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Evaluation and Comparison of Water Qualityparameters from Fresh Water Surface Streams and Hand- Dug Wells in Isiokpo Community, Rivers State, Nigeria.

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Abstract
In order to establish the quality of water from two main sources of drinking water in Isiokpo community of Rivers State, water from six fresh water streams and four hand- dug wells were analysed for their physicochemical characteristics including levels of some heavy metals, using spectrophotometric and other standard methods.Mean levels of the characteristics were generally within acceptable limits of national and international standards.In both sources, however, pH values were lower than recommended standards. With the exception of Co and Mn in some of the sampling points, the metal levels were also below the permissible limits of these standards. From a chemical view point, the surface water source in Isiokpo may be considered as fit for human consumption. However, in view of the relative higher levels of Mn in the wells and the concomitant hazardous effects of prolonged exposure of the metal to humans, it is suggested that water from the wells be treated before it is collected .
Keywords: Freshwater streams, hand-dug wells, physicochemical characteristics, heavy metals, Isiokpo.

INTRODUCTION

The essentiality of water to life cannot be over-emphasized. There is hardly any human activity that does not involve water. It is a life giver *per excellence* and fulfils a number of functions where there is no substitute (Clarke, 1991). It is thus important to ensure the availability of high quality water, especially for drinking.

Surface water and ground water, which serve as main sources of drinking water for humans, are however, threatened by pollution arising from the release of dissolved inorganic ions and organic compounds such as oil. The pollution of these sources raises inherent health implications (Agbalagba*et al*., 2011), especially when the levels of the pollutants exceed recommended standards.

Studies conducted in a number of communities in Nigeria (Ibe*et al*., 2001; Iguisi*et al*., 2001; Ekpete, 2002; Salami *et al,* 2003 and Obire*et al*, 2003) on the quality of water from these sources indicate the presence of heavy metals and toxic organic compounds, arising probably from surface runoffs and indiscriminate dumping of refuse at river banks.These revelations have informed us to conduct similar studies on the various water sources for drinking in Isiokpo community of Rivers State, since there are no records of such studies conducted in the area.

The Isiokpo community in Ikwerre Local Government Area of Rivers State, Nigeria lies within Longitude 4^o56'N-5^o 0'N and Latitude 6^o51'E - 6^o52'E (Fig 1). It is made up of 8 villages with fresh water streams flowing through them. Whereas some of the streams are located at the outskirts of the villages, the functional hand-dug wells are situated within the habitable areas of the villages. A number of the wells have, however, become dysfunctional as a result of visible intrusion of sewage from privies in their vicinities.The banks of most of the streams, especially those at the outskirts, have become refuse dumpsites. However, inhabitants collect water from the upstream reach of the streams.

A comparison of the levels of various physicochemical characteristics of water from these main water sources with recommended standards may establish baseline data for future references.

METHODOLOGY

Water samples were collected in clean plastic containers from six freshwater streams and four functional hand–dug wells, twice monthly in June, July and August, 2013. Samples for heavy metal analyses, collected in clean plastic sample bottles, were preserved with Concentrated HNO_3.

The depths of the wells were measured using a rope and a measuring tape. Measurements of temperature, electrical conductivity and total dissolved solids were conducted *in situ* using the Hanna multivariate instrument (HI- 98129 model). Measurements of pH were also done *in situ* using the mobile Hanna microprocessor instrument standardised with a bufferof pH 7. Determination of colour, turbidity, phosphate and sulphate concentrations, alkalinity and Total Hardness was carried out by photometric method using the analytical water test tablets prescribed for Palintest® photometer 7100 series. Ammonia and nitrate concentrations were determined spectrophotometrically (APHA, 1998) while chloride concentrations were determined by the Argentometric titration method.

The Winkler method (APHA, 1998) was employed in the determination of Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD) levels in the water samples. The concentrations of the heavy metals (Co, Mn, Ni, Cr and Fe) were determined using the Atomic Absorption Spectrophotometer – Agilent AA SPECTRA 55B model.

RESULTS and DISCUSSION

The mean levels of the physicochemical characteristics of water from the streams and wells in Isiokpo as well as the recommended standards for these characteristics have been presented in Table 1. Mean temperature values ranged between 25.10±0.1^{o}C and 25.80±0.40^{o}C in the streams and between 26.70±0.50^{o}C and 27.25±0.05^{o}C in the wells. These ranges compare favourably with the national and international standards (25^{o}C – 30^{o}C) as well as those recorded in other parts of the state (Obunwo *et al*, 2012;). The trapping of heat in the shallow wells (about 7m in depth) may have contributed to the slight increase in temperature of the water from them. On the other hand, the canopy of vegetation around the streams may be contributory to the slight decrease in temperature of the water in the streams.

