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HEAVY METAL ASSESSMENT IN PORTABLE WATER CONSUMED IN OFFA METROPOLIS

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Abstract: **This study is aimed at assessing the concentrations of some trace elements (chromium, nickel, lead, cadmium, zinc and arsenic) in tap water, borehole water, stream and sachet water consumed in Offa metropolis. The concentrations of these trace elements were determined using standard method of analysis. The results obtained indicated that chromium, lead, and cadmium concentrations have values of (0.01-0.27)mg/L,(0.05-0.09)mg/Land(0.00-0.08)mg/L respectively which above WHO threshold limits of heavy metals except in a sample where cadmium concentration falls within WHO threshold limits. The results for nickel shows the value of (0.004-0.04)mg/L, only four samples have concentrations above the WHO threshold limits. While the results for zinc and arsenic were within WHO threshold limits for all the samples analysed, with the concentrations values of (0.0014-0.013)mg/L and (0.0001-0.00138)mg/L. The statistical analysis shows that there is significant difference at P<0.05 in the concentrations of all the metals analysed in different water samples except in arsenic.**

Keywords: **AAS, Heavy metals, Offa metropolis, Portable water, UV-Spectrophotometer and WHO.**

1. INTRODUCTION

Water is an essential element in the maintenance of all forms of all life and living organism can only survive for short periods without water. (Chukuw, 2008). Water plays a vital role in in prevention of diseases. Water that fit for human consumption is referred to as portable water. Drinking eight glasses of water daily can reduce the risk of colon cancer by 45% and bladder cancer by 50% as well as risk of other cancers (APEC, 1999). The introduction of anthropogenic chemicals which have serious impact on health even in trace amount in drinking water becomes problem (Oparaocha and Obi, 2010).Even in the absence of anthropogenic source, there is tendency for natural levels of metals and other chemical to be harmful to human health (Anawar et al., 2002).Various metals and metallic compounds released from anthropogenic activities increases their natural levels in water. Some of these metals play essential roles in biological process but at higher concentrations they may be toxic (Dara, 2006).

Despite the bio-importance of some heavy metals as trace elements, their general biotoxicity is of greater health issues (Jarup, 2003). A subfield of geology which is the medical geology studies the effects of chemical in the environment, especially trace elements on the health of humans and animals. The role of the geology is to identify the environment that may influence the incidence of disease. Cadmium is classified as toxic trace element. It is found in very low concentration in most rocks, as well as in coal and petroleum and in combination of zinc. Cadmium appears to accumulate with age especially in the kidney and it is considered also as a cancer and cardiovascular diseases (Salem et al., 2000).

Chromium is essential to animals and human. Excess amount of chromium especially in the hexavalent can be toxic. Chromium is used in metal alloys, pigments for paints and other materials. Chromium has been known to cause damage to skin and lung as well as potential lung cancer (Salem et al., 2000).The common fatal effects of heavy toxicity in drinking damaged or reduced mental and central nervous function as well as lower energy level. Heavy metals also cause irregularity in blood composition which affects vital organs such as kidney and liver (Chaitali and Jayashree, 2013).

Heavy metal pollution of surface and groundwater sources may leads to serious soil pollution and pollution increase as a result of dumping of mined ores especially when mining are done by unprofessional (illegal miners) on ground for manual process. Surface dumping exposes the metals to air and rain, thereby washed down the metals into the soil which spreading the pollution rate. These metals are taken up by plants and finally accumulate in their tissue (Trueby, 2003). Animals that graze on such contaminated plants and drink from polluted waters also accumulate the metals in their tissues and if these plants and animals are consumed by human it might lead to various biochemical disorders. Heavy metals are persistent in the environment because of their non-biodegradable and non-thermo degradable and readily accumulate to toxic levels. (Sholadoye and Nwoye, 2015). Heavy metals such Fe,Zn,Ca and Mg have been reported to bio-importance to man and their daily medicinal and dietary allowances have been recommended. However, metals like arsenic, cadmium, lead and methylated mercury have been reported with zero bio-importance in human biochemistry and physiology and consumption even at very low concentrations can be toxic (Nolan,2003;Young,2005). Arsenic has been reported to be a trace element of nutritional importance to humans but its functions in the biological system is not clear (Duruibe et al., 2007). Any level of concentration of silver in drinking water is not allowed by both World Health Organization (WHO) and National Agency for Food and Drugs Administration and Control (NAFDAC). Efforts based on literature review have shown that scanty work has been done on the levels of heavy metals in portable water consumed in Offa community.

