African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 3, Issue 4, 2020 (pp. 96-102)
www.abjournals.org

MINERAL ELEMENT COMPOSITION OF SELECTED COMMERCIALLY SMOKED MARINE AND FRESHWATER FISH SPECIES IN IBADAN, OYO STATE

Adeosun O., Adeleke R.T. and Mustapha B.L.

Department of Fisheries Technology, Oyo State College of Agriculture and Technology, Igboora.

Correspondence E-mail: moriyike2006@gmail.com: +2347033832479

ABSTRACT: *All living organism requires mineral element for biochemical activities at moderate levels. The deficiency of the principal mineral elements induces a lot of malfunctioning. Fivemarine fish species and four freshwater fish species were collected at Bodija market, dried in the oven, ground and kept for mineral analysis. The data obtained were analyzed using Analysis of variance (ANOVA). The result revealed that the macro elements Na, k, Mg and Ca were in large quantities and decreasing order K >Ca> Mg > Na. Values obtained for micro elements were lower than macro elements and are in decreasing order Fe >Zn > Cr >Mn> Cu >Al. The values of Pb, Hg, As and Cd were negligible in all the fish species sampled. Considering the nutritional benefits associated with fish consumption, it is therefore important that the mineral composition of some commercial marine and freshwater fish species be analyzed.*

KEYWORDS: Calcium, Potassium, Smoked Fish, Mineral Element, Nigeria

INTRODUCTION

Fish is a highly proteinous food, consumed by a large percentage of the populace because of its availability and palatability (Foran*et al*., 2005). Fish has an edge over meat, in Nigeria, because it is cheaper and relatively more abundant in Nigeria (Adewumi and Olaleye,2011). Mineralelements present in food can be essential, non-essential or toxic to human. Elements such as iron, copper, zinc and manganese are essential and play important roles in biological systems. Meanwhile, mercury, lead and cadmium are toxic even in trace amounts. However, essential mineral elements can also produce toxic effects at high concentrations (Sivaperumal*et al*., 2007). Variations in mineral composition of marine and freshwater fish can occur due to seasonal and biological differences, area of catch, processing method, food source and environmental conditions (Alasalver*et al.*, 2002; Turhan*et al*., 2004). Trace elements can make up less than 0.01% of the dry weight of an organism and are required for its normal healthy functions and development. These elements include manganese, copper, zinc and iron. The objective of this study is to determine and compare the mineral elements in selected commercially smoked marine and freshwater fish species in Ibadan metropolis.

Materials and Method

Sample collection and Analysis

A total of five of each of the smoked fish species used were purchased at Bodija market Ibadan. The species of fish used are *Trachurustrachurus, Merlucciusparadoxux*,

African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 3, Issue 4, 2020 (pp. 96-102)

www.abjournals.org

Scomberscombrous,Sardinellamaderensis, Ethmalosafimbriata, Clarias gariepinus, Chrysichthysnigrodigitatus, Oreochromisniloticus and Heterobranchusbidorsalis. The smoked fish were oven dried, the head and tail of each were separated from the fish, and the flesh, skin and bone were homogenized. Elemental analysis of the samples was done at the Animal science laboratory, University of Ibadan, Ibadan using the method of Association of Analytical Chemists (AOAC, 2005). Data obtained was analysed using Analysis of variance (ANOVA) and significant level was determined at $\alpha \leq 0.05$.

RESULTS

The results of the percentage means of mineral element composition in marine fish speciesare presented in Table 1.

Table 1: Mean Mineral element composition of smoked marine fish species (mg/kg)

