Some Metals and Nutrients Composition of Selected Sea Food from Amariama River in Bonny Island, Rivers State, Nigeria

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ABSTRACT

Background: *Shrimps, Prawns and Crabs are good and edible aquatic food which is widely consumed in Nigeria, especially by the people of the Niger Delta region.*

Objective*: to evaluate the level of heavy metal contamination and nutrients composition in selected seafood from Amariama River in Bonny Local Government Area of Rivers State.*

Method: *Samples of three most commonly consumed fresh shellfish from Amariama River (Shrimps, Prawns and Crabs) were purchased from local sellers along the Shore of Amariama River. Selected minerals and heavy metals content were determined using Flame photometer and Atomic Absorption Spectrophotometer (AAS), Carbohydrate and amino acid contents were analyzed using High performance liquid chromatography (HPLC) while Vitamin content was analyzed with UV Spectrophotometer.*

Result*: the concentrations of lead (Pb) in Prawn (0.10 ± 0.00 mg/kg) was significantly (P<0.05) low when compared to that of shrimp (0.35 ± 0.00 mg/kg).The concentrations of cadmium (Cd), sodium (Na), potassium (K), and calcium in Prawn were statistically (P<0.05) lower when compared with shrimp. Also Mannitol and Glucose concentrations in Crab were significantly (P<0.05) higher than in shrimp and prawn. VitaminB_{12} concentration in crab was high when compared with the vitamin B_{12} concentrations in shrimp and prawn. The result of the amino acids content showed that lysine, arginine, leucine, glycine and alanine concentrations in shrimp were significantly higher when compared to that of prawn and crab.*

Conclusion: *This study showed that Cd content of crabs and prawns had no significant difference, while its level in shrimp was beyond the permissible limit. Also the result showed that sea foods are good sources of essential nutrients which are adequate for human nutrition.*

Keywords: Nutritional, Metals, Shrimps, Prawns, Crabs,

Received: 07-07-2022
Accepted: 31-08-2022
doi: https://dx.doi.org/10.4314/njns.v44i1.14

INTRODUCTION

Aquatic organisms are good sources of nutrients that play an important role in human nutrition. Sea foods are edible aquatic organism, its global catch has remained relatively unchanged for the past decades due to the worlds' increasing demand for aquatic food [1,2]. Prawns of the genus *Macrobrachium* and *Peneaus* are of high economic importance globally, source of animal protein and are highly cherished by the coastal dwellers [3]. The demand for sea food is rapidly

increasing all over the world due to increase in population and their rising purchasing power [4]. Recent survey has indicated the leading drivers of seafood consumption to be their nutritional benefit, taste, and convenience [4]. Sea foods are classified as nutritious and protein-rich foods providing essential and trace elements as nutrients for human health. However, some seafood has the ability to accumulate heavy metals in their bodies and could affect human health when consumed [2].

Crustaceans, especially members of the order Decapods (shrimps, crabs and lobsters) are ecologically and economically important [5], but the presence of metal pollutants in fresh water has been found to disturb the delicate balance of the aquatic ecosystem thus manifesting in the fish physiology as fish tends to concentrate some metals in their body tissues [5]. Heavy metals like Zinc (Zn), lead (Pb), Iron (Fe), Copper (Cu) and Cadmium (Cd), are naturally occurring metals, having an atomic number greater 20 and an elemental density greater than 5gcm-3 [6]. They are abundant in the environment and contribute largely to the sustainability and equilibrium of ecosystem processes. However because of their bio-accumulation, non-degradability, and excessive amounts in which they exit, these metals contaminate the food chain and subsequently become a source of toxicity to human beings and the entire ecological function.

Aquatic organisms like fish and shellfish are exposed to toxic chemicals released from industrial, agricultural and municipal sources. They absorb and accumulate these metals from water, sediment, food, and suspended particulate matters [7].Many toxic chemicals that are carcinogenic accumulate in fish and shellfish, binding to fatty tissues or muscle tissues. The dietary exposure is therefore the predominant route of exposure of humans to these contaminants [8,9]. Amariama community is one of the fishing settlement and landing site for fish catch along Bonny River that is affected by crude oil spillage and hydrocarbons found in crude oil, have the potential to accumulate in aquatic organisms resulting in potential health risk through ingestion of contaminated sea food [10]. Bonny River is at high risk of being contaminated with hydrocarbons due to the oil exploration activities going on in the Island. With increase in demand of seafood and the continuous rise in crude oil spillage in most fishing settlements in Nigeria, there is need to investigate the nutritional composition and level of heavy metal contaminants in the selected seafood.