This study involved the assessment of metals concentration in some portable water samples consumed in Offa metropolis, Kwara State using Atomic Absorption and UV-Spectrometry. The results obtained were compared with World Health Organization (WHO) and National Administration for Food and Drug Control (NAFDAC).

2. MATERIALS AND METHOD

2.1 Study Area:

Offa Local Government is located on Latitude 4.62^0-4.74^0N and Longitude 8.11^0-8.22^0E in Kwara State, Nigeria. It is known for its savanna vegetation with farming as main occupation.

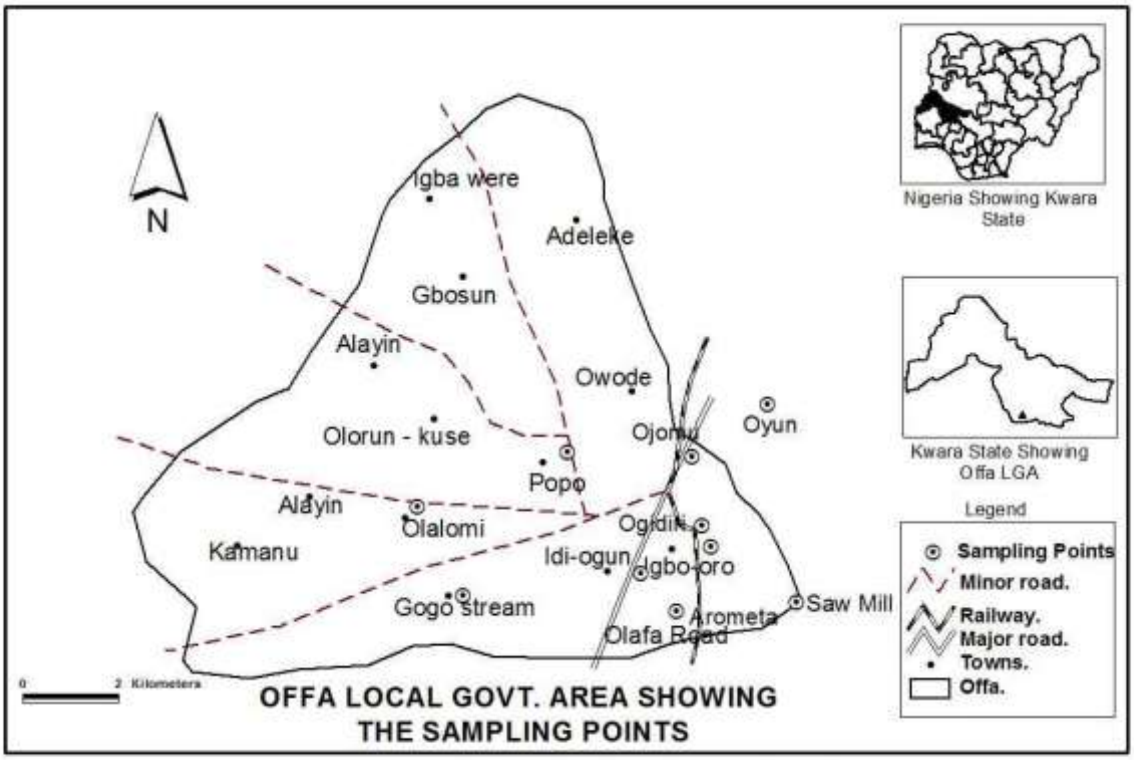

Fig. 1: Location of samples analysis for trace element

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Twenty five different water samples were collected in twenty five sampling sites and labeled as follows: Idi-Ogun bore(A), Igbo–oro borehole(B),Popo borehole(C), Temitope borehole(D), Olalomi borehole(E), Ogidiri borehole (F), Oyun borehole(G), Idi-ogun sachet water(H), Kemla sachet water(I), Oyun sachet water(J), Pennywise sachet water(K), Yauz sachet water(L),Oyun stream water(M), Gogo stream water(N), Oyun tap water(O), Idi-ogun tap water(P), Popotap water(Q), Arometa well water(R), ogidiri well water(S), Popo well water(T), Igbo-oro well water(U),Sawmill well water(V),Oyun well water (W), Idi-ogun well water and Ojomu well water(Y).

