

Nutritional Analysis of Bicol Region's Smoked Round Scad (*Decapterus macrosoma*) and Pinangat Products

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Abstract

The study was carried out to determine proximate content of the Bicol One Town One Product (OTOP) smoked round scad (*Decapterus macrosoma*) and *pinangat* and evaluate their nutrient content based on the Philippine Dietary Reference Intakes (PDRI) for selected age groups. Smoked fish samples were gathered from the two largest producers in Mercedes, Camarines Norte, while the *pinangat* samples were obtained from three Department of Trade and Industry (DTI)-accredited OTOP producers in Camalig, Albay. Samples were subjected to various analyses using standard analytical techniques. The proximate analysis of smoked fish products revealed the moisture content of 54.84%; ash content, 9.71%; crude protein, 31.29%; carbohydrates, 0.47%; and total fat, 3.70%. The mineral content of the fish indicated that Na (2210mg) and Ca (157mg) were the most abundant. The overall nutritional composition of smoked fish showed that it is highly nutritive with crude protein having the largest quantity of the dry matter in the fish samples. *Pinangat* products contained moisture (65.48%), ash content (2.3%), crude protein (4.2%), carbohydrates (3.83%), and total fat (24.3%). Presence of major and trace minerals (sodium, calcium, iron, and zinc) was reported, with sodium being the most abundant mineral. In all age groups from children to adults, nutrient contents of smoked fish and *pinangat* products in general ranged from low to high levels based on the recommended range in requirement estimated for groups with different activity levels. The study suggests that smoked fish and *pinangat* can serve as sources of different nutrients and minerals needed by the body, however, moderate consumption must be observed due to the high sodium content which exceeds the recommended dietary amount.

Keywords: *Colacasia esculenta* L., OTOP, proximate analysis, round scad, mineral composition

Introduction

Access to sufficient amount of nutritious food is a key to sustaining life and promoting good health. However, malnutrition still remains as one of the biggest problems in the country, affecting children the most. In the 8th National Nutrition Survey (NNS) conducted by Food and Nutrition Research Institute of the Department of Science and Technology (DOST FNRI), 19.9% of children were found to be underweight, and 30.3% of children were stunted. Bicol region was even included under top regions with highest prevalence of malnutrition than the national average (DOST FNRI, 2014). Problem arises not only due to lack of adequate food, but also to lack of nutritious complementary food.

Food, as one of the basic needs of man, provides

the health requirements of a person in order to live. The composition of food largely determines its nutrition, physicochemical properties and quality attributes. The growing concern over the chemical composition of food, most especially its effect to the consumer, generates the need for food nutrition analysis.

The Philippines has a number of policies being implemented, recognizing the pivotal role of improving food production and supply to meet the growing demand for food. The need for food nutrition analysis of Philippine food products is embodied in House Bill No. 1469 prescribing nutrition labelling in food products in the country. This intends to help the consumers become more knowledgeable on the nutritional value of the food

available in the market thereby ensuring food safety (Food Industry Asia, 2014). Furthermore, Republic Act No. 7394 otherwise known as Philippine Consumer Act and the Philippine National Standards (PNS) govern the Philippines marking and labeling requirements (International Trade Administration, 2019). Thus, the locally manufactured food products must also conform to these national regulations.

The issue of nutrition labeling is a pressing concern not only in the nutrition community but also in government, industries, and several other consumers. Nutrition labels describe the nutrient content of a food and must guide the consumer in food selection. The nutrition information provided must be selected on the basis of consistency with dietary recommendations (Van den Wijngaart, 2002). The Philippines adopted the Codex Guidelines on the Use of Health and Nutrition Claims for Food since 2007. This plays an important role in encouraging harmonization between national standards with international standards. The guidelines include provisions for voluntary nutrient declaration, calculation and presentation of nutrient information (Food and Agriculture Organization [FAO]/World Health Organization [WHO], 2017).

Still, many food products in the Philippines, particularly the bioethnic food products, have not undergone nutritional analysis, which could have ensured that the products are of good quality. This study therefore, looked into the assessment of nutritional qualities of selected Bicol ethnic food products which are promoted as delicacies under the banner "One Town One Product (OTOP)."

