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Canned Anchoita (Engraulis Anchoita): Technological Process and Sensory Analysis - an Alternative for Human Feed

Roger Vasques Marques[1,*], Helena Genevez Porto Azambuja[2], Denise Back Perius[2], Gustavo Amaro Bittencourt[3], Rodrigo Bilhalva Moncks[4], Érico Kunde Corrêa[3], Milton Luiz Pinho Espírito Santo[2]

[1]Department of Agroindustrial Science and Technology, Universidade Federal de Pelotas, Pelotas, Brazil
[2]Chemistry and Food School,Universidade Federal de Rio Grande, Rio Grande, Brazil
[3]Engineering Center, Universidade Federal de Pelotas, Pelotas Brazil
[4]Center of Language, Literature and Communication, Universidade Federal de Pelotas, Pelotas, Brazil
*Corresponding author: rrogermarques@ibest.com.br

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Abstract The increasing world population presses the productive sector for a supply of food increasingly more expressive. For this reason, the search for innovative nutritional alternatives becomes crucial to ensure food security for mankind. This way, anchoita (*Engraulis anchoita*), a pelagic with nutritional technological characteristics similar to sardine (*Sardinella brasiliensis*) appears, with a potential to be an alternative food to consumer market, relieving the relentless search for sardine. Therefore, this work performed a comparative study between the two species as a raw material, considering physical and chemical evaluations and microbiological and freshness of the fish, in addition to a control in the process of seaming. As a result, it was observed that the fish in natura was transformed into a food with all its own characteristics, through the employment of quality control for the canning process, ensuring a product with good acceptability to consumers by means of sensory analysis, which revealed an acceptance of 86.44% for canned anchoita with no significant difference ($p < 0.05$) between this product and one of the most consumed canned fish in the market (sardine).

Keywords: *novel foods, canning, sensory evaluation, seaming, food quality*

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1. Introduction

The world's population is more than seven billion people, with prospects to reach nine billion by the year of 2050, increasing the demand for food and their need for production [1]. Accordingly, fishing plays an important role in human nutrition. In relation to agricultural activity, it produces least waste and has greater economic viability in cost/production, because it requires less energy and uses less fresh water in industrialization [2]. However, fishing sector over the years reported concern with stocks of fish for human consumption, where the main cause is the predatory fishing. This fact implies the need of search for new species able to enter the consumer market without their capture significantly affects the ecosystem where they are [3].

In this context, anchoita (*Engraulis anchoita*), a small pelagic fish found in the Atlantic Ocean between Patagonia - Argentina (47°S) and Cabo Frio - Brazil (23°S), has a high reproductive capacity and fast growth, measuring 14 to 21cm in the adult phase, appearing as a great bioeconomic potential, once that is in a low fishing state [4]. In addition, there are no impediments on the order of environmental legislation that thwart the initiation of an activity of fishing on this resource [5].

Anchoita is the most important species of pelagic fish in the southwest part of the Atlantic Ocean, for being under-exploited in Argentina and Uruguay, but in Brazilian waters this resource has remained unexplored until the recent decade, combining this way, the search for new products that meet the nutritional demand, with an alternative for preservation of the species already lagged by fishing [6].

The pelagic species of fish have a distribution in large areas of the oceans, and can incorporate many geographical barriers, living in different climatic and environmental conditions [4]. A Very consumed kind of fish, is the true sardine (*Sardinella brasiliensis*), hake for decades in Brazil, and used for canning, having a variation in annual production of 20 thousand tones to 200 thousand tones [7]. These species are usually marketed in the form of canned in edible oil, tomato sauce and in a natural way [8].

A common characteristic among all pelagic species is the similarity in nutritional aspects and technological

exploitation of its resources. Commonly are employed similar processes for the transformation of this raw material in food products, such as the processes in which transform the fished in foods that are most used are canning, salting and marinating [9].

Being a highly perishable food and its sensory characteristics being affected by preservation processes involving acidification or fermentation, a heat treatment in strict appertized packaging, becoming essential to ensure the food security of canned products, expanding its lifespan beyond 24 months [10].

