

Acceptability of anchovy-based (*Engraulis anchoita*) preparations

Bianca Barbieri Corrêa da Silva¹

Ângela Galvan de Lima²

Márcia Arocha Gulate³

Milton Luiz Pinho Espírito Santo⁴

Fabiana Torma Botelho¹

¹ Department of Nutrition, Public Service Area, Federal University of Pelotas. Pelotas, RS, Brazil.

² Department of Nutrition. Technological High Education in Gastronomy. Federal University of Pelotas. Pelotas, RS, Brazil.

³ Center of Food, Pharmaceutical and Chemical Science. Federal University of Pelotas. Pelotas, RS, Brazil.

⁴ Food and Chemical School. Federal University of Rio Grande. Rio Grande, RS, Brazil.

Correspondence

Bianca Barbieri Corrêa da Silva

E-mail: bibarbieri_dp@hotmail.com

Abstract

This study aimed to assess the acceptability of two preparations of Argentine anchovy with 69 untrained panelists of a university in the southern state of Rio Grande do Sul, Brazil, given the importance of fish consumption for health, the need to increase fish consumption by the Brazilian population and the possibility of using a new self-sustaining fishery resource. Acceptability was assessed using a scale of 7 points and purchase intent by a 5-point scale. Chemical composition of preparations was analyzed in the laboratory, following the methodology of Adolfo Lutz Institute. The results showed that the pizza and baked rice with anchovy had excellent acceptability, 92% and 86%, respectively. There was a significant difference between the averages of preparations, in which the pizza achieved better acceptability and better purchase intent than the baked rice with anchovy. In the analysis of the chemical composition of preparations, the pizza had a higher content of protein and fat due to use of other ingredients with high protein content and vegetable oil. It was concluded that both preparations with anchovy could be an excellent vehicle to include fish more often in people's diet and increase the consumption of fish in Brazil.

Key words: Seafood. Sustainable Development Indicators. Sustainability. Food Consumption. Acceptance.

Introduction

The Ministry of Fisheries and Aquaculture (MPA) in Brazil supports governmental policies that promote the development of strategies to provide the growth of the fishery industry in a sustainable manner, ensuring the organization of the fishery resources and encouraging marketing and consumption of fish.¹ The fishery industry has been growing considerably whereas fish intake by Brazilians has not increased in the same rate by several reasons, among them because of lack of habit of consuming fish as well as limitations in the distribution and sale of seafood. There are also precarious preservation conditions after fishing and lack of innovation by the industries, when compared to beef and poultry.^{2,3}

According to the United Nations' Foods and Agriculture Organization (FAO)⁴, fish protein represents about 20% of the food sources of animal protein consumed in the world. Fish intake is recommended by the *Guia Alimentar para a População Brasileira*⁵ (Dietary Guide for the Brazilian Population) and by the American Heart Association⁶ as a food to be consumed at least twice a week.

In Brazil, according to MPA,⁷ average fish consumption was up 40% in the last seven years, and the consumption of 6.46kg of fish/habitant/year in 2003 rose to 9.03kg/habitant/year in 2009. Such figures are still low considering the amount recommended by the World Health Organization,⁸ i.e., 12kg of fish/habitant/year.

Fish is rich in essential fat acids and has excellent nutritional value due to proteins of high biological value and is also a source of vitamins, such as vitamin B and minerals, such as iron and calcium⁵. Among the several benefits of fish to human health, it can be mentioned the important role of this food in the prevention of heart diseases. It has been observed that the higher the intake of fish the greater the protection effect,^{9,10} as well as in the prevention of cataracts,¹¹ depression and loss of cognitive function.¹²⁻¹⁴

Among the least consumed fish species, we can cite the Argentine anchovy (*Engraulis anchoita*), belonging to the family *Engraulidae*, genus *Engraulis*. Argentine anchovy is a small pelagic fish, a co-generic species of sardine, and is present in large quantities almost all the year round.¹⁵⁻¹⁷ Argentine anchovy is found in the southern coast of Brazil, with a catch potential of 100 thousand tons of the fish per year.¹ It can be considered a direct food and a nutritious source for humans, making it a suitable, rational and sustainable food, once it is economically profitable and help reduce wastes.¹⁸

Anchovy has protein contents of 16.1 and 17.9 %¹⁹⁻²¹, and lipids around 3.4 to 6.79 %, ^{20,22} being considered a semi-fat fish.^{21,23} Its composition varies according to the gender and age of the fish and the season of the year when it is caught. Processed anchovy, canned in tomato sauce, may represent a nutritious food alternative because of its low contents of lipids, proteins and sodium, being considered 28.3% less caloric than canned sardine. Furthermore, it has high concentrations of omega 3 and omega 6, which can improve the immunological system and contribute to the prevention of heart diseases and cancer, characterizing it as an a food with excellent nutritious value.^{4,24}