MATERIALS AND METHODS

Study area: The Bonny River (4°26′ 0″ N and 7°10′ 0″ E), Bonny is about 40 km from Port Harcourt and it covers an estimated area of 206 square kilometers. The Bonny River is one of the Nineteen Rivers that empty into the Atlantic Oceanat the Bight of Benin and Bonny River Estuary is dominated by the red mangrove *Rhizophoraracemosa* and *Rhizophoramangle*. The River is a terminal for the export of crude oil. Along the coast of Bonny are oil and gas exploration companies (Shell Nigeria, Liquefied Natural Gas, NLNG). Amariama community (4 ° 24′ 10″ N and 7 °18′12″ E) is located in Finima town, Bonny Island, Bonny Local Government Area, downstream of Bonny River, and on the East of NLNG company export site. It is a fishing settlement and a landing place for fish catch.

Sample collection: Shrimp (*Macrobrachim*), tiger prawn (*Penaeusmonodon*), the blue crab (*Callinectesamniocola*), were purchased from the local fishermen at the landing site of Amariama water front. They were washed and packaged separately in a ziplock freezer bag appropriately labeled A, B, and C, and then placed in the cooling container for preservation and transported to the laboratory. On arrival at the laboratory, two gram each of the samples were weighed out and homogenized, and samples kept in the refrigerator at 30°C until required foruse.

Metals Analysis: Each sample (2 g) was weighed into a flask containing 20 ml of acid mixture 650 ml of Conc. HNO_3, 80 ml of perchloric acid and 20 ml of Conc. H_2SO_4. The flask was then placed on a hotplate in a fume cupboard and heated until digest was obtained. The digest was allowed to cool and make up to 100 ml with distilled water. The solution was analyzed for presence of metals

(Pb, Cd , Na, As, K, Ca and Ni) with Atomic Absorption Spectrophotometer (Agilent FS240 AA) [11].

Analysis of Carbohydrate: Total carbohydrate was determined by weighing about 2 g each of homogenized sample and transferred into 100 ml measuring cylinder containing 10 ml of distilled water and stirred with a glass rod. Then 10 ml of 52 % cold perchloride acid was added and stirred for about 30 minutes,the content was diluted to100 ml with distilled water. The set-up was properly mixed and filtered into 250 ml graduated flask, filled to the mark with distilled water and mixed by shaking thoroughly to obtained carbohydrate extract of sample [12]

Analysis of vitamins: Vitamin A was analyzed by the method of [13]. Emmerie-Engel reaction as reported by [14] was used to estimate Vitamin E content. Vitamin C was analysed with spectrophotometer as described by [15]. Vitamin D was assayed according to the method of 16].Vitamins B_1, B_2, and B_{12} were analyzed with spectrophotometer, while B_3 and B_6were analyzed by titremetric method.

Analysis of amino acids: Amino acid analysis: Lyophilized samples (0.1 g) each was weighed into a 16 × 125-mm screw-cap Pyrex tube, 15 mL of 6N hydrochloric acid was added and the tube was thoroughly flushed S with N2, capped and placed in an oven at 110°C for 24 hours for hydrolysis. The hydrolyzes sample was filtered and the filtrate was made up to 25 mL with distil water. An aliquot of the solution was filtered through a 0.50 μm pore-size membrane. A standard solution of the sample was pipette into a 10 × 5-mm tube and dried at 65°C . 30 μL of the methanol-water-phenylisothiosonate (2:2:1 v/v) was added with 30 μL of derivatizing reagent, agitated and allow to stand at room temperature for 20 minutes. The solvent was removed under nitrogen stream and the tube was sealed and stored at 4°C [17].