In view of these aspects, the objective of this work was to develop a new canned fish that meets the nutritional needs, sensory and standard of quality by supplying the market with safe food to collaborate in the range of a desired sustainability, relieving the fishing pressure on the species of sardine.

2. Materials and Methods

An Experimental analyzes were carried out in parallel in two lines, the fish before they are submitted to the canning, and after the processing. For raw materials, analyzes were performed to proximal composition, determination of the parameters that define the freshness of the fish (pH, nitrogenous bases volatile and trimethylamine), presence of *Salmonella* spp. and count of coagulase positive *Staphylococcus*.

For microbiological analyzes of raw materials, the legislation established by the National Health Surveillance Agency (ANVISA), through the RDC Nº. 12 of January 2, 2001, establishes food microbiological standards which amplify the raw materials as frozen fished *in natura*, not consumed raw, so that it is compulsory to carry out analyzes of detection of *Salmonella* spp and counting of coagulase positive *Staphylococcus* [11].

The fishery products were submitted to the following quality tests: analysis of chlorides, proteins, lipids, reaction of gas hydrogen sulphide, index of peroxides, drained net weight, percentage of water in declared net weight, evidence of internal glaze and microbiological test for sterility.

To the total were performed five captures throughout the experiment. All data were obtained through analysis in triplicate for each one of the captures of fish.

2.1. Sampling

Specimens of anchoita with medium size of 11.5 cm and 8g were captured on the south coast of Brazil near the border with Uruguay, on trips of one week interspersed every 15 days, of the first week of August until the last of October, 2010, in cruises conducted by Oceanographic Vessel South Atlantic from the Federal University of Rio Grande (FURG), RS, Brazil.

After captured, the fish is stored on board in proportions of fish, ice and sea water in the ratio of 1:1:1 [12]. In each trip, the boat captured about six tons of fish.

Later, the fish was intended for the company MG Pescado S/A from Rio Grande - RS - Brazil (Lat: -32° 02' 06"; Long: -52° 05' 55"), where it was washed with chlorinated water to 5 $mg.L^{-1}$ in rotary kilns and after this step, tem aliquots (of 60 kilos each) were randomly collected from the whole and homogenised to obtaintion of a representative sample. A share was immediately submitted to processing, and another was targeted to the Center of Food Technology at FURG (NUCLEAL), and finally, the surplus was stored at a temperature of -18°C.

The sardine samples were obtained and handled likewise since the capture until the reception in the industrial plant, and they were captured in the same time of year, in the southern coast of Brazil.

2.2. Preparation of Laboratory Samples

For the analyzes, the raw materials were thawed in refrigeration temperature (4ºC) for 24 hours, eviscerated and homogenized in *Blender* for 2 minutes. For the analyzes of the product, the fish was removed from the tin can with the net coverage and homogenized in *Blender* for 3 minutes.

2.3. Sauce for the Coverage

The sauce for the coverage, concentrated of tomato, contained the following ingredients: water, iodized salt, starch, sugar, soy oil, tomato pulp, red pepper, oregano, parsley, onion, sage, citric acid, monosodium glutamate and synthetic flavoring identical to the natural.

2.4. Proximal Composition

The analysis was performed of moisture content, proteins, lipids and fixed mineral waste (ash) for anchoita and sardines.

Moisture: the moisture content was determined by the official method of the Association of Official Analytical Chemists [13], where 5g of sample were weighed in a vial pre-weighed and dried in the oven (105°C ± 5°C) until constant weight of the sample.

Ashes: the ash content was determined according the Association of Official Analytical Chemists [13], where 2g of sample were calcined in a Bunsen burner and incinerated in muffle furnace at 550°C for 4 hours.