The acceptability of fish-based products has been shown to be effective in sensory analysis designed for the purposes of determining preferences and the development of products/preparations with better consumers' acceptance. Thus, such data are important for the fisheries industry and marketing, either for the sale or transformation of this foodstuff, as well as for the development of new fish-based products with good acceptance by the market.²⁵⁻²⁷

Given the importance of fish intake for health, the need to increase the consumption of fish by the Brazilian people and the possibility of using a new self-sustained resource, this study aimed to evaluate the acceptability of anchovy-based preparations (*Engraulis anchoita*) in an university community located in the south of the state of Rio Grande do Sul.

Materials and Methods

Raw material

Samples of canned anchovy in tomato sauce were provided by the *Anchoita Project* of the Federal University of Rio Grande (FURG) in partnership with MPA. The other ingredients were purchased in a supermarket in the city of Pelotas, Rio Grande do Sul, Brazil.

Methods

Two preparations using fish were made: pizza with anchovy and baked rice with anchovy. The original recipes employed beef, which was replaced by fish for the purposes of this study. New preparation technical sheets were developed using canned anchovy in tomato sauce, because according to the Administrative Rule No. 63, canned foods must contain at least 60% of fish in relation to its net weight. Both preparations were chosen for meeting the nutritional requirements

compatible with the prevention and treatment of epidemiological diseases in Brazil and are easily cooked. The recipes were prepared in the Laboratory of Dietary Techniques of the Faculty of Nutrition, Federal University of Pelotas.

The work was conducted at the Laboratories of Dietary Techniques and Collective Foodservice, both of the Course of Nutrition and Gastronomy, Federal University of Pelotas.

Development of pizza with anchovy

The pizza with anchovy was developed according to the formulation described in Table 1.

Table 1. Quantity (%) of the ingredients used in the anchovy pizza and in the anchovy baked rice. Pelotas, RS, 2012.

Ingredients (%)	Pizza	Baked rice
Fish	32	44
Wheat flour	20	0
Milk	20	0
Eggs	3	7.5
White rice	0	28
Tomato	11.5	3
Onion	6	1
Carrot	0	11
Sweet pepper	1	0
Grated cheese	4	5
Yeast	0.5	0
Oil	2	0.5

To prepare the pizza topping sauce, onion, tomatoes, sweet pepper and anchovy were cooked for 20 minutes. To make the bread dough, the liquid ingredients (milk, oil and eggs) were mixed in a blender (Mallory, Black filter model, 600 watts), while wheat flour was added slowly until the whole content was evenly blended. Then, the dough base was placed in a 20-cm x 60-cm aluminum-baking tray, and the topping sauce with anchovy was spread on the pizza and covered with grated cheese. The pizza was baked in an electric oven (Mueller, Sonetto model with timer, 1750W nominal power, 50160 Hz nominal frequency) at 200°C for 35 minutes. When ready, it was cut in 30-g portions and placed in individual white plastic plates for further sensory analysis.

Development of baked rice with anchovy

The anchovy baked rice was prepared according to the formulation contained in Table 1. First, tomatoes, onion and anchovy were cooked for 20 minutes. The rice was cooked in a separate pan, fried in oil for 30 seconds and then added with boiling water. When ready, the rice was covered with the anchovy stew and grated carrot, chopped boiled eggs and finally grated cheese. The preparation was put in an electric oven (Mueller, Sonetto model with timer, 1750W nominal potency, 50160 Hz nominal frequency) at 180°C for 15 minutes until cheese was melted and golden. When ready, 30-g portions of the rice preparation were placed in individual white plastic plates for further sensory analysis.

Centesimal analysis

With respect to the centesimal composition, the contents of moisture, ashes, proteins, lipids and dietary fibers in the preparations were analyzed in triplicate. Carbohydrates were calculated by difference, by subtracting the values of ashes, proteins, lipids and fibers. Following recommendation by the Adolfo Lutz Institute,²⁹ moisture was determined after drying in oven at 105°C. The ashes were carbonized and then incinerated in a muffle furnace at 500-550°C, and the lipids analysis was performed via solubility, using petroleum ether as solvent. For determination of the proteins concentration, it was employed the Kjeldahl method recommended by the Association of Official Analytical Chemists (AOAC),³⁰ with a conversion factor (% N x 6,25).

Sensory analysis

The preparations were evaluated concomitantly by 69 untrained panelists, aiming to reach the average consumer, in July 2012. The Committee of Ethics in Research of the Faculty of Nursing, Federal University of Pelotas, approved the research under Protocol no. 063/2012.

