Effects of Seasonal Variations on the Heavy Metal and Proximate Composition of Prawn Samples from Two Locations in Bayelsa State, Nigeria

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ABSTRACT

Prawn is widely consumed seafood harvested in the riverine parts of Nigeria providing a source of proteins, vitamins, minerals and essential fatty acids. Oil production activities in the Niger Delta region have significantly affected water bodies with resultant effect on seafood production and consumption. Prawn samples were collected from Nembe and Azuzuama, Bayelsa State, Nigeria and analyzed for comparison of heavy metal and proximate composition over the dry and wet seasons. High levels of cadmium (0.033 ppm and 0.027 ppm) and chromium (0.021 ppm and 0.020 ppm) were reported although they were below the recommended permissible limits. The proximate composition of the prawn samples were within the documented range. However, carbohydrate and energy content increased during the wet season while protein and lipid content reduced. The results were significant at p(0.05) $r_{(cal)}0.814 < r_{(tab)}0.974$. Further studies at regular intervals are recommended for effective monitoring in a region of increasing oil production activities.

Keywords
Prawn, Heavy metals, Proximate composition, Oil production.

Introduction
Prawn (*Macrobrachium rosenbergii*) is common seafood consumed in most parts of the world. Seafood include vertebrate and invertebrate aquatic animals of marine or fresh water origin [1]. Seafood is a vital source of protein, constituting 40% of animal protein in an average Nigerian [2]. Prawn is harvested and consumed as seafood in various parts of Bayelsa State in the Niger Delta region of Nigeria. This region has suffered decades of environmental, socio-economic and physical damages due to oil exploration and exploitation [3]. This has resulted in the accumulation of various substances including heavy metals in the water bodies that are carried along the food chain [4,5]. This brings about environmental and public health consequencies since seafood is the main stay of the riverine communities [6].

Prawns are often used as biomarkers of the extent of surface water contamination [7].

A lot of seafood including the prawns inhabits the benthic zone, which accounts for aquatic production [8]. Prawn and other seafood serve as sources of high quality protein, vitamins, minerals and essential fatty acids [9]. The consumption of these has generally resulted in improved neural development and reduced cardiovascular risk factors [10].

Unsuitable practices in oil production within the Niger Delta region over the years have affected the inhabitants as well as the environment that has a diverse ecosystem of mangrove swamps, freshwater swamps and rainforests [11]. Contamination of seafood in this region could result from contamination by microorganisms, contamination by crude oil and contamination by heavy metals [12,13]. Contamination could affect the quality of seafood, which will ultimately affect harvesting, and consumption [14].

Materials and Methods
Study area
The study was carried out at two locations within Bayelsa State, Nigeria. These are Isuokiri, Member ($4^0$32'N,$6^0$18É) and Clough Creek-Tebidaba, Azuzuama ($4^0$43'N$5^0$57É).

Sample Collection
Samples were collected twice within the year during the dry season and the wet/rainy season [15]. Dry season sampling was carried out between January and March while the wet season sampling was carried out between July and September. Prawn samples were collected in duplicates using the stratified sampling method [16] in the company of local fishermen. Samples were preserved in ice blocks and transported to the laboratory for furtehr analysis.

Heavy Metal Analysis
Optical Emission Spectroscopy (ICP-OES) was used for the determination of heavy metal composition after standard digestion using 60% nitric acid and 30% hydrogen peroxide. Levels of zinc (Zn), lead (Pb), nickel (Ni), copper (Cu), cadmium (Cd) and chromium (Cr) in prawn samples were determined and expressed in parts per million (ppm) [5].

Proximate Analysis
Proximate analysis of prawn for moisture, ash, lipids, crude fibre, carbohydrates and proteins was carried out as described by Bradley [17]. Ash and moisture content were combined for convenience using microwave drying. Fibre content was determined after extraction using the Goldfish method [17]. Protein content was determined based on nitrogen content using the Kjeldhal method. Carbohydrate content was determined using chromatography. Energy content in the samples was determined using the Atwater factor [18].
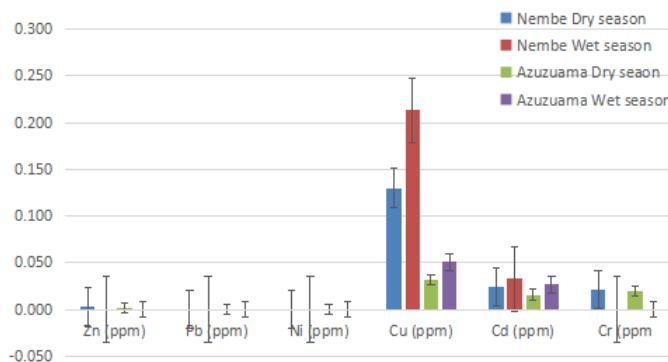
Results and Discussion
The results obtained for heavy metal composition of prawn samples from the two locations over the dry season and the wet season are presented in Table 1. During the dry season, lead and nickel were not detected in samples from any of the locations. Zinc, copper, cadmium and chromium were detected at various levels at both locations. During the wet season, zinc, lead, nickel and chromium were not detected in any of the samples while copper and cadmium were detected at various levels.