Parameters	*Scomber Scombrous*	*Merlucciuss Paradoxux*	*Sardinella Maderensis*	*Ethmalosa Fimbriata*	*Trachurus Trachurus*	SEM
Al	2.60^{c}	3.10^{ab}	2.90^{bc}	2.20^{d}	3.40^{a}	0.12
Cr	6.50^{a}	5.90^{c}	4.80^{d}	4.50^{e}	6.20^{b}	0.21
Ni	0.11^{bc}	0.90^{cd}	0.15^{a}	0.06^{d}	0.13^{ab}	0.011
Ca	367.20^{c}	371.30^{a}	369.60^{b}	354.40^{e}	362.53^{d}	1.27
Mg	76.83^{c}	78.20^{b}	73.53^{e}	75.13^{d}	81.40^{a}	0.72
Na	72.80^{b}	69.80^{c}	66.40^{d}	63.53^{e}	78.23^{a}	1.37
K	826.30^{b}	818.50^{c}	815.60^{d}	809.53^{e}	838.70^{a}	2.69
Pb	1.40^{c}	1.70^{b}	1.100^{d}	0.80^{e}	2.33^{a}	0.14
Cd	0.80^{d}	0.13^{bc}	0.15^{ab}	0.11^{cd}	0.17^{a}	0.01
Cu	1.60^{e}	3.10^{b}	2.80^{c}	3.53^{a}	1.90^{d}	0.20
Zn	8.60^{c}	9.50^{a}	7.20^{d}	8.30^{c}	9.10^{b}	0.22
As	0.37^{b}	0.29^{c}	0.44^{a}	0.26^{d}	0.35^{b}	0.02
Fe	11.2^{c}	12.30^{a}	11.73^{b}	12.50^{a}	9.60^{d}	0.28
Mn	2.60^{d}	3.50^{c}	4.10^{b}	3.87^{bc}	4.57^{a}	0.18
Hg	0.01^{ab}	0.01^{ab}	0.01^{b}	0.01^{a}	0.01^{ab}	0.00

Means followed by the same superscripts are not significantly different (P<0.05)

Among the mineral elements investigated, the values obtained for aluminum, chromium, nickel, calcium, magnesium, sodium, potassium, lead, cadmium, copper, manganese were significantly ($p<0.05$) different across the fish samples. However, the highest level of calcium (371.30 mg/kg) was found in *Merluccius paradoxux* followed by 369.60mg/kg in *Sardinella maderensis*, 367.20mg/kg in *Scomber scombrous* and 354.40mg/kg was found in *Ethmalosa fimbriata.* The highest and lowest magnesium content 81.40mg/kg and 73.53mg/kg were found in *Trachurus trachurus* and *Sardinella maderensis*, respectively. The highest sodium level (78.23mg/kg) was found in *Trachurus trachurus* followed by (72.80mg/kg) found in *Scomber scombrous*, the lowest level (63.53mg/kg) was found in *Ethmalosa fimbriata*. The highest potassium level (838.70mg/kg) was found in *Trachurus trachurus* and the lowest level (809.53mg/kg) was found in *Ethmalosa fimbriata.*

African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 3, Issue 4, 2020 (pp. 96-102)
www.abjournals.org

The highest aluminum level of 3.40mg/kg was found in *Trachurus trachurus* followed by *Merluccius paradoxux* (3.10mg/kg), *Sardinella maderensis* (2.90mg/kg) and the lowest level 2.20mg/kg found in *Ethmalosa fimbriata*. The highest chromium level (6.50mg/kg) was found in *Scomber scombrous* followed by *Trachurus trachurus* (6.20mg/kg), *Merluccius paradoxux* (5.90mg/kg) and the lowest level (4.50mg/kg) was found in *Ethmalosa fimbriata*. The highest nickel level (0.15mg/kg) was found in *Sardinellamaderensis* and the lowest level (0.06mg/kg) was found in *Ethmalosa fimbriata*. The highest copper level (3.53mg/kg) was found in *Ethmalosa fimbriata* and the lowest level (1.60mg/kg) was found in *Scomber scombrous*. The highest zinc level (9.50mg/kg) was found in *Merluccius paradoxux* and lowest in *Sardinella maderensis* (7.20mg/kg). The highest manganese level (4.57mg/kg) was found in *Trachurus trachurus* followed by (4.10mg/kg) was found in *Sardinellamaderensis* and the lowest level (2.60mg/kg) was found in *Scomberscombrous.*

The highest lead level (2.33mg/kg) was found in *Trachurus trachurus* and the lowest level (0.80mg/kg) was found in *Ethmalosa fimbriata.* The highest and lowest cadmium level (0.17mg/kg) and (0.80mg/kg) were found in *Trachurus trachurus* and *Scomberscombrous* respectively. The highest and lowest arsenic level (0.44mg/kg) and (0.26mg/kg) were found in *Sardinellamaderensis* and *Ethmalosafimbriata* respectively. There is no significant difference in the mercury level of all the fish sampled ($p>0.05$).

