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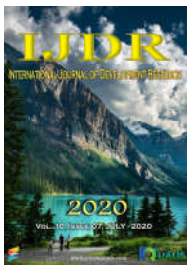

RESEARCH ARTICLE OPEN ACCESS

OSMOTIC DEHYDRATION, DRYING, LIQUID SMOKING AND POWDER OF FILLETS OF (*PSEUDOPLATYSTOMA* SP)

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ABSTRACT

To verify the influence of processing methods on painted files (*Pseudoplatystoma* sp) wet salting was performed, with binary solution and ternary solution, dry salting, liquid smoking and powder smoke, microbiological analysis identified absence of *Salmonella* sp in both fresh and processed fillets and decreased *Staphylococci* in fillets after processing. The moisture obtained for fillets with dry salting was lower than that osmotically treated with binary and ternorian solutions, and in the smoked fillets the powder smoking presented lower humidity than the liquid smoking. Protein levels were lower in the treatment of liquid smoke 21.20% and higher in dry salting treatment 23.75%. The intensity of red showed higher values in fillets with smoking, followed by fillets with ternarian solution, binary solution and dry salting with the lowest value. Among the salting processes, the processes with binary and ternary solution showed higher water activity, and among the smoking processes the values of water activity found were 0.9333 for fillets with liquid smoke and 0.9800 for fillets with powdered smoke.

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INTRODUCTION

The search for healthy eating has increased fish consumption in recent years. According to Ozpolat and Patir (2015) the nutritional benefits of fish are linked to high quality protein and the presence of certain vitamins and minerals. In addition, Boran et al. (2008) describe that fish contain polyunsaturated fatty acids that play an important role in human health. Research also indicates that freshwater fish contain high levels of eicosapentaenoic and docosaexaenoic fatty acids (Agren et al., 1989; Wang et al., 1990; Suárez-Mahecha et al., 2002; Sartori and Amâncio, 2012). However, fish are very susceptible to the deterioration process due to pH close to neutrality, high water activity in tissues, high content of nutrients easily usable by microorganisms, unsaturated lipid content, rapid destructive action of enzymes naturally present in tissues and high metabolic activity of the microbiota (Leitão, 1983; Ogawa and Maia, 1999). To maintain the quality of food, salting and smoking are described in history as the oldest methods of conservation (Ferreira et al., 2002). With the rapid development of new technologies, the importance of salting and smoking as conservation methods has declined, and these techniques are still used to produce aroma, flavor and color to the products. Several studies have already reported the improvement in the conservation and durability of fish submitted to salting processes (Nates et al., 2014; Simões, 2007). And to maintain the nutritional and organoleptic characteristics of the products, combinations of processing techniques have been researched. In the smoking Gonçalves and Oliveira (2011) describe that the action of smoke, salt and drying are combined leading to the reduction of the water activity of the product and chemical action of the smoke components on microorganisms. Although smoke has antioxidant and bacteriostatic action (Slamova et al., 2017),

health-harmful substances were also detected in smoke and smoked products (Belichovska et al., 2019). Thus, new smoking techniques are researched to obtain the conservation benefits and organoleptic characteristics of smoking, without the deleterious defects of smoke. Liquid and powder smoke appear as a way to produce smoked foods with better uniformity and practicality, and eliminates the presence of high levels of carcinogenic elements in smoked products (Belichovska et al., 2019). In this context, the objective was to evaluate the centesimal, microbiological composition, water activity and color of fillets of pintado (*Pseudoplatystoma* sp) submitted to dry salting and wet salting, and smoked by liquid smoke and powdered smoke.

MATERIALS AND METHODS

Raw material: The breeding and slaughter of fish in this study is registered and approved by the Ethics Committee on the Use of Animals of the Catholic University Don Bosco under protocol no. 012/2017. Being in accordance with the precepts of Law no. 11.179, of October 2008, of Decree no. 6.899 of July 15. 2009, and with rules issued by the National Council for Animal Experimentation Control. The pintado ones (*Pseudoplatystoma* sp) were created in the fish farming sector of the School Farm of the Catholic University Don Bosco. After the breeding period, 100 fish were caught at random with the aid of a trawl after 8 hours of fasting, were desensitized by thermal shock through immersion in water and ice and slaughtered by insertion of the caudal vein. Then, the carcasses were packed in thermal boxes and transported to the Food Technology Laboratory of the Catholic University Don Bosco. The fish were gutted and washed with chlorinated water (05 ppm) for removal of blood and offal, then manually filleted and fillets with an average weight of 274.50g packed and frozen. For each processing, 20 fillets were used, each fillet being considered as an experimental unit.

