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Determination of Some Heavy Metals in *Procambaris clakii*, *Palaenon* sp., *Macrobrachium vollenhovenii* and *Penaeus notalis* from the Coastal Water of Ondo State, Nigeria

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Abstract: Trace heavy metals (Cd, Zn, Ni, Cu, Pb and Co) were determined in Penaeus notalis, *Macrobrachium vollenhovenii, Palaenon* sp. and *Procambaris clarkii* obtained from coastal water of Ondo State, Nigeria using atomic absorption spectrophotometry. Co and Ni were higher in the water sample than in the prawn samples, while Pb and Zn were the most abundant metals in *Palaenon* sp. than other samples. Cd was not detected in all the samples. The highest correlation was found between Ni and Pb. Pb and Zn showed the highest levels of bioconcentration factor of 1.27, respectively in *P.* sp. The physical parameters of the water in sample were within the recommended standards for aquaculture. Concentrations of metals in the sample were found to be low and the levels do not pose a health hazard for consumers. Regular monitoring of the costal water is recommended.

Key words: Trace metals, prawns, bioconcentration, coastal, water

INTRODUCTION

Prawn plays a major role in the intake of a number of nutritional and toxic trace metal in human and animals. Some metals are essential for growth (Ni, Mn, Zn, Fe, etc) and some have beneficial uses (As and Ba). Metal (Cd, Hg, Pb, and Ti) which to appear to have no known functions are referred to as non-essential[1,2]. When these metals are concentratod in the environment, food and water they can cause morphorlogical abnormalities, reduced growth, increase mortality and mutagenic effects in human and animals[3].

Pollution has remained a major problem in fish farming and wild life, because this poses the problem of an ultimate diequilibrum in the natural ecological balance[4-6]. Uptake of toxicant by aquatic organism may be followed by metabolism of the toxicants into more toxic derivative. Prawn an aquatic organism may act as toxicant amplifier making the toxicants available to consumers at dangerously high levels.

In Nigeria, public health on trace metals in sea foods have been a concern hence leading to many researches in ponds, rivers and lagoons[5,7-9]. However, very little information is available on the levels of trace metals in coastal water and seafoods in the southwest part of the country particularly Ondo States is presented. The aim is to provide additional information seafoods and nutrition data and to check if the metal levels comply with international standards for water and food.

MATERIALS AND METHODS

The prawn samples (*P. notalis*, *M. vollenhovenii*, *P.* sp. and *P.clarkii*) were purchased from fishermen in Igbokoda, Ondo State, Nigeria. The samples were identified, washed with distilled water, dried, frozen at 4°C prior to analysis. The prawn samples were refrozen, weighed, sun dried for 7 days, ground in a Kenwood blender and kept in a dry container prior to analyses. Water samples were taken just below the water surface at the location where the prawn samples were harvested with acid leached polyethylene bottles.

Temperature, pH, conductivity, alkalinity and chloride of the water samples were determined immediately after sampling. pH was measured with a KENT EIL 7020 pH-meter and conductivity measured with JSI model 33 conductivity meter after standardizing with KCl and NaCl solutions. Total alkalinity was determined by titration using bromocresol green/methyl red mixed indicator, chloride by Mohr's method, total hardness by EDTA titration using Erichrome Black T indicator. Total dissolved solid was determined gravimetrically by filtering 100 cm^3 sample through a weighed filter paper followed by evaporation and ignition. Total suspended solids were determined gravimetrically after filtration and drying for 1h in an over (Gallenkamp 300, Gallenkamp, UK). Oil and grease was determined by visual observation. Dissolved oxygen was determined using standard methods[10].

Five cm^3 of concentrated HCl was added to 250 cm^3 of water sample at the time of analysis and evaporated to 25 cm^3 volumetric flask. All metals in this report were determined by means of AAS (Perkin-Elmer 306,USA). Determinations were done in triplicate.

RESULTS AND DISCUSSION

Table1 depicts the physicochemical parameters of the coastal water. The pH (7.05) obtained in the sample was within the range of 6.50-9.00 meant for water to contain a good fish population[11,12]. The Dissolved Oxygen (DO) reported was 1.02 mg L^{-1}. The low result may be due to the period of collection. It was reported that when there is no appreciable photosynthesis occurring then the values of DO is expected to be low[13]. When there is increase in photosynthesis there is likelihood of increase in DO above 2 mg L^{-1}. Seafood do not feed or grow well when Do is below 5 mg L^{-1}[14]. Temperature (30.2°C) recorded in this report was within the range of 25 and 30°C needed by fish to grow well. Temperature dependence is one of the most important factors influencing fish biology and the behaviour[15]. The levels of total hardness and total alkalinity for fish and prawn culture generally were within the range 20 to 300 mg L^{-1}. Present result fell within this range. The conductivity was high. Gulp *et al.*[16] have reported 50-550 μS m^{-3} for the required level of conductance for fresh warm water aquaculture. The values obtained for suspended solids and total dissolved solids were lower than the maximums of 25 and 2000 recommended for suspended solid and total dissolved prawn samples to higher levels of metal in their environment. The Pb values in the present study were higher than those in the literature. This is evident that the environ may be associated with lead either from vehicular emission of lead, solids. These parameters are major factors in determining the diversity and abundance of aquatic life in water sources. These values indicated that the coastal water belongs to the category of clear water. The levels of total hardness and total alkalinity for fish and prawn culture were within 20 and 300 mg L^{-1}[17]. The results obtained in the work were within this range. Chloride level in water is a useful measure in water sample. High level is not known to be injurious to fresh water organisms. It means that 56.2 mg L^{-1} recorded in this water sample was safe for this prawn samples.