The results of the percentage means of mineral element composition in freshwater fish specieswere given in Table 2**.**

Table 2: Mean Mineral element composition of smoked freshwater fish species (mg/kg)

Parameters (mg/kg)	***Clarias Gariepinus***	***Oreochromis Niloticus***	***Chrysichthys Nigrodigitatus***	***Heterobranchus Bidorsalis***	**SEM**
Al	1.70^{c}	1.50^{c}	2.30^{b}	2.87^{a}	0.016
Cr	3.90^{b}	3.40^{c}	5.60^{a}	3.875^{b}	0.26
Ni	1.03^{a}	0.04^{b}	0.15^{b}	0.13^{b}	0.12
Ca	389.30^{b}	394.50^{a}	365.30^{d}	368.30^{c}	3.84
Mg	53.20^{c}	52.40^{d}	76.40^{b}	78.40^{a}	3.72
Na	58.30^{c}	53.70^{d}	68.50^{b}	75.80^{a}	2.60
K	659.20^{d}	691.80^{c}	821.30^{b}	831.50^{a}	23.04
Pb	0.050^{c}	0.030^{c}	1.30^{b}	2.40^{a}	0.30
Cd	0.004^{c}	0.002^{c}	0.05^{b}	0.12^{a}	0.05
Cu	0.80^{c}	0.60^{c}	2.30^{b}	2.80^{a}	0.29
Zn	3.40^{d}	4.40^{c}	7.80^{b}	8.30^{a}	0.64
As	0.17^{c}	0.13^{d}	0.39^{a}	0.36^{b}	0.03
Fe	6.30^{c}	5.70^{d}	12.70^{b}	13.4^{a}	1.07
Mn	0.80^{c}	0.50^{d}	3.60^{b}	3.80^{a}	0.46
Hg	0.003^{bc}	0.001^{c}	0.006^{a}	0.005^{ab}	0.0007

**Means (±SD) within a row followed by the different superscript are significantly different (P<0.05)*

African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 3, Issue 4, 2020 (pp. 96-102)
www.abjournals.org

H. bidorsalis had highest value of Al (2.87mg/kg) followed by *C. nigrodigitatus*, *C. gariepinus*, and *O. niloticus*with a value of 2.30mg/kg, 1.70mg/kg and 1.50mg/kg respectively. The values were significantly different (P<0.05) between *C. nigrodigitatus* and *H. bidorsalis* but values obtained for *C. gariepinus* and *O. niloticus* were not significantly different (p>0.05). Values of Cr were significantly different (p<0.05) across the fish samples, *C. nigrodigitatus*had the highest value 5.60mg/kg followed by *C. gariepinus*, *H. bidorsalis*and *O. niloticus* with values of 3.90mg/kg, 3.875mg/kg and 3.40mg/kg respectively. *O. niloticus* had the lowest value of Ni (0.04mg/kg) while *C. gariepinus* had the highest value of 1.03mg/kg followed by *C. nigrodigitatus*and *H. bidorsalis*with values of 0.15mg/kg and 0.13mg/kg respectively,

*H. bidorsalis*had the highest value of Mg (78.40mg/kg) followed by *C. nigrodigitatus*, *C. gariepinus*, and *O. niloticus* with values of 76.40mg/kg, 53.70mg/kg and 53.20mg/kg respectively, there is significant difference across the fish samples Mg. *O. niloticus*had the lowest value of Na (53.70mg/kg) while *H. bidorsalis*had the highest (75.80mg/kg) and the values obtained for all the fish samples were significantly different (p<0.05). Values of K were significantly different (p<0.05) across the fish samples, *H. bidorsalis* had the highest value (831.50mg/kg) and the lowest value was obtained *C. gariepinus* (659.20mg/kg). There was no significant difference (p<0.05) in the values of Pb between *C. gariepinus* and *O. niloticus*,*H. bidorsalis* had highest value of Pb (2.40mg/kg) and lowest value was obtained in *O. niloticus* (0.030mg/kg). *O. niloticus* recorded the lowest value of Cd (0.002mg/kg) while *H. bidorsalis*has the highest (0.12mg/kg), here is no significant differences (p>0.05) in the values of Cd between *C. gariepinus* and *O. niloticus.* The values of Cu ranged from 0.60mg/kg to 2.80mg/kg, *H. bidorsalis* had the highest value 2.80mg/kg and values obtained in all the fish samples were significantly different (p<0.05). The values of Zn obtained in all fish samples were significantly different (p<0.05), the following values; 8.30mg/kg, 7.80mg/kg, 4.40mg/kg and 3.40mg/kg were recorded in fish samples. *C. nigrodigitatus* had the highest value Ar 0.39mg/kg, and values were significantly different (p<0.05) among the fish samples. *H. bidorsalis* had the highest value of Fe (13.40mg/kg) and followed by *C. nigrodigitatus*, *C. gariepinus* and *O. niloticus*with a value of 12.70mg/kg, 6.30mg/kg and 5.70mg/kg respectively. The values of Mn were significantly different (p<0.05) in all samples with *H. bidorsalis* having the highest value 3.80mg/kg and *C. nigrodigitatus*, *C. gariepinus* and *O. niloticus* with values of 3.60mg/kg, 0.80mg/kg and 0.50mg/kg respectively. The highest value of Hg (0.006mg/kg) was found in *C. nigrodigitatus* and lowest value 0.001mg/kg was found in *O. niloticus.* The values of Hg were significantly different (p<0.05) among fish samples.