Proteins: The total nitrogen was determined by the micro-Kjeldahl method, according to the Association of Official Analytical Chemists [13], where 0.5g of sample was transferred to Kjeldahl tube. 2.5g of catalyst mixture (copper sulphate and sodium sulphate) and 7ml of sulfuric acid PA were added. The tube was heated in block digester at 50ºC for 1 hour, the temperature was gradually raised until the solution in the tube passed from a limpid and transparent aspect to a green/blue shade. After cooling in room temperature, 10ml of distilled water were added. The Kjeldahl tube was linked to a distiller and an Erlenmeyer containing 20 ml of boric acid 4% and 2 ml of mixed indicator. 20ml of sodium hydroxide 50% were added to the tube. In the end of the distillation, the ammonia disengaged from the sample and retained in the Erlenmeyer was titrated with a standardized solution of hydrochloric acid 0,1 $mol.L^{-1}$ until the color of the indicator changed.

Lipids: The total lipids were determined by the extraction method of Soxhlet, according to the Association of Official Analytical Chemists [13]. 5g of kiln-dried sample was inserted in filter paper cartridge and taken to extractor. 150 ml of petroleum ether (Merck® 814562) were added during 6 hours of extraction. The ballon containing the solvent was dry and the lipid mass contained in this container was weighed.

2.5. Determination of Physical and Chemical Parameters

Determination of pH: The determination of pH was performed according to [13], where 2g of fish were diluted in 2 mL of distilled water forming a solution 1:1, a digital pH meter (SoloStocks, São Paulo, Brazil) model MPA-210 was used for measurement.

Determination of TVBN and TMA: The determination of the Total Volatile Base Nitrogen (TVBN) was performed adapting the methodology suggested by [14]; where 50g of sample were grinded with 150ml of trichloroacetic acid 5% until obtaintion of a homogeneous mass, which was carried out to filtration with the same solvent. The obtained filtrade was distilled when add 20 ml of distilled water and 1g of magnesium oxide. The obtained distillate was collected in an Erlenmeyer flask of 250 ml containing 20 ml of boric acid 4%. From this solution, na aliquot of 6 ml was collected to TMA analysis. In the Erlenmeyer containing the destillate, 4 drops of mixed indicator were add. After collecting 100 ml of destillate from the Erlenmeyer, the solution was titrated with sulfuric acid 0,01N until the color changed from light blue to pink.

The aliquote designed to TMA analysis was transferred to the Erlenmeyer and 0.6 ml of formaldehyde 37% (Merck 104003) was added, then titrating with sodium hydroxide solution 0.01N [15].

Chloride Analysis: For the determination of chloride content (such as NaCl), it was used the precipitation-titration method (Mohr method), where 5g of crushed sample were weighed and diluted in a volumetric flask with 250 ml of distilled water. An aliquote of 10 ml from the solution was transferred to a flask containing 50 ml of distilled water and 2 ml of potassium chromate 10% solution. The solution was titrated with silver nitrate 0,1 $mol.L^{-1}$ [15].

Reaction of sulphide gas: The reaction of sulphide gas was performed according to the methodology suggested by [15] where 10g of homogenized sample was transferred to an Erlenmeyer of 250ml, and the nozzle of the container was sealed with double filter paper and impregnated with a solution of lead acetate 5%. The flask was submitted to thermostatic bath at 100ºC for 10 minutes. The abstence of black spots in the paper indicate absence of hydrogen sulfide in the sample.

Peroxides index: the presence of lipids in a state of rancidification was assessed from the Test of Kreis, according to the methodology suggested by [15], where 5 ml of lipid fraction was transferred to a beaker of 50 ml and 5 ml of hydrochloric acid PA were added. The flask was agitated for 30 seconds and afterwards 5 ml of phoroglucine 0.1% in eter were added, performing a new agitation for 30 seconds and leaving the flask quiescent for 10 minutes. The inferior layer of the beaker shows a pink or red tone when there is presence of rancid substances.