Students, teachers and employees of a local university were invited randomly to participate in the sensory analysis. The testers received 30-g portions of each preparation served in plastic white plates and the sensory analysis sheet, as well as plastic cups with filtered water, at room temperature, to be ingested between one preparation and the other in order to clean the palate.

The sensory analysis sheet contained questions about the identification of the panelist, such as gender, age and education. For the hedonic test, a structured seven-point like/dislike scale was used,³¹ in which the overall acceptance and attributes such as color, appearance, texture and taste of the preparations were evaluated in a scale varying from 1 = dislike very much and 7 = like very much. The preparations purchase intent was assessed in a five-point hedonic scale, which varied from 1 = definitely would buy it and 5 = definitely wouldn't buy it.

The mean values of the sensory attributes were transformed into indices of acceptability (IA) by multiplying the mean value by 100 and divided by the seven points of the hedonic scale. For a product to be considered well accepted regarding its sensory attributes it must reach over 70% of the panelists' acceptability.

Finally, it was investigated how much the participants liked fish preparations and how often they consumed it. Regarding how they liked fish, the participants should indicate their preferences in a scale of: 1 = like very much and 5 = do not like. Regarding how often they ate fish, the scale ranged from 1 = consume very much (3 or more times a week); 2 = consume moderately (once a week); 3 = consume little (less than 3 times a month); 4 = consume very little (less than once a month); 5 = never consume.

Statistical analysis

The results were tabulated and analyzed through Microsoft Excel 2007® for descriptive analyses. Averages were calculated by ANOVA, Student's t-test for comparison between the averages and chi-square to evaluate the associations between the categorical variables of the sensory analysis and consumer's profile, confirmed by Fischer's exact test through software STATA 9.1®. The significance level considered was $p \leq 0.05$.

Results and Discussion

The results of the centesimal analysis indicated a significant difference ($p \leq 0.05$) between the preparations regarding moisture, lipids and proteins (Table 2). It was probably due to the composition of the pizza, which has ingredients with higher contents of protein (milk, eggs and grated cheese), also rich in fats, and the preparation was added with a larger quantity of vegetable oil.

Table 2. Centesimal composition (%) of the anchovy pizza and anchovy baked rice preparations. Pelotas, RS, 2012.

	Pizza %	Baked rice %	t-test
Moisture	51.01±0.07 ^a	73.43±0.21 ^b	p=0.0028
Lipids	14.2±0.66 ^a	1.54±0.16 ^b	p=0.0296
Proteins	11.9±0.88 ^a	8.36±1.28 ^b	p=0.0511
Ashes	3.41±0.03 ^a	2.09±0.14 ^a	p=0.0625
Fibers	0.41±0.00 ^a	0.58±0.12 ^a	p=0.3028
Carbohydrates	19.05±0.16 ^a	13.99±0.96 ^a	p=0.0702
Total Kcal/100g	251.6	103.26	

Means and standard deviation followed by the same letter do not indicate a significant difference according to Student's t-test ($p \leq 0.05$).

According to Cortez Netto et al.,³² the chemical composition of their preparations consisting of breaded pacu fish, catfish and tilapia indicated protein results of 20%, 20% and 19% respectively, which are higher than the values found in the preparations of this study, once in the preparation of breaded foods it is required at least 10% of protein, according to legislation.³³ In the study conducted by Borges et al.,²⁷ the moisture content in nuggets and meatballs made of southern kingfish (*Menticirrhus americanus*) was of 62% and 71.5%; ashes corresponded to 2.6% and 2.9%, and lipids 6.6% and 1.9%, respectively. Such study showed lower levels of lipids compared with the anchovy pizza and higher contents of lipids compared to the anchovy baked rice. Concerning moisture and ashes, the results were similar to those found in this study.

In a centesimal analysis of anchovy fish preserved in tomato sauce conducted in a previous study, it was found moisture content of 74.21%, 19.28% of proteins, 3.79% of lipids, and 0.37% of carbohydrates²⁶. So, the addition of anchovy to other food preparations may help improve the nutrients intake, especially low-fat proteins, as well as the consumer's palatability and acceptability of fish foods.

The analysis of the data in Table 3 shows that the profile of the panelists was represented mostly by females (67.6%), young people aged 20 to 35 years (53%), followed by panelists below the age of 19 years (34%). Regarding the educational background, most of the testers had incomplete higher education, representing the university students (73%).

With respect to the frequency of fish consumption, it was found that 35% of the respondents reported eating fish at least three times a month, 32% less than once a month, and 31% once a week (Table 3). In a previous study, also performed in the south of Rio Grande do Sul with 51 testers, 38% reported that they ate fish once or twice a month, 24% less than once a month and 20% three or four times a month,²⁰ which indicates low consumption of fish. However, in a study conducted with 50 panelists aged between 19 and 30 years to determine the acceptability of canned sardine, the majority (54%) reported that they had the habit of eating canned fish in their meals.