DISCUSSION

Metals such as calcium, magnesium, sodium, and potassium are essential since they play an important role in biological systems. The main role of these metals can be described as structural and functional. Structurally, they stand out for their role as integrators of organic compounds in the body. From a functional standpoint, they have a role in controlling important biological functions (Ozden*et al.*, 2010). The concentrations of these metals in the fish samples were comparable with the range reported by Moreiras*et al.*, (2011). The abundant presence of these elements may be due to the fact that the body needs these macro

elements in more amount than the micro elements in the structure and function of the body (Gopakumar, 2000).

The highest values of the micro elements in these marine fishes are in the decreasing order Zn>Cr>Mn>Cu>Al>Ni. Nickel concentrations are generally low in the aquatic environment (Tepe*et al*., 2008). The nickel concentration in the present study was in accordance with the reported values for T. *trachurus* (1.5± 0.13) (Tuzen, 2009). The value of zinc reported in this study is higher in hake than other species. The lower levels of arsenic in these fish are low which make them ideal for consumption.

It may be noted that the mineral elements content of each species is a function of the availability of these elements in their local environment, diet absorptive capability and as well as their preferential accumulation (Fawole*et al*., 2007). However, it was discovered that micro elements recorded very low values, this may be due to the fact that the body demands them in trace amounts and that their concentration in the water body is very low. Moreover, some minerals might have been lost during processing of the fishes.

The variations in the concentration of the different nutritional components in both species could have been as a result of the rate in which these components are available in the water body (Yeannes and Almandos, 2003) and the ability of the fish to absorb and convert the essential nutrients from diet or the water bodies where they live. This is supported by the findings of other researchers (Ricardo et al., 2002; Adewoye*et al*., 2003; Fawole*et al*., 2007). Sodium is an activator of transport ATP–ases in animals and possibly also in plants (Adeyeye, 2005). Calcium is good for growth and maintenance of bones, teeth and muscles (Turan*et al*., 2003). Normal extra cellular calcium concentrations are necessary for blood coagulation and for the integrity, intracellular cement substances (Okaka and Okaka, 2001). Manganese functions as an essential constituent for bone structure, for reproduction and for normal functioning of the nervous system. Zinc plays important role in the management of diabetes, which result from insulin malfunction (Okaka and Okaka, 2001).

The variations recorded in the concentration of the different nutritional components in the fish examined could have been as a result of the rate in which these components are available in the water body (Yeannes and Almandos, 2003) and the ability of the fish to absorb and convert the essential nutrients from the diet or the water bodies where they live. This is supported by the findings of Ricardo *et al*. (2002), Adewoye*et al*. (2003) and Fawole*et al*. (2007). Both Sample B and Arecorded high level of calcium, the benthic nature of these species and their relative preference for consumption of hard structure could be a contributing factor. This conforms to the submission of Adewoye*et al.*, (2003) that the high calcium content recorded in the samples could probably be due to preferential accumulation and calcification of scales and hard tissues. Hg composition of the fish samples recorded variations in their concentrations both within and between the selected species sampled. This observation was supported by the findings of Windom *et al.*, (1987) which showed that such variations in concentrations of these mineral elements from one species of fish to another was due to the chemical forms of the elements and their concentrations in the local environment. The presence of zinc in the fishes could mean that the fishes can play valuable roles in the management of diabetes, which result from insulin malfunction (Okaka and Okaka, 2001). Minerals are important for vital body functions such as acid, base and water balance. Calcium is good for growth and maintenance of bones, teeth and muscles (Turan*et al*., 2003). Normal extra cellular calcium concentrations are necessary for blood coagulation and for the

integrity, intracellular cement substances (Okaka and Okaka, 2001). Sodium is an activator of transport ATP-ases in animals and possibly also in plants (Adeyeye, 2005). There is also direct relationship of sodium intake with hypertension on human, iron is an important constituent of heamoglobin (Onwordi*et al*., 2009).

