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DETERMINATION OF MINERAL CONTENTS OF EDIBLE PARTS OF SHELLFISHES FROM OKPOKA CREEKS IN RIVERS STATE, NIGERIA.

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ABSTRACT: *The study was conducted to determine the mineral contents of some selected shellfishes from Okpoka Creek in River State. Copper, iron, manganese, calcium and sodium were quantified using Atomic Absorption Spectrophotometric method and the concentration of the minerals varied between the different species of shellfishes. High amount of calcium was recorded in C. guanhumi (212.33±1.45mg/100g) while the lowest was observed in T. fuscatus (48.39±1.4mg/100g). The manganese content was higher in T. coronata (1.82±0.10 mg/100g) and lower in T. fuscatus (0.25±0.11mg/100g). Meanwhile the iron content was more in C. gasar (29.5±0.5mg/100g) and lower in C. amnicola (8.07±1.485mg/100g). However, T. coronate showed higher content of copper (10.15±0.17mg/100g) while the lowest copper content was observed in T. fuscatus (2.15±0.43m g/100g). C. amnicola (115.9±0.26mg/100g) recorded the highest amount of sodium while T. coronate (17.43±0.11mg/100g) recorded the least sodium content. The results suggest that these shellfishes are nutritious and are valuable additions to our diet.*

KEYWORDS: Shellfish, Copper, Calcium, Iron, Manganese and Zinc

INTRODUCTION

Minerals make up the micronutrients that are very necessary for physiological and biochemical processes by which the human body takes in and utilizes food to maintain health and activity (Mohapatra *et al.,* 2009). Micro minerals play a very vital role in the body such as iron needed for red blood cell production, zinc for healthy skin, reproductive and immune function, magnesium for nervous system health and calcium for strong healthy bones and teeth (Möttönen and Uhari, 1997). The human body cannot provide all of these micro-nutrients, therefore, they must be supplied through different diet we consume. The use of marine resources for human consumption has improved greatly around the world, so making good use of minerals from marine organisms is important especially in shellfishes (Watanabe *et al.,* 1983). Shellfishes have become a worldwide delicacy amongst seafood lovers. They are high in essential nutrients and are very beneficial to human health (Soundarapandian *et al.,* 2013).

Mineral like copper is believed to be necessary for the formation of the pigment melanin and consequently skin pigmentation, for the formation of bone and connective tissue and for maintaining the integrity of the myelin sheath of nerve fibres (Khan *et al.,* 2006). Iron plays an essential role in the respiratory pigments haemoglobin and myoglobin while manganese functions as an enzyme activator for some enzymes that mediate phosphate group transfer and calcium is firmly linked to many of the roles that vitamin D plays in the body (Bresgen *et al.,* 2010). Sodium is a vital mineral that act as the main monovalent ion of extracellular fluids constituting 93% of the ions (bases) found in the blood stream (Underwood, 1999). Micro mineral are a significant body mineral, important to both cellular and electrical functions (Turan *et al.,* 2003).

Shellfishes comprise of invertebrate animals such as periwinkle, rock snail, oyster and crabs which possess exoskeleton called shells which may be single or double over the body (Moss, and Erlandson, 2010). There has been a lot of investigation into the food value and fatty acid contents of food items (Luzai *et al.*, 2003). Shellfishes have been reported as a major source of protein to both riverine communities and the general population, as they occur abundantly in the brackish and fresh waters of Nigeria (Adebayo-Tayo *et al.,* 2008). The consumption and utilization of these natural resources for human consumption has improved rapidly over time. In general, shellfishes which include Rock snail (*Thais coronata*), Mud-flat periwinkle (*Tympanotonus fuscatus*), Mangrove oyster (*Crassostrea gasar*), Marine crab (*Callinectes amnicola*), and Land crab (*Cardisoma guanhumi*) have been given credit for their health benefits.