Concerning how much the panelists liked consuming fish, 56% responded that they liked extremely or very much and 34% moderately (Table 3). Regarding how often fish was consumed, it depended on demographic variables, such as education, sex, age, socio-economic conditions, which determined the consumer's preference and choice of products.³⁵⁻³⁷

Table 3. Consumers' socio-demographic characteristics and fish consumption. Pelotas, RS, 2012.

	N	%
Sex		
Female	46	67.6
Male	22	32.4
Total	68	100
Age		
<19	23	33.82
20 to 35	36	52.94
36 to 45	3	4.41
46 to 55	5	7.35
>56	1	1.47
Total	68	100
Education		
Elementary school	1	1.47
High school	2	2.94
Higher education	7	10.29
Undergraduate	50	73.53
Post-graduate	8	11.76
Total	68	100
Frequency of fish consumption		
3 or more times/week	1	1.47
Once a week	21	30.88
Less than 3 times/ month	24	35.29
Less than once/month	22	32.35
Never	0	0
Total	68	100
How much like fish		
Like extremely	12	17.25
Like very much	26	38.24
Like moderately	23	33.82
Like slightly	5	7.35
Do not like	2	2.94
Total	68	100

Regarding the sensory attributes, the anchovy pizza attained higher averages regarding taste (6.6), texture (6.4) and overall impression (6.4), when compared to the averages of the anchovy baked rice. On the other hand, the anchovy baked rice attained higher averages in color (6) and appearance (5.75) compared to the anchovy pizza (Table 4). The respondents indicated that they liked moderately to very much all attributes of both anchovy preparations once all averages of the evaluated attributes were close to or over 6.

Table 4. Averages of the sensory attributes of the anchovy pizza and anchovy baked rice. Pelotas, RS, 2012.

	Pizza		Baked rice		
	Average/DP	IA%	Average/DP	IA %	
Appearance	5.73±1.34	81.85 ^a	5.75±1.19	82.14 ^a	p=0.81
Color	5.64±1.47	80.57 ^a	6±1.12	85.71 ^b	p=0.01
Taste	6.6±0.79	93.85 ^a	6±1.1	86.28 ^b	p=0.001
Texture	6.4±1.07	92 ^a	6.1±0.94	87.28 ^b	p=0.038
Overall impression	6.4±0.86	92 ^a	6.1±0.89	86.85 ^b	p=0.03

Averages and standard deviation followed by the same letter in the same row are not significantly different according to the Student's t-test ($p \leq 0.05$).

The highest IAs were appearance (82%) and color (86%) for the anchovy baked rice and texture (92%), taste (94%) and overall impression (92%) for the anchovy pizza (Figure 1). All IAs were over 70%, meaning that both preparations achieved an excellent acceptability.

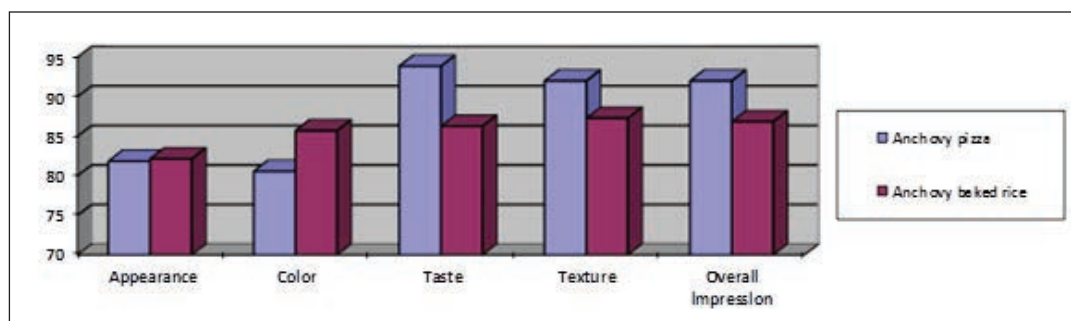


Figure 1. Comparison of the sensory attributes relating to the acceptability index (%) for the anchovy pizza and baked rice rated by the panelists

When analyzing the results statistically (Table 4), there was a significant difference among the IAs regarding color ($p=0.01$), taste ($p=0.001$), texture ($p=0.038$) and overall impression ($p=0.03$). The color of the anchovy baked rice had a higher average than the anchovy pizza, but the latter had the highest scores in the other attributes.

Maluf et al.,³⁸ in their work, developed pasta enriched with smoked pacu fish (*Piaractus mesopotamicus*) and also had an excellent acceptability rate: 80% evaluated the appearance and taste of the preparation between excellent and good, results that are similar to those found in this study.