2.6. Determination of Microbiological Parameters

Detection of *Salmonella* spp.: The technique of analysis was performed in accordance with the methodology suggested by [16], where 25g of sample were diluted in 225 mL of Lactose Broth (HiMedia M1003) is inoculated to 36°C ± 1°C for 24 hours, followed by the selective enrichment in Tetrathionate Broth (HiMedia MM032) and in Selenite Cystine Broth (Merck 107709). After incubation the colonies were replicated to Bismuth-Sulfite Agar (HiMedia M027). Typical colonies of *Salmonella* spp. were subjected to tests of confirmation in Lisine-Iron Agar (HiMedia M377) and Triple-sugar-iron Agar (HiMedia M021);

Counting of coagulase-positive *Staphylococcus*: The technique of analysis was performed in accordance with methodology suggested by [16], where 25g of sample were diluted in 225mL of buffered salted peptone water 0,1% (BPW) and 0,1mL were placed on Baird Parker Agar (HiMedia M043), the culture was combined with potassium tellurite (0.01%), glycine (1.2%) and lithium chloride (0.5%) as selective agents and the reduction of potassium tellurite and the hydrolysis of egg yolk emulsion as differential agents. The plates were inverted incubated at 36°C ± 1°C for 48 hours. The enumeration was determined by direct plating on the surface. Circular black colonies with a translucent circular halo were considered typical colonies, and these were biochemically proven through the test of coagulase, reaction of resistance thermometers in DNase and release of catalase in hydrogen peroxide.

2.7. Quality Control of the Canned Products

Drained Net Weight and percentage of water on the Declared Net Weight (%PLD): To obtain such parameter, the canned final products were weighed. Then, the sauce to cover the fish, the fish itself and the tin were removed and weighed separately using a methodology suggested by [11];

Internal Glaze: To perform the test, the fish and its sauce of coverage were removed from the cans, and subsequently, these cans were washed with water and detergent and dried in an oven at 60°C for 1 hour. Then, the cans were immersed in a solution of copper sulphate 10% and left to rest for 48 hours.

Microbiological test for sterility: According to the methodology of [16], the canned products were incubated in an oven for 10 days at 36°C ± 1°C to evaluate mesophilic activity and at 55°C ± 1°C to evaluate termophilic activity. After this period, cans with ineffective sterilization were those braised and/or leaking, incubated at 35-37ºC and 55ºC, respectively.

2.8. Canning

Figure 1 shows the general flow chart for canning.

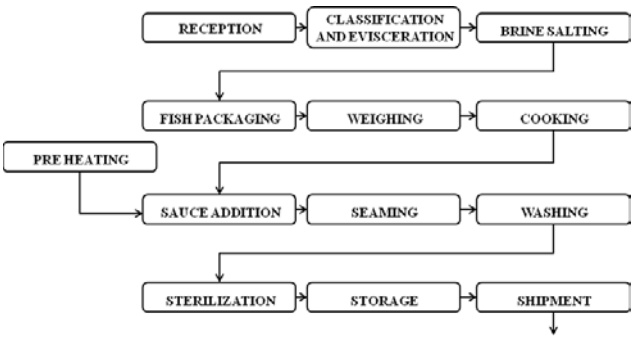


Figure 1. (Color online) Forward single pass experimental set-up for evaluating EDFA performance

2.9. Seaming Test

The seaming test aimed to control the sealing of the cans, ensuring that they are hermetically sealed, prolonging its lifespan [17]. The Equation 1 allows the calculation of the percentage of coating of the hooks of produced cans, from measurement performed in the sealing of cans sliced crosswise and measures with a pachymeter [18].

$$R\% = \frac{SH - (2CT + BT)}{CH + BH + CS - SH} \quad (1)$$

Where, R% is the hook's overlap, SH is the seam heigth, CT the cover thick, BT is the body thick, CH the cover hook, BH the body hook, and CS the cover sink.

2.10. Sensory Analysis

The acceptance test was conducted with 68 volunteer consumers, in the laboratory of Sensory Analysis and Quality Control of the Federal University of Rio Grande (FURG) who would evaluate the samples, on different days, through the hedonic scale of nine points anchored in "1 - dislike extremely" to "9 - like extremely". Evaluating the intention to purchase through a scale structured anchored in "1 - definitely would not buy" to "5 - definitely would buy" [19].

The data were evaluated through Student's t-distribution ($\alpha = 0.05$). It was also calculated the Consumer Acceptance for both samples, indicating the acceptability among consumers in terms of sensory characteristics of quality in a global perception [20].

3. Results and Discussion

3.1. Physicochemical Characterization of Fresh Fish

Table 1 presents the data on the physicochemical characteristics of the different species of fish.

