

Chemical Composition, Mineral Contents and Nutrition Fact Analysis of Bottled Smoked Sardines

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ABSTRACT: Proximate composition, mineral content (Na, K, Ca, Fe and Zn) and nutrition facts of fish products is of great importance to fisheries managers, consumers and the nutritionist. In this study, smoked sardines were processed and thermally processed using bottles and packed in oil and in tomato sauce, proximate composition, mineral elements (sodium, potassium, calcium, iron and zinc) and nutrition fact were determined of the two different bottled products. The samples are smoked at the same time and temperature and packed in an 8oz glass jar using different types of media, the vegetable oil and tomato sauce and kept at ambient room temperature, and every analysis was done in triplicate. The sample products submitted for analysis at DOST V. The data also revealed that the total fat percentage is much higher for Sample A than Sample B. Interestingly, the protein for both samples were almost the same and it is within the standard (USFDA). Both samples contained appreciable concentrations of sodium, calcium, carbohydrates, potassium, calcium iron and zinc which indicates that these products are a good source of minerals. The result obtained from this study indicates that these bottled smoked fish analyzed were of high nutritional value and mineral content, but there is need to keep them at optimum temperature and not for too long in storage to enable consumers to derive the appropriate benefit from their consumption.

KEYWORDS: Nutrition Fact, Analysis, Bottled, Smoked, Sardines

I. INTRODUCTION

Fish constitutes a very important component of the diet for many people, often providing the much needed nutrient not readily available in cereal based diets as reported by Olomu (1995) [1], fish is rich in protein with amino acid composition which is very well suited to human dietary requirements comparing favorably with egg, milk and meat in the nutritional value of its protein (Odiko and Obirenfoju, 2017) [2]. The benefits of including fish in a diet are well known and have been documented in several studies. Fish is a good source of many important nutrients such as protein, vitamins and minerals and it is associated with improved heart/cardiovascular and other related health conditions (Damsgaard et al., 2006) [3]. According to them, fatty fish such as sardines are a natural source of high-quality protein and essential fatty acids in the human diet. Fish lipids contain long-chain n-3 polyunsaturated fatty acids (n-3 PUFA), of which eicosapentaenoic acid (EPA, 20:5n-3) and docosahexaenoic acid (DHA, 22:6n-3) play a vital role in human nutrition and promotes good health. Canning or bottling belongs to the most important means of fish preservation. Many marine species produce excellent canned products, supporting an important role in the field of human nutrition. It is a modern method of preserving food which involves hermetically sealing the food in a container, during canning process, sterilization step assures the safety of the product and are aimed at prolonging the shelf life which is adjusted to different coating media of the product; however during high temperature treatment (>115°C) changes of nutritive composition, especially fatty acid composition can be substantial. Canned products can be stored for a long time without refrigeration, quality loss in taste; colour and amount of certain essential nutrients will slowly continue (Berkel et al., 2004) [4]. Moreover, during the canning/bottling process, both enzymes and bacteria are permanently inactivated by heat. Heat-processed fish keeps for a very long time. Fish tissue is an excellent source of macro and essential trace elements such as iron (Fe), zinc (Zn) and selenium (Se) (Briggs and Schweigert, 1990) [5]. The accurate determination of these elements is therefore important in nutrition studies, particularly because meat, as a biological material,

exhibits natural variations in the amounts of nutrients contained (Greenfield and Southgate, 2003) [6]. Proximate composition generally means percentage composition of basic constituents such as water, protein, lipids, carbohydrates and minerals within a fish body. The chemical composition traditionally is used as an indicator of the nutritional value of the fish (Moghaddam et al., 2007; Aberoumand, 2011)[7]. It varies widely from species to species and it is also greatly affected by the feeding habit, sex and seasonal variations (Islam et al., 2005)[8].