2.2 Sample Collection and Preparation:

Samples were obtained from Offa Local Government and some areas in Ijabgo town in Oyun Local Government all in Kwara State. Samples were collected from all sources of drinking water in the town such as well, borehole,tap,stream and sachet water using a clean plastic polythene container.

2.3 Sampling of Sachet water:

Sachet water were purchased both in Offa and Oyun Local government, Kwara State, and filled into 5litres sample container. All samples bottles and cap were rinsed thrice with water to be sampled during sampling (Akoto and Adiyiah, 2007).

2.4 Sampling of Stream and **Tap water:**

Grab samples were collected from top, bottom and middle of the stream, along the direction of flow three times at the interval of 3hours. These were mixed to obtain a composite sample and collected in a five litres polythene plastic container. While samples for tap water were collected thrice daily at an interval of an hour, mixed to obtain composite samples and filled in a 5litres polythene container (Soylak et al.,2002).

2.5 Sampling of Well and Borehole water:

Samples were collected from well and borehole after the well has been pumped to for a ground water source representative. Grab samples were collected thrice daily at an interval of 3hours and mixed to obtain composite samples and collected in a five litre polythene plastic container. Fore borehole water was allowed to run for few minutes before collection for a uniform flow rate (Soylake et al., 2002)

2.6 Elemental Analysis of Water Sample

5.0 liters of each water samples was evaporated to dryness using Pyrex beaker and hot plate. The residues were digested to with 50cm^3 of 0.25moldm^{-3} HNO_3 and transferred into 120cm^3 plastic container for Atomic Absorption Spectrophotometer analysis. Metals Concentrations were extrapolated from standard calibration curve (Jimoh and Sholadoye, 2011).

2.7 Determination of Arsenic Concentration in water Samples

3.6cm^3 of water sample was pipetted into a test tube, 5.0cm^3 of ammonium molybdated-hydrazine mixture and 2 drops of sodium metabisuphite were added. To this mixture.1.0cm^3 of iodine-potassium iodide solution and 0.2cm^3 sodium hydrogen carbonate were added. This misture was heated in a water bath at 95^{0}C . After cooling the absorbance reading was taken with UV-Visible Spectrophotometer at 840nm (Bassett et al., 1983). The concentration of metals was extrapoliated from stansard calibration curve.

2.8 Statistical Analysis

All the data obtained were statistically analyzed using Inter tack graph, a statistic software package by determined Mean, Standard deviation, Standard Error of the mean and Coefficient of Variation.

3. RESULTS AND DISCUSSION

The concentration of chromium in the samples is shown in Table1.

The concentration ranges from 0.01mg/l -0.27mg/l. Twenty one samples have concentrations above WHO (2008) Standard while four samples have the concentrations within Standard set by both WHO and NAFDAC. Statistical comparison of the chromium concentration in each water sources (Table2) shows that there is significant difference between Borehole and Well at P< 0.05, Sachet and Well at P< 0.01 and Tap and Well at P< 0.05. Sachet water has the highest variation of chromium concentration of 67.75 and borehole with the least variation of 32.41 (Table 3). The range of chromium concentration in this study is lower than 0.06mg/l-2.65mg/l reported by (Abolude et al., 2009) but higher than 0.00mg/l -0,02mg/l reported by (Javid Hussain et al., 2012). Chromium is essential for organism as micro nutrient for fat,protein and carbohydrate metabolism but higher concentration of it may result to cancer (Malami et al.,2014).