CONCLUSION

This study therefore, showed that smoked marine and freshwater fishes are good sources of mineral elements that may contribute to health, growth and development of human beings and a safe food from environment concernsdue to negligible level of elements that can pose serious health risks. It was also discovered that, microelements (Zinc, manganese and copper) recorded very low values; this may be due to the fact that the body needs them in trace amounts and that the concentrations in the water body is very low. It is therefore important to equally consider the minerals status of fish and the persistence food safety of the fish prior to consumption in addition to the prevailing choice of taste, size, type and external morphology of fish.

REFERENCES

Adewoye, S.O., Fawole, O.O and Omotosho, J.J. (2003).Concentrations of selected elements in some freshwater fishes in Nigeria. *Science Focus, 4*: 106-108

Adewumi, I. K., and Olaleye, V. Y. (2011). Livestock waste-menace: Fish wealth-solution. *African Journal of Environmental Science and Technology*, 5(3), 149-154.

Adeyeye, E.I. (2005). Distribution of major elements (Na, K, Ca, and Mg) in various anatomical parts of Fadama crops in Ekiti State, Nigeria. *Bull. Chem. Soc. Ethiop*. 19: 175-183.

Alasalvar, C., Taylor, K. D. A., Zubcov, E., Shahidi, F. and Alexis, M. (2002). Differentiation of cultured and wild sea bass (*Dicentrarchuslabrax*): total lipid content, fatty acid and trace mineral composition. *Food Chemistry* 79(2): 145–150.

Fawole O.O, Ogundiran M.A, Ayandiran T.A, Olagunju O.F. (2007) Proximate and mineral composition in some selected freshwater fishes in Nigeria. *Journal of Food safety; 9*: 52-55.

Foran J. A, Carpenter D. O, Hamilton M. C, Knuth B. A, Schwager S. J, (2005): Risk- based consumption advice for farmed Atlantic and wild pacific salmon contaminated with dioxins and dioxinlike compounds. *Environ. Health. Persp*, 33, 552-556.

Gopakumar K. (2000) Biochemical composition of food fish of India. Central Institute of fisheries technology, Cochin-682029 ICAR.

Moreiras O, Carbajal A, Cabrera L, Cuadro C. (2011): Tablas de Composición de los Alimentos. Madrid, Spain: *Piramide*; ***2011***. 15. USDA.

Okaka, J.C. and Okaka, A.N.O. (2001).Food composition, spoilage and shelf-life extension. Ociarco Academic publishers, Enugu, Nigeria, pp. 54 -57

Onwordi, C.T., A.M. Ogungbade and A.D. Wusu, 2009. The proximate and mineral composition of three leafy vegetables commonly consumed in Lagos, Nigeria. *African Journal of Pure Applied Chemistry*, 3: 102-107.

Ozden O, Erkan N, and Uluosy S. (2010) "determination of the mineral composition of three commercial fish species". *Environmental monitoring and assessment*, vol.170, no.1-4, pp.353-363.

Ricardo, C.M., Cyrino, J.E.P., Portz, L and Trugo, L.C. (2002). Effect of dietary lipid level on nutritional performance of the SurubimPseudoplatystomacoruscans.*Aqua*, 209: 209-218.

Sivaperumal, P., Sankar, T.V. and Viswanathan Nair, P.G. (2007). Heavy metal concentrations in fish, shellfish and fish products from internal markets of India vis- à-vis international standards. *Food Chemistry* 102(3): 612-620.

Tepe Y, Turkmen M and Turkmen A (2008), "Assessment of heavy metals in two commercial fish species of four Turkish seas, *Environmental monitoring and assessment*, vol. 146, no 1-3, pp. 227-284.

Turan, M.., Kordali, S., Zengin, H., Dursun, A. and Sezen, Y. (2003). Macro and micro-mineral content of some wild edible leaves consumed in Eastern Anatolia. ActaAgricScand Sect .*Plant Soil Science*. 53: 129-137.

Turhan, S., Ustun, S. N. and Altunkaynak, B. (2004).Effect of cooking methods on total and heme iron contents of anchovy (*Engraulisencrasicholus*). *Food Chemistry* 88(2): 169–172.

Tuzen M. (2009) "Toxic and essential trace elemental contents in fish species from the black sea, Turkey." *Food and chemical toxicology*, vol.47, no. 8, pp. 1785-179

Windom H., Stein D., Sheldon R., Smith J. R (1987): Comparison of trace metal concentations in muscle tissue of a benthopelagic fish (*Coryphaenoidesarmatus*) from the Atlantic and Pacific Ocean. *Deep Sea Research* 34: 213 - 220

Yeannes, I.M and Almandos, M.E. (2003) Estimation of fish proximate composition starting from water content. *Journal of Food Composition Analysis*, 16: 81-92.