TRACE METALS OF RIVER CHANCHAGA AND TAP WATER IN MINNA TOWNSHIP, NIGER STATE, NIGERIA.

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Abstract

The study assessed heavy metal (Copper, iron, potassium, sodium, lead, magnesium, manganese and calcium) concentration of River Chanchaga and tap water for public consumption and fisheries in Minna Township from June to November 2004. There were variations in the concentration of these metals during the sampling period, but they all fell within tolerable limits for both fish culture and for public water consumption. The mean concentration for some of these metals were Sodium (6.10-8.83mg/l), potassium (2.84-3.56mg/l) and copper (0.27-3.40mg/l).

Introduction.

Natural levels of heavy metals are inherited primarily from the rocks by weathering processes which organisms have adapted themselves to during the course of evolution and are usually harmless to the organisms (Goel, 2001). Minor sources could be from automobile exhaust (Kolo, 1989, Sikoki and Kolo, 1993, Ronald, 1993). The quality and quantity of trace metals may vary depending on the surrounding parent rock, sediments and water sources (Ronald, 1993). Metals are of special concern because they are non-degradable and therefore persist in the environment. The sources of lead are batteries, gasoline, paints, rubber and plastics. Lead can cause a variety of neurological disorder and could reatard brain cell development in children. Lead also prevents the uptake of iron, so people ingesting lead often exhibit symptoms of anemia including pale skin, fatigue, irritability and mild headaches.

Metal plating, electrical equipment, pesticides, paint additives and wood preservatives are sources of copper. Copper is toxic to juvenile fish depending on the concentration. Copper is an essential trace element in the nutrition of plants and animals including man (Ireland 1986). WHO (1971) has indicated that the highest desirable level of copper in drinking water is 1.5mg/l.

Other toxicants that are associated with industrial effluent are mercury, silver, iron, zinc, cadmium and manganese.

Allen *et al.* (1982) reported that some of these trace metals are carcinogenic to experimental animals. Clotilde and Bourg (1995) noted that trace quantities of metal pollutants disrupt some metabolic processes, reproduction, development and growth of aquatic organisms. In some countries such as Sweden and USA, unacceptably high levels of mercury have been found in water and sediment, or in fishes caught from such areas. This has led to banning of commercial fishing in such areas (Allen *et al.*, 1982).

Pollution through of mining activities, agricultural chemicals, industrial effluents, and fossil fuels has considerably increased global levels of heavy metals. Many of these metals are essential for growth of organisms at lower concentration, but they are poisons when their concentration exceeds certain levels. Several disasters of the meal poisoning have been recorded from time to time which have caused great ecological damage and led to a large number of human casualties (e.g. Mimata incidence in Japan) (Goel, 2001). River Chanchanga plays very important role to many people because it serves many purposes ranging from irrigation farming to fishing and domestic water supply sources to Minna city, and some towns along the river, (e.g. Gidan kwano, Kateregi). Since it is known that rivers influence man's economic activities, there is the need to assess the heavy metal concentration of this river.

Materials and Methods

The source of the River Chanchaga is the hilly area near Kafinkoro town located on latitude 9^0 31N and longitude 07^0 0 E. It flows through the topography of the area that generally follows a gently sloping pattern in the North South direction. It has so many tributaries that increase its size and capacity from the upstream section.

The study area covers the confluence of Tagwai Dam and River Chanchaga. Three sampling stations were located along the river and two stations of treated water. The first station was at entry point of River Tagwai into the Chanchaga River. The second station was at the stabilization reservoir at Chanchaga Water Works before entry into the in take plant. The third station was the treated tap water at the Chanchanga Water Works, the fourth station was down stream of the river at military barracks where domestic activities take place; and the fifth station was the public tap water in Mobil area, Minna. Water samples were taken at these sites for the determination of heavy metals (Copper, Lead, Iron, Calcium, Magnesium and others.

The water samples were preserved by addition of concentrated nitric acid prior to analysis. A range of standard solution of each metal was prepared. The absorbance of the standard of each metal was read at the recommended wave-length for each metal from Atomic Absorption Spectrophotometer (A. A. S), Model pu 9100 Phillips). A standard curve was drawn for each metal from the readings obtained. The absorbance of each water sample was read along side with the corresponding standards for each element. Thus each sample was analyzed for its lead, copper, iron, manganese, magnesium and potassium. Sodium and calcium were measured using Flame Photometer.

Results

The monthly variation in lead concentration at different stations is shown in Table 1. The lowest value was recorded in stations 2 (stabilization reservoir), 3 (Chanchaga water works treated water) and 5 (tap water in Mobil) with mean values of 3.2lmg/l, 3.93mg/l and 3.46mg/l respectively. Station 1(i.e. confluence of Tagwai River and River Chanchaga) had the highest mean value. The analysis of variance did not show significant difference ($P<0.05$) between the stations (Table 1). The highest mean value was recorded in June with mean value of 7.00mg/l and the lowest in September with mean value of 2.33mg/l (Table 2). There was significant difference ($P>0.05$) between the months.

Stations 3 (treated water) and 4 (inside barracks) had the lowest mean value of copper with mean value 2.14mg/l and 2.15mg/l respectively. Station 5 (tap water in Mobil) had the highest with mean value of 3.40mg/l though, statistically there was no significant difference between the stations ($P<0.05$) (Table 1). The highest copper level recorded was in October and November with mean value of 5.50mg/l.The lowest was in August with mean value of 0.12mg/l. There was significant difference between June, July, Aug and Sept, Oct, November (Table 2).