Table I: Concentration of the metals in water samples analyzed (mg /l)

Sampling Code	Cr	Ni	Pb	Cd	Zn	As
A	0.03	0.010	0.035	0.01	0.045	0.00018
B	0.05	0.008	0.05	0.02	0.0036	0.00016
C	0.03	0.006	0.03	0.01	0.0045	0.00015
D	0.04	0.008	0.02	0.00	0.0014	0.00012
E	0.06	0.004	0.03	0.02	0.0055	0.000096
F	0.06	0.006	0.055	0.02	0.0014	0.00018
G	0.07	0.008	0.025	0.02	0.0055	0.00015
H	0.07	0.006	0.025	0.03	0.0059	0.00012
I	0.03	0.006	0.0150	0.04	0.0073	0.00012
J	0.01	0.006	0.02	0.03	0.0082	0.00012
K	0.10	0.012	0.015	0.05	0.0077	0.00015
L	0.11	0.006	0.01	0.03	0.0032	0.00012
M	0.08	0.004	0.015	0.07	0.005	0.00014
N	0.13	0.004	0.09	0.06	0.0032	0.00022
O	0.10	0.018	0.025	0.05	0.0059	0.00013
P	0.10	0.016	0.03	0.04	0.0068	0.00119
Q	0.12	0.01	0.04	0.04	0.0045	0.0002
R	0.08	0.008	0.02	0.07	0.0068	0.0001
S	0.12	0.004	0.05	0.06	0.0077	0.00022
T	0.18	0.03	0.06	0.05	0.0064	0.00138
U	0.21	0.022	0.035	0.08	0.0068	0.00022
V	0.18	0.022	0.04	0.07	0.0014	0.00017
W	0.27	0.012	0.03	0.05	0.0091	0.00029
X	0.27	0.012	0.06	0.06	0.0132	0.00132
Y	0.24	0.032	0.04	0.05	0.014	0.00017

Table II: Comparison of Chromium Concentration in Water samples using Tukey-Kramer Multiple Comparison test.

Samples	q	P value
Borehole vs Sachet	0.752	ns P> 0.05
Borehole vs Stream	2.009	ns P> 0.05
Borehole vs Tap	1.024	ns P> 0.05
Borehole vs Well	8.006	**ns P< 0.001
Sachet vs Tap	0.365	ns P> 0.05
Sachet vs Well	6.495	**ns P< 0.01
Stream vs Tap	0.990	ns P> 0.05
Stream vs Well	3.204	ns P> 0.05
Tap vs Well	5.076	**ns P< 0.05

The P value is 0.0001 significant, if q greater than 4.232, then P is less than 0.05, ns= means not significant at 95% Confidence interval; ** = means Significant

Table III: The Mean Concentration of the Chromium (mg/L) in the Water Samples

Samples	Mean±**SD**	SD Error of Mean	CV
Borehole	0.048±0.017	0.0059	32.41
Sachet	0.064±0.043	0.0194	67.75
Stream	0.064±0.043	0.0250	33.68
Tap	0.073±0.0 55	0.0318	75.11
Well	0.194±0.068	0.0242	35.31

Nickel concentrations in the samples are shown in Table 1. The concentrations ranges from 0.004mg/l-0.04mg/l. Twenty samples have concentrations within the WHO limit and five sample have concentrations above both WHO and NAFDAC. The range of nickel concentration obtained is lower than 0.02mg/l-5.20mg/l reported by Abolude et al.,2009 and 0.012mg/l -0.375mg/l reported by Kar et al.,2008. Statistical comparison (Table 4) of the nickel concentrations in various water source shows that there is significant difference between borehole and well at $P < 0.05$. Well water has the highest variation (Table 5) of nickel concentration of 56.50 and zero variation observed in stream water. The hazardous effect of nickel has been reported to cause cancer on rat (Chaitali and Jayashree, 2013). Nickel concentrations in ground water depend on soil, pH and depth of the sampling. Acidic rain increase nickel mobility in the soil and thus increase nickel concentrations in ground water (IPCS, 1991).

Table IV: Comparison of Ni Concentration (mg/L) in Water samples using Tukey-Kramer Multiple Comparison test.