Smoked fish (made from round scad (*Decapterus macrosoma*)) is classified as OTOP of Mercedes, Camarines Norte. Smoking process has been used for centuries for preservation and preparation of food (Omodara et al., 2016). It is a process of treating fish by exposing it to smoke from smoldering wood or plant materials. This process is usually characterized by an integrated combination of salting, drying, heating, and smoking steps in a smoking chamber (FAO, 2013). Some advantages of fish smoking include prolonged shelf life, enhanced flavor and increased utilization in various dishes and allowing storage for longer season. It also increases protein availability to people throughout the year and makes fish easier to pack, transport, and market (Adeyeye & Oyewole, 2016).

Pinangat, on the other hand, is a well-known OTOP of Camalig, Albay. Pinangat in the Bicol Region,

Philippines, is a traditional dish which combines *gabi* (*Colocasia esculenta* L.) leaves, chili, meat, and coconut milk. The ingredients are wrapped in *gabi* leaves, tied securely with coconut leaf, and cooked in coconut milk.

Thus, this study aimed to evaluate and characterize the food quality of chosen Bicol OTOP namely smoked fish and *pinangat*. Specifically, it provides the proximate content of the smoked fish and *pinangat* available in the market and compares the nutrient content with the Philippine Dietary Reference Intakes (PDRI) for children (6–18 years old) and adults (19–70 years old and above).

Materials and Methods

Sample Collection

A total of eight kilograms of smoked round scad (*Decapterus macrosoma*), locally known as *galunggong*, was purchased from the two biggest processors of smoked fish in Mercedes, Camarines Norte. Upon purchase, samples were placed in sterile plastic bags and immediately transported in cool bags to the laboratory. *Pinangat* samples on the other hand were randomly collected from the (3) biggest DTI-accredited *pinangat* producers in Camalig, Albay. Upon purchase, the *pinangat* samples were placed in sterile plastic bags and conditioned at 4 °C in cold container and were immediately transported to the laboratory. These samples were subjected to various physical and chemical analyses.

Proximate Analysis

The proximate analyses including moisture, ash, crude fat, and crude protein of the smoked fish and *pinangat* samples were determined in accordance with the official methods of analysis established by the Association of Official Analytical Chemists (AOAC). Moisture content was determined using AOAC 971.28, determination of ash content was based on AOAC 925.51, while AOAC 930.09 was adapted to determine the percentage fat content of food samples. Kjeldahl nitrogen determination for crude protein analysis was done in accordance with AOAC 977.02. Each analysis was carried out in triplicate and reported in percentage. Analyses were conducted at the Department of Science and Technology–Regional Office V–Regional Standards and Testing Laboratory (DOST-ROV-RSTL).

Mineral Composition Analysis

Quantitative Mineral Composition analyses for sodium (Na), iron (Fe), zinc (Zn), and calcium (Ca) were carried out using 4200 Agilent Technology Microwave Plasma-Atomic Emission Spectrophotometer (MP-AES) at Department of Science and Technology–Regional Office V–Regional Standards and Testing Laboratory (DOST-ROV-RSTL). Each analysis was carried out in triplicate and reported in percentage.

Calculations and Statistical Analysis

The fatty acid values were obtained by multiplying crude fat value of each sample with a factor of 0.8 (i.e. crude fat × 0.8 = corresponding to fatty acids value). Percent carbohydrates was calculated by difference (subtracting the sum total of moisture; protein, fat, and ash content from 100%). The energy values (kJ/100g) were calculated by adding up the carbohydrate × 17 kJ, crude protein × 17 kJ, and crude fat × 37 kJ for each of the samples. Standard deviations were calculated from the three determinations done on each sample for the proximate composition, and it was used as the measure of dispersion.

Results and Discussion

Proximate and Mineral Composition of Smoked Fish

Proximate analyses include moisture, ash, fat, proteins, carbohydrates, fatty acid, and metabolisable energy available per 100 grams of sample, while the mineral composition analyses include calcium, iron,

sodium, and zinc determination. Table 1 presents the result of the smoked fish proximate and mineral composition analyses. However, these values cannot be compared with the standard since no Philippine National Standard (PNS) for proximate analysis for smoked fish has been established so far. Thus, available literatures were used for comparison and interpretation of results.