Table 1. Physicochemical parameters of different fresh fishes

Parameter	Anchoita*	Sardine*
Proteins (% w.b.)	12.41 ± 0.28[a]	15.60 ± 0.95[b]
Lipids (% w.b.)	4.02 ± 0.62[a]	5.73 ± 0.62[b]
Chlorides (%)	0.12 ± 0.01[a]	0.13 ± 0.01[a]
PLD	61.85 ± 1.47[a]	62.07 ± 3.07[a]
%PLD	10.83 ± 0.34[a]	10.75 ± 0.49[a]

* - Average and standard deviation of 15 repetitions
** - Wet basis
a,b - equal letters in lines does not significantly differ, different letters in the lines significantly differ ($p < 0.05$)
TVBN - Total Volatile Basic Nitrogen

From the results showed in Table 1, we can observe that the values found for the proximal composition of anchoita *in natura* are according to the literature, in which were found values of relative moisture between 71% and 76% [21], of proteins and lipids of 17.6% and 2.9%, respectively [22], of fixed mineral waste (ash) of 2.4% [21].

Regarding the proximal composition of sardines *in natura*, we observe that the values obtained are in agreement with the literature, in which were found in accordance with the relative moisture between 78.2 and 82.7% [23] and 69.69 and 71.13% [24], of proteins and lipids of 22.73% and 2.75% respectively [24], and of fixed mineral waste between 1.0% and 4.41% [24] with the data obtained being between these two values.

Comparing the proximal composition between the two species, it was not identified a significant difference ($p < 0.05$) in the levels of serum lipids and ash. However, there was a discrepancy in the content of protein and moisture percentage, with the anchoita presenting lower protein content and greater amount of free water. This fact can be explained by the difference in protein structure of the anchoita, making it to produce a greater Water Retention Capacity (WRC) in the muscle, reflecting in a product with better texture, especially in sensory attributes of tenderness and juiciness to the consumer [25].

From the analysis of TVBN, it was obtained 15.60 and 12.41 mg.100g $^{-1}$ for the samples of anchoita and sardine, respectively. A maximum value of 30 mg. 100g $^{-1}$, being between 30 - 35mg. 100g $^{-1}$ already makes the fish unwanted by the bad odor exhaled [8]. The values 11.5 mg.100g^{-1} for anchoita in natura and 20.2 mg.100g $^{-1}$ for the pulp were found by [21], whereas11.47 to 22.19 mg. 100 g^{-1} were obtained by [26] for fresh sardines marketed in wholesale market. It was reported by [21] that the anchoita from different catch show great variation in its content of TVBN, which is attributed to the differences in biological condition, feed, water temperature, between other things. Therefore the significant difference detected between the fresh fishes in this analysis was expected.

The analysis of trimethylamine revealed that the anchoita and fresh sardines contained 3.19 and 2.84 mg.100g $^{-1}$, respectively, with no significant difference between them ($p < 0.05$). The values 2.8 mg.100g $^{-1}$ for anchoita in natura and 3.1 for anchoita pulp were achievied by [21], and these values were close to the ones found in this work. As well as other volatile nitrogen compounds of marine fish, trimethylamine is a product from the reduction of the Trimethylamine N-oxide (TMAO) by bacteria, being a relevant point of control for quality of fresh fish, mainly because it is a precursor of ammonia odors and reflect in a high bacterial contamination when it reaches values around 15 mg. 100g^{-1} [27]. This way, the levels of trimethylamine, allied with pH and TVBN, form a framework of great quality, where both the anchoita as the sardine fit the standards for fresh fish.

By Table 1, we can observe that the fresh anchoita presented a pH significantly higher than the sardine (6.8 and 6.4 respectively), however, both raw materials fall under the Brazilian legislation that regulates the maximum threshold of pH in 6.8 [8]. The pH is the first sign of the conservation status of fresh fish, since a food near neutrality favors the development of microorganisms, however, with the contents of TMA and TVBN below the maximum threshold, we can assign the pH higher of the anchoita for the amount of glycogen consumed since catching up, to the death of this fish being greater than the sardines, reducing the energy reserves to conversion into lactic acid at the end of rigor mortis, reflecting in a pH closer to neutral [12].