The IA of the anchovy pizza was 92% and of the anchovy baked rice was 86%, both achieving excellent acceptability, as shown in Figure 1. In other fish acceptability study, Colembergue et al.³² evaluated the acceptability of canned sardine (*Sardinella brasiliensis*) in tomato sauce, which attained an IA of 84%, similar to the preparations developed in this work.

However, in the study by Bordignon et al.³⁹ using two formulations of breaded croquettes of Nile tilapia, using mechanically separated meat and chips of the fillet “V” cutting, the results showed moderate acceptability by 30 testers. The averages were between 3 and 3.53 in a scale of nine points. In a sensory evaluation conducted in another study with anchovy in tomato sauce, IA was as high as 90%²⁶, showing the excellent acceptability of the fish without having been added to preparations.

When the respondents were asked about the intention of purchasing the preparations (Figure 2) if they were sold ready for use, the baked rice with anchovy achieved an average of 2.2 (± 0.85) and the pizza with anchovy 1.94 (± 0.96), indicating that they would probably buy the preparations. However, in the study by Marengoni et al.,⁴⁰ when fish hamburger was developed from meat mechanically separated from Nile tilapia, the panelists scored averages that ranged from 3.86 to 3.98, with results between “maybe would buy/maybe wouldn’t buy” and “possibly would buy the product”.

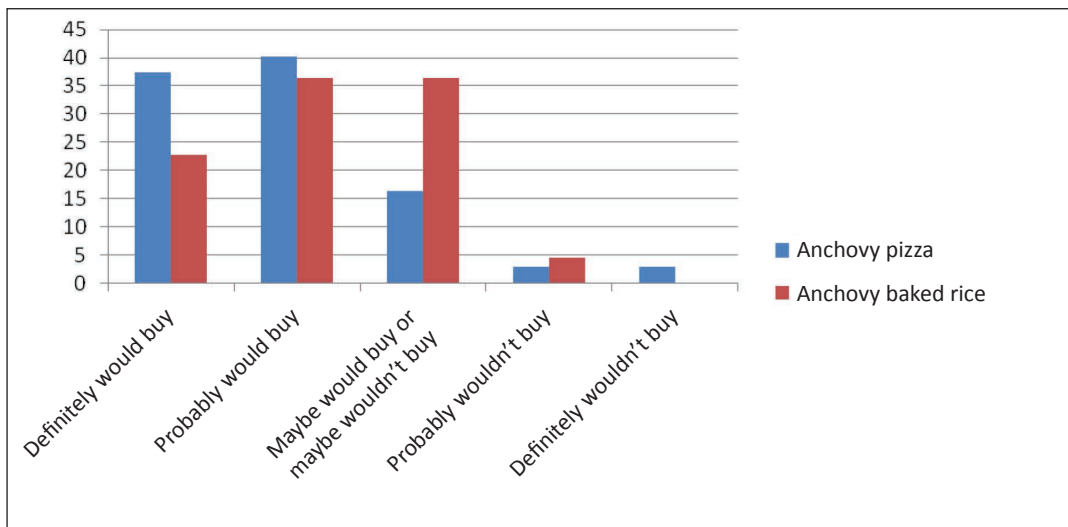


Figure 2. Comparison of the purchase intent indices (%) for the anchovy pizza and the baked rice rated by the panelists

The statistical analysis indicated that there was a significant difference between the purchase intent of both preparations ($p=0.03$) (Table 4), which shows that the pizza not only had a higher IA than the rice with anchovy but also had better purchase intent. However, it might be interesting to employ seasonings and different cooking methods in the preparation of anchovy baked rice to achieve higher averages of taste and texture and, consequently, better acceptability, once it has a lower fat content than the anchovy pizza and is a common preparation in the dietary habits of Brazilians.

The association between the averages of purchase intent with the overall impression, either for the anchovy baked rice ($p=0.000$) or the anchovy pizza ($p=0.000$), was highly significant, indicating that the testers who attributed higher grades to overall impression would be those who certainly or probably would buy the products.

Regarding the relation of the respondents' socio-demographic characteristics with the sensory attributes, there was only an association ($p \leq 0.05$) of sex with appearance, color and overall impression both for the anchovy pizza and the anchovy baked rice. Females liked better the appearance (76.5% gave scores 6 and 7), color (80.8% gave scores 6 and 7) and overall impression (97.8% gave scores 6 and 7) for the anchovy pizza than males (43%, 43% and 71.4% scored

between 6 and 7, respectively. Regarding the baked rice 74.5% of females gave scores 6 and 7 for appearance, 82.9% for color and 85.1% for overall impression, whereas males rated 52.3%, 57.1% and 61.90%, respectively.