The vast coastal features of the Niger Delta which includes creeks, marsh, rivers, streams, beach ridges, mangrove and forest swamps serve as natural habitats for numerous species of shellfish (Jamabo, 2008). Periwinkle, rock snail, crabs, and oyster among many other invertebrates are considered as essential shell fishery products in West Africa (Nalan *et al.*, 2003) and have very high economic values in Nigeria. Information on the nutritive value and importance mineral composition of the marine crabs (*Callinectes amnicola*), Rock snail (*Thais coronata*), Periwinkle (*Tympanotonus fuscatus*), Land crab (*Cardisoma guanhumi*) and the Mangrove oyster (*Crassostrea gasar*) from Okpoka creek is not well known, therefore this study was carried out to highlight the nutritive value and mineral importance of these shellfishes from this creek.

METHODOLOGY

Sample collection site

Okpoka Creek is one of the several adjoining creeks off the Upper Bonny River estuary in the Niger Delta. It lies between Latitude 4°47 North and Longitude 7°15 East and it is about 6 km long. The area is typically characterised by estuarine tidal water zone with little fresh water input extensive mangrove swamps and inter-tidal mud flats. The creek is influenced by semi-diurnal tidal regime and is strategically located at South-western flanks of Port Harcourt and Okrika in Rivers State.

Collection of Samples

The healthy edible parts of the samples were collected from the creeks. *T. fuscatus* and *T. coronata* were handpicked from the mud flat while *C. gasar* was harvested from the prop root of the mangrove tree during low tide. The swimming crabs were caught using a drag net while *Cardisoma guanhumi* was caught using a trap. The Specimens collected were preserved in an ice-chest before they were transferred to the laboratory for analysis. All the species are presented in plates 1.1 to 1.5.

Plate 1.1: ***Cardisoma guanhumi***

Plate 1.2: ***Thais coronata***

Plate 1.3: ***Crassostrea gasar***

Plate 1.4: ***Callinectes amnicola***

Plate 1.5: ***Tympanotonus fuscatus***

Laboratory Work

The samples were identified using Food and Agriculture Organization species identification sheets. They were separated and transported to a food chemistry laboratory for analyses. All the individual samples were rinsed very well with tap water and sorted in the laboratory.

Mineral Analysis

The mineral compositions of the samples were determined by the Atomic Absorption Spectrophotometric method, (AOAC, 2005). In the process, 1.0g of dried sample was weighed out and put into a previously dried and weighed porcelain crucible and dried in an oven at 105°C for 30 minutes. The crucible and its content was then placed in a muffle furnace and heated for 3 hours at 550°C to allow the samples to ash. Then 5ml of concentrated HCl was added to the ash and this was stirred with a glass rod, and 20ml of distilled water was added and the content of the crucible heated on a plate until it was half the original volume. The solution was allowed to cool and filtered into a 50ml volume flask. The mineral assay was the taken to the Atomic Absorption Spectrophotometric for analysis. The wavelength of each of the elements was then selected before air and gas flow was adjusted with other settings as required. (Cu = 324.7nm, Fe = 248.3nm, Mn = 279.5nm, Ca = 422.7nm and Na = 589.9nm). The hollow cathode lamp was given adequate time to stabilize, then standard mineral concentration for each element was run to calibrate the equipment and to obtain the calibration graph. The concentration of each element in the digest was displayed on the equipment screen. The blank which is the solvent used in dissolving the digest was run to eliminate error.

$$(\%) \text{ of the element} = \frac{C\ (\text{ppm}) \times \text{solution Vol.(ml)}}{10^3 \times \text{sample Wt (g)}}$$

Where C = concentration of the element in the digest as displayed.

These results were expressed in mg/100gm of specimen respectively. All determinations were in triplicates and the same was repeated for all the species and the values recorded.

Statistical Analysis

Statistically data was analyzed using a one way ANOVA and Duncan's multiple range tests to compare the mean values of the samples and to avoid error inherent in performing multiple *t*-tests. Results were tested for statistically significant differences at the 0.05 level.