3.2. Microbiological Analyzes of Fresh Fishes

Table 2 shows the results of the microbiological analyzes obtained in raw materials.

Table 2. Microbiological evaluation of fresh fishes

Microorganism	*Salmonella* spp. (25g)	Coagulase-positive *Staphylococcus* (cfu.g^{-1})
Anchoita*	Absence	Absence
Sardine*	<10²	<10²

* - Results of triplicates

Food microbiological standards were established by [11], framing the raw materials as fished *in natura*, frozen and not consumed raw, where the count threshold for coagulase-positive *Staphylococcus* is of 10^3 cfu.g^{-1} and absence in 25 g for *Salmonella* spp. All samples were in agreement with the existing law, characterizing the raw materials as appropriate for the processing in a microbiological point of view.

3.3. Content of Proteins, Lipids and Sodium Chloride of Canned Fish

Table 3 presents the levels of proteins, lipids, chlorides, PLD and %PLD**.** The values of sodium chloride are also shown below.

Table 3. Physicochemical parameters of canned fishes

Parameter	Anchoita*	Sardine*
Relative Moisture (%)**	76.28 ± 0.11^a	73.58 ± 0.46^b
Proteins (%)**	18.94 ± 0.21^a	22.26 ± 1.14^b
Lipids (%)**	2.38 ± 0.22^a	2.15 ± 0.12^a
Ash (%)**	2.33 ± 0.88^a	1.97 ± 0.17^a
pH	6.8 ± 0.03^a	6.4 ± 0.04^b
TVBN (mg N. 100g^{-1})	15.60 ± 0.62^a	12.41 ± 0.61^b
Trimethylamine (mg. 100g^{-1})	3.19 ± 1.06^a	2.84 ± 0.61^a

* - Average and standard deviation of 15 repetitions
a,b - equal letters in lines does not significantly differ, different letters in the lines significantly differ ($p < 0.05$)
w.b. – Wet Basis
PLD - Drained Net Weight (From Portuguese Peso Líquido Drenado)
%PLD - Water percentage on the net weight drainedesults of triplicates

The products showed significant differences between each other ($p < 0.05$) for the total protein content, in agreement with the discrepancy in protein content of the raw materials. The products showed 12.41% and 15.60% of protein for the anchoita and sardine, respectively. Several brands of canned sardines in sauce with tomatoes already consolidated in the national and international market, present the results of 15.83% (industrial mark A), 20.00% (industrial mark B) and 16.67% (industrial mark C), which were removed from the packaging of the products for comparison of obtained results. The products presented significant differences between each other ($p < 0.05$).

The lipid content of the products showed a significant difference between them ($p < 0.05$), where the anchoita showed 4.02% and the sardine 5.73%, the cause for the content of lipids of this product being greater than the previous one, can be explained by the greater percentage of intramuscular fat than the anchoita, causing lower loss on disposal of excess fat in evisceration of fishes. However, containing a larger intake of total lipids reflects in a greater energy supply and not necessarily in the supply of essential fatty acids such as omega-3 and omega-6, and other lipids beneficial to health such as Polyunsaturated Fatty Acids (PUFAs), demanding a more specific analysis for determination of these compounds in canned products [28,29].

According to the regulation of Industrial and Sanitary Inspection of Products of Animal Origin [11] the maximum allowed value of sodium chloride is 2%. Therefore, the results presented in Table 3 show that the products were within the established limit, and that did not differ significantly between the two fish species studied.

The results of PLD frame the product in the existing legislation [11] for canned sardines, because shows average values of percentage of drained fluid above 60%. The recent project of canning of anchoita under these conditions does not allow yet to the government bodies to create a specific legislation for this fish. Therefore, by the similarity between both species on the technological aspects, were taken as the reference for the anchoita existing legislation for canned sardines. The products analyzed also fall under the same legislation for the %PLD, because they presented a parameter below the maximum threshold (10.83% in anchoita cans and 10.75% in sardine cans) established in 12%.