Samples	q	P value
Borehole vs Sachet	0.021	ns P> 0.05
Borehole vs Stream	0.863	ns P> 0.05
Borehole vs Tap	2.400	ns P> 0.05
Borehole vs Well	4.511	**P< 0.05
Sachet vs Stream	0.842	ns P> 0.05
Sachet vs Tap	2.250	ns P> 0.05
Schat vs Well	0.842	ns P> 0.05
Stream vs Tap	2.572	ns P> 0.05
Stream vs Well	3.828	ns P> 0.05
Tap vs Well	1.002	ns P> 0.05

The P value is 0.0137 considered significant; If the q value is greater than 4.233 then the P value is less than 0.05. ns= means not significant at 95% Confidence interval; ** = means Significant.

Table V: The Mean Concentration of the Nickel (mg/L) in the Water Samples

Samples	Mean±**SD**	SD Error of Mean	CV
Borehole	0.0071±0.002	0.00074	27.32
Sachet	0.0072±0.003	0.00120	37.26
Stream	0.004±0.000	0.000	0.00
Tap	0.014±0.004	0.0024	28.38
Well	0.018±0.010	0.0036	56.50

The concentrations of lead in the samples analysed are shown in Table 1. The concentration ranges from 0.015mg/l-0.090mg/l. Only one sample of the twenty five samples analysed have concentration within WHO threshold limit while twenty four samples have the concentrations above WHO and NAFDAC limits.

Lead concentrations in this study are lower than 0.16mg/l-0.86mg/l,0.00mg/l-2.59mg/l and 0.00mg/l-0.23mg/l reported by Indu et al., (2010), Abolude et al., (2009) and Eletta (2007) respectively. Statistic comparison (Table 6) of the entire water source shows no significant difference. Stream water had the highest variation(Table 7) of 101and Tap water has the least variation of 24.12.High lead concentrations in all the water samples analysed may be as a result of terrestrial run –off from sewage effluent and waste sites, excess lead concentration may be attributed to the agricultural practice in the sampling areas. Lead poisoning causes inhibition of the synthesis haemoglobin; dysfunctions in kidney, joints and reproductive system and acute and chronic damage to the central nervous system (Ogwuebgu and Muhanga, 2005).

Table VI: Comparison of Pb Concentration (mg/L) in Water samples using Tukey-Kramer Multiple Comparison test.

Samples	q	P value
Borehole vs Sachet	2.632	ns P>0.05
Borehole vs Stream	1.869	ns P>0.05
Borehole vs Tap	0.414	ns P>0.05
Borehole vs Well	1.137	ns P>0.05
Sachet vs Stream	3.633	ns P>0.05
Sachet vs Tap	1.720	ns P>0.05
Sachet vs Well	3.736	ns P>0.05
Stream vs Well	1.954	ns P>0.05
Stream vs Tap	1.151	ns P>0.05
Tap vs Well	1.291	ns P>0.05

The P value is 0.0832 considered not significant; If the q value is greater than 4.232 then the P value is less than 0.05; ns= means not significant at 95% confidential interval.

Table VII: The Mean Concentration of the Pb (mg/L) in the Water Samples

Samples	Mean±**SD**	SD Error of Mean	CV
Borehole	0.035±0.013	0.0049	36.89
Sachet	0.017±0.006	0.0026	33.53
Stream	0.052±0.053	0.0375	101.00
Tap	0.013±0.008	0.0044	24.12
Well	0.042±0.014	0.0050	33.74

Cadmium concentrations in the samples are shown in Table1. The concentrations range between 0.00mg/l-0.08mg/l. All the water samples analysed have the cadmium concentration above WHO maximum permissible limits except one sample. Abolude et al., (2009) and Indul et al., (2010) also reported high concentration of Chromium in their work 0.00mg/l-0.30mg/l and0.06mg/l-0.13mg/l respectively. The Satistical comparison (Table 8) of the water source reveals significant difference in chromium concentrations except Sachet and Tap, Stream and Well, Stream and Tap and Tap and Well. Borehole water (Table 9) had the highest cadmium concentration variation of 55.00 and Stream water with the least variation of 10.88. Higher concentrations of cadmium in all the water samples may be attributed cadmium bearing materials that might be contained soluble form of cadmium which might be leached or washed down to water bodies. Also, disposal of cadmium bearing products such as automobiles tyres, fungicides and fertilizer application practiced in the community may contributed largely to the higher concentrations.

