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Determination of Selected Heavy Metals in Drinking Water Commonly Used in main campus Usmanu Danfodiyo University Sokoto

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Abstract:
Background: *This study analyzed five water samples commonly used for drinking in the community of Usmanu Danfodiyo University Sokoto main campus for the concentration of Lead (Pb), Cadmium (Cd), Chromium (Cr), Iron (Fe) and Copper (Cu).*
Materials and Methods: *The water samples (tap, well and sachet) were obtained from student's hostel, Dundaye village and university minimart. The samples were acid digested, filtered, and diluted for analysis using Flame Atomic Absorption Spectrophotometer (FAAS).*
Results*: Results of the analysis revealed absence of lead, high concentration of Cd (0.0174 ppm), Cr (0.1195 ppm), Fe (4.169 ppm) and low concentration of Cu (0.2503 ppm) in comparison with WHO recommendation.*
Conclusion: *Heavy metals contamination was more pronounced in the well water from Dundaye village, which therefore pose health threat to consumers. In light of this observation regular monitoring is needed to alert consumers about the menace of heavy metals in drinking water from time to time.*
Key Word: *Heavy metals, Water, AAS, WHO*

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I. Introduction

Water is important for the continuity of life, as well as for domestic and industrial purposes. Thus adequate supply of safe drinking water is inevitable for the maintenance of healthy life. The distribution of water on earth comprises of oceans (97%), fresh water (2%), lakes and rivers (1%). Being a good solvent, water dissolves large variety of substances including heavy metals compared to any other liquid.(1)

Heavy metals refer to as trace elements have the potential to cause toxicity in water as they accumulate.(2) The major anthropogenic source of heavy metals are wastes from industrial mining sites, manufacturing industries, domestic waste water and run off from the roads. Examples of heavy metals include Lead (Pb), Aluminium (Al), Mercury (Hg), Selenium (Se), Arsenic (As), Cadmium (Cd), Iron (Fe), Copper (Cu), Chromium (Cr), Molybdenum (Mo), Manganese (Mn) and Cobalt (Co).(3) Some of these metals interfere with the enzymes systems and metabolic pathways and they have been reported to be deleterious to aquatic ecosystem and human health.(4)

Elinge *et al*.(5) reported high levels of Pb, Co, Fe, and Cr in water samples from Kebbi State University of Science and Technology Aliero (KSUSTA) above the World Health Organization (WHO) permissible limits. The study investigated heavy metals concentration from three sites in Aliero local government of Kebbi state and their report revealed highest levels of Fe in KSUSTA water sample. In addition, all the three samples have high levels of Copper (Cu) and Nickel (Ni) compared to WHO recommended limits. Another study by Shafa'atu *et al.* (6) also reported low level of lead (Pb) in different water samples from Sokoto metropolis except the water sample from Gidan Hamma village with 52.0 ±2.9 µg/L compared to 50µg/L recommended by WHO. In the present study, five water samples commonly used in the community of Usmanu Danfodiyo University Sokoto main campus were analysed for Lead (Pb), Cadmium (Cd), Chromium (Cr), Iron (Fe) and Copper (Cu) concentrations using flame atomic absorption spectroscopy.

Atomic Absorption Spectroscopy is an established method commonly used for quantification of trace elements in view of its sensitivity, efficient matrix removal, high sampling frequency and less expenditure. (7)

II. Material And Methods

Study Location: Three sampling sites in the university were selected for this research project: student's hostel, Dundaye village behind Chemistry Department, and University minimart.
Study Duration: November, 2018
Sample size: Five

Sampling: Water samples were collected in 1L plastic bottles from the above mentioned locations. Three samples of sachet water mostly used by the students were purchased from the school minimart. They are Hujja, Jireh, and Garka sachet waters. Tap water from male student's hostel (block A) was allowed to run for two minutes before filling the container which has been rinsed severally with the sample to be collected. Well (ground) water from Dundaye village was collected directly from the well in a local fetcher and transferred to the sampling bottles. The containers were closed tightly and stored prior to analysis.

Sample Treatment/digestion: Digestion of sample is one of the steps taken to preserve the samples from bacterial activities and to release metals in to the analytical solution. [8] From each sample, 50 ml was measured in to evaporating dish and 5 ml of concentrated nitric acid (HNO_3) was added. The samples were digested for about 15 minutes using digestion block in a fume cupboard until the solution reduced to 10 to 15 ml. Each digested sample was allowed to cool and filtered in to a 60 cm^3 sample bottles, the volume was refilled to 50 cm^3 mark with distilled water and then kept for analysis.

