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Heavy Metals Assessment of Some Selected Packaged Drinking Water in Nasarawa State, Nigera

Ibrahim, E.G[1] and Gube –Ibrahim, M.A[2]

[1.] Ikukplasi Laboratory Services, Akwanga, Nasarawa State
[2.] Department of Chemistry, College of Education, P.M.B 05 Akwanga, Nasarawa State.
ezekiel_ibrahim@yahoo.com

Abstract: *The concern over exposure to drinking water contamination and the resultant adverse effect on human health has prompted several studies evaluating the quality of drinking water sources. The aim of this study is to assess contamination of drinking packaged water in Nasarawa state by Heavy metals (Fe, Zn, Mg, Mn, As, Pb, Cu, Hg, Cr, and Cd) using the AAS. The results shows the mean values ranges for Fe (0.08-0205mg/l), Zn(0.02-0.009mg/l), Mg (0.205-1.35mg/l), Mn (0.02-0.09mg/l), As(0.003-0.01mg/l), Pb(0.006-0.010mg/l),Cu(0.023-0.11mg/l), Hg(0.001-0.002mg/l), Cr(0.00-0.004mg/l and Cd(0 .001-0.002mg/l), in the five local government of studies. These values are all within the World Health Organization and Standard Organization of Nigeria standard for portable drinking water. This could mean proper filtration, sedimentation, aeration, flocculation, ion exchange, ozonation and other water treatment is carried out before packaging*.

Keywords: *heavy metals, packaged water and water quality.*

1. Introduction

Water is an essential element in the maintenance of all forms of life and most living organism can survive only for short period without it (Pat, 1992, Kegley and Andrews, 1998). Water plays a key role in prevention of diseases; drinking eight glasses of water daily can decrease the risk of colon cancer by 45% and bladder cancer by 50% as well reducing the risk of other cancers (APEC, 1999). Water is one of the major abundant compound found in nature, covering approximately three fourth of the earth surface, inspite of this apparent abundant several factors serve to limit the amount of water available for human use (Balogun, 2007). Addition to being in abundant supply, the available must have specific characteristic signifying its quality (Deborah, 1996).

Water is of the most important of all natural resources. It is vital for all living organisms. Accessibility and availability of fresh clean water is a key to sustainable development an essential element in health, food production and poverty reduction (Maureen N.B etal, 2012). As important as water may be, its economics importance as a medium of water related which constitutes a significant percentage of the diseases that afflict human, must not be over –looked. An estimated 1.2 billion around the world lack access to safe water [United Nations Non-Governmental Liaison Services (NGLS) Third World water Forum on water, 2003]. Every twenty second, a child dies from a water related disease (WHO, 2009). Diarrhea remains the second leading cause of death among children under five globally. Nearly one in five child deaths – about 1.5 million each year is due to diarrhea. It kills more young children than AIDS, Malaria and Measles combined (WHO, 2009).

Various researchers have reported on the serious and severe illnesses like typhoid, cholera, dysentery etc resulting from the use of contaminated water supply (Okuofu, A.C et al 1990, Onuh, C.A and Gongchi L.C 1998 and Antai, S.P and Anozei S.O 1987).

The quality of drinking water is a function of treatment and natural process as well as anthropogenic activities. Nitrate compounds, heavy metals pesticides etc that are contained in our drinking water can also constitute undesirable pollutant when they are not within World Health Organization (WHO) guidelines for drinking water (WHO, 1996). From environmental standpoint, there is a need to ascertain the level of water quality of a locality to avoid or reduce some of the health hazards (Maureen, B.N etal, 2012).

Water quality assessment has become a big issue today because of the potential hazards associated with the use of contaminated drinking water. Contamination of drinking water from any source is therefore of primary importance because of the danger and risk of water borne disease (Edema, M.A etal, 2001).

Heavy metal contamination of water is a worldwide environmental problem affecting water resource (Tukura etal, 2014) because of their strong toxicity even at low concentration. Heavy metals are natural components of the earth's crust and they can enter the water and food cycles through a variety of chemical and geological processes (Nkansah, M. A and Ephraim, J.H, 2009 and Obi, C.N and George P, 2011). Exposure to unsafe level of heavy metals can cause serious health effects with varying symptoms depending on the nature and quantity of the metal ingested (Kucuksezgm, F. Uluturhan, E and Batki, H, 2008, Uffia, I.D, Ekpo, F. E an Etim, D. E, 2013 and Adeyemi, D, Oloyede , O. B and Oladyi, A.T, 2007).

Heavy metals toxicity can result in damaged or reduced metal and central nervous function, lower energy level and damage to blood composition, lungs, kidneys, liver and other vital organs (Jamp, L. 2003) Long time exposure may result in slow and progressive physical, muscular and neurological degenerative processes such as muscular dystrophy and multiple sclerosis (Momodu M.A and Anyakora, C.A 2010 and Meghdapl P. etal, 2013).