Table VIII: Comparison of Cd Concentration (mg/L) in Water samples using Tukey-Kramer Multiple Comparison test.

Samples	q	P value
Borehole vs Sachet	5.696	**P <0.01
Borehole vs Stream	9.715	** P<0.001
Borehole vs Tap	6.465	**P<0.01
Borehole vs Well	13.983	** P<0.001
Sachet vs Stream	5.324	**P<0.01
Sachet vs Tap	1.542	ns P>0.05
Sachet vs Well	6.803	** P<0.001
Stream vs Well	3.645	ns P>0.05
Stream vs Tap	0.729	ns P>0.05
Tap vs Well	4.065	ns P>0.05

The P value is 0.0001 considered extremely significant. If the value of q is greater than 4.232, then P value is less than 0.05 ; ** = means significant; ns= means not significant at 95% confidence interval.

Table IX: The Mean Concentration of the Cd (mg/L) in the Water Samples

Samples	Mean±**SD**	SD Error of Mean	CV
Borehole	0.014±0.008	0.0030	55.00
Sachet	0.036±0.009	0.0040	24.84
Stream	0.065±0.007	0.0050	10.88
Tap	0.043±0.006	0.0033	13.33
Well	0.061±0.011	0.0040	18.37

The Zinc concentrations in water samples analyzed are shown in Table 1.The concentration ranges between 0.0014mg/l - 0.013mg/l, all the water samples analysed have the concentrations within WHO threshold limits. The Zinc concentration in this study is lower than 0.15mg/l-0.17mg/l obtained by Indu et al., (2010) and 0.23mg/l-0.98mg/l reported by Eletta(2007). Statistical comparison of the Zinc concentrations in the entire water source shows that there is only significant difference between Borehole water and Well water at P<0.05(Table 10) . The highest variation in Zinc concentrations was observed in Borehole water 56.88 while the least variation was observed in Sachet water 13.64(Table 11). Zinc concentration can be much higher as a result of leaching of zinc from piping and fittings. Zinc is considered to be relatively non-toxic especially if taken orally. However, excess amount can cause system dysfunctions that result in impairment of growth and reproduction (Nolan, 2003).

Table X: Comparison of Zn Concentration (mg/L) in Water samples using Tukey-Kramer Multiple Comparison test.

Samples	q	P value
Borehole vs Sachet	2.702	ns P>0.05
Borehole vs Stream	0.479	ns P>0.05
Borehole vs Tap	1.758	ns P>0.05
Borehole vs Well	4.739	** P<0.05
Sachet vs Stream	1.432	ns P>0.05
Sachet vs Tap	0.505	ns P>0.05
Sachet vs Well	1.527	ns P>0.05
Stream vs Well	0.908	ns P>0.05
Stream vs Tap	2.616	ns P>0.05
Tap vs Well	1.831	ns P>0.05

The P value is 0.0401 considered significant, If the q value is greater than 4.232 the P value is less than 0.05; ** =means significant; ns= means not significant.

Table XI: The Mean Concentration of the Zn (mg/L) in the Water Samples

Samples	Mean±**SD**	SD Error of Mean	CV
Borehole	0.0033±0.002	0.0030	56.88
Sachet	0.0065±0.001	0.0040	13.64
Stream	0.0041±0.001	0.0050	31.05
Tap	0.006±0.001	0.0033	20.22
Well	0.0082±0.004	0.0040	49.17

Arsenic concentrations in the samples analysed are shown in Table 1.The concentration ranges between 0.0001mg/l-0.00138mg/l. All the samples analysed have concentrations within WHO threshold limits. The Statistic comparison

(Table 12) shows that no significant difference in arsenic concentrations in the entire water source at P<0.05. Tap water had the highest arsenic variation of 116.90 and Borehole with least variation of 0.53 (Table 13).The predominant forms of arsenic in ground water and surface water arsenate (+5) and arsenite (+3). Oxidation state is the most important factors that dictate the fate and transport of arsenic in drinking water (Jekel, 1994).