RESULTS/FINDINGS

The mineral contents of the edible parts of *T. fuscatus, T. coronata, C. gasar, C. guanhumi and C. amnicola* from Buguma and Okpoka Creeks in mg per 100g of sample are presented in Table

Copper

The copper content in the shellfishes from Okpoka Creek showed that *T. coronata* (10.15±0.17mg/100g) had the highest followed by *T. fuscatus* (2.15±0.43mg/100g) while *C. amnicola* (0.55± 0.03mg/100g) had the least value (Table 1). There was a significant difference ($p<0.05$) between the ash content of the different shell fishes from the two creeks.

Iron

The iron content of the shellfish analysed from Okpoka Creek also indicated a significant difference ($p<0.05$) where *C. gasar* (29.5±0.51mg/100g) recorded the highest followed by *C.*

guanhumi while *C. amnicola* (8.07±1.48mg/100g) recorded the least (Table 1). The ANOVA values indicated that these differences did not vary significantly (p>0.05) in the iron content of the different shell fishes from the two creeks.

Manganese

The results from Okpoka Creek showed that there was significant difference (p<0.05) between the manganese content of the five shellfishes with *T. coronata* recording the highest value (1.82±0.10mg/100g) followed by *C. guanhumi*. *T. fuscatus* (0.25±0.11mg/100g) had the least manganese content (Table 1). The ANOVA results showed that the manganese content of the different species of shellfishes from both creeks were low.

Calcium

The calcium content recorded from that of Okpoka Creek showed the same trend, with *C. guanhumi* (212.33±1.45mg/100g) recording the highest calcium content followed by *C. amnicola* while *T. fuscatus* (48.39±1.41mg/100g) had the least (Table 1). ANOVA results revealed that the calcium content in the flesh of the different shellfishes from both creeks showed no significant difference, p>0.05.

Sodium

The sodium content of the five shellfishes from Okpoka creek showed significant differences (p<0.05) with *C. amnicola* recording the highest followed by *C. guanhumi*, *C. gasar* while *T. coronata* and *T. fuscatus* had 17.43±0.11mg/100g and 17.6±0.30mg/100g respectively (Table 1). Statistically significant variation were observed (P < 0.05) in sodium content between the different shellfishes from both creeks.

Table 1: Mean value of mineral content (mg/100g) of the shellfishes from Okpoka Creeks in Rivers State, Nigeria.

Minerals	*T. fuscatus*	*T. coronata*	*C. gasar*	*C. guanhumi*	*C. amnicola*
Copper	$2.15{\pm}0.43^{b}$	$10.15{\pm}0.17^{a}$	$0.69{\pm}0.02^{C}$	2.14 ± 0.09^{b}	$0.55{\pm}0.03^{C}$
Iron	$9.69{\pm}0.25^{d}$	$12.35{\pm}1.48^{c}$	$29.5{\pm}0.51^{a}$	$18.13{\pm}0.08^{b}$	$8.07{\pm}1.48^{d}$
Manganese	$0.25{\pm}0.11^{C}$	$1.82{\pm}0.10^{a}$	$0.59{\pm}0.09^{b}$	$0.78{\pm}0.02^{b}$	$0.75{\pm}0.03^{b}$
Calcium	$48.39{\pm}1.41^{e}$	$122.88{\pm}1.2^{C}$	$60.14{\pm}0.18^{d}$	$212.33{\pm}1.45^{a}$	$197.3{\pm}0.33^{b}$
Sodium	$17.6{\pm}0.30^{d}$	$17.43{\pm}0.11^{d}$	$83.40{\pm}2.19^{C}$	$96.77{\pm}0.88^{b}$	$115.9{\pm}0.26^{a}$

* In each row, mean with a common letter are not significantly different (P>0.05).