Statistical Analysis: The data obtained from the experiment were subjected to statistical analysis to determine the Mean and Standard Error of Mean (Mean ± SEM) using InStat3 software.Values with $P<0.05$ are significantly different when compared with the corresponding values in other samples.

Table 1: Materials

S/N	Items	Manufacturer
1	AAS	Shimadzu, Japan
2	Digestion block	-
3	Fume cupboard	-
4	Glasswares	Pyrex, England

Table 2: Water samples

S/N	Sample	NAFDAC NO.	Labelling
1	Hujja	B1-4599L	A
2	Jireh	01-002L	B
3	Garka		C
4	Hostel tap	-	D
5	Village well water	-	E

Table 3: Setting of AAS for the experiment

Parameters	Wavelength (nm)	Slit width (nm)	Fuel	Support	Lamp intensity (mA)
Pb	283.3	0.7	C_2H_2	Air	10
Cr	357.9	0.7	C_2H_2	Air	10
Cd	228.8	0.7	C_2H_2	Air	8
Fe	248.3	0.2	C_2H_2	Air	12
Cu	324.8	0.7	C_2H_2	Air	6

Pb = Lead, Cr = Chromium, Cd = cadmium, Fe = Iron, Cu = Copper, AAS = Atomic Absorption Spectrophotometer

III. Result

Table 4: AAS Result of metals in the samples of water commonly used in UDUSOK

S/N	Metals	Mean± SEM (ppm)					WHO recommendation (ppm)
		Hujja	Jireh	Garka	Tap	Well	
1	Pb	ND	ND	ND	ND	ND	0.00
2	Fe	2.812±0.09	3.529±0.23	3.922±1.09	2.527±0.65	4.169±0.36	0.30
3	Cd	0.0013±0.02*	0.0108±0.02*	0.0112±0.02*	0.0062±0.01*	0.0174±0.02*	0.003
4	Cu	0.1542±0.03	0.1296±0.03*	0.2132±0.03	0.1700±0.02	0.2503±0.01*	2.00
5	Cr	0.0379±0.02	0.0415±0.02	0.0573±0.02	0.0930±0.06	0.1195±0.05	0.05

ND = Not detectable, SEM = Standard Error of Mean, WHO = World Health Organization

Values with * are significantly different ($P<0.05$) when compared with the corresponding values in other samples.

IV. Discussion

The results of the present study showed no detectable level of Lead in all the samples, perhaps because its level was below the detection limit standardized in this method (0.0005 ppm). In this study, was not detected which previously reported to be present in drinking water especially sachet water [5,6]. Iron which is the most commonly available metal on planet, [9] was observed to be highest in the well water of Dundaye village (4.169±0.36 ppm) compared to the concentration found in the hostel tap water (2.527±0.65), both levels of which are high compared to the WHO standard limit of 0.3 ppm. Statistical analysis revealed no significant difference ($P>0.05$) in all the samples. The high levels of iron could be as a result of clay deposits. Similarly, presence of iron may be responsible for the brownish-red colour of the water when allowed to stay for some minute [5]. Change in color may also be as a result of iron coagulants or corrosion of the steel pipes used during water processing and distribution.[10]

Further analysis showed that four samples have cadmium levels above the WHO permissive values and one sample (Hujja) has Cadmium level of 0.0013±0.0002 ppm below the WHO permissible value of 0.003 ppm which is significantly low ($P<0.05$) when compared with that of Jireh, Garka and well water. There was also significant increase ($P<0.05$) in the level of cadmium in the well water when compared with that of tap water. The highest level was detected in Dundaye ground water, and this could be attributed to zinc impurities present in galvanized pipes, solders and some metal fittings. [10] Presence of Cadmium in drinking water should be of great concern considering the fact that its effect mimics that of oestrogen in humans.[11] Besides, cadmium is responsible for several cases of food poisoning and even small quantities of Cd could cause high blood pressure (BP) and other effects related to the kidney functions.[12]

