higher than that established by the legislation, and treatment F2 met the legislation's recommendations.

The centesimal composition values found in this study are similar to those obtained in other studies with fish-based sausages; however, Chuapoehek, Raksakulthai and Worawattanamateekul (2001) found a variation in protein content from 13.67 to 13.91 g.100 g^{-1} , and Bispo et al. (2004) found that the lipid concentration was 16.54 g.100 g^{-1} . The protein values were lower than those in the present study, perhaps because the proportion of fish meat:surimi was 40%:60%, resulting in less protein because surimi has a lower protein content. According to the literature, the content and composition of the protein of fish may vary depending on the species, size, sex, time of the year, and other factors (Ogawa, 1999). The lower lipid content of hybrid *Clarias* catfish was probably the explanation for the obtained results.

Table 2: Centesimal composition (g.100 g^{-1}) of the different sausage formulations.

Formulation	Moisture*	Proteins*	Lipids*	Ash*	Carbohydrates*	Caloric value**
C	72.73a	18.88a	2.90a	4.20a	1.277a	106.697a
F1	71.05b	18.90a	5.45b	4.04a	1.300a	130.492b
F2	68.82c	18.85a	8.33c	3.86a	1.277a	155.475c

Means followed by equal letters in the same column do not differ at 5% significance. N = Newton. C = 0% fat addition; F1 = 4.5% fat addition; F2 = 9% fat addition; * g.100 g^{-1} ; **K.cal $^{-1}$.

Studies demonstrate that texture is related to the centesimal composition of meat products, varying according to their water (Cofrades et al., 2000), protein, and fat (Cengiz; Gokoglu, 2007) contents. According to Colmenero et al. (1995) and Lee Whiting and Jenkins (1987), higher fat contents imply a reduction in the texture attributes, which occurs mainly when the increase in fat is followed by a decrease in the protein and water contents in the formulations. In the present experiment, it was proved that as the fat content of the treatments is increased, texture is reduced probably due to the reduction of the moisture content. Shear force was significantly lower ($p < 0.05$) in treatment F2 (Table 3). In their study, Huda et al. (2012) compared five commercial samples of fish sausage and found SF values ranging from 5.29 to 10.98 N; these values are within the range of values observed in this work.

Table 3: Physical analyses of the different sausage formulations.

Formulation	Mean		
	SF (N)	WHC (%)	CWL (%)
C	8.14a	74.61a	24.21a
F1	7.67a	71.83a	26.59a
F2	5.92b	74.71a	25.57a

Means followed by equal letters in the same column do not differ at 5% significance. N = Newton, C = 0% fat addition, F1 = 4.5% fat addition, F2 = 9% fat addition, SF = shear force, WHC = water-holding capacity, CWL = cooking weight loss.

As occurred with WHC, cooking weight losses did not differ statistically among the treatments ($p > 0.05$) (Table 3). The cooking weight loss is defined as the meat's ability to retain water, even when external pressures are applied onto it, such as cutting, heating, grinding, and pressing. Excessive losses result in economic losses in many ways, both to consumers and to the industry. Besides water, protein and vitamins are components carried away with the loss of moisture, which may affect the processing characteristics. The meat WHC is inversely related to CWL (Huff-Lonergan; Lonergan, 2005): the higher the WHC, the lower the CWL, as demonstrated in the present study.

Microbiological analyses

The results of the microbiological analyses are shown in Table 4. No pathogenic microorganisms were detected in the treatments during the 12 days of storage at 4 °C.

Table 4: Microbiological analyses of the different sausage formulations.

Mesophiles*				
Formulation	Day 0	Day 3	Day 7	Day 12
C	4.51a	2.77a	4.38a	5.58a
F1	3.27a	3.74b	5.00a	6.61a
F2	3.34a	4.31b	5.07a	6.81a
Psychrotrophs*				
Formulation	Day 0	Day 3	Day 7	Day 12
C	2.33a	3.76a	4.2a	6.1a
F1	1.35a	3.65a	5.3a	7.3a
F2	1.82a	7.7a	5.66a	7.3a
Total coliforms*				
Formulation	Day 0	Day 3	Day 7	Day 12
C	2.32a	2.28a	2.93a	3.5a
F1	3.35a	2.37a	2.94a	4.39a
F2	2.5a	2.2a	3.69a	4.1a
Thermo-tolerant coliforms*				
Formulation	Day 0	Day 3	Day 7	Day 12
C	1.3a	1.4a	1.6a	1.8a
F1	1.4a	1.26a	1.36a	2.26a
F2	1.2a	1.3a	1.5a	2.2a

Means followed by equal letters in the same column do not differ at 5% significance. C = 0% fat addition, F1 = 4.5% fat addition, F2 = 9% fat addition. *log CFU g⁻¹.

For total and thermo-tolerant coliforms, no statistical difference ($p > 0.05$) was found among the different treatments (Table 4).

The count of psychrotrophic bacteria present in the sausages showed an increasing multiplication from day zero to the twelfth day of cold storage without significant differences among the treatments ($p > 0.05$) (Table 4). In a sausage prepared with *Nemipterus japonicus* (Raju; Shamasundar; Udupa, 2003), an increase in the count of psychrotrophic bacteria was only observed from 30 days of storage at 6 °C.