There is an increasing concern about the quality of canned foods in several parts of the world, determination of the proximate composition of fish and other nutrients of fish is often necessary to ensure they are within the range of dietary requirements and commercial specifications. The deficiency in principal nutritional mineral elements induces a lot of malfunctioning in humans which is associated with a number of diseases especially with cardiovascular, kidney, nervous, bone diseases, reduces productivity and causes diseases such as inability of blood to clot, osteoporosis, anaemia. (Waterman, 2000; Abulude, 2005, Effiong and Fakunle, 2011)[9,10,]. Sardines make up a significant part of the catch of small-scale fishers in the Philippines. In Bicol during the annual glut season large amounts are dumped back into the sea due to an inability of fishers and processors to cope with such a volume. To address this situation and to help enhance the livelihoods of small scale fishers and their families, the Coastal and Wetland Center (CWC) of Partido State University would like to look into the possibility to preserve the sardines applying canning procedures and also to investigate Proximate composition, mineral content (Na, K, Ca, Fe and Zn) and nutrition fact This study attempt to assess the influence canning method on the quality smoked bottled sardines, taking into consideration the possibility of its introduction as a new product into the market for canned goods. Canning improves shelf life enabling storage of the canned product for several years; but the processor, nutritionist, cook and the consumer have a direct interest in the composition of fish, as they are all interested in the nutritional contribution of the fish to the diet as to translate to good health. It is therefore important to assess approximate composition, mineral content (Na, K, Ca, Fe and Zn) and nutrition facts of these newly developed bottled products.

II. METHODOLOGY

Raw Materials. 50 kilos of Sardines was bought directly to fisherman this is to ensure that the product is still fresh. The fish was packed in a cooler with a chilling temperature. **2.2. Smoking process.** Immediately after reaching the fish processing laboratory of PSU Sagnay Campus the fish was immediately smoked at 100 OCdifferent periods of time (30, 45, 60 minutes). The smoking was done in a conventional smoking facility with temperature control. The smoke was produced from the saw dust. The temperature will be maintained at 1000C. Before smoking the sardines was first in concentrated salt solution using sampalok juice (boiled the 1 kilo sampalok leaves to 10 liters of water)

Bottling Process. After smoking, smoked fish were packed in 8 oz jars using two (2) different formulations, one was packed in oil and other ingredients (Carrots, pickles, Red and black pepper, garlic) and the other one was in tomato sauce. Both formulations were processed 75 minutes at 121oC (Pressure 15 psi) with a process lethality (F0) of 5 minutes.

Chemical Analysis. Proximate composition of all the content of the bottled fish were determined according to the method of Association of Official Analytical Chemistry (AOAC, 2016), Microwave Plasma-Atomic Emission Spectroscopy (MP-AES) and USFDA- NLR and DOST-FNRI-PDRI, 2015, respectively.

Statistical Analysis. Data collected were subjected to statistical analysis using the t test at $p < 0.05$ level of significance. The software used for the analysis was Statistical Package for Social Sciences (SPSS version 21).

III. RESULTS AND DISCUSSION

ChemicalAnalysis of Bottle Smoked Sardines

Table 1. Comparison of Proximate Chemical Analysis of Bottle Smoked Sardines in Oil and in Tomato Sauce

Parameters	Smoked Fish in Oil (Sample A)	Smoked Fish in Tomato sauce (Sample B)
Ash %	2.64	5.18
Total Fat %	36.75	7.00
Protein %	15.48	14.55
Moisture %	42.01	67.48
Carbohydrates %	3.15	5.79

The proximal chemical analysis was carried out by the AOAC methods. Results showed (Table 1) that smoked fish in tomato sauce has higher moisture content (67.48) as compared to smoked fish in oil (42.01). The differences in both constituents among samples when comparing values may be explained in terms of media that were used, the oil and tomato sauce rather than being due to the sterilization of the canned product. The data also revealed that the total fat percentage is very much higher for bottled smoked packed in oil. The percentage fat content observed during this study indicates that different canned fish have very high percentage of fat, one

of the most important natural sources of polyunsaturated fatty acids and a rich source of vitamins A, D, E, and K which are soluble in oil, have been proven to have useful effects on human health and metabolism (Saoud et al., 2008; Rafflenbeul, 2001)^[11,12]. Interestingly, the protein percentage observed the differences is minimal or it was almost the same. Protein and fat are the major nutrients in fish, but species composition, however, varies depending on age, sex, environment and season, and their percentage level helps to define the nutritional status of a particular organism (Aberoumad and Pourshafi, 2010)^[13]. The differences observed in percentage protein in the individual products can be attributed to the food the fish consume or its absorption capability and conversion potentials of essential nutrients from this diet from their environment of origin (Adewoye et al., 1997)^[14]

Mineral Composition of Bottle Smoked Sardines

Table 2. Comparison of the Mineral Composition of Bottle Smoked Sardines in Oil and Tomato Sauce