Statistical Analysis: All data were presented as mean ± standard deviation. Data were analyzed with one-way analysis of variance (ANOVA) using the SPSS version 20.0. Results were compared among groups with the Scheffe's post hoc test and considered significant at 95% confidence level ($p < 0.05$).

RESULTS

Table 1.Concentration of metals in shrimps, prawns and crabs

Metals	Shrimp(mg/kg)	Prawn(mg/kg)	Crab(mg/kg)
Pb	0.35 ± 0.00^{b}	$0.10 \pm 0.00^{*a}$	$0.44 \pm 0.00^{*b}$
Cd	0.4 ± 0.00^{bd}	$0.01 \pm 0.00^{*a}$	$0.01 \pm 0.00^{*ac}$
Na	2.34 ± 0.00^{bd}	$2.22 \pm 0.00^{*ad}$	$1.97 \pm 0.00^{*bc}$
As	0.02 ± 0.00	BDL	BDL
K	2.89 ± 0.00^{bd}	2.19 ± 0.00^{ad}	$2.09 \pm 0.00^{*bc}$
Ca	3.79 ± 0.004	$3.08 \pm 0.00^{*ad}$	$3.28 \pm 0.00^{*bc}$
Ni	BDL	BDL	BDL

Values are express as mean ± s.d. Values with superscript (*) difference is significant at 0.05 level when comparing sample (shrimp) with other. Also values with superscript (ab) differs significantly when comparing sample (prawn) with others (cd) also show significant when compare sample (Crab) with others. BDL=Beyond Detection Limit.

Table 2.Carbohydrate compositions of shrimps, prawns and crabs fom Amariama River

Sugars	Shrimp(mg/kg)	Prawn(mg/kg)	Crab(mg/kg)
HMF	6.66 ± 0.00^{bd}	1.92± 0.00^{*ad}	1.23±0.00$^{*b\ c}$
Ribose	1.90 ± 0.00^{bd}	1.41±0.00^{*ad}	2.16± 0.00^{*bc}
Fructose	10.05 ± 0.00^{bd}	11.65 ± 0.00^{*ad}	5.52 ± 0.00^{*bc}
Xylose	4.59± 0.00	BDL	BDL
Maltose	2.13± 0.00^{bd}	2.12± 0.00^{*ad}	4.39± 0.00^{*bc}
Manitol	1.73 ± 0.00^{bd}	1.72± 0.00$^{*\ ad}$	15.35± 0.00^{*bc}
Rabinose	1.06 ± 0.00^{bd}	1.06± 0.00	6.10± 0.00^{*bc}
Glucose	4.68± 0.00^{bd}	4.69± 0.00^{*ad}	14.4± 0.00^{*bc}
Galatose	3.19± 0.00	3.19± 0.00	BDL± 0.00
Sorbitol	0.87± 0.00^{bd}	0.87± 0.00^{ad}	7.01± 0.00^{*bc}

Results are expressed as mean± standard deviation. Values are express as mean ± s.d. Values with superscript (*) difference is significant at 0.05 level when comparing sample (shrimp) with other. Also values with superscript (ab) differs significantly when comparing sample (prawn) with other (cd) also show significant when compare sample (crab) with others. BDL=Beyond Detection Limit; HMF= Hydroxylmethylfurfural.

Table 3.Vitamins content in shrimps, prawns and crabs

Vitamins	Shrimp(mg/kg)	Prawn(mg/kg)	Crab(mg/kg)
Vitamin A	4.45± 3.85	5.72± 0.24	8.65± 0.19
Vitamin E	14.32±0.26	10.42± 9.02	12.01±0.35
Vitamin C	68.24±1.15^{bc}	66.37±0.22^{*ad}	69.44±0.96^{bc}
Vitamin D	3.41±0.37^{bd}	5.19±0.23^{*ad}	4.34± 0.28^{*bc}
Vitamin B_1	0.03±0.00^{b}	0.02±0.00^{*a}	0.02±0.00
Vitamin B_2	0.01±0.00^{d}	0.001±0.00^{a}	0.02±0.00^{*bc}
Vitamin B_3	0.56±0.05^{ad}	0.55±0.02^{*ad}	0.43±0.03^{*bc}
Vitamin B_6	0.24±0.001^{bd}	0.25±0.01^{ad}	0.21±0.001^{*bc}
Vitamin B_{12}	3.37±0.09^{bd}	2.69±0.15^{*ad}	3.86± 0.12^{*bc}

Results are expressed as mean± standard deviation. BDL=Beyond Detection Limit. Values are express as mean± std. Values with superscript (*) difference is significant at 0.05 level when comparing sample (shrimp) with other. Also values with superscript (ab) differs significantly when comparing sample (prawn) with other (cd) also show significant when compare sample (crab) with others.