Mechanism of metal toxicity include complexion of Heavy metal with proteins to form complexes in which carboxylic acid (-COOH) amine (-NH_2) and thiol (-SH) groups are involved. These modified biological molecules and lose their ability to function properly which result in the malfunction or death of the cells (Tukura etal, 2014). When metals bind to these groups, they inactivate important enzymes systems or affect protein structure which is linked to the catalytic properties of enzymes. This type of toxin may also cause the formation of radicals which are dangerous chemicals that cause the oxidation of biological molecules (Meghdad, P.etal, 2013).

2. Materials And Method

2.1. Description of Study Area

Nasarawa state is one of the thirty six state in Nigeria located centrally in the middle belt region of the country and lies between latitude 7^0 45^1 and 9^0 24^1 N of the equator and between longitude 7^0 and 90 37^1 E of the Greenwich Median (Adeyemi, D. etal 2007).

2.2. Sample Preparation

Water samples were bought from different producers and empty into pre-washed bottles, and 5cm^3 concentrated HNO_3 were added for preservation (APHA, 1985). Digestion of water samples was carried out (US EPA, 1983) 3cm^3 of concentrated HNO_3 was added and covered with a glass and heat gradually on hot plate and continuously added until digestion was completed. The solution was evaporated to near dryness and cooled. Small quantity of 1:1 concentrated Hcl was then added, warm and filtered and volume adjusted to 25cm^3 for heavy mental determination. Heavy metal contents were quantified using AAS. Internally added standard were used for calibration of the AAS.

3. Results And Discussion

The samples were mainly collected from five local government of the state and more samples were collected where the population is denser: the major source of this drinking packaged water is from borehole exception of the sample taken from Akwanga which the producer collects treated water from Nasarawa state water board. The Variation of these heavy metal in Lafia the headquarter of the state show high variation in magnesium which range from 0.160 to 2.030mg/l with the mean value of 1.350mg/l even though this is within the limit allowed for drinking water (2.00mg/l) by the WHO. This show that Lafia soil is somehow rich in magnesium which leached to the ground water, the know effect of magnesium concentration at a higher concentration above the WHO standard is that it cause staining of pipes and taste problem in water (WHO 2011). Majority of this heavy metal were actually low in the packaged drinking water produced in Lafia probably the efficiency of the treatment machines which contain resin in the buildup industrial filter for removal of ions is good and also since Lafia is not industrialized water pollution through anthropogenic activities is less. In sample A for Lafia Mn, As, Pb were not detected probably their concentration is below the detection limit for AAS. The variation of this heavy metal is show in table1.

Table below (Table1) shows concentration of heavy metals (mg/I) of packaged drinking water in Lafia.

Table1

Element	S/N	A	B	C	D	E	F	G	H	Mean	NIS
Fe	8	0.010	0.070	0.040	0.120	0.120	0.120	0.110	0.06	0.080	0.30
Zn	8	nd	0.030	0.020	0.020	0.020	0.050	0.040	0.000	0.020	3.000
Mg	8	1.570	1.650	0.160	0.410	1.410	1.410	1.150	2.030	1.350	2.000
Mn	8	nd	0.020	0.020	0.020	0.020	0.020	0.040	0.000	0.020	0.200
As	7	nd	0.002	0.006	0.008	0.008	0.008	0.008	-	0.006	0.010
Pb	8	nd	0.10	0.003	0.006	0.006	0.006	0.009	nd	0.006	0.010
Cu	7	0.100	0.040	0.030	0.030	0.030	0.020	0.040	-	0.041	1.00
Hg	7	nd	0.000	0.000	0.000	0.007	0.000	0.000	-	0.001	0.010
Cr	8	0.010	0.000	0.000	0.000	0.000	0.010	0.000	0.000	0.000	0.010
Cd	7	nd	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.003

Note: nd = not detected

NIS= Nigeria Industrial Standard, SON= Standard Organization of Nigeria

Keffi also have high value of Magnesium concentration ranging from 0.280 to 1.80mg/l with average value of 1.250m/l, this agreed with Okorafor etal who reported higher value of magnesium in borehole water from Calabar Municipal compared with other ions (2.94-4.65mg/l). Sample A for Keffi shown the value of iron 0.340mg/l which is higher than the set standard for drinking water quality in Nigeria (NIS, SON 2008) with the value 0.3mg/l. Actually apart from magnesium iron seems to be higher in most of the sample in Keffi compared with other ions this range from 0.100 to 0.340mg/l with mean value of 0.185mg/l. In all the samples studies from the five local government area mercury show the least concentration from 0.001 to 0.007mg/l. For all samples studies Cd, Ag, Cr, Cu, Pb, As Zn, Mn, and Mg were found to be within the standard for drinking water quality.