The mesophilic bacteria showed an increased growth from day zero; however, when the sausage was subjected to refrigeration, this count decreased due to the action of the temperature on this bacterial class, which notably grows at room temperature (Table 4). According to the results presented only on day 3, it was found that the sausages with fat (F1 and F2) showed a significantly

higher count of mesophilic bacteria than the sausage with no fat (C) ($p < 0.05$), with no significant differences for the other times ($p > 0.05$).

The Brazilian legislation (Brasil, 2001) has no specific norms established for fish sausages, although for products based on cooled or frozen fish the limits for bacterial contamination are: thermo-tolerant coliforms, maximum of 10^3 CFU.g⁻¹; maximum coagulase-positive *Staphylococcus* of 10^3 CFU.g⁻¹; and *Salmonella*, absence in 25 g of sample. There are no limits for the counts of total coliforms or mesophilic and psychrotrophic aerobic bacteria.

Nevertheless, the ICMSF (1986) recommends that the population of these bacteria in foods intended for human consumption not exceed $7.0 \log$ CFU.g⁻¹. Stannard (1997) established a minimum and a maximum limit for the count of mesophilic and psychrotrophic bacteria of 5 to 7 log CFU.g⁻¹, respectively, and results above the minimum value indicate deterioration and non-acceptance of the meat products. Therefore, all treatments remained within the limits established by the literature until the seventh day of cold storage, so they were suitable for consumption.

Oliveira Filho et al. (2010) did not detect pathogenic microorganisms (*Staphylococcus aureus* and *Salmonella* sp.) in a sausage based on minced Nile tilapia (*O. niloticus*) and total coliform population in the sausage evaluated by the Most Probable Number (MPN) method. In addition, according to those authors, the population of psychrotrophic bacteria showed a rather pronounced multiplication after 40 days of storage at 0 °C.

Sensory Analysis

The sensory analysis demonstrated that the treatments were well accepted by the tasters. Considering the average acceptability index of the attributes for each treatment (Table 5), it can be observed that all of them showed acceptability values

above 80%. According to Dutcosky (2011), the acceptability index of 70% is the minimum percentage for a product to be considered accepted in terms of sensory traits. However, it should be emphasized that although they were not evaluated statistically, higher mean values for acceptability were obtained by treatment F2, which was produced with a higher fat content, followed by F1, with an intermediate level of fat, and lastly treatment C, which had no fat addition, suggesting greater preference, by the judges, for the sausage with the highest fat contents. According to Juárez et al. (2012), the fat has an important role in the acceptability of a meat; in addition to being associated with flavor, tenderness and juiciness, fat provides the lubrication between the muscle fibers, increasing the perception of tenderness and juiciness in the meat. Veit et al. (2012) and Neiva et al. (2011) also found high acceptability rates in products developed from fish.

The purchase intention of the participants was also questioned in the sensory analysis. Regarding treatment C, 34.5% said they would definitely buy it. For treatment F1, the resolute intention to buy was 37%. Treatment F2, in turn, obtained the highest percentage of tasters decided to acquire the product, accumulating 61% of the purchase intentions. In this regard, an increasing purchasing intention was found as the concentration of fat in the treatments was increased.

According to Table 6, the means of the scores given by the tasters for the aroma, color, texture, and overall appearance attributes did not show a significant statistical difference at the significance levels of $p = 0.08112$, $p = 0.6712$, $p = 0.08438$, and $p = 0.1712$, respectively. For the attribute flavor, the treatment with most fat addition (F2) showed a significantly higher score ($p = 0.01009$) than the others. Sausages with fat (F1 and F2) showed a significantly higher ($p = 0.01469$) average score for the juiciness attribute than the control group, which had no fat addition.

Table 5: Indices of acceptability of the sensory attributes for the different formulations.

Formulation	Index of acceptability					
	Aroma	Color	Flavor	Juiciness	Texture	Overall appearance
C	82.8	80.2	85.4	83.2	82.6	83.2
F1	85.6	81	86.6	87	85.2	82.2
F2	86.6	83.4	92	88.2	87.2	85.8

C = 0% fat addition, F1 = 4.5% fat addition, F2 = 9% fat addition.

Table 6: Test of comparison of means for the attributes of the different formulations.

Formulation	Attribute					
	Aroma	Color	Flavor	Juiciness	Texture	Overall appearance
C	4.143a	4.012a	4.274a	4.167a	4.131a	4.167a
F1	4.286a	4.059a	4.333a	4.357b	4.262a	4.119a
F2	4.333a	4.178a	4.607b	4.417b	4.369a	4.298a

Means followed by equal letters in the same column do not differ at 5% significance. C = 0% fat addition, F1 = 4.5% fat addition, F2 = 9% fat addition.

CONCLUSIONS

All the evaluated treatments showed an elevated nutritional state, with an important emphasis for the protein contents. Moreover, they showed satisfactory microbiological conditions until the seventh day of cooled storage. There was also high sensory acceptability for all treatments regarding the evaluated attributes, with greater preference for the treatment with the largest amount of fat. The high acceptance rate and intention to purchase these products reinforce the market potential of this sausage, with the prospect of the insertion of a new product in the market.

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