Table 4. Amino acid content in shrimps, prawns and crabs

Amino acids	Shrimp(mg/kg crude protein)	Prawn(mg/kg protein)	crude Crab(mg/kg crude protein)
Giycine	4.21 ± 0.02^{bd}	4.11± 0.00^{*ad}	3.55± 0.01^{*bc}
Alanine	6.29± 0.00^{bd}	5.74± 0.00^{*ad}	3.79± 0.07^{*bc}
Serine	4.33 ± 0.00^{bd}	4.39 ± 0.01^{*ad}	4.47 ± 0.00^{*bc}
Proline	3.03 ± 0.00^{bd}	2.85 ± 0.00^{*ad}	4.14 ± 0.00$^{*b\ c}$
Valine	3.03 ± 0.00^{bd}	4.37 ±0.02^{*ad}	4.57 ± 0.00^{*bc}
Theronine	4.33 ± 0.05^{bd}	4.15 ± 0.00^{*ad}	2.25 ± 0.03^{*bc}
Isoleucine	4.60 ± 0.00^{bd}	4.20 ± 0.09^{*ad}	4.10 ± 0.1^{*bc}
Aspartate	10.69 ± 0.07^{bd}	10.35 ± 0.00^{*ad}	11.15 ± 0.1^{*bc}
Lysine	9.72 ± 0.01^{bd}	8.89 ± 0.00^{*ad}	6.31 ± 0.1^{*bc}
Methionine	1.50 ± 0.00^{bd}	1.37 ± 0.00^{*a}	1.37 ± 0.00^{c}
Glutamate	14.46 ± 0.00	14.34 ± 0.01^{*ad}	14.46 ± 0.1^{bc}
Phenylalaline	3.91 ± 0.00^{bd}	3.95 ± 0.01^{*ad}	5.16 ± 0.00^{*bc}
Histidine	3.37 ± 0.00^{bd}	2.99± 0.00^{*ad}	2.89 ± 0.00^{*bc}
Arginine	6.55± 0.07^{bd}	5.69± 0.01^{*ad}	4.98 ± 0.01^{*bc}
Tyrosine	2.92± 0.1^{bd}	3.00± 0.00^{*ad}	3.30± 0.1^{*bc}
Tryptophan	1.11± 0.1^{bd}	1.35± 0.1^{*ad}	1.29± 0.01^{*bc}
Cystine	1.14± 0.00^{bd}	1.35± 0.02^{*ad}	1.29± 0.00^{*bc}
Leucine	8.98± 0.00^{d}	8.00± 0.1^{*ad}	7.72± 0.1^{*bc}

Results are expressed as mean± standard deviation. BDL=Beyond Detection Limit. Values are express as mean± std. Values with superscript (*) difference is significant at 0.05 level when comparing sample (shrimp) with other. Also values with superscript (ab) differs significantly when comparing sample (prawn) with other (cd) also show significant when compare sample (crab) with others

Amino Acids composition of sea food

Results for the amino acid compositions of Shrimp, Prawn, and Crab from Amariama River are shown in table 4.

DISSCUSION

Heavy metal contamination in different useful and consumable sea foods has been a prevalent concern over the last decades because of the damages it can cause in the human system. Sea foods such as shrimp, prawn and crab are contaminated by heavy metals from the atmosphere, soil and water, and this poses health risk to humans and animals [18]. The result of metals concentration in Table 1 showed that Lead (Pb) concentration in prawn was statistically low when compared with the (Pb) concentration of shrimp and crab. Lead is a metal frequently used

in the production of batteries and metal products, it can induce the production of reactive oxygen species which could cause increase or decrease in the levels of lipid peroxidation or antioxidant defence mechanisms in the brain [19]. The maximum allowable level of Lead (Pb) contaminants in sea foods is 1 mg/kg and the level of lead obtained from this study is below the recommended guideline [20]. The concentrations of Cadmium (Cd), sodium (Na), Potassium (K) and calcium in prawn were statistically ($P<0.05$) lower when compared to crab and shrimp.