Results obtained for the samples are presented in Table 2. The mean determination and the respective standard errors were given with the precision expressed as a 95% confidence interval. The values obtained for the metals in water were higher than those of prawn samples. It was observed that *P.* sp. had the greatest contribution to Cu, Pb and Zn which may be due to the relative metals concentrations in the water, plant concentrating metals in their body, the organic content of the water and the food

Table 1: Physico chemical properties of coastal water analyzed

Properties	Value (±SD)
Oil and grease	No visible floating
pH	7.05 (0.5)
Dissolved oxygen	1.02 (0.8)
Temperature (°C)	30.2 (5.1)
Total hardness (mg L^{-1})	78.0 (6.2)
Calcium hardness (mg L^{-1})	12.6 (1.2)
Total dissolved solids (mg L^{-1})	105.2 (10.3)
Suspended solids (mg L^{-1})	2.4 (0.2)
Alkalinity (as $CaCo_3$)	54.3 (5.2)
Conductivity (mhos cm^{-3})	120.0 (1.3)
Chloride (mg L^{-1})	56.2 (0.8)

Table 2: Trace metal composition of water and prawn samples (mg g^{-1} dry weight)

Sample	Cu	Cu	Ni	Pb	Cd	Zn
Water	3.8	ND	5.6	1.5	ND	1.5
Procambis clarkii	1.5	0.5	5.0	1.0	ND	0.9
Palaenon sp.	3.0	0.3	4.6	1.9	ND	1.9
Macrobrachim vollenhovenii	2.4	0.3	4.4	1.3	ND	1.6
Penaeus notalis	2.8	0.4	4.0	1.3	ND	1.7
Mean	2.7	0.4	4.7	1.4	-	1.5
Standard error	0.38	0.08	0.28	0.15	-	0.17
CV (%)	31.20	25.50	12.90	23.70	-	24.8
t-test	0.346	4.038	1.761	2.194	-	2.288
Significant (95% Confidence interval)	0.747	0.061	0.153	0.093	-	0.084

ND– Not detected

Table 3: Composition of the concentration of trace metals (mg g^{-1} dry weight) in prawn with other literature values

Area	Cu	Pb	Zn	Ni	Cd	Co	Ref
Hong Kong costal H_20	31.84	ND	39-146	-	ND	-	[19]
North East Altantic Ocean	10.61	-	40-70	-	1.86.6	-	[20]
Coastal Zone Kenya	45-90	0.1-0.6	49-102	-	1.1-8.5	-	[21]
Bay of Bengal	-	0.8-1.2	24-35	2.8-5.8	0.2-0.4	-	[22]
Lagos, Lagoon	17-163	-	38-137	91.209	3.8-7.6	3.8-10	[5]
Coastal water, Nigeria	ND-0.5	1.3-1.9	0.9-1.9	4.0-5.0	ND	1.5-3.0	Present study

ND – Not detected

Table 4: Correlation coefficient for the samples

	Co	Cu	Ni	Pb	Zn
Co		0.044	0.622	0.207	0.232
Cu	0.044		0.0271	0.409	0.558
Ni	0.622	0.271		0.969	0.474
Pb	0.207	0.409	0.969		0.089
Zn	0.232	0.558	0.474	0.089	

Table 5: Bioconcentration factors of trace metals in the prawn samples

	Metals	*P. clarkii*	*P.* sp.	*M. vollenhovenii*	*P. notalis*	Mean±SD	CV (%)
Co	0.40	0.79	0.63	0.74	0.64	0.17	27.09
Cu	ND	ND	ND	ND	-	-	-
Ni	0.89	0.82	0.79	0.71	0.08	0.08	9.29
Pb	0.67	1.27	0.87	0.87	0.92	0.25	27.36
Cd	ND	ND	ND	ND	-	-	-
Zn	0.6	01.27	1.07	1.13	1.02	0.29	28.57

they depend on, which are obtained in the sea-bottom where deposits accumulate due to run-off from the shore[18]. There were low variations in the concentration of all the metals from one specie to the other. This was attested to by the low coefficient of variation recorded in the result. This probably suggests that these prawns concentrated the metals at almost the same rate.

The current report is compared to literature values (Table 3). All the prawn samples determined in the literature exhibited high proportion of Cd level, but ND was recorded in this work. This suggests exposure of the leaded paint used in older houses or from other uses of lead in domestic purposes. In this area any contaminated prawn sample has the potential to increase the blood lead levels.

Correlation analysis between metals in the water and prawn samples are shown in Table 4. Some elements were correlated with almost all the others. The highest correlation in the samples (>0.9) was found between Ni and Pb. In all the samples analyzed, the mean concentration of all the elements were below the WHO limits (WHO, 1993).

The biocencentration factors for trace metals are shown Table 5. This factor provides the basis from which inferences are drawn as to probable biologic indicators for various metals in the prawn samples. The bioconcentration factors were much higher for *P.* sp. than for *P. clarkii, M.vollenhovenii and P. notalis*, and this was consistent with all four metals. This implies that, for a given level of metal in water, *P.* sp. accumulated far greater amount of metals than other samples. The sequence of metal concentrations in the prawn samples was Co>Ni>Pb>Zn for *P.* sp. and *M. vollenhovenii*, Co>Zn>Pb>Ni for *P. clarkii* and Ni> Co>Pb>Zn for *P.notalis*.

CONCLUSIONS

The report on the physiochemical properties of the water sample fell within the recommended standard for prawns to feed and grow well. The prawn samples contained trace heavy metals, which were below deleterious levels. Hence both the prawns and the coastal water were not polluted. It is recommended that constant monitoring must be ensured to avoid the intake of contained prawns and water.

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