3.4. Parameters of Quality Qcontrol of Canned Fishes

In the Reaction of Hydrogen Sulphide Gas there were not dark spots, which indicated the absence of hydrogen sulphide gas in the samples. There was not rancid in the peroxides index. The results of the two analyzes demonstrate that the products are presented in a good state of preservation.

In the test of internal glaze, the analyzed cans showed oxidized regions inferior to 10% of the total internal surface, demonstrating that the internal liner is adequate.

In the microbiological test for sterility, none of the samples studied, after ten days of incubation, showed signs of fullness or leaking, proving the efficiency of sterilization, which indicates that the product is safe for human consumption.

3.5. Seaming Test

Equation 1 was used to obtain the percentage of coating of the hooks. All of the cans had acquired 0.25 mm of thickness, as provided by the manufacturer. Table 4 shows the measures obtained in the seaming test of canned products.

According to the results obtained, all the cans analyzed had an appropriate seaming, given that they presented %R above 50%. The index variation of coating can be allocated by any mechanical problems of the seamer or even the lack of training of the operator of the equipment. However, the index between 50 and 80% of coating of the hooks, demonstrates an appropriated hermetic closure, ensuring that the life span of the product extends for at least two years [18].

3.6. Sensory Analysis

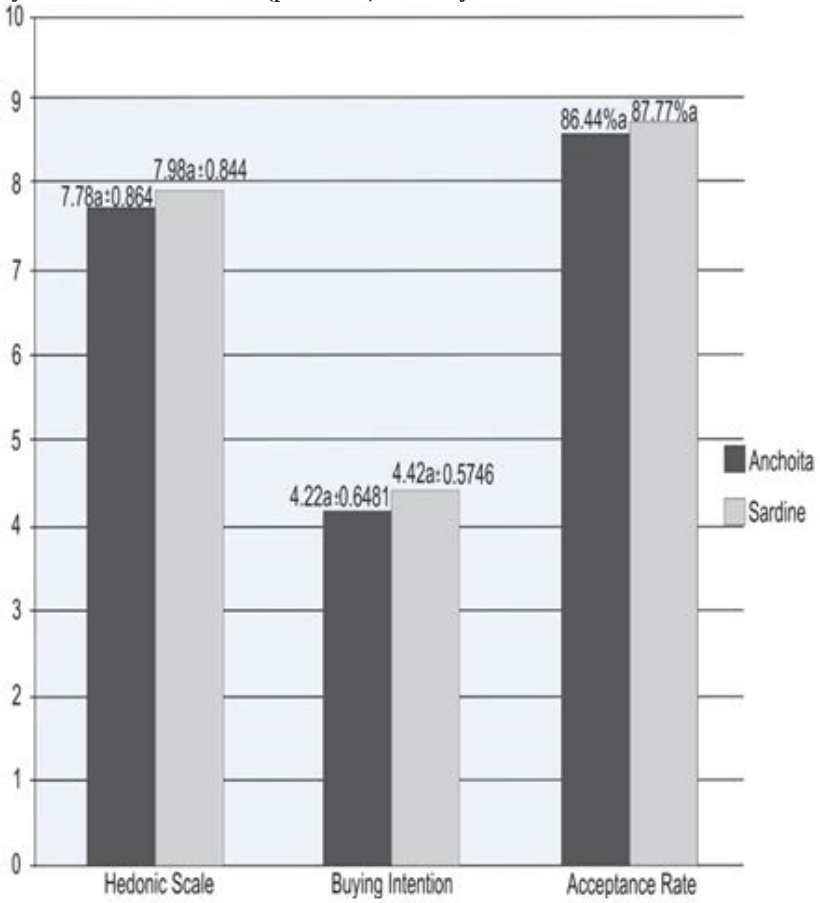
Figure 2 represents the values found in statistical treatment for hedonic scale, buying intention and acceptance rate of canned fish.