Cd poisoning in man could cause anemia, renal damage, bone disorder and cancer of the lungs. The concentration of cadmium in the aquatic environment may increase by industrial processes such as smelting or electroplating and the addition of fertilizers. Cadmium may cause kidney failure and the softening of bones by long term or high dose exposure contamination [21]. The maximum level of Cadmium in sea foods as recommended by the European Community Legislation is 0.05mg/kg [22], the result obtained showed that the level of cadmium in prawn and crab were below permissible limit thus indicating safety for consumption while its level in shrimp was beyond the permissible limit [22] .Different chemical forms of Arsenic are present in sea foods but organic arsenic is less toxic than inorganic arsenic because organic arsenic can be efficiently and rapidly excreted in urine [23]. Humans are prone to cancer if the level of inorganic arsenic in sea foods consumed is high. Anaemia, liver damage and death may be caused by an acute high-level exposure to arsenic contamination while chronic exposure may give rise to several health effects which include the gastrointestinal tract, respiratory tract, skin, liver and cardiovascular system [23]. The normal concentration range is 0.02 – 0.04mg/kg [20], the result obtained showed that the level of arsenic in shrimps is within the permissible limit.

Metal load of several Rivers in Nigeria and water bodies were reported low [24]. [25] worked on Ase River, Southern Nigeria and noted that different organisms may bio-accumulate differently and that there might be specific factor influencing selective bioaccumulation of metals in the various organisms.

The results in Table 2 showed that Maltose, Mannitol, Rabinose, Glucose and Sorbitol concentrations in crab were significantly ($p<0.05$) higher than in shrimps and prawns. The HMF concentration for shrimp was significantly higher when compared with the values for prawn and crab. Also fructose concentrations in prawn and shrimp were significantly high when compared with its concentration for crab.

The results in Table 3 showed that Vitamin B_{12} concentration in crab was significantly high compared to the vitamin B_{12} concentration for shrimp and prawns. This is similar to the report given by [25]. The report indicates that a 100 grams crab and other shellfish meats served will provide more than the dietary reference intake of these vitamins. Vitamin B_{12} helps the body maintain sheathes around nerve fibers. It is found exclusively in animal products and vitamin B_{12} fortified plant products, such as meat replacements. Vitamin B_{12} deficiencies are observed among the elderly, who may not have enough acid in their stomach to helprelease vitamin B_{12} from food and allow it to bind to the carrier that aids in absorption of the vitamin [26].Vitamin D concentration in prawn was significantly high when compared with the values for crab and shrimp.

From the results in Table 4, showed that Lysine, Arginine, Leucine, Glycine, and Alanine concentrations in shrimp were significantly high when compared when to that of prawn and crab. The Phenylalaline, Aspartate, Proline, and Serine contents in crab also showed significant difference when compared with shrimp and prawn. Work on amino acids content in crab by [27] showed that the values of valine, methionine, tryptophan, and cystine were similar to our findings. The values of alanine, serine, threonine, phenylalanine and histidine in the report were higher than the values in our findings. However our result showed that the values of proline, isoleucine, aspartate, glutamate and leucine were higher than that reported by [27]. Also from both studies, glutamate had the highest value in comparison with the values of other amino acids.

From the Nutritional point of view, the high

concentrations of carbohydrate, vitamin, amino-acid calcium, and potassium and sodium contents in these organisms are particularly important, since deficiencies in these minerals are widespread, even in European countries [25].Deficiencies in these minerals can contribute to poor growth, intellectual impairments, perinatal complications, and increased risk of morbidity and mortality [28].

CONCLUSION

This study has provided information on the nutritional and metals content in shrimps, prawns and crabs from Amariama in Bonny Local Government Area Rivers State Nigeria. The result showed that the samples contained adequate amounts of the selected essential nutrients, which are required for the maximum growth and development of the human body.

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