Moisture content of food is important to food manufacturers because it is a determining factor in food quality, preservation, and resistance to deterioration. Moisture content of 12% is the level beyond which fish products begin to grow molds after few days (Daramola et al., 2007). Analysis revealed that smoked fish has a mean moisture content of 54.84%. This result suggests that immediate mold growth can occur in smoked fish samples upon storage apart from temperature effect at the point of storage and other storage conditions.

In the mean proximate composition, the crude protein (31.29%) formed the largest quantity of the dry matter in the smoked fish samples. This provides the basis that smoked fish is a high source of protein. This result further coincides with the findings of Besharati in 2004. The percentage of protein increases during drying and smoking; this corresponds with the decreasing percentage of water, which can result in concentration of nutrients.

Proximate analysis of smoked fish recorded the lowest value for carbohydrate (0.47%). The low concentration of carbohydrate in smoked fish is in agreement with the findings of Aremu et al. (2013)

Table 1. Proximate and Mineral Composition of Smoked Fish (SF)

Parameters	SF-01	SF-02	Mean + SD
Moisture, %	58.82	50.86	54.84 ± 5.63
Ash, %	8.62	10.80	9.71 ± 1.54
Total Fat, %	1.84	5.55	3.70 ± 2.62
Protein, %	29.79	32.79	31.29 ± 2.12
Carbohydrates, %	0.93	0.00	0.47 ± 0.65
Fatty Acid, %	1.47	4.44	2.96 ± 2.10
Energy (KJ/100g)	590.32	762.78	676.55 ± 121.94
Iron (mg/100g)	1.22	0.99	1.11 ± 0.16
Sodium (mg/100g)	2229.00	2173.00	2201.00 ± 39.60
Zinc (mg/100g)	0.73	0.68	0.71 ± 0.04
Calcium (mg/100g)	204.00	109.00	157.00 ± 67.18

and Salihu-Lasisi *et al.* (2013) that carbohydrate is normally of low concentration in smoked fish samples. Low fat (3.79%) and fatty acid (2.96%) contents were also observed from the samples. Low fat content may be attributed to possible loss of fat due to the high temperature in the smoking process (Ahmed *et al.*, 2011). This can be explained by oxidation and break down of crude fat into other components due to oxidation of poly-unsaturated fatty acids (PUFA) contained in the fish tissue (Daramola *et al.*, 2007).

Mineral composition analysis shows that the most abundant mineral in the smoked fish samples was sodium with a mean value of 2201 mg/100g sample. This result can be explained by the process of soaking fish samples in the saturated brine solution for one to two hours prior to smoking, which leads to absorption of the salt. The WHO Guideline on Sodium Intake for Adults and Children (2012) limits consumption to <2g sodium per day, thus a consumption of 100g of smoked fish already suggests exceeding the allowed sodium intake from the daily limit. Calcium has a mean value of 157 mg/100g followed by iron with a mean value of 1.05 mg/100g, while the least concentrated mineral was zinc at 0.7080 mg/100g. These data suggest that smoked fish can also serve as a source of different minerals needed by our body, however, moderate consumption must be observed due to its high sodium content, which can lead to various diseases.

The proximate and mineral analyses of smoked fish also showed variations in results as compared to other

studies (Motohiro, 1989; Adebowale *et al.*, 2008). This implies that a composition of fish will differ according to environment, age, sex, species, migration, nutrient and method of preservation (Sesugh *et al.*, 2012) in addition to smoking methods, smoking time, and salt concentration (Adegunwa *et al.*, 2013).

Proximate and Mineral Composition of Pinangat

Proximate and mineral composition analyses were done on three *pinangat* samples each coming from a different producer labeled as P-01, P-02, and P-03. However, the results (Table 2) cannot be compared with a standard or with any existing study due to a very limited literature on this product. This analysis will be one of very few (if there is) proximate analysis done on this Bicol OTOP food product.

High moisture content of *pinangat* samples was noted from the three different producers. This can be explained by the ingredients used and cooking process which is similar for all the three samples. The percentage of protein, fat, carbohydrates, and ash content were observed to be higher in samples with lower moisture content and lower for samples with higher moisture content. This inverse proportionality is based on the increased amount of dry matter in food after water loss resulting to concentration of nutrients present in the sample.