Parameters	Smoked Fish in Oil (Sample A)	Smoked Fish in Tomato sauce (Sample B)
Sodium, mg/100g	566	1,352
Potassium, mg/100g	206	352
Calcium, mg/100g	383	680
Iron, mg/100g	1.6	2.71
Zinc, mg/100g	1.25	1.69

Mineral composition was determined using the Microwave Plasma-Atomic Emission Spectroscopy (MP-AES). It was observed the sodium is very much higher in smoked fish in tomato sauce which may have resulted from the addition of sodium chloride (salts) and other condiments during processing for canning. The main role of these minerals can be described as structural and functional. Structurally, they stand out for their role as integrators of organic compounds in the body, while functionally, they are important in controlling biological functions (Ozden et al., 2010)^[15].

Nutrition Facts of Bottled Smoked Sardines in Oil(%Daily Value)

Table 3. Nutrition Facts Computation (%Daily Value) Bottled Smoked Sardines in Oil

Nutrition Facts			
Serving size 1/3 cup (55g)			
Serving per container 4			
Amount Per Serving		Per 100g	
Calories 220		Calorie 410	
Calories from Fat 180	% Daily Values	Calories from Fat 330	% Daily Values
Total fat 20g		37g	57%
Sodium 310mg		570mg	24%
Potassium 115mg		210mg	6%
Total Carbohydrates 2g		3g	1%
Protein 9g		15g	
Calcium	20%		40%
Iron	4%		8%
Zinc	4%		8%
*Percent daily values are based on 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie need			
Calories	2,000	2,500	
Total Fat	Less than	20g	25g
Cholesterol	Less than	300g	300g
Sodium	Less than	2,400g	2,400g
Total Carbohydrates		300g	375g
Dietary fiber		25g	25g
Calories per gram:			
Fat 9		* Carbohydrates 4	*Protein 4

Both samples contained appreciable concentrations of sodium, calcium, potassium, iron and zinc which indicates that these fish are a good source of minerals. Calcium content was observed to be higher in all the samples B and it is an important mineral essential for growth, maintenance of bones, teeth and muscles (Turan et al., 2003)[16]. There was also great variability in the amounts of calcium and potassium, due to the bones being already soft. Bones are the main storage site of calcium in the body. Your body cannot make calcium. The body only gets the calcium it needs through the food you eat, or from supplements. If you do not get enough calcium in your diet, or if your body does not absorb enough calcium, your bones can get weak or will not grow properly Midline Plus,(2018)[17]. The nutrition facts were computed on the Percentage daily value. Nutrition facts are usually found on the labels of food products. The nutritional information found on a food label is based on one serving of that particular food. In this study, the serving size is 1/3 cup (55g) and serving per container is four (4) and percent daily values are based on a 2,000 calorie diet. However, your daily values may be higher or lower depending on your calorie needs. The calorie in this study per serving is 220 and 410 per 100 grams. Since there are 4 servings per container therefore if you eat the content of the container you have an equivalent of 880 calories which is less than the daily values of 2,000. Hence, eating these products can be attributed to good daily consumption. Interestingly, based on the USFDA- NLR, the daily recommended value for fat, sodium and carbohydrates is less than 20g, 2,400g and 300g respectively. In this study, the total fat is 20g, sodium is 310g and carbohydrates is 2g which results is within the recommended limit. Hence this product can be recommended as part of the diet of an individual.

Nutrition Facts Bottled Smoked Sardines in Tomato Sauce(%Daily Value)

Table 4. Nutrition Facts Computation (%Daily Value) Bottled Smoked Sardines in Tomato Sauce

Nutrition Facts			
Serving size 1/3 cup (55g)			
Serving per container 4			
Amount Per Serving		Per 100g	
Calories 80		Calorie 140	
Calories from Fat 30	% Daily Values	Calories from Fat 60	% Daily Values
Total fat 4g		7g	11%
Sodium 740mg		1350mg	56%
Potassium 195mg		350mg	10%
Total Carbohydrates 3g		6g	2%
Protein 8g		15g	
Calcium	20%		70%
Iron	4%		15%
Zinc	4%		10%
*Percent daily values are based on 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie need			
	Calories	2,000	2,500
Total Fat	Less than	20g	25g
Cholesterol	Less than	300g	300g
Sodium	Less than	2,400g	2,400g
Total Carbohydrates		300g	375g
Dietary fiber		25g	25g
Calories per gram:			
Fat 9	* Carbohydrates 4	*Protein 4	

