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PROXIMATE COMPOSITION AND MINERAL CONTENTS OF DIFFERENT BRANDS OF CANNED FISHES MARKETED IN EDO STATE NIGERIA

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ABSTRACT: *Proximate composition and mineral content (Na, Ca, P and Mg) of fish is of great importance to fisheries managers, consumer and the nutritionist. In this study, seventeen different types of canned fish products were collected from super-stores and open market, proximate composition and the mineral elements (sodium, phosphorus, calcium and magnesium) of the different brands purchased were determined between January and September, 2015. The entire sample used were bought at the same time and kept at ambient room temperature, and every analysis was done in triplicate. The results obtained showed that a gradual reduction in the food value (proximate composition) and the percentage mineral content of the different brands with a progressive reduction in the different months. Analysis of variance (ANOVA) and Duncan multiple range test (DMRT) at 5% level of significance, revealed that there were significant differences in the proximate and mineral components of the different brands and among the months, although some of these parameters were not significantly different for some brands. Results obtained from correlation analysis during the study revealed that there was a negative correlation relationship between fat/oil, fibre, nitrogen free extract (NFE) with moisture content, while there was also a positive significant relationship between protein/ash content, protein/moisture; also, a positive correlation existed between sodium, calcium, phosphorus and magnesium. The result obtained from this study indicates that these canned fishes 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 consumer to derive the appropriate benefit from their consumption.*

KEYWORDS: Proximate, Analysis, Brands, Mineral, Benin City, Canning

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), fish is rich in protein with amino acid composition which is very well suited to human dietary requirements comparing favourably with egg, milk and meat in the nutritional value of its protein.

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). According to them, fatty fish such as sardines are a natural source of high-quality protein and essential fatty acids in human diet. Fish lipids contain long-chain n-3 polyunsaturated fatty acids (*n*-3 PUFA), of which eicosapentaenoic acid (EPA, 20:5*n*-3) and docosahexaenoic acid (DHA, 22:6*n*-3) play a vital role in human nutrition and promotes good health.

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Canning 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 (>115ºC) 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).

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). 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).

Proximate composition generally means percentage composition of basic constituents such as water, protein, lipids, carbohydrate and mineral 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). 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).

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 requirement 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).

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 nutritional contribution of the fish to the diet as to translate to good health. It is therefore important to assess the proximate composition and mineral content of canned fish imported into Nigeria.

MATERIALS AND METHODS

The study was carried out in Benin City, Edo State Nigeria. Edo state is located in the southern part of Nigeria on geographical location between latitude 6° 19'N 5° 36'E / 6.317°N 5.600°. It is a city approximately 25 miles north of the Benin River, established in the 13th century with an estimated population of 1,147,188 people (Census, 2006).

Sample collection

A total of seventeen different brands of canned fish products were used for this study, fifteen samples each per brand were collected at Lagos Street, Hallmark Supermarket and Coka Pharmacy and Stores at Sapele road all located in Benin City.

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Table 1: Records of Collected canned fish products in Benin City, Edo State.

Brand name	storage medium	Fish species canned	Expiry date	Manufacturing country
Unico	Sunflower oil	Skipjack tuna	3/2019	Thailand
Star Kist	Sunflower oil	Tuna fish	10/2016	Ghana
Laser	Vegetable oil	Sardines	6/2017	Morocco
Napa Valley	Vegetable oil	Flake tuna	7/2017	Thailand
Pastene	Vegetable oil	Skipjack tuna	9/2017	China
Miettes De Thon	Vegetable oil	Tuna fish	7/2018	Thailand
Soil	Vegetable oil	Sardines	9/2017	China
Geisha	Vegetable oil	Sardines	7/2017	China
Founty	Vegetable oil	Sardines	12/2017	Morocco
Titus	Vegetable oil	Sardines	6/2017	Morocco
Best	Brine	Skipjack tuna	5/2016	Thailand
John west	Brine	Sardines	6/2017	Portugal
Just	Tomato sauce	Mackerel	5/2018	Thailand
Geisha	Tomato sauce	Mackerel	11/2016	China
Costa	Tomato sauce	Mackerel	7/2016	China
Brunswick	Curry sauce	Sardines	7/2016	Poland
Brunswick	Soya oil	Sardines	7/2019	Poland

Proximate composition of all the content of the canned fish brand samples collected was determined according to the method of Association of Official Analytical Chemistry (AOAC, 2005).