With respect to the taste, texture, and purchase intent of the preparations, there was only a significant association ($p \leq 0.05$) of the anchovy pizza with females, showing that this public had higher acceptance of these attributes. It was observed that 80.8 and 89.3% of females gave score 7 for taste and texture, whereas 52% and 27% of males gave 7 for the same attributes; 85% of females and 57% of males stated that definitely or probably would buy the anchovy pizza. In general, researches that evaluate the consumer behavior regarding fish foods reported that women consume more fish than men.^{41,42}

In Brazil, fish consumption amounts to 9.0Kg/habitant/year, one of the lowest world indices.⁴ A study that aimed to detect individual determinants of fish consumption among adolescents aged 12-17 years showed that 11.9% of them never consumed fish and that the other groups comprising adolescents that reported enjoying fish very much were not those who more often consumed it.⁴³ Assunção et al.⁴⁴ evaluated 4,325 adolescents in the city of Pelotas, RS, aged 14.7 years on average, of which 72.4% reported consuming fish rarely or never, and the frequency of daily intake of red meats was higher than white meats (43.0% and 9.7%, respectively). Some studies also showed low fish consumption in other countries.^{45,46} A study with 854 adult Australians showed low fish consumption among the respondents, even though most of them recognized its importance for health. Thus, it was concluded that an increase in projects aiming to the sensitization and learning of the benefits of fish and a higher exposure of this product would be crucial to increase the consumption of fish/seafoods.⁴⁷

Conclusion

Both preparations with anchovy achieved excellent acceptability, showing that there is a market potential despite the low frequency of fish intake as reported by consumers. The anchovy pizza had better acceptability and better purchase intent than the anchovy baked rice, but the baked rice was lower in fats. Both preparations could be an excellent vehicle for including fish more often in the dietary habits of the population and increase consumption in Brazil.

References

1. Brasil. Ministério da Pesca e Aquicultura. Prestação de contas ao Presidente da República [Internet]. Brasília: CGU; [2011?] [atualizado em 2012 Abr 2; acesso em 2012 Jul 20]. Disponível em: <http://www.cgu.gov.br/publicacoes/prestacaocontaspresidente/2011/Arquivos/Parte-IV/4.2.2.pdf>
2. Bombardelli RA, Syperreck MA, Sanches EA. Situação atual e perspectivas para o consumo, processamento e agregação de valor ao pescado. *Arq cien vet zool*. 2005;8(2):181-95.
3. Trondsen T, Scholderer J, Lund E, Eggen AE. Perceived barriers to consumption of fish among Norwegian women. *Res Rep. Appetite*. 2003; 41(3):301-14.
4. Food and Agricultural Organization of the United Nations. The state of world fisheries and aquaculture 2006 (SOFIA). Rome: FAO; 2007.
5. Brasil. Ministério da Saúde. Guia Alimentar para a população brasileira: promovendo a alimentação saudável. Brasília: Ministério da Saúde; 2006.
6. American Heart Association. ¿Cómo puedo seguir una dieta saludable? [Internet]. Dallas: AMA; c2012 [atualizado em 2012 maio 18; acesso em 2012 nov 27]. Disponível em: http://es.heart.org/dheart/HEARTORG/GettingHealthy/How-Do-I-Follow-a-Healthy-Diet_UCM_308999_Article.jsp.
7. Brasil. Ministério da Pesca e Aquicultura. Boletim Estatístico da Pesca e Aquicultura no Brasil 2008-2009 [Internet]. Brasília: CGU; c2010 [atualizado em 2011 set 1; acesso em 2012 jul 26]. Disponível em: <http://www.mpa.gov.br/index.php/informacoes-e-estatisticas/estatistica-da-pesca-e-aquicultura>.
8. World Health Organization. Food and Agricultural Organization of the United Nations. Report of the joint FAO/WHO expert consultation on the risks and benefits of fish consumption [Internet]. Roma: FAO; c2012 [atualizado em 2010 jan 29; acesso em 2012 jul 26]. Disponível em: <http://www.fao.org/docrep/014/ba0136e/ba0136e00.pdf>.
9. Larsson SC, Virtamo J, Wolk A. Fish consumption and risk of stroke in Swedish women. *Am J Clin Nutr*. 2011;93(3):487-93.
10. Bjerregaard LJ, Joensen AM, Dethlefsen C, Jensen MK, Johnsen SP, Tjønneland A, et al. Fish intake and acute coronary syndrome. *Eur Heart J*. 2010;31:29-34.
11. Lu M, Cho E, Taylor A, Hankinson SE, Willett WC, Jacques PF. Prospective study of dietary fat and risk of cataract extraction among US women. *Am J Epidemiol*. 2005;161(10):948-59.
12. Fernandes AC, Medeiros CO, Bernardo GL, Ebone MV, Di Pietro PF, Assis MAA de, Vasconcelos F de AG de. Benefits and risks of fish consumption for the human health. *Rev Nutr*. 2012;25(2):283-95.
13. Erkkilä AT, Lichtenstein AH, Mozaffarian D, Herrington DM. Fish intake is associated with a reduced progression of coronary artery atherosclerosis in postmenopausal women with coronary artery disease. *Am J Clin Nutr*. 2004;80(3):626-32.
14. Kalmijn S, Van Boxtel MPJ, Ocké M, Verschuren WMM, Kromhout D, Launer IJ. Dietary intake of fatty acids and fish in relation to cognitive performance at middle age. *Neurology*. 2004;62(2):275-80.
15. Goulas AE, Kontominas MG. Effect of salting and smoking-method on the keeping quality of chub mackerel (*Scomber japonicus*): biochemical and sensory attributes. *Food Chem*. 2005;93(3):511-20.