Salting: For the salted fillets, the processing tested were: wet salting with binary solution, wet salting with ternary solution and dry salting. Two solutions were used in wet salting, one binary solution with water and 25% NaCl and one ternary solution of water containing water, 20 % sucrose and 20 % NaCl. After remaining for 72 hours in osmotic dehydration, the fillets were packed in an oven with forced ventilation at 40ºC for 24 hours. For dry salting, the fillets were salted only once in the proportion of 30% salt in relation to the initial weight, remaining in contact with salt for 72 hours.

Smoking: In the smoking processing, powder smoke and liquid smoke were tested. For this, two marinating solutions were elaborated where the fillets remained for 24 hours. In smoke powder smoking the marinating solution contained: powdered smoke, curing salt, color fixer, sugar, laurel, clove, allspice and salt and in liquid smoke smoke the marination solution contained: curing salt, color fixer, sugar, bay, clove, allspice and salt. After the marinating period, the smoking fillets with powdered smoke were packed in a forced ventilation oven at 80ºC for 8 hours. The fillets of liquid smoke were sprinkled with 5 mL of liquid smoke per kg of fillet and taken to the forced ventilation oven at 80ºC for 8 hours.

Microbiological analyses: To evaluate the hygienic and sanitary conditions of fillets in natura and after salting and smoking processing, positive coagulase staphylococci and salmonella sp presence were investigated, according to the methodology recommended by the American Public Health Association (APHA, 2002).

Physicochemical analyses: After filleting, the samples were crushed separately in a food processor. The centesimal composition was performed to determine moisture content, ash, lipids, carbohydrates and proteins according to the AOAC method (2012) and water activity (Aw) with the use of an Electronic Fiber Hygrometer, and color using a color Colorquest II color benchtop spectrophotometer equipment (Hunter Lab), with Cielab color system, previously calibrated, operating with D65 illuminator, 10° angle in RSIN mode, in the CIE (Commission Internacionale de L'Eclairage) L*, a*, b*.

Regarding color analysis, we have:

L*: luminosity (the maximum value of L is 100, and represents a perfect diffuse reflection, while the minimum value is zero and constitutes black);

a*: intensity of red color ("a" does not have specific numerical limits, Ranges from red "+a" to green "-a");

b*: yellow color intensity ("b" does not have specific numerical limits, Ranges from yellow "+b" to blue "-b");

The design of the experiment was completely randomized with five treatments and twenty replicates.

Statistical analysis: The results of the centesimal composition, color and water activity evaluation were statistically analyzed through descriptive data analysis (mean ± standard deviation) followed by variance analysis (ANOVA), and their means were compared by tukey's test at 5% probability.

RESULTS

Table 1 shows the results obtained from microbiological analyses of fillets of Pintado (*Pseudoplatystoma* sp), in natura and processed, against *Salmonella* sp and Staphylococci positive coagulase, required by resolution - RDC no. 12, of January 2001, of the Health Surveillance Agency - ANVISA (Brasil, 2001).

Table 1. Microbiological analyses of fillets of Pintado (*Pseudoplatystoma* sp) in natura and after having been submitted to salting and smoking processes

	Salmonella sp	*Staphylococci* positive coagulase	Brazilian legislation
In natura	Absent in 25 g	$<1x10^3$ UFC/g	1×10^3 UFC/g
Salting	Absent in 25 g	Absent	5×10^2 UFC/g
Smoking	Absent in 25 g	$<1x10^2$ UFC/g	5×10^2 UFC/g

UFC: Colony forming unit.

Table 2. Centesimal composition of fillets of Pintado (*Pseudoplatystoma* sp) submitted to salting and smoking processes, based on natural matter

	Centesimal composition %			
	Moisture	Extract Ethereal	Protein	Ash
Dry salting	35.34^{d}	19.31^{a}	23.75^{a}	21.18^{b}
Binary solution	41.38^{c}	15.97^{b}	22.50^{b}	20.15^{c}
Ternary solution	40.21^{c}	14.57^{c}	22.86^{b}	22.36^{a}
Liquid smoke	58.37^{b}	13.85^{d}	21.20^{c}	5.67^{d}
Smoke powder	56.95^{a}	14.76^{cd}	22.68^{b}	6.52^{e}
CV	1.45	8.38	1.79	4.06
P	P<0.0001	P<0.0001	P<0.0001	P<0.0001

Values followed by distinct letter, in the column, differ from each other by the Tukey test at 5% probability.