Statistical Analysis

Data collected in three replicates were subjected to statistical analysis using one-way analysis of variance (ANOVA) test at $p< 0.05$ level of significance and means were separated using the Duncan Multiple Range Test at 5% level of significance. The software used for the analysis was Statistical Package for Social Sciences (SPSS version 21).

RESULTS

The proximate composition and mineral contents of seventeen samples of different canned fish products sold in Benin City were analyzed for moisture, protein, nitrogen free extract, fibre, fats/oil, ash while the mineral contents analyzed were sodium, phosphorous, calcium and magnesium (Tables 2 and 3).

Results obtained from this study shows that there was a negative correlation relationship between fat/oil, fibre, NFE with moisture content, a positive significant relationship between protein/ash content, protein/moisture, while a positive correlation existed between sodium, calcium, phosphorus and magnesium.

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The average moisture content for all the canned fish by months gradually increased from the start of the study ranging between 40.72 – 52.81%. With regards to brands, Unico had the highest moisture content of 55.95 ± 6.34% and star kist had the lowest value of 35.70 ± 4.80% during the study period.

The mean protein value by month for the different brands ranged between 14.26% – 19.26% it was also observed that there was a gradual reduction in the protein content as the study progressed. Titus sardine had the highest protein content of 21.45 ± 3.19% and Geisha mackerel in Tomato sauce had the lowest value of 9.91 ± 1.54% as showed in Table 2 and 3,

The mean monthly range of fat during this study was 9.56 – 15.62%. Fats content of the different canned fish types ranged between 4.58 – 16.60% and Geisha mackerel in tomato sauce had the highest fats/oil content of 16.60 ± 3.61% and Pastene had the lowest value of 4.58 ± 9.24%.

Fibre content of the canned fishes gradually increased during the study period ranging between 0.166 – 0.224% by months. Fibre content of the different canned fish types ranged between 0.028 – 0.530% but Titus sardine had the highest fibre content of 0.530 ± 06% and Pastene had the lowest value of 0.28 ± 0.03%.

The mean ash content by months ranged between 0.079– 0.107% while by brands the ash content ranged between 0.009 – 0.171%, the highest value of 0.171 ± 0.021% was observed in Soil sardine in vegetable oil and the least value of 0.009 ± 0.001 was observed in Tuna flakes in vegetable oil.

Nitrogen free extracts (NFE) content of all analyzed sample by months ranged between 14.67 – 35.21% as shown in Table 2. The highest NFE value of 29.81 ± 10.98% was recorded in John west sardine and the lowest value of 18.64 ± 9.15% in Just mackerel as shown in Table 3.

Analysis of variance (ANOVA) showed that for all the proximate components (moisture, protein, fibre, fat, ash and NFE) analyzed, there were significant differences ($p<0.05$) among the brands, further analysis with DMRT showed that a significant difference ($p<0.05$) existed across the months and among the different brands of canned fishes as shown in Table 2 and 3.

Mineral contents

Sodium (Na)

The mean sodium content by months ranged between 8.10 – 10.95%,with regards to brands the sodium content of Titus sardine had the highest value of 29.28 ± 8.80%, whileFounty sardine had the lowest value of 0.529 ± 0.068% during the study period.There was a significant difference ($p<0.05$) between months and among the different brands analysed. Although further analysisshowed that some brandswere not significantly different ($p>0.05$)as shown in Table 3.

Phosphorus (P) content ranged by months between 1.07 – 0.120%while by brands Phosphorus content ranged between 0.044 - 32% with the highest value of 1.32 ± 6.11 in Titus sardine and the lowest value of 0.044 ± 0.20 in Founty sardine. Analysis of variance test showed that there was a significant difference ($p< 0.05$) in the sodium content of the different canned fish. Further

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analysis with Duncan's multiple range tests also revealed a significant difference ($p<0.05$) among the means, though some were not significantly different ($p> 0.05$) as shown in Table 3.