In this sample, smoked fish in tomato sauce contained appreciable concentrations of sodium, calcium, carbohydrates, potassium, calcium iron and zinc which indicates that these products are a good source of minerals. Calcium content was observed higher in all the samples and it is an important mineral essential for growth, maintenance of bones, teeth and muscles (Turan et al., 2003)[18]. Zinc is also traceable in the sample. (Vidyavati, et al., 2016)[19] Stated that zinc is also an essential trace element for health used in diarrhea, respiratory infections & malaria too. Zinc is essential for the body's good immune system, hormone secretion,

mental wellbeing, fetal growth, and normal body development. Further, calorie content is very limited which can be recommended to be added in daily food intake. The RENI is used to denote recommendations for energy and 21 nutrients including protein, folate, calcium, and zinc for the maintenance of health and well-being of nearly all healthy persons in the population. Moreover, some nutrients should be consumed more frequently, such as water-soluble vitamins like vitamin C. Other nutrients, on the other hand, can be harmful if more than what is recommended is taken, like vitamin A. RENI is the standard of achieving adequate energy and nutrient intakes for Filipinos (FNRI-DOST, 2014).

Nutrition Facts of Bottled Smoked Sardines in Oil(%RENI)

Table 5. Nutrition Facts Computation (%RENI) Bottled Smoked Sardines in Oil

Nutrition Facts				
Serving size 1/3 cup (55g)				
Serving per container 4				
Amount Per Serving		%RENI	Per 100g	
			%RENI	
Calories 220		9%	Calorie 410	
Calories from Fat 180			Calories from Fat 330	
Total fat 20g			37g	
Sodium 310mg			570mg	
Potassium 115mg			210mg	
Total Carbohydrates 2g			3g	
Protein 9g		13%	15g	
Calcium 30%			50%	
Iron 8%			15%	
Zinc 10%			20%	
*Percent RENI values are based on a 2015 PDRI reference of a male adult 19-29 years of age with 2530 calorie need.				
Calories per gram			*Protein 4	
Fat 9			* Carbohydrates 4	

In this study, the computation for RENI was based on a 2015 PDRI reference of male adult 19-29 years of age with 2530 calorie needs. The calorie in this study per serving is 220 and 410 per 100 grams. Since there are 4 servings per container therefore if you eat the content of the container you have an equivalent of 880 calories which is less than the daily values of 2530. Hence, eating this products can be attributed for good daily consumption particularly for adult male 19-29 years old. Moreover, based on the standard of other mineral elements, the sample is within the standard. Hence, this is good to be included for daily intake of an adult individual.

Nutrition Facts of Bottled Smoked Sardines in Tomato Sauce (%RENI)

Table 6. Nutrition Facts Computation (%RENI) Bottled Smoked Sardines in Tomato Sauce

Nutrition Facts				
Serving size 1/3 cup (55g)				
Serving per container 4				
Amount Per Serving		%RENI	Per 100g	
			%RENI	
Calories 80		3%	Calorie 140	
Calories from Fat 30			Calories from Fat 60	
Total fat 4g			7g	
Sodium 740mg			1350mg	
Potassium 195mg			350mg	
Total Carbohydrates 3g			6g	

Protein 8g	13%	15g
Calcium		90%
50%		
Iron		25%
10%		
Zinc		25%
15%		
*Percent RENI values are based on a 2015 PDRI reference of a male adult 19-29 years of age with 2530 calorie need.		
Calories per gram		
Fat 9	* Carbohydrates 4	*Protein 4

Sample B (Table 6) the total fat (4g) is lesser than Sample A (20g) (Table 5). On the other hand, sodium and Potassium is higher in Sample A, this may be associated with the addition of tomato sauce because tomato sauce also has an amount of sodium and potassium. However, the result is within the range of the standard (Philippine Dietary Reference Intake, 2015). Hence, this product can be recommended as part of the diet of an adult individual.

IV. CONCLUSION

The samples are smoked at the same time and temperature and packed in an 8oz glass jar using different types of media, the vegetable oil and tomato sauce. The bottled smoked sardines are good sources of nutrients and minerals which should be included in the human diet as they were found to contain high protein and fat contents. All samples had adequate amounts of protein adequate for infants and adults; they were low in calories, high in protein, potassium and calcium; with a varied amount of sodium which is of no significant health implications. Hence this product can be recommended as part of the daily individual diet.

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