Table 4. Measures of seaming and percentage of coating of the cans of anchoita (A) and sardine (S) – in mm

Batch	Can1				Can 2				Can 3				%R*
	SH	BH	CH	SD	SH	BH	CH	SD	SH	BH	CH	SD	
A1	3	1.93	1.98	3.11	3.05	2.1	2.03	3.14	3.0	2.02	2.06	3.10	54.77 ± 1.10
A2	3	1.99	1.82	3.10	3.13	2.08	1.99	3.20	3.15	2.06	1.97	3.24	57.76 ± 0.43
A3	2.91	1.88	1.85	2.99	2.81	2.01	2.01	2.92	2.85	2.03	1.96	2.95	52.64 ± 3.59
A4	2.9	1.87	1.91	3.0	2.89	2.0	2.04	3.0	2.95	1.88	2.16	3.04	53.42 ± 1.93
A5	2.92	1.87	1.96	3.01	3.0	1.96	2.04	3.11	2.95	2.01	1.92	3.05	54.90 ± 0.41
S1	2.96	1.96	1.90	3.05	3.1	1.99	2.0	3.19	3.1	1.90	1.91	3.2	57.88 ± 2.09
S2	2.98	1.90	1.93	3.09	3.0	1.93	2.13	3.11	2.9	2.14	1.96	3.01	53.87 ± 2.77
S3	2.93	1.89	1.88	3.02	3.14	1.96	1.85	3.24	3.05	2.01	2.02	3.14	57.81 ± 2.89
S4	2.98	1.79	1.91	3.08	2.97	1.93	2.01	3.08	2.95	1.92	1.94	3.06	56.30 ± 2.08
S5	2.96	1.98	1.89	3.07	3.03	1.89	2.0	3.12	2.95	2.03	2.03	3.06	55.19 ± 2.28

Caption: SH: Seaming Height; **BH**: Body Hook; **CH**: Cover Hook; **SD**: Seaming Depth
* Average and standard deviation of 3 samples

We can observe that consumers judged the products as the hedonic scale classifying the anchoita and sardines between "Like moderately" and "Like very much", where they do not significantly differ between them ($p < 0.05$). The same equality was observed about the intention of purchase of the products, showing responses between the anchors "Probably would buy" and "Definitely would buy".



Note: Hedonic Scale had anchors on 7 - "Like moderately" and 8 - "Like very much" the intention of buying had anchors in 4 - "Probably would buy" and 5 - "Definitely would buy"
a, b: same letters in the paired columns does not significantly differ, different letters in the paired columns significantly differ (Student's "t" test; $p<0.05$; $\nu = 98$).

Figure 2. Average values and standard deviation of anchoita and sardine for hedonic scale, buying intention and acceptance rate

It was suggested by [20] that an acceptance rate of emerging products should be greater than 70% for it to compete with similar products on the market, in addition to offering attractive prices, trespassing the barriers imposed by the consumer which is faithful to a particular brand of product.

The three parameters observed by sensory analysis show that the anchoita has capacity to enter the consumer market, because it reaches the same levels of acceptance and yearning for purchase that the sardine, a more consumed fish that dominates the current market in this type of processing.

4. Conclusion

Through the studies carried out in this work, it was possible to identify the nutritional, physical-chemical and technology similarities between the sardine and anchoita, this fact indicates that this fish has great potential for industrialization, resulting mainly in canned food, with life span of at least two years, thus fueling the market with a new product, ensuring that consumers have a source of protein and vital fatty acids available, especially in closed seasons or breaks of fishing of the sardines.

The sensory analysis of the developed products shows the anchoita as a fish that can be inserted in the market, mostly because the high acceptance of consumers it is similar to the one with sardines.

Therefore, being raised these aspects, we can conclude that an innovative food was originated, with all the nutritional characteristics, quality and consumer acceptance within the standards for inclusion of canned anchoita in sauce with tomato as a commercial product, collaborating in this way in the guarantee of promoting the food security of the population and making the company one step ahead to achieve the desired sustainability, without compromising the generations that will succeed.

Suggestions for Future Work

We suggest for subsequent works, an analysis of consumer preference by varying the concentrations and times of brine bath during canning. It is also valid the study of the concentration of the sauce to be used and its reflection to consumers. The packing of these fishes in edible oil would be also worth of testing, seeking to expand the range of preference of the consumer market and evaluate the nutritional intake before different heat treatments.

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