Calcium (Ca) content ranged between 18.83 – 25.45% during the period of study; andBrunswick sardines in soya oil had the highest value of 35. 16 ± 4.31 and Pastene had the lowest value of 0.027 ± 0.10.Analysis of variance test showed that there was a significant difference ($p< 0.05$) among months and in different brands in their calcium content

On monthly basis magnesium (Mg) content ranged between 1.46 – 1.98%, while by brands, the highest value of 3.11 ± 0.13 was observed in Titus sardine and the lowest value of 0.031 ± 0.13 in Pastene. Analysis of variance and DMRT showed that there was a significant difference ($p>0.05$) in the magnesium content of the different brands and in the different months of study.

Table 2: Proximate and Mineral composition of different brands of canned fish during the study period by month

	January'15	March'15	May'15	July'15	September'15	p
Moisture	40.72±6.12	42.94±6.45	45.20±6.79	48.74±5.66	52.81±7.12	0.000
Protein	19.26±4.23	18.70±4.10	15.82±3.47	15.03±3.30	14.26±3.13	0.000
Fat/oil	15.62±4.68	12.93±3.85	10.62±3.16	10.09±3.01	9.56±2.85	0.000
Fibre	0.22±0.14	0.20±0.13	0.20±0.13	0.19±0.12	0.17±0.11	0.232
Ash	0.08±0.04	0.08±0.04	0.09±0.05	0.09±0.04	0.11±0.05	0.018
NFE	14.67±5.98	16.65±5.30	26.37±4.77	29.96±4.73	35.21±6.28	0.000
Na	10.95±4.84	10.63±4.70	8.99±3.97	8.54±3.77	8.10±3.58	0.001
P	1.07±0.54	0.88±0.44	0.84±0.42	0.79±0.40	0.12±0.06	0.000
Ca	25.45±13.45	20.90±11.04	20.68±10.94	19.86±10.49	18.83±9.95	0.037
Mg	1.98±1.20	1.82±0.84	1.75±0.81	1.63±0.98	1.46±0.89	0.088

Table 3: Proximate and Mineral composition of different brands of canned fishes during the study period (January – September 2016) sold in Benin City

Canned Fish	Moisture	Protein	Fat/oil	Fibre	Ash	CHO	Na	P	Ca	Mg	p
Founty sardine	47.68±5.28	14.79±1.91	9.11±1.81	0.10±0.01	0.06±0.01	26.65±7.84	0.53±0.07	0.04±0.02	10.33±1.20	0.10±0.01	0.000
Laser sardines veg oil	46.30±5.13	19.14±2.47	11.41±2.27	0.23±0.02	0.07±0.01	21.25±8.60	15.68±2.02	1.31±0.59	33.06±3.82	3.07±0.35	0.000
Geisha sardine	45.65±5.06	17.94±2.31	11.48±2.28	0.18±0.02	0.11±0.01	23.04±8.39	7.30±0.94	0.61±0.28	17.50±2.02	1.43±0.17	0.000
Soil sardines in veg oil	44.48±4.68	18.17±2.45	11.37±2.31	0.34±0.04	0.17±0.02	25.20±8.65	9.38±1.27	0.78±0.36	15.67±1.92	1.83±0.22	0.000
Geisha mackerel	51.44±5.70	20.53±2.65	6.93±1.38	0.17±0.02	0.12±0.01	19.22±8.60	8.29±1.07	0.69±0.31	22.16±2.56	1.62±0.19	0.000