Appreciable amounts of crude fat and fatty acid content of *pinangat* were also observed. One reason can

Table 2. Proximate and Mineral Composition of Pinangat (P)

Parameters	P-01	P-02	P-03	Mean + SD
Moisture, %	63.94	67.12	65.37	65.48 ± 1.59
Ash, %	1.92	2.40	2.58	2.30 ± 0.34
Total Fat, %	25.30	26.26	21.30	24.30 ± 2.63
Protein, %	3.97	3.70	4.74	4.10 ± 0.54
Carbohydrates, %	4.87	0.62	6.01	3.83 ± 2.84
Fatty Acid, %	20.20	21.01	17.04	19.42 ± 2.10
Energy (KJ/100g)	1086.38	1045.06	970.85	1034.10 ± 58.54
Iron (mg/100g)	1.47	1.39	1.80	1.55 ± 0.22
Sodium (mg/100g)	370.00	423.00	429	407.00 ± 32.47
Zinc (mg/100g)	0.68	0.75	0.86	0.76 ± 0.09
Calcium (mg/100g)	187.00	216.00	153.00	185.00 ± 31.53

be attributed to the use of coconut milk and meat as part of the ingredients. Coconut milk contains mixture of saturated, monounsaturated, and polyunsaturated fats (Dayrit, 2014). In contrast with fats, proteins, and carbohydrates gave the smallest percentages among the three macronutrients. Considering all the ingredients used in making the food product, no major source of carbohydrates and proteins can contribute to the percentages of these nutrients.

The mineral composition in mg/100g of *pinangat* sample (Table 2) shows that sodium is the most abundant mineral present with a mean value of 407 mg/100g sample. This is followed by calcium (85 mg/100g), iron (1.55 mg/100g), and zinc (0.76 mg/100g). These data suggest that *pinangat* can be a source of different minerals but only as needed by the body.

Comparison of Smoked Fish and Pinangat Nutrients with the PDRI for Selected Age Groups

The recommended nutrient intake (RNI) is defined as the intake level sufficient to meet the daily requirements of most individuals in a specific life-stage and gender group. They are recommended intakes estimated to exceed the requirements of most individuals to ensure that the needs of nearly all individuals in the population are met. The % Daily Values (%DVs) is based on the daily value recommendations for key nutrients. The % DV can be used to determine if a serving of food is high or low in nutrient. The United States Food and Drug Administration (US FDA, 2013) suggests that a 20% or more daily value is high for all nutrients while 5% or less daily value is considered low for all nutrients.

The percent coverage of daily supply for selected nutrients and macro- and microelements by consuming one serving of each product (85g of smoked fish and 55g of *pinangat*) was calculated. Table 3 presents the comparison between the nutrient content of Bicol OTOP food products with the Philippine Dietary Reference Intakes. Four groups with varying energy needs: (1) 10–18 years old children, male; (2) 10–18 years old children, female; (3) 19–70 years old and above, male; and (4) 19–70 years old and above, female were compared with the nutrients available from the smoked fish and *pinangat* samples.

Protein. A safe protein intake level for adults is defined as the lowest level of dietary protein intake that will balance the losses of nitrogen from the body in persons maintaining energy balance at modest levels of physical activity (FAO/WHO/UNU, 2007). For all age

groups (children and adult, male and female) ranging from 10 to >70 years old, %RNI of proteins are all above 20%. This result suggests that smoked fish can be regarded as a rich source of protein, which implies that smoked fish can provide sufficient amount of protein to meet their daily needs to build and repair body tissues for growth and maintenance. For *pinangat* samples, all %DVs for all age groups fell below 20%, which is an indication that *pinangat* is not a rich source of protein. For age groups ranging from 10–18 years old where %DVs still range from 5–7%, it shows that *pinangat* can still provide them with proteins in low to moderate amount. However, for adults (male and female) 19–70 years old and above, protein content in one serving size of *pinangat* is no longer enough to meet their dietary needs.