Table 3. Color and water activity of fillets of Pintado (*Pseudoplatystoma* sp) submitted to salting and smoking processes

	Color Components			
	L	a*	b*	Aw
Dry salting	18.3900[d]	1.9883[e]	2.9150[c]	0.6880[c]
Binary solution	20.1666[c]	1.3237[d]	3.9262[a]	0.7780[b]
Ternary solution	22.1466[b]	2.6433[c]	3.0600[b]	0.7700[b]
Liquid smoke	23.9600[a]	4.0716[a]	0.6116[d]	0.9333[a]
Smoke powder	23.7600[a]	3.9783[b]	0.7833[d]	0.9800[a]
CV	1.84	9.31	12.18	6.29
P	0.002	0.0032	0.0015	P<0.0001

The centesimal composition of the fillets was influenced in different ways by the processing methods (Table 2). The color and activity of water varied according to the processing (Table 3).

DISCUSSION

Microbiological analysis identified the absence of *Salmonella* sp in both fresh and processed fillets. The fillets in natura showed results of $<10^3$ CFU/g for coagulase positive staphylococci, but after salting the painted fillets these microorganisms were not found. The smoking process was also shown to be efficient, as the results demonstrated the decrease of these microorganisms when compared with in natura fillets. Oetterer (1998), through his research, observed that the useful life of smoked fish is 7 days at 4ºC and 13 days, at 0ºC, as well as factors such as hygiene in the preparation of the raw material, different salt concentrations, smoking temperature, storage temperature, are fundamental for the useful life of the product. The results showed that the painted fillets used in the research presented microbiological patterns within the limits established by the Brazilian legislation, ANVISA (2001), confirming that the sanitary and hygienic procedures were correctly followed from capture to the preparation of raw material, therefore suitable for processing and/or consumption, however if the presence of these bacteria was confirmed, the raw material should be discarded. According to Table 2, it is noted that the moisture obtained for the fillets painted with dry salting was lower than that osmotically treated with binary and ternary solutions, demonstrating the influence of impregnated solids on the raw material during the osmotic dehydration stage, modifying the equilibrium condition. Among the salting processes, the moisture of the products ranged from 35.34 to 41.38%, with no major difference between binary and ternary salting, these data are in accordance with the Technical Regulation of Identity and Quality of Salted Fish and Dry Salted Fish ANVISA (2001) which determines maximum humidity of 45% in salted fish.

Brazilian legislation does not determine minimum or maximum humidity for smoked fish and there is no reference to chemical composition in the Technical Identity and Quality Regulation for cured fish (Brazil, 2017). Liquid smoking had a humidity of 58.37% and powder was 56.95%. Gonçalves and Cezarini (2008) report moisture content of 57.35% in jundiá fillets (*Rhamdia quelen*), traditionally smoked between 71 and 82ºC, and addition of smoke for three hours and 15 min. Also, Souza et al. (2004) cite moisture values of 63% in Nile tilapia fillet (*Oreochromis niloticus*), submitted to traditional smoking between 50 and 90ºC, for four hours of adding smoke. The moisture content of smoked fish is important for the evaluation of its organoleptic quality, although the partial loss of water is important for the preservative effects of smoking, because as the moisture decreases, the product becomes increasingly dry and hard, which decreases its acceptability (Gonçalves and Prentice-Hernández, 1998). In general, leather fish, such as the painted fish and their hybrids, are classified as fatty fish, with lipid contents higher than 10% (Ogawa and Maia, 1999; Gonçalves et al., 2011). After the process, as a result of the decrease in moisture content, the lipid concentration increases and the values of ether extract vary from 13.85 to 19.31%. Ayuba et al. (2019) analyzing the chemical composition of smoked Catfish (*Clarias gariepinus*) found lipid values from 19.65 to 21.34%. The values of protein content found in the evaluated samples were lower in the treatment of liquid smoke 21.20% and higher in dry salting treatment 23.75%, being very significant values, so the pintado (*Pseudoplatystoma* sp) can be considered a product as an important protein source. The values found in this study were higher than those found by Tonial et al. (2010), in their study conducted with salmon, values of 17.89% were found for salmon in natura and, studies conducted with sardines by Viana (2008) and Bruschi (2001), the values found were 20 and 18%, being lower than that found in this study. Among the salting processes, the percentage of ash varied from 21.18 to 22.36%, and probably this high value is related to salt absorption during the dehydration process. And, among the smoking processes, smoking using powder smoke showed higher ash value, probably due to the inclusion of powdered smoke in the marination.