16. Schwingel PR, Castello JP. Programa para desenvolvimento da pescaria da anchoita (*Engraulis anchoita*) no sul do Brasil [Relatório final]. Itajaí (SC): Universidade do Vale do Itajaí, 2000.
17. Castello JP. A Anchoita (*Engraulis anchoita*, *Engraulididae*, Pisces) no sul do Brasil [tese]. Rio Grande (RS): Universidade Federal do Rio Grande; 1997.
18. Food and Agricultural Organization of the United Nations. The State of World Fisheries and Aquaculture 2008. Rome: FAO; 2009.
19. Bertolotti MI, Manca E. Processamiento y comercialización de la anchoita (*Engraulis anchoita*) del Mar Argentino. Rev invest des pesq. 1986;20(5):224-46.
20. Garcia IV. Avaliação das propriedades funcionais da anchoita (*Engraulis anchoita*) e das modificações produzidas durante o armazenamento em gelo e água do mar e processamento [dissertação]. Rio Grande (RS): Universidade Federal do Rio Grande; 2007. 135 p.
21. Furlan VJM, Silva APR, Queiroz, MI. Avaliação da eficiência de extração de compostos nitrogenados da polpa de anchoita (*Engraulis anchoita*). Cienc Tecnol Aliment. 2009;29(4):834-9.
22. Fuselli SR et al. Microbiology of the marination process used in anchovy (*Engraulis anchoita*) production. LWT - Food Science and Technology. 1994;27(3):214-8.
23. Bressan MC. Processamento de pescado de água doce. In: Anais da 2ª Feira da Pequena Agroindústria; 2002; Serra Negra (SP): CATI; 2002. p. 59-85.
24. Pastous-Madureira IS et al. Current and potential alternative food uses of the Argentine (*Engraulis anchoita*) in Argentina, Uruguai and Brazil. In: Hasan MR (Org.). FAO fisheries technical paper: towards sustainable aquaculture: selected issues and guidelines. Rome: FAO Fish Utilization and Marketing Service; 2009. V. 518, p.269-87.
25. Queiroz MI, Treptow RO. Análise sensorial para a avaliação da qualidade dos alimentos. Rio Grande (RS): FURG; 2006.
26. Colemborgue JP, Carbonera N, Espirito Santo MLP. Avaliação química, física e sensorial de conserva de anchoita (*Engraulis anchoita*) em molho com tomate. Rev Inst Adolfo Lutz. 2011;70(4):522-7.
27. Borges NS, Passos EC, Stedefeldt E, Rosso VV de. Aceitabilidade e qualidade dos produtos de pescado desenvolvidos para a alimentação escolar da Baixada Santista. Alim Nutr Araraquara. 2011;22(3):441-8.
28. Brasil. Ministério da Agricultura, Pecuária e Abastecimento. Secretaria de Defesa Agropecuária. Portaria nº 63, de 13 de novembro de 2002. Instrução Normativa que trata dos Regulamentos Técnicos de Identidade e Qualidade de Conserva de Peixes, Conservas de Sardinhas e Conserva de Atum e Bonito. Diário Oficial da União 28 nov. 2002.
29. Instituto Adolfo Lutz. Métodos físico químicos para análise de alimentos [Internet]. São Paulo: IAL; 2012 [atualizado em 29 out 2008; acesso em 2012 jul 26]. . Disponível em: http://www.ial.sp.gov.br/index.php?option=com_remository&Itemid=7&func=select&orderby=1&Itemid=7.
30. Association of Official Analytical Chemists. Official methods of analysis. Arlington; 1995.
31. Dutcosky SD. Métodos Subjetivos ou Afetivos. In: _____. Análise sensorial de alimentos. Curitiba: Champagnat; 2007. p.141-73.