Mean pH values of the streams ranged from 5.00 ±0.20 to 5.50±0.35. The relatively low pH values may be attributed to organic acids from decaying vegetation (Reddy and Reddy, 2011) in the surroundings. On the other hand, the mean pH values of water from the wells ranged between 4.52±0.02 and 5.47±0.09. In comparison, water from the wells was more acidic than from the streams. However, the pH of water from both sources are much lower than the acceptable limits for drinking water (6.5 – 8.5), implying that the well water is too acidic for human consumption as it can cause acidosis (Nkansah*et al*, 2010).

A comparative study of some physicochemical properties of water in Asariver and surrounding wells in Ilorin, Nigeria (Okeola*et al*, 2010) revealed that the mean pH values of the well samples were relatively similar to those of the river samples and attributed the relationship to geographical location and geological foundation of the sampling area. In this study, the pH values in both sources are not only substantially different, they also are much lower than those reported in other parts of the State (Braide*et al*, 2004; Nwala*et al*, 2007 and Agbalagba*et al*, 2011).

Levels of other physicochemical parameters in both water sources were below permissible limits for drinking water. The concentrations of Iron (Fe), Chromium (Cr) and Nickel (Ni) were also below acceptable levels in water. However, Cobalt (Co) concentrations in water samples from two streams, STH (0.08±0.02mg/l), STG (0.06±0.02mg/l) exceeded the national permissible limits (0.05mg/l). The banks of thesestreams are littered with refuse dumpsites; these sites may be the source of Co in the water body. On the other hand, the concentrations of Manganese (Mn) in three of the wells, W. L (0.335±0.065mg/l), W.O (0.092±0.020mg/l) and W.Z (0.06±0.01mg/l) were higher than national and international standards (0.05mg/l).These wells are shallow and uncovered. Metal objects (such asnails, metal cans, pieces of roofing sheets, andused lead batteries) mayinadvertently be thrown into the wells either by children or through surface runoffs. These objects become rusty in the wells and may contribute to the increased levels of Manganese in the water.

Although, Mn is an essential element for living organisms, including humans, prolonged exposure to Mn intake may have some health effects. Studies by Kondakis*et al*., (1989) on possible health effects of high Mn concentration in drinking water indicated that progressive increases of Mn concentration in drinking water were associated with progressively higher prevalence of neurological signs of chronic manganese poisoning.

CONCLUSION

The results obtained present baseline data for future references. Water samples from both sources were more acidic than recommended limits. The levels of Co and Mn in these sources were also higher than permissible levels. These observations call for treatment strategies for these water sources and suggest that similar studies on the quality of drinking water in other communities be carried out since factors such as soil type, water chemistry and anthropogenic may differ from place to place.

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Table 1: Physicochemical characteristics of water from streams and wells in Isiokpo