Color is a sensory attribute of great importance for the acceptance of fish and their processed products (Oliveira et al., 2017). In fish, which do not have high levels of myoglobin, color change is associated with protein denaturation that occurs under high pressures, similar to the cooking process (Teixeira et al., 2014). Nates et al. (2014) describes that the Luminosity "L*" varies from white (maximum) to black (minimum), thus it can be affirmed that the dry salting dehydration processing was darker, possibly due to the denaturation of the protein in the presence of NaCl, associated with lower water and moisture activity observed in this processing that decreases the ability of light refraction. While smoked fillets showed higher luminosity associated with higher water and humidity activity. The data of "a", intensity of red, showed variation as a function of processing, presenting the highest red contents in fillets with smoking, followed by fillets with ternarian solution, binary solution and dry salting with the lowest value. Comparing the salting processes, osmotic dehydration with ternary solution presents higher red content, probably due to the presence of sucrose in the solution. According to Ramos et al. (2009), the lack of pigmentation in the muscles of fish and birds is desired by the consumer, however, processed products can be made more attractive with more intense red coloration combined with greater luminosity. One of the most important properties for the processing, conservation and storage of food is water activity (Aw), this dimensions the degree of connection with the water contained in the product and consequently its availability to act as a solvent and participate in chemical, biochemical and microbiological transformations. The decrease in moisture in processed products inhibits food deterioration agents increasing their durability (Ayuba et al., 2019; Pradhan et al., 2020). Regarding water activity (Aw), the mean values found in this study ranged from 0.6880 to 0.9800. Among the salting processes, the processes with binary and ternary solution showed higher water activity. Although there

is no standard proposed by legislation for water activity in salted fish. Sabadini et al. (2001) describe that dehydrated meat products should present water activity from 0.74 to 0.78. Márisco et al. (2009) describe values ranging from 0.70 to 0.84 for water activity in commercial cod. However, because this parameter is very important for the stability of products, according to Brazil (1997), it is necessary to use the Aw value of 0.75 as the maximum limit for salted and dried fish. Among the smoking processes, the values of water activity found were 0.9333 for fillets with liquid smoke and 0.9800 for fillets with powdered smoke. Decree No. 9,013 of March 29, 2017 (Brazil, 2017) establishes that refrigerated smoked fish must have water activity below 0.94, thus powdered smoke fillets have higher values, indicating the need for longer heating time. The absolute value of water activity gives a safe indication of the free water content of the food, which is the only form of water used by microorganisms. Thus, the possibility of microbial alteration in food decreases as water activity decreases (Hoffmann, 2001).

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Conclusion

Dry salting, wet salting and liquid smoking techniques showed to be efficient in microbiological control, besides preserving the nutritional value and conditions of appearance of the product. Being recommended as techniques to add value to the final product.

REFERENCES

Agren, J., Muje, P., Hanninen, O., Herranen, J., Penttila, I. (1987). Seasonal variations of lipid fatty acids of boreal freshwater fish species. Comp Biochemistry Physiology. 88, pp. 905-09.

Anvisa (Agência de Vigilância Sanitária de 02 de janeiro de 2001). Regulamento Técnico Sobre Padrões de Qualidade para Alimentos. Resolução –RDC.n.12.

APHA – AMERICAN PUBLIC HEALTH ASSOCIATION. Compendium of methods for biological examination of foods. 3. ed. Washington. Americam Public Heath Association. 2002. 1219 p.

Association of Official Analytical Chemists (2012). Official Methods of Analysis. Washington D.C., USA. 18th Edition.

Ayuba, L.O., Jackson, B.A, Onah, O. R, Adamade, C.A and Ozumba, I.C. (2019). Effects of smoking process and conditions on the proximate composition of catfish (*Clarias gariepinus*). Annals. Food Science and Technology, v.20, n.2, p. 183-190.