Calcium. The FAO/WHO Recommended Nutrient Intake (RNI) which was adopted for Filipinos was based on intake at which excreted calcium equals net absorbed calcium (FNRI-DOST, 2002; Barba & Cabrera, 2008). The %DV of smoked fish samples both for children and adults ranging from 9–11% indicates that for all age group smoked fish can only give them calcium in moderate amount to provide their daily needs. *Pinangat* samples on the other hand provide 16% DV of calcium for children indicating that *pinangat* can be a good source of calcium while for adults having a range of 20–21% DV result suggests that *pinangat* is a high source of calcium, which is enough to help them build and maintain strong bones as well as to keep them from diseases associated with lack of calcium in the body.

Iron. Iron is an essential nutrient that serves several important functions in metabolic processes including transport of oxygen throughout the body as a part of red blood cells (Abbaspour *et al.*, 2014). The smoked fish analyzed in the study exhibited low amounts of iron, which on average covered only 2–5% of the daily requirement for all age groups while *pinangat* was found to provide 5–13% of the daily requirement of iron recommended. Both products can only contribute low to moderate amount of iron, thus, it can be deduced that the two OTOP samples are not good sources of this mineral. The iron requirements cannot be met by simply taking this product and so intake of iron-rich and iron-fortified foods and the use of supplements can be recommended.

Zinc. Zinc serves as the body's defense system and plays significant role in physiologic and metabolic functions of the body. Zinc is a trace mineral and

Table 3. Comparison of the Nutrient Contents of Smoked Fish and Pinangat Samples with the Philippine Dietary Reference Intakes (PDRI) 2015 for Selected Age Groups

Age Groups, year	Energy, kcal	Protein			Calcium			Iron			Zinc		
		% RNI,g	% RNI per serving size		RENI, mg	% DV per serving size		RENI, mg	% DV per serving size		RENI, mg	% DV per serving size	
			Smoked Fish	Pinangat		Smoked Fish	Pinangat		Smoked Fish	Pinangat		Smoked Fish	Pinangat
Children, Male													
10-12	2060	43	40	7	1000	9	16	12	5	11	6.6	6	10
13 - 15	2700	62	27	5	1000	9	16	19	3	7	9.2	4	7
16 - 18	3010	72	24	4	1000	9	16	14	4	9	9.0	4	7
Children, Female													
10-12	1980	46	37	7	1000	9	16	20	3	7	6.1	6	11
13 - 15	2170	57	30	5	1000	9	16	28	2	5	7.4	5	9
16 - 18	2280	61	28	5	1000	9	16	28	2	5	7.2	5	9
Adults, Male													
19 - 29	2530	71	24	4	750	11	21	12	5	11	6.5	6	10
30 - 49	2420	71	24	4	750	11	21	12	5	11	6.5	6	10
50 - 59	2420	71	24	4	750	11	21	12	5	11	6.5	6	10
60-69	2140	71	24	4	800	11	20	12	5	11	6.5	6	10
>70	1960	71	24	4	800	11	20	12	5	11	6.5	6	10
Adults, Female													
19 - 29	1930	62	27	5	750	11	21	28	2	5	4.6	8	14
30 - 49	1870	62	27	5	750	11	21	28	2	5	4.6	8	14
50 - 59	1870	62	27	5	800	11	20	10	6	13	4.6	8	14
60-69	1610	62	27	5	800	11	20	10	6	13	4.6	8	14
>70	1540	62	27	5	800	11	20	10	6	13	4.6	8	14

is needed by the bodies only in small amounts. The recommended intake for children 10–18 years old ranges from 6.1–9.2 milligrams. After the age of 18, the requirement decreases to 6.5 milligrams per day that is required for all adult males. For females over the age of 18, the requirement becomes stable at eight milligrams per day. The relatively small zinc content of smoked fish samples (4–8% DV in all age groups from children to adult) implies that smoked fish can only provide low to moderate amount of zinc. Moderate amount of zinc on the other hand can be obtained from *pinangat* products ranging from 7–14% DV for both children and adults.

Nutritional Labeling. For the purpose of computing, the nutrient content expressed in terms of % RNI shall be based on the PDRI (DOST FNRI, 2015) for male adults ages 19 to 29. Figure 1 shows the nutrition facts derived from the proximate and mineral analyses of *pinangat* and smoked fish samples.

Calories. Calories provide a measure of how much energy a person can get from a serving of a food. The derived nutrition facts states that one serving of smoked fish (55g) provides basic nutrients such as protein (17g) and fat (2g) with low amount of carbohydrates (<1g). Thus, consumption of one serving of smoked fish can provide 90 kcal. Higher amount of calories (200 kcal) can be obtained from a serving size (85 g) of *pinangat*.