S/N	Parameter	STH	STG	STF	STE	STC	STA	W. P	W. O	W. L	W. Z	WHO Std	NSDW
	coordinates	N5º09' E6º52'	N5º00' E6º53'	N4º59' E6º53'	N4º59' E6º53'	N4º58' E6º53'	N4º57' E6º53'	N5º00' E6º52'	N5º00' E6º53'	N4º59' E6º53'	N4º59' E6º53'		
1.	**Colour Pt/count**	50.00±5.00	37.50 ±2.50	75.00±10.00	80.00 ± 0.10	77.50± 7.50	167.50± 12.50	27.50± 2.50	5.00± 0.10	10.00± 1.00	7.50± 2.50		
2.	**pH**	5.00 ± 0.20	5.09 ± 0.01	5.22 ± 0.09	5.11 ± 0.13	5.39 ± 0.29	5.50 ± 0.35	5.47 ± 0.09	4.52 ± 0.02	4.57 ± 0.12	4.95 ± 0.17	6.5-8.5	6.5-8.5
3.	**Temp. ^{O}C**	25.80 ± 0.40	25.45 ± 0.15	25.65 ± 0.25	25.40 ± 0.10	25.10 ± 0.10 0.10	25.70 ± 0.10	27.25 ±0.05	26.70 ± 0.50	27.10 ±0.20	26.95 ± 0.05	25-30	25-30
4.	**EC (µS)**	9.50 ± 3.50	11.50 ± 6.50	9.00± 4.00	7.50± 0.50	8.50± 0.50	11.00± 1.00	79.00± 2.00	249.0± 3.00	53.00± 0.10	138.5± 4.50	500	
5.	**Tub (FTU)**	2.00± 0.01	2.00± 0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	5	5
6.	**TDS (mg/L)**	7.00± 3.00	7.50± 4.50	6.00± 3.00	5.00± 1.00	6.50± 0.50	7.00± 0.10	58.00± 1.50	186.5± 1.50	40.50± 1.50	104.5±2.50	500	100
7.	**DO(mg/L)**	1.63± 0.40	5.28± 3.16	3.65± 0.41	4.06± 0.81	2.84± 0.41	2.24± 0.21	3.45± 2.14	7.71± 1.22	9.14± 3.05	10.15± 6.49	10	
8.	**BOD(mg/L)**	0.46± 0.10	0.23± 0.61	1.22± 0.40	1.22± 0.40	1.015± 0.20	0.608± 0.20	2.232± 1.42	3.25± 2.93	4.67± 2.64	4.06± 2.08	10	
9.	**PO_4^{3-}(mg/L)**	0.63± 0.19	0.35± 0.13	0.65± 0.21	0.57± 0.09	0.47± 0.04	0.51± 0.09	0.45± 0.15	0.24± 0.02	0.32± 0.09	0.30± 0.02	5.0	
10.	**NO_3^-(mg/L)**	0.27± 0.02	0.24± 0.02	0.44± 0.12	0.29± 0.06	0.22± 0.04	0.34± 0.23	0.38± 0.10	1.51± 0.07	0.81± 0.04	0.75± 0.03	10	
11.	**SO_4^{2-}(mg/L)**	19.00± 3.50	46.00 ± 3.20	27.5± 4.50	17.70 ± 2.00	15.00± 2.00	16.00± 1.00	18.00± 3.00	23.50± 5.50	14.00± 2.00	13.00± 1.00	250	250
12.	**Cl^-(mg/L)**	0.593± 0.39	2.10± 1.11	2.08± 0.09	1.19± 0.09	BDL	3.67± 1.00	12.65± 2.26	25.19± 3.46	6.42± 0.49	17.19± 2.00	250	250
13.	**NH_4^+(mg/L)**	0.08± 0.06	0.07± 0.03	0.21± 0.11	0.03± 0.10	0.04± 0.04	0.11± 0.10	0.12± 0.10	1.55± 0.03	0.07± 0.05	0.03± 0.01	0.5	0.2
14.	**Total hardness (mg/L)**	40.50± 6.50	58.00 ± 1.00	52.00± 9.00	44.00 ± 5.00	33.00± 1.00	92.00± 4.90	32.00± 2.00	43.50± 4.50	31.00± 5.00	41.50±2.50	500±	
15.	**Total alkalinity (mg/L)**	17.50± 2.50	15.00 ± 2.10	10.00± 1.00	15.00 ± 1.50	10.00± 1.00	15.00± 1.50	10.00± 1.00	15.00± 1.50	5.00± 1.00	5.00± 1.00	500±	
16.	**Cobalt (mg/L)**	0.080± 0.01	0.06± 0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL		0.05
17.	**Chromium (mg/L)**	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.05	0.1
18.	**Manganese (mg/L)**	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.092± 0.02	0.335± 0.50	0.06± 0.01	0.05	0.05
19.	**Iron (mg/L)**	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.03	
20.	**Nickel (mg/L)**	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.02	0.02

BDL = Below Detection Limit
WHO = World Health Organization
NSDW= National Standard for Drinking Water

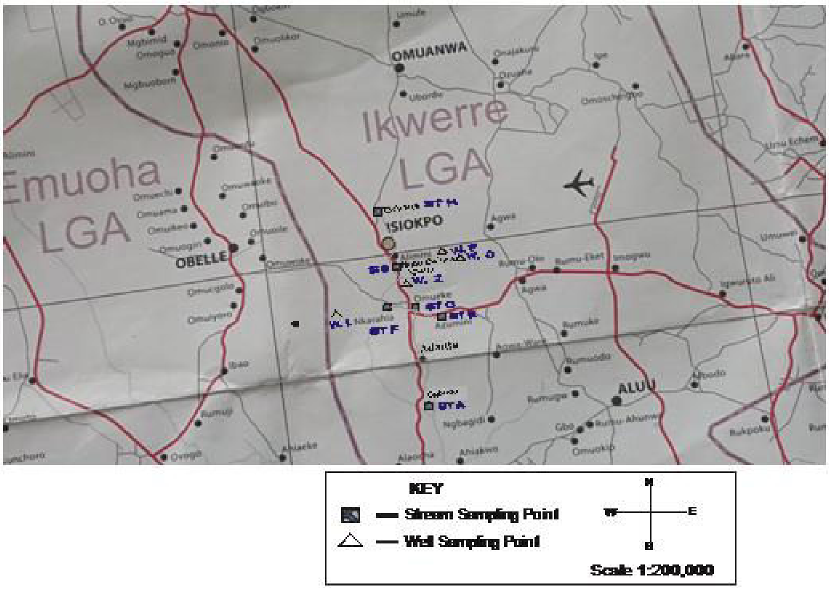

Fig. 1: Map of study area