DISCUSSION

From the study, higher copper content in the *T. coronata* was observed from Okpoka creek when compared to the land snail *Archatina marginata* as reported by (Babalola and Akinsoyinu, 2009) which could be attributed to the habitat of the organism, dietary pattern and other ecological interactions and overall body size of the shellfish species. The daily requirement of copper is 1-3mg/day (Fox and Cameron, 1980), therefore, just as if 100g of snail is consumed per day which will adequately supply the body daily requirement of copper, consuming *T. coronata* in such quantity will equally supply the daily copper requirement of the body.

The analysis of the composition of minerals revealed that all the species contained iron in different amounts. However *C. gasar* had the highest amount of iron from the creeks. The iron content also varies from one locality to another depending on the mineral content of the soils where these snails are raised (Wosu, 2003). The high iron content recorded in *C. gasar* agrees with Yankson *et al.,* (1996) who reported that the local oyster could serve as a rich source of iron all the yearlong.

The manganese content in *C. guanhumi* was higher than what Elegbede and Fashina-Bombata, (2013); Fagbuaro *et al.,* (2013); Kpee and Edori, (2014) reported on *Cardisoma armatum*. This disparity in the manganese concentration could be attributed to the difference in their feeding habits and other environmental factors. Manganese is known as trace elements that are necessary for the normal functioning of the body and a required co-factor for an enzyme called prolidase, which is necessary to make collagen as a structural component of the skin (Fagbuaro *et al.,* 2013).

There was high calcium content in the flesh of all the five shell fish species. The calcium content in the edible part of *C. guanhumi* was higher compared to the earlier work obtained on *C. armatum* as reported by Elegbede and Fashina-Bombata, (2013). This might be due to the feeding habit of the shellfish on rich mineral source from the aquatic environment. Calcium in addition with other microminerals and protein can help in bone formation with calcium acting as principal contributor. Calcium is important in blood clotting, muscles contraction and in certain enzymes in metabolic processes (Abulude *et al.,* 2006).The sodium content in the shellfish revealed that *C. amnicola* had the highest sodium content followed by *C. guanhumi* from the same creek. The sodium content in *C. amnicola* was within the recommended sodium intake range (2g/day) for adults and children by World Health Organization (WHO, 2012). This value of sodium in *C. amnicola* agrees with previous finding by Udo and Vivian (2012) on the same species of crab but was lower than what Varadharajan and Soundarapandian (2014) recorded for the fresh water crab *Spiralothelphusa hydrodroma.*

These differences in the sodium content among the shellfishes could be attributed to the nature of food they eat and the different minerals they absorbs directly from their aquatic environment through their body surfaces and gills ((Hughes *et al.,* 1980). According to Asuquo *et al.,* (2004) sodium plays a vital role in regulating the pH, osmotic pressure, water balance, nerve impulse transmission and active transport of glucose/amino acid. Form the study, the shellfishes shows good composition of minerals which are of great necessity to health and growth of the body, helping muscles, nerves and absolute metabolism of the body.

SUMMARY

The mineral contents of the shellfish (*T. fuscatus, T. coronata, C. gasar, C. guanhumi,* and C. *amnicola*) collected from Okpoka Creek confirmed that the shellfishes are rich sources of minerals especially calcium, iron and sodium. Iron is vital for the formation of haemoglobin, copper play crucial role in iron absorption and sodium is a vital mineral that act as the main monovalent ion of extracellular fluids constituting 93% of the ions (bases) found in the blood stream. The shellfish are good sources of some vital minerals which can be gotten at minimal cost, considering the high cost associated with fatty foods, poultry and other high dairy proteins.

CONCLUSION

The consumption of these shellfishes and other marine products has always been a major factor in the economy and nutrition of the coastal population. The present study revealed that the shellfish species from Okpoka creeks can provide good sources of protein at different levels; therefore, they can be used as substitutes for meat, finfish and for animal feed formulation. Mineral components are needed for human nutrition. The trace elements like Iron, manganese and sodium that are essential for normal tissue metabolism and for maintenance of health are ample in these shellfishes. The quality of the aquatic environment also influenced the physiological and nutritional compositions of these shellfishes.

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