The monthly variation in iron is shown in Station 4 (down stream, at the Barracks) had the highest level of iron with mean value of 6.71mg/l and the lowest was recorded in station 3 with mean value of 4.75mg/l. Analysis of variance showed no significant difference ($P<0.05$) between all the stations (Table 1). It showed significant difference in the months ($P>0.05$). The lowest mean was recorded in October with a value of 2.00mg/l and the highest mean value was 8.51mg/l which was recorded in June (Table 1).

The highest mean value for manganese was recorded in stations 2 and 5 with value of 5.08mg/l and 5.38mg/l respectively (Table 2). Station 1 had the lowest with mean value of 3.99mg/l (Table 1). There was no significant difference ($p<0.05$) between all the stations. The highest level was recorded in June with mean value of 10.73mg/l which differ significantly ($P>0.05$) from other month (Table 1).

The monthly variation in magnesium is shown in (Table 1). The highest mean level of magnesium was recorded in June with mean value of 11.64mg/l and the lowest was in August with mean value of 3.50mg/L (Table 2. There was significant difference between the months (p>0.05). Station 5 has the highest mean value of 7.54mg/l; there was no significant difference between all the stations (Table 2)

The highest level of calcium was observed in stations 3 and 1 with mean value of 14.58mg/l and 13.01mg/l respectively, and the lowest recorded was in station 5 with mean value of 8.86mg/l. Analysis of variance showed significant difference between the stations (Table 2). There was a continuous decrease in the value of calcium as rainy season progress until November when it went up again.

It was observed that station I had the lowest level of sodium with mean value of 6.10mg/l and the highest in station 3 with mean value of 8.83mg/l though no significant difference was observed statistically (Table 2). There was significant difference between the months (Table 1). The highest level was observed in June with mean value of 15.40mg/l.

The lowest level of potassium was observed in October with mean value of 2.13mg/l and the highest level in July with mean value of 4.47mg/l (Table 1). There was significant difference between the months (P>0.05) (Table 1). Station 2 had the lowest level of potassium with mean value of 2.54mg/l and highest level in station 4 with mean value of 3.56mg/l and there was significant difference between stations (Table 2).

Table 1: Monthly mean values of Heavy metals measured at different stations on River Chanchaga and Portable water in Minna, Niger State.

	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	SE
K	3.46^{b}	4.47^{c}	4.24^{c}	2.60^{a}	2.13^{a}	2.33^{a}	0.19
N_a	15.40^{b}	4.06^{a}	4.78^{a}	5.97^{a}	7.27^{a}	7.19^{a}	± 0.81
Lead	7.00^{a}	5.31^{bc}	3.33^{ab}	2.33^{a}	266^{a}	3.32^{ab}	±0.41
Copper	0.20^{a}	0.27^{a}	0.12^{a}	4.50^{b}	5.50^{b}	5.50^{b}	±0.50
Iron	8.51^{b}	5.00^{ab}	4.50^{ab}	8.00^{b}	2.00^{a}	4.50^{ab}	± 0.63
M_n	10.73^{b}	4.50^{a}	2.00^{a}	2.00^{a}	3.00^{a}	5.00^{a}	± 0.69
M_g	11.64^{c}	8.86^{b}	3.50^{a}	6.50^{b}	6.00^{ab}	8.50^{b}	±0.57
C_a	18.37^{d}	12.58^{c}	11.58^{bc}	6.50^{ab}	4.50^{a}	17.00^{cd}	±0.18
Mean values on the s ame row carrying the same superscript letter s are not significantly different (P>0.05)							

Table 2: **Mean values of Heavy metals measured at different Stations on River Chanchaga and Portable water in Minna, Niger State.**

	ST_1	ST_2	ST_3	ST_4	ST_5	SE
K	3.49^b	2.84^a	3.01^a	3.56^b	3.14^{ab}	± 0.19
N_a	6.10^a	8.01^a	8.83^a	7.40^a	6.87^a	± 0.81
Lead	4.91^a	3.21^a	3.93^a	4.46^a	3.46^a	± 0.41
Copper	3.06^a	0.27^a	2.14^a	2.15^a	3.40^a	± 0.50
Iron	4.97^a	5.00^{ab}	4.75^a	6.71^a	5.79^a	± 0.63
M_n	3.99^a	4.50^a	4.15^a	4.11^a	5.38^a	± 0.69
M_g	6.97^a	8.86^b	7.36^a	7.60^a	7.84^a	± 0.57
C_a	13.01^{ab}	12.58^c	14.58^b	10.23^{ab}	8.86^a	± 1.18

Meen values on the same row carrying the same superscript letter are not significantly different (P>0.05)

Discussion

The higher mean value of lead obtained in station 1 could be due to the cumulative effect of the adjoining rivers (Chanchaga and Tagwai). Station 3 and 5 had the least mean value of lead because they are treated water. The concentration of copper is higher in station 1, may be due to erratic allochthonons input due to human activities. The higher value recorded in November could be due to the concentration effect.

The high concentration of iron could be attributed to the use of iron materials during the washing and fetching, it could also be due to mineralization process going on in the bedrock and sediment materials. The high manganese values in all the stations suggest the autochthonous origin of manganese in the system. It could also be attributed to the input from erratic effluent discharges into the river from the neighbouring villages.

The high value of calcium and magnesium could be as a result of human activities that take place in stations 1, 2 and 4 for instance washing, bathing e.t.c. These heavy metal levels found in this river could be attributed to corrosion of metal pipes, sewage sludge discharges in to the river, which agrees with the findings if Williams et. al. (1974) who reported that sewage sludge if discharged into water may be a significant source of Cu, Ag, Cd, Zn, and Pb. It may also be as a result of run-off during rainy season rich in certain heavy metals like Cu, Zn, Cr and Pb, and from automobiles.

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