Belichovska, K.; Belichovska, D.; Pejkovski, Z. (2019) Smoke and smoked fi sh production. Meat Technology, v.60, n.1, p. 37-43. DOI: https://doi.org/10.18485/ meattech.2019.60.1.6

Boran, G., Boran, M. And Karacam, H. (2008). Seasonal changes in proximate composition of anchovy and storage of anchovy oil. J. Food Qual. 31, pp. 503–513.

Brasil (2017). Regulamento da Inspeção Industrial e Sanitária de Produtos de Origem Animal (RIISPOA). Ministério da Agricultura, Pecuária e Abastecimento. Disponível on line em : http://www.agricultura.gov.br/noticias/diariooficial-publica-decreto-do-novo-regulamento-de-inspecao-industrial-e-sanitaria

Brasil. Ministério da Agricultura. pecuária e Abastecimento. Secretaria de Defesa Agropecuária. Departamento de Inspeção de Produtos de Origem Animal. Regulamento da inspeção industrial e sanitária de produtos de origem animal. Aprovado pelo Decreto n. 30.691. 29 mar. 1952. alterado pelos Decretos n.1255. 25 jun. 1962. 1236. 02 set. 1994. 1812. 08 fev. 1996 e 2244. 04 jun. 1997. Diário Oficial. Brasília. 05 jun. 1997. Seção 1. p.1155-1156.

Bruschi, F.L.F. Rendimento. composição química e perfil de ácidos graxos de pescados e seus resíduos: uma comparação. 2001. 65f. Trabalho de conclusão (Graduação em oceanografia) – Centro de Ciências Tecnológicas da Terra e do Mar. Universidade do Vale de Itajaí. Itajaí. Santa Catarina.

Ferreira, M.W.; Silva, V.K.; Bressan, M.C.; Faria, P.B.; Vieira, J.O.; Oda, S.H.I. (2002). Pescados processados: maior vida de prateleira e maior valor agregado**.** Lavras: Universidade Federal de Lavras, (Boletim de Extensão).

Gonçalves, A.A.; Cezarini, R. (2008). Agregando valor ao pescado de água doce: defumação de filés de jundiá (*Rhamdia quelen*). Revista Brasileira de Engenharia de Pesca, 3, pp.63-79.

Gonçalves, A.A.; Oliveira, A.C.M. (2011). Defumação de pescado. In: GONÇALVES, A.A. Tecnologia do pescado: ciência, tecnologia, inovação e legislação. São Paulo: Editora Atheneu. p. 166-180.

Gonçalves, A.A; Prentice-Hernández, C. (1998). Defumação líquida de anchova (*Pomatomus saltatrix*): efeito do processamento nas propriedades químicas e microbiológicas. Ciência e Tecnologia de Alimentos, v.18, pp.438-443,. DOI: 10.1590/ S0101-20611998000400016.

Hoffman, F.L. (2001). Fatores limitantes à proliferação de microrganismos em alimentos. Brasil Alimentos, 9 (3), pp. 23-30.

Leitão, M.F.F. (1984). Deterioração microbiana do pescado e sua importância em saúde pública. Higiene Alimentar, São Paulo, v.3, n.3/4, p.143-152.

Márisco, E. T; Silva, C., Barreira, V. B.; Mantilla, S. P. S.; Moraes, I. A. (2009). Parâmetros físico-químicos de qualidade de peixe salgado e seco (bacalhau) comercializado em mercados varejistas. Revista do Instituto Adolfo Lutz (Impresso), 68(3), 406-410.

Nates, V.A.; Ferreira, M. W.; Trindade, C.S.P.C.; Santos, R.M.; Silva, T.A.S.; Valadares, R.S.S. (2014). Filés de tambacu submetidos a salga seca e salga úmida. Revista Brasileira de Saúde e Produção Animal, Salvador, v.15, n.2, p.450-458 abr./jun. http://www.rbspa.ufba.br. ISSN 1519 9940

Oetterer. M. Técnicas de beneficiamento e conservação do pescado de água doce. Panorama da Aqüicultura. 46, pp.14-20. 1998.

Ogawa, M. Alterações da carne de pescado por processamento e estocagem. In: OGAWA, M.; MAIA, E.L. (Eds.) (1999). Manual de pesca – ciência e tecnologia do pescado. São Paulo: Varela, v.1, p.221-249.