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Brunswick sardines in curry source	43.42±4.45	21.03±3.08	9.67±2.04	0.25±0.03	0.14±0.02	26.03±8.38	11.32±1.66	0.94±0.44	25.29±3.41	2.21±0.30	0.00
Brand just mackerel	48.64±5.75	14.79±1.95	15.53±3.12	0.14±0.02	0.14±0.02	18.64±9.15	13.20±1.74	1.10±0.50	29.78±3.54	2.58±0.31	0.00
John west sardine	37.68±5.73	17.60±2.52	14.93±3.34	0.21±0.03	0.11±0.01	29.81±10.98	0.74±0.11	0.06±0.03	10.86±1.43	0.15±0.02	0.00
Geisha mackerel in tom source	46.92±4.98	9.91±1.54	16.60±3.61	0.18±0.02	0.07±0.01	27.39±9.11	10.34±1.61	0.86±0.40	34.70±5.03	2.02±0.29	0.00
Titus sardines	38.55±4.02	21.45±3.19	10.79±2.29	0.53±0.07	0.07±0.01	29.28±8.80	15.89±2.36	1.32±0.61	32.99±4.53	3.11±0.43	0.00
Brunswick sardines in soya oil	46.20±4.86	10.27±1.39	16.56±3.36	0.36±0.04	0.15±0.02	26.19±8.73	11.25±1.52	0.94±0.43	35.16±4.31	2.20±0.27	0.00
Tuna flakes vegetable oil	47.98±5.25	18.61±2.39	11.88±2.36	0.24±0.02	0.01±0.00	19.82±8.76	8.06±1.04	0.67±0.31	18.01±2.08	1.58±0.18	0.00
Star kist sun flower oil	35.70±4.80	15.99±2.28	15.86±3.30	0.08±0.01	0.04±0.01	29.39±9.50	11.52±1.64	0.96±0.44	27.22±3.56	2.25±0.29	0.00
Tuna flakes in brine	50.81±6.86	18.41±3.39	14.25±5.41	0.17±0.03	0.05±0.01	18.71±10.06	7.65±1.41	0.64±0.30	17.14±4.00	1.50±0.26	0.00
Costa mackerel	41.30±8.42	17.75±2.42	10.53±2.15	0.08±0.01	0.13±0.02	27.68±11.39	11.37±1.55	0.95±0.43	29.48±3.65	2.22±0.28	0.00
Pastene	54.68±6.60	11.46±1.53	4.58±0.92	0.03±0.00	0.05±0.01	26.94±7.85	7.32±0.97	0.41±0.19	0.03±0.01	0.03±0.01	0.00
Unico	55.95±6.34	14.64±2.46	8.48±1.92	0.03±0.00	0.06±0.01	22.50±8.80	10.73±1.80	0.32±0.15	0.07±0.03	0.06±0.02	0.00

DISCUSSIONS

Protein and fat are the major nutrients in fish, but speciescomposition, 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). 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 dietfrom their environment of origin (Adewoye *et al.*, 1997)

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

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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). There was variation in the fat content of the different species in the different brands and storage media, but the brands with small pelagic fish in olive oil and tomato sauce were better source of fatty acids.

Fish generally have very low levels of NFE (USDA, 2010). The average percentage range of the various canned fish used in this study indicates that they were poor sources of NFE and this according to Das and Sahu (2001) may be attributed to high values of moisture and protein content and low glycogen contribution to the body tissue reserves of fish.

The same is true for the protein value in canned mackerel and sardine which was seen to have higher protein content than that of the fresh form contrary to the decrease in percentage protein of canned fish. Tarley *et al.* (2004) reported that canned sardines in oil or tomato sauce have high protein content, a value that is close to the protein level of fresh sardines.

The variations observed in the concentration of the different nutritional components in fish generally and even in the study brands may have resulted from their innate availability in their natural body components, the ability of the fish to absorb and convert the essential nutrients from the diet or the water bodies where they live, methods of filleting and processing (Ricardo *et al*., 2002; Fawole *et al*., 2007).

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).

All fish samples analysed contained appreciable concentrations of sodium, calcium, phosphorus and magnesium which indicates that these fish are good source of minerals. Calcium content was observed to be higher in all the samples and it is an important mineral essential for growth, maintenance of bones, teeth and muscles (Turan *et al.*, 2003). There was also great variability in the amounts of calcium and phosphorus, due to the size of the fish canned. The tendency is for bigger species to be totally filleted as compared to smaller species that retains more bone due to the difficulty of removing all the bony tissue during the fillet process (Watt and Merrill, 1963).

Sodium content was high in the different brands of the canned fish during this study which may have resulted from the addition of sodium chloride (salts) and other condiments during processing for canning.

CONCLUSION

The species of fish found in the different brands analysed were sardine, tuna and mackerel. Canned fish 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 the brands of canned fish studied had adequate amount of protein adequate for infants and adults; they were low in calories, high in omega-3 fatty acids, high in protein, potassium and calcium; with a varied amount of sodium which is of no significant health implications.

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The length of storage from this study was significant, as the food value tended to reduce gradually over time. The storage conditions were also very important as the canned fishes were kept at ambient room temperature which may have also contributed to the rapid rate of reduction in the food value. The proximate values obtained from this study will help consumer and nutritionist in choosing the very best brands based on their nutritional values. Therefore, it is essential that nutrient compositions of canned products sold in the country be regularly monitored, to determine their quality composition and possible changes over certain period of storage.

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