Table XII: Comparison of As Concentration (mg/L) in Water samples using Tukey-Kramer Multiple Comparison test.

Samples	q	P value
Borehole vs Sachet	0.144	ns P>0.05
Borehole vs Stream	0.153	ns P>0.05
Borehole vs Tap	1.987	ns P>0.05
Borehole vs Well	2.481	ns P>0.05
Sachet vs Stream	0.247	ns P>0.05
Sachet vs Tap	1.993	ns P>0.05
Sachet vs Well	2.400	ns P>0.05
Stream vs Well	1.368	ns P>0.05
Stream vs Tap	1.469	ns P>0.05
Tap vs Well	0.129	ns P>0.05

The P value is 0.2857 considered significant, If the q value is greater than 4.232 the the P value is less than 0.05; ns= means not significant.

Table XIII: The Mean Concentration of the As (mg/L) in the Water Samples

Samples	Mean±**SD**	SD Error of Mean	CV
Borehole	0.00015± 0.079E-5	1.163E-5	0.53
Sachet	0.00013±0.34E-5	6.00E-6	2.71
Stream	0.00018±0.657E-5	4.00E-5	3.65
Tap	0.00051±0.00059	0.000342	116.90
Well	0.00048±0.00054	0.000190	111.16

Table XIV: WHO and NAFDAC maximum permissible limits (mg/L)

Metal	WHO (2008)	NAFDAC
Zn	5.0	5.0
As	0.01	0.0
Cd	0.003	0.0
Pb	0.01	0.0
Cr	0.05	0.05
Ni	0.07	

4. CONCLUSION AND RECOMMENDATIONS

The results of investigation of the trace metal concentrations in drinking water in Offa communities have shown that most of the water sources are unfit for human consumption as of the time of this research due high concentration of Pb, Cd, Cr and Ni which exceeded WHO threshold limits.

5. RECOMMENDATION

- Routine chemical analysis of drinking water in the Communities is very important as well as public enlightenment on the sources and effects of drinking contaminated water.
- The pH of the water in the communities should be monitored because it is an important factor which determined the solubility of metals in water bodies.
- Further research should be carried out in the communities both in hamattern and raining seasons so as to ascertain the portability of the water for consumption.

REFERENCES

[1] Abolude, D.S.,Davies, O.A. and Chia, A.M.(2009): Distribution and Concentration of trace Elements in Kubanni Reservoir in Northern Nigeria.Journal of Environmental and Earth Science.1(2):39-44

[2] Akoto, O and Adiyiah, J.(2007): Chemical Analysis of Drinking of Water from Some Communities in the Brong Ahafo Region.Int,J.Environ.Sci.Tech.,4(2),211-214.

[3] Anawara, H.M.,Akaib, J., Mostofac,K.M.G., Safiullahd, S.and Tareqd,S.M.(2002): Arsenic Poisoning in Ground Water Health.Risk and Geochemical Sources Bangladesh.Environ.Int.,(27):587-604.

[4] APEC(1999): Health Information-Importance of Water and Human Health.htt://www. Freedrinkingwater.xom /waterducation/waterhealth.htm

[5] Bassete, J.,Denney .R.C., Jefferg,G.H., Mendhan, J. (eds)(1983: Vogel's Textbook of Quantitative Inorganic Analysis 4th ed. Longman New York,Pp451-453.

[6] Chaitali,V.M and Jayashree,D.(2013):Review of Heavy metals in Drinking water and their effect on Human Health. International Journal of Innovative Research in Science,Engineering and Technology.Vol(2):2992-2996.

[7] Chukwu,G.U(2008): Water Quality Assessment of Boreholes in Umuahaia South Local Government Area of Imo State,Nigeria.The Pacific Journal of Science and Technology.9(2):592-508.

[8] Dara, S.S.,(2006): Environmental Chemistry and Pollution Control,8th ed, S.Chand and Company Ltd. Ram Nagar, New Delhi.Pp177-215.