Oliveira, F. A.; Neto, O. C.; Santos, L. M. R.; Ferreira, E. H. R.; Rosenthal, A. (2017). Effect of high pressure on fish meat quality – a review. Trends Food Sci Technol, 66, pp. 1-19.

Özpolat, E.; Patir, B. (2016). Determination of shelf life for sausages produced from some freshwater fish using two different smoking methods. Journal of Food Safety, v.36, pp. 69-76, doi: 10.1111/jfs.12214

Pradhan, N.; Shrestha, M.K.; Rai, S., Jha, D.K.; Sah, S.K. (2020). Evaluation of Different Drying Methods on Shelf-life Quality of Mrigal *Cirrhinus mrigala* (Hamilton, 1822). Asian Fisheries Science, 33, pp.31–41.

Ramos, E.M.; Gomide, L.A.M. (2009). Avaliação da qualidade de carnes: fundamentos e metodologias. 22.ed. Viçosa, MG. Universidade Federal de Viçosa, p.242–243.

Sabadini, E., Hubinger, M. D., Sobral, P.J. Do A., & Carvalho Jr, B.C. (2001). Alterações da atividade de água e da cor da carne no processo de elaboração da carne salgada desidratada**.** Food Science and Technology, 21, pp. 14-19.

Sartori, A.G.O.; Amancio, R.D. (2012). Pescado: importância nutricional e consumo no Brasil. Segurança Alimentar e Nutricional, Campinas, 19, pp. 83-93.

Silva, N. Da; Junqueira, V. C. A.; Silveira, N. F. De A. (2001). Manual de métodos de análise microbiológica de alimento. São Paulo: Varela, 2 ed. 317 p.

Simões, M.R. (2007). Desidratação osmótica, secagem e defumação líquida de filés de tilápia do Nilo (*Oreochromis niloticus*), variedade Tailandesa. Campinas, SP: [s.n.]. Tese (doutorado) – Universidade Estadual de Campinas. Faculdade de Engenharia de Alimentos.

Slamova, T., Frankova, A., Hubackova, A., Banout, J. (2017). Polycyclic aromatic hydrocarbons in Cambodian smoked fish**.** Food Add. Cont. Part B**.** 10, pp. 248-255

Souza, M.L.R.; Baccarin, A.E.; Viegas, E.M.M.; Kronka, S.N. (2004). Defumação da Tilápia do Nilo *(Oreochromis niloti*cus) Inteira Eviscerada e Filé: Aspectos Referentes às Características Organolépticas, Composição Centesimal e Perdas Ocorridas no Processamento**.** Revista Brasileira de Zootecnia, 33, pp.27-36.

Suárez-Mahecha, H.; Francisco, A.; Beirão, L.H.; Block, J.M.; Saccol, A.; Pardo-Carrasco, S. (2002). Importância de ácidos graxos poliinsaturados presentes em peixes de cultivo e de ambiente natural para a nutrição humana. Boletim do Instituto de Pesca, São Paulo, 28, pp. 101 – 110.

Teixeira, B.; Fidalgo, L.; Mendes, R.; Costa, G.; Cordeiro, C.; Marques, A.; Saraiva, J. A.; Nunes, M. L. (2014). Effect of high pressure processing in the quality of sea bass (*Dicentrarchus labrax*) fillets: pressurization rate, pressure level and holding time. Innov Food Sci Emerg Technol, 22, pp. 31-39.

Tonial, I.B.; Oliveira. D.F.; Bravo. C.E.C.; Souza. N. E.; Matsushita. M.; Visentainer. J.V. (2010) Caracterização físico-química e perfil lipídico do salmão (*Salmo salar* L.). Alimentos e Nutrição. Brazilian Journal of Food and Nutrition. 21, pp. 93-98.

Viana. Z. C. V. (2008) Avaliação da composição mineral e centesimal em peixes consumidos no Estado da Bahia. Tese (Pós-Graduação em doutorado em Química) – Escola de Química. Universidade Federal da Bahia. Salvador.

Vieira R.H.S.F, Rodrigues D.P, Barreto N.S.E, Souza O.V, Tôrres R.C.O, Ribeiro R.V et al. (2004). Microbiologia, higiene e qualidade do pescado; teoria e prática. São Paulo: Varela.