Table 1: Heavy metal content of prawn samples.

Station/	Nembe		Azuzuama	
Metal	Dry season	Wet season	Dry seaon	Wet season
Zn (ppm)	0.001	0.000	0.002	0.000
Pb (ppm)	0.000	0.000	0.000	0.000
Ni (ppm)	0.000	0.000	0.000	0.000
Cu (ppm)	0.130	0.213	0.032	0.051
Cd (ppm)	0.024	0.033	0.016	0.027
Cr (ppm	0.021	0.000	0.020	0.000

The results indicated that at Nembe, zinc, copper and chromium content reduced significantly during the wet season. However, cadmium content increased from 0.24 ppm to 0.33 ppm during the wet season. The bar chat with the various error bars are presented in Figure 1.

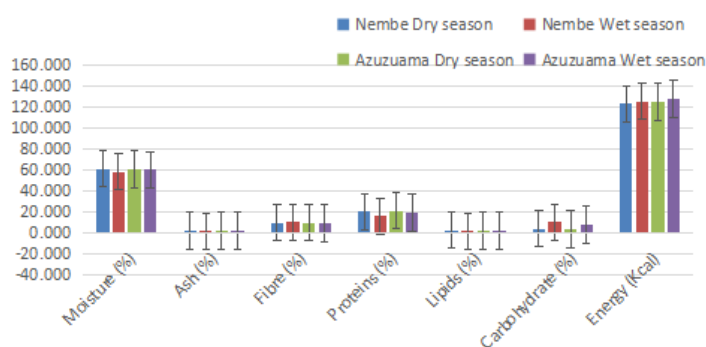**Figure 1:** Heavy metal content of Prawn samples.

At Azuzuama, zinc and chromium reduced significantly during the wet season while copper and cadmium increased significantly. Copper and cadmium were higher during the wet season at both locations. Similar results for heavy metal composition were reported by Capeme et al. [19] and Oranusi et al. [20]. The results were significant for the Pearson correlation coefficient at p(0.05) $r_{(cal)}$0.814<$r_{(tab)}$0.947.

The proximate composition of the prawn samples from the two locations are presented in Table 2. From the results obtained, moisture content, protein content and lipid content was higher during dry season at both locations.

Table 2: Proximate composition of prawn samples.

Station/	Nembe		Azuzuama	
Content	Dry season	Wet season	Dry season	Wet season
Moisture (%)	61.533	58.671	61.110	60.263
Ash (%)	0.883	1.983	0.820	1.024
Fibre (%)	10.030	10.487	10.087	9.443
Proteins (%)	20.647	16.238	21.563	19.536
Lipids (%)	2.600	1.964	2.607	2.116
Carbohydrate (%)	4.307	10.657	3.813	7.618
Energy (Kcal)	123.213	125.256	124.967	127.660

This implies a reduction during the wet season. The reductions recorded for protein and lipid were significantly higher compared to moisture content. Ash, carbohydrate and energy content increased during the wet season at the two locations. Significant increase was recorded for ash and carbohydrate content compared to the energy content. For fibre, Nembe recorded increase during the wet season while Auzuama recorded reduction during the wet season. The bar chart showing the various error bars are presented in Figure 2.

Figure 2: Proximate composition of prawn samples.

Conclusion

Heavy metals were detected in some of the prawn samples analyzed. In all the samples, the recorded levels of heavy metals were below the World Health Organization (WHO) recommended Minimum Permissible Limit (MPL). However, significantly high levels of cadmium and chromium gives room for concern since these substances have the ability of bioaccumulation over time and can be carried along the food chain.

The Niger Delta region is characterized by inflow of water from upstream especially during the annual seasonal flooding mainly from the River Nun and this contributes to the reduction in the concentration of various substances within the water system. Oil production activities will significantly result in increasing the heavy metal levels of water and seafood over time.

The prawn samples recorded higher carbohydrate and energy content during the wet season. Changes in proximate composition over seasons could affect the quality and consumption of product. For proper monitoring of the aquatic ecosystem and its biotic component for sustainable development in view of increased oil production activities, it is recommended that further studies be carried out within the locations at regular intervals.

Acknowledgement

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