As for the level of copper, it was observed that well water from Dundaye village has significantly high level of copper ($P<0.05$) compared to that of Jireh sachet water (0.1296±0.03 ppm) and overall, all the five samples have copper levels below the WHO permissible limits of 2.00 ppm, and this may be as a result of low PH and some geological factors.[13]

The concentration of chromium was found to be high (0.1195±0.0490 ppm) in Dundaye ground water compared to that of Hujja sachet water (0.0379±0.0181 ppm). Chromium level in Garka sachet water was slightly above the WHO recommended limit of 0.05 ppm, similarly in the hostel tap water and Dundaye well water, chromium level was considerably high (0.0930±0.06 and 0.1195±0.05 ppm). However, there is no significant difference ($P>0.05$) in the level of chromium in all the samples. The marginally elevated of Chromium in the three samples could be due to the variability of Chromium in nearly all uncontaminated aquatic and terrestrial ecosystem. Similarly, presence of Chromium in soaps and detergents used for washing could contribute to the high level of chromium in these water samples.[14] Chromium may also find its way in water when boreholes / wells were constructed near chromium deposits and places with Chromium related industrial activities. Chromium is believed to have little nutritional value although its toxic effects outweigh its value. Water industries should therefore be mindful of such sites. Thus, the chromium level above WHO recommended limits could serve as a threat to human health. It is interesting to note that the levels of Fe, Cu, and Cr observed in this study, were lower than those reported by Elinge *et al.*[5] making the water samples used here safer.

V. Conclusion

As expected, the findings revealed low quality of drinking water with respect to heavy metals especially in the water sample from Dundaye village. This exert a potential source for water borne disease associated with heavy metals.

References

[1]. Mustapha,S. Physiochemical Analysis of Raw and Treated water. A thesis submitted to the faculty of science, UDU, Sokoto Dept. of Chemistry, 1999, 6-13.

[2]. Ademoroti C.A. Standard Methods for Water and Effluent Analysis. Foludex press ltd, Ibadan, 1996, page111.

[3]. Bhatia, C.S., Environmental pollution and control in chemical process industries, First Ed., 2001 (4):279-282.

[4]. Vijaya CB, Kiran K, Nagendrappa G. Assessment of heavy metals in water samples of certain locations situated around Tumkur, Karnataka, India. Ejournal of Chemistry. 2010;7:349-352.

[5]. Elinge CM, Itodo AU, Peni IJ, Birnin – Yauri UA, Mbongo AN. Assessment of heavy metals concentrations in bore-hole waters in Aliero community of Kebbi State. Advances in Applied Science Research, 2011,

[6]. Shafaatu G., Muazu G., Abdullahi Z., and Daha U., Determination of Lead Concentration in different water sources in Sokoto metropolis. Journal of applied science 2014(7) 00 53-56.

[7]. Fang, Z. Flow Injection Atomic Absorption Spectrometry, John Wiley and Sons Ltd West Sussex, England.1995.

[8]. Itodo, U.A. Abdulrahman, F.W. Hapiness, A.U. and Abubakar, M.N. Journal of Science

[9]. Moscow S, JothivenkatachalamK ,Subramani P, Der ChemicaSinica, 2011, 2 (2): 199-206

[10]. WHO 2008, Guidelines for drinking water quality, World Health Organization, GenevaEducation.Info.Comm.Tech. 2009, 1(1):164 – 167.

[11]. Johnson, M.D.; Kennedy, N.;Stoica, A.; Hilakivi, C.L.; Singh, B.; Chepko, G.; Clark, R.; Sholler,P.F.; Lirio, A.A.; Foss, C.. Cadmium mimics the in vivo effects of estrogen in the uterus and mammary gland. Nature Medicine 2003;9 (1):1081-1084 Khanna Publishers, Naisarak, Delhi India, 2001, 23 – 25

[12]. Rajappa, B., Manjappa, S &Puttaiah, E.T. 2010. Monitoring of heavy metal concentration in groundwater of Hakinaka Taluk, India. Contemporary Engineering Sciences, 3(4):183-190.
[13]. World Health Organization (WHO). Guide lines for drinking water Quality, Health criteria and other supporting information 1999; (2ndedVol 2). AITBS publishers, New Delhi. Pg119-138.
[14]. Ali N, Oniye, Bararabe SJ, Auta MI, Chem Class Journal, 2005, 2(1): 69-73.
[15]. Education.Info.Comm.Tech. 2009, 1(1):164 – 167.

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