32. Cortez Netto JP, Boscolo WR, Feiden A, Maluf MLF, Freitas JMA, Simões MR. Formulação, análises microbiológicas, composição centesimal e aceitabilidade de empanados de jundiá (*Rhamdia quelen*), pacu (*Piaractus mesopotamicus*) e tilapia (*Oreochromis niloticus*). Rev Inst Adolfo Lutz. 2010;69(2):181-7.
33. Ministério da Agricultura Pecuária e Abastecimento. Instrução Normativa nº 6, de 15 de fevereiro de 2001. Regulamentos técnicos de identidade e qualidade de paleta cozida, produtos cárneos salgados, empanados, presunto tipo serrano e prato elaborado pronto ou semi-pronto, contendo produtos de origem animal. Diário Oficial da União 19 fev 2001.
34. Colembegue JP, Gualarte MA, Espírito Santo MLP. Caracterização química e aceitabilidade da sardinha (*Sardinella brasiliensis*) em conserva adicionada de molho com tomate. Alim Nutr. 2011;22(2):273-8.
35. Nu CT, MacLeod P, Barthelemy J. Effects of age and gender on adolescents' food habits and preferences. Food Qual Prefer [periódico na Internet]. 1996 Jul-Out [acesso em 2012 jul 26];7(3-4):251-62. Disponível em: <http://www.sciencedirect.com/science/article/pii/S0950329396000237>.
36. Gonçalves A, Passos MG, Biedrzycki A. Tendência do consumo de pescado na cidade de Porto Alegre: um estudo através de análise de correspondência. Estudos Tecnológicos. [periódico na Internet]. 2008 jan-abr [acesso em 2012 Jul 26]; 4(1):21-36. [16 páginas]. Disponível em: <http://www.estudostecnologicos.unisi.nos.br/pdfs/82.pdf>.
37. Golan E, Unnevehr L. Food product composition, consumer health, and public policy: introduction and overview of special section. Food Policy [periódico na Internet]. 2008 Dez. 33(6):465-9. [4 páginas]. Disponível em: <http://www.sciencedirect.com/science/article/pii/S0306919208000511>.
38. Maluf MLF, Weirich CE, Dallagnol JM, Simões MR, Feiden A, Boscolo WR. Elaboração de massa fresca de macarrão enriquecida com pescado defumado. Rev Inst Adolfo Lutz. 2010;69(1):84-90.
39. Bordignon AC, Souza BE de, Bohnenberger L, Hilbig CC, Feiden A, Boscolo WR. Elaboração de croquete de tilápia do Nilo (*Oreochromis niloticus*) a partir de CMS e aparas do corte em 'V' do filé e sua avaliação físico-química, microbiológica e sensorial. Acta Scientiarum. Animal Sciences. 2010;32(1):109-16.
40. Marengoni NG, Pozza MS dos S, Braga GC, Lazzeri DB, Castilha LD, Bueno GW, Pasquetti TJ, Polese C. Caracterização microbiológica, sensorial e centesimal de *fishburgers* de carne de tilápia mecanicamente separada. Rev Bras Saúde Prod An. 2009;10(1):168-76.
41. Verbeke W, Vackier I. Individual determinants of fish consumption: application of the theory of planned behavior. Appetite. 2005;44:67-82.
42. Pieniak Z, Verbeke W, Olsen SO, Hansen KB, Brunso K. Health-related attitudes as a basis for segmenting European fish consumers. Food Policy. 2010;35:448-55.
43. Mitterer-Daltoé ML, Machado JL, Carbonera N, Saint Pastous-Madureira L, Queiroz, MI. Potencial de inserção de empanados de pescado na merenda escolar mediante determinantes individuais. Cienc Rural. 2012;42(11):2092-8.

44. Assunção MCF, Dumith SC, Menezes AMB, Schneider BC, Vianna CA, Machado EC, Wehrmeister FC, Muniz LC, Zanini RV, Orlandi, SP, Madruga, SW. Consumo de carnes por adolescentes do Sul do Brasil. *Rev Nutr.* 2012;25(4):463-72.
45. Van Gelderet BM, Tijhuis M, Kalmijn S, Kromhout D. Fish consumption, n-3 fatty acids, and subsequent 5-y cognitive decline in elderly men. The Zutphen Elderly Study. *Am J Clin Nutr.* 2003;85(4):1142-7.
46. Virtanen JK, Mozaffarian D, Chiuve SE, Rimm EB. Fish consumption and risk of major chronic disease in men. *Am J Clin Nutr.* 2008;88(6):1618-25.
47. Grieger JA, Miller M, Cobiac L. Knowledge and barriers relating to fish consumption in older Australians. *Appetite.* 2012;59(2):456-63.

Received: 02/8/2013

Revised: 06/5/2013

Approved: 09/4/2013