However, 180kcal of this comes from fat due to high fat content (20g) of *pinangat* products.

Fats and Fatty Acid. The Acceptable Macronutrient Distribution Ranges (AMDR) of fat for Filipinos is 15–30% for children and adults. The upper limit is the maximum intake level recommended by most dietary guidelines as a preventive measure against the risk of cardiovascular and other degenerative diseases. As shown in the computed nutrition facts (Figure 1), smoked fish with 4% DV of total fat indicates having low amount of fat and fatty acid content. *Pinangat* on the other hand, shows higher fat value of 30%. This implies that the *pinangat* samples are high sources of fat enough to supply essential fatty acids and to serve as carriers of fat-soluble vitamins (A, D, E, K). However moderate consumption of this sample must also be observed to avoid cardiovascular and other chronic diseases.

Carbohydrates. Carbohydrates' main function is to supply energy to the body and take part in building body tissues. The AMDR of carbohydrates for Filipinos ranges from 55–79% for children and adults. The percent carbohydrate composition of the two OTOP food samples (0% for smoked fish and 1% for *pinangat*) implies that smoked fish and *pinangat* products are not adequate to supply the needed carbohydrates of the body.

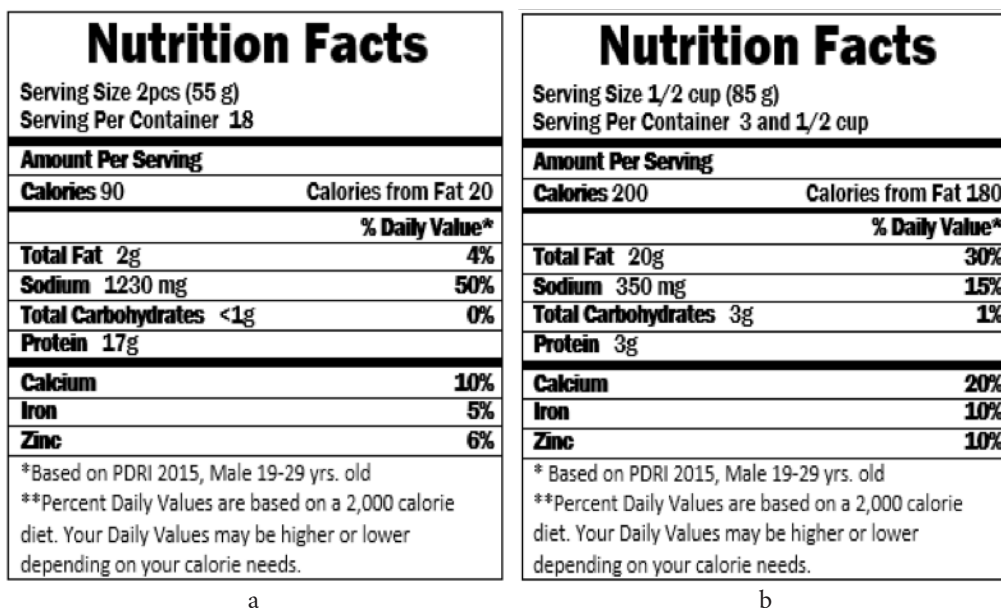


Figure 1. Sample Nutritional Facts for Smoked Fish (a) and Pinangat (b)

Conclusions

The study was conducted to assess the nutritional composition of two Bicol OTOP (smoked fish and *pinangat*) and to compare it with the PDRI for different age groups. Proximate analyses show that smoked fish is a high source of protein while the *pinangat* contains an appreciable amount of fat and fatty acids. Presence of major and trace minerals have also been observed in both products, which can help in the body's growth and development. However, moderate consumption must be observed due to its high sodium content which can lead to various diseases. Generally, in all age groups from children to adults, nutrient content ranging from low to high both for smoked fish and *pinangat* products fell within the recommended range in requirement estimated for groups with different activity levels based on PDRI. This is suggestive that both smoked fish and *pinangat* products can provide nutrients needed to maintain health and to provide reasonable levels of reserves in body tissues.

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