[9] Duruibe, J.O.,Ogwuegbu,M.O.C and edwurugwu,.J.N(2007):Heavy Metal Pollution and human biotoxic effects. International Journal of Physical SciencesVol.2 (5),Pp112-118.

[10] Eletta,A.A(2007): Determination of Some Trace Metals Levels in Asa river Using AAS and XRF Techniques International Journal of Physical Science Vol.2(3),Pp56-60.

[11] Indu.V.N, Kailash.S, Arumuugam.M.,Grangadhar.K and Carlson.D.(2012): Trace Metal Quality Kottayam, Kerala (India) by Principal Component Analysis. Applied Science. Journal 9(10);1100-1107.

[12] IPCS (2002): International Programme on Chemical Safely.Nickel Genera,world Health Organisation (Environmental health Criteria 108).

[13] Jarup, L.,(2003): Hazards of Heavy metal Contamination Br Med. Malaysia,48,167-82.

[14] Javid,H.,Jehangr, S.,Iktiar. K.,Wilson.A., Rosemario.C.S., Souza. J.D.S.S., Edvaido.P.Q.J and Iraeema.A.N (2012):Analysis of Trace Metals in Mardan District KPK, Pakistan. American-Eurasian J.Agris&Environ.Sci.,12(8):1091-1094

[15] Jekel, M.R(1994): Removal of Arsenic in Drinking Water Treatment.Chapter 6 in Nriagu,J.O (ed): Arsenic in the Enviroment Part1: Cyclin and Characterization: John Wiley and Sons, Inc. New York Pp.119-132.

[16] Jimoh,W.L.O and Sholadoye, Q.O.(2011): Trace Elements as an Indicator of Quality of Drinking Water in Offa Metropolis, Kwara State, Nigeria. Bajopas Vol.4(2): 103-108.

[17] Kar,D., Sur. P., Mandal, S.K., Saha,T. and Kale, R.K(2008): Assessment of Heavy Metal Pollution in Surface Water-Int.J. Environ.Sci.Tech., 5(1):119-124

[18] Malami,D.I, Zakaria, Z.I,Mohammed, M.I and Audu,A.A(2014):Comparision of Levels of Some Metala in the Water and Sediment from Challawa Gorge Dam,Kano Nigeria. Bajopas vol.(7)1:80-84.

[19] Nolan,K(2003):Agloba Assessment of natural Sources of atmospheric.Trace metals,Nature,338:47-49.

[20] Ogwugbu.M.O.C and Muhanga, W(2005):Investigation of Lead concentration in blood of people in the Copper belt province of Zambia. J.Environ.(1):66-75.

[21] Oparaocha, E.T and Obi,R.K(2010): Assessment of Quality of Drinking water Sources in the Federal University of Technology,Owerri,Imo State,Nigeria.Journal of Applied Biodciences.32(3):1964-1976.

[22] Salem, H.M.,Eweida,A and Azza.(2000):Heavy Metals in Drinking water and their Environmetal Impact on Health. ICEHM, Cairo University, Egypt, Pp542-556.

[23] Sholadoye,Q.O and Nwoye, E.E.(2015): Heavy Metal Assessment of Dumpsities in Ilorin Metropolis, Kwara State.Asian journal of Sciences and Technology,Vol.6(11),Pp2006-2009.

[24] Soylak,M. Ayidin,F.A., Saracoglu,Elci,L and Dogan,M.(2002): Chemical analysis of Drinking Water Samples from Yozagt,Turkey. Polish Journal of Environ. Studies 11:151-156.

[25] Trueby,P.(2003):Impact of Heavy Metals on Forest Trees from Mining Areas.In : International Conference on Mining and the Environment(III) Sudbury,Ontario Canada.

[26] WHO(2008):World HealthOrganisation-Guidelines for Drinking Water Quality 3rd ed.(WHO,Geneva,2008).

[27] Young,R.A(2005): Toxicity profilies: Tocixity Summaries for Cadmium Risk Assessment Information System,RAIS, University of Tennessee.