For Karu local government which is one of the most populated local government in the state due to its proximity to federal capital Abuja magnesium show a higher values ranging from 0.021 to 2.03mg/l with the average value of 0.82mg/l which is the highest among the Heavy metal assessed, this mean that all over the state the soil seems to be rich in magnesium deposit or waste which can also leached to underground water pollution is made up of mostly magnesium containing material which is responsible for this values that show all over the state.

All the metal studied are available in the samples investigated in Karu, even though at a concentration lower that the maximum allowable limit by the WHO and SON, but since they are present in minute concentration this show that over a time if attention is not given to proper sanitation there may be increase in the concentration.Comparing the average concentration of the Heavy metal assessment of these drinking water (packaged) from various producer in the five local government of studied with the Nigeria industrial standard from Standard Organization of Nigeria (NIS 554: 2007) all the values are within the standard permissible by Standard Organization of Nigeria for drinking water, this may be due to proper filtration sedimentation, aeration, ion exchange, reverse osmosis or even ozonation before packaging.

Table 2 shows concentration of heavy metals (mg/I) of packaged drinking water in Keffi

Table2

Element	SN	A	B	C	D	Mean	NIS
Fe	4	0.340	1.100	0.140	0.160	0.185	0.300
Zn	4	0.180	0.020	0.050	0.08	1.250	3.000
Mg	4	1.130	1.780	1.810	0.280	0.053	2.000
Mn	4	0.010	0.010	0.030	0.160	0.009	0.200
As	4	0.006	0.008	0.03	0.017	0.009	0.010
Pb	4	0.016	0.002	0.007	0.010	0.027	0.010
Cu	4	0.040	0.004	0.020	0.080	0.001	1.000
Hg	4	0.000	0.002	0.000	0.000	0.002	0.010
Cr	4	0.010	0.000	0.004	0.000	0.004	0.010
Cd	4	0.001	0.003	0.004	0.001	0.002	0.003

Table 3 shows concentration of heavy metals (mg/I) of packaged drinking water in Karu

Table3

Element	S/N	A	B	C	D	E	F	G	H	I	J	K	L	M	Mean	NIS
Fe	13	0.02	0.26	0.32	0.06	0.08	0.05	0.08	0.12	0.21	0.05	0.04	0.09	0.09	0.113	0.30
Zn	13	0.04	0.02	0.32	0.02	0.01	0.04	0.05	0.04	0.03	0.04	0.03	0.05	0.05	0.057	3.00
Mg	13	2.03	0.34	0.021	1.21	1.07	1.42	0.16	1.61	1.85	0.28	0.22	0.22	0.27	0.823	2.00
Mn	13	0.24	0.26	0.18	0.23	0.03	0.01	0.13	0.03	0.02	0.01	0.11	0.02	0.01	0.098	0.20
As	11	0.031	0.004	0.006	0.010	0.003	0.01	0.013	0.012	0.007	0.009	0.009	-	-	0.010	0.010
Pb	13	0.009	0.009	0.012	0.010	0.004	0.003	0.010	0.009	0.004	0.001	0.013	0.010	0.004	0.008	0.010
Cu	13	0.01	0.07	0.01	0.03	0.01	0.01	0.01	0.03	0.03	0.04	0.008	0.002	0.04	0.023	1.00
Hg	13	0.001	0.004	0.003	0.00	0.00	0.00	0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.001	0.010
Cr	13	0.01	0.01	0.01	0.01	0.00	0.04	0.00	0.001	0.006	0.003	0.004	0.001	0.001	0.007	0.010
Cd	13	0.003	0.003	0.002	0.002	0.001	0.00	-.002	0.00	0.00	0.002	0.002	0.001	0.001	0.002	0.003

Table 4 shows concentration of heavy metals (mg/I) of drinking in Nasarawa

Table4

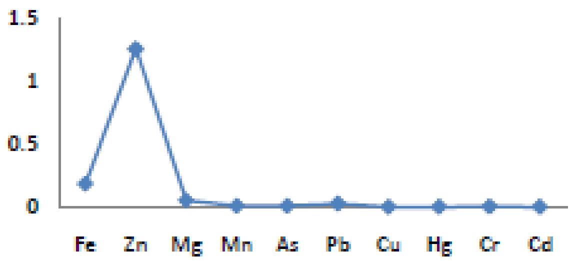
Element	SN	A	B	C	Mean	NIS
Fe	3	0.04	0.15	0.19	0.127	0.30
Zn	3	0.25	0.01	0.01	0.090	3.00
Mg	3	0.08	1.18	0.24	0.500	2.00
Mn	3	0.04	0.01	0.14	0.190	0.20
As	3	0.004	0.004	0.00	0.003	0.010
Pb	3	0.002	0.004	0.004	0.003	0.010
Cu	3	0.120	0.06	0.04	0.073	1.00
Hg	3	0.004	0.00	0.002	0.002	0.010
Cr	3	0.001	0.00	0.00	0.000	0.010
Cd	3	0.002	0.002	0.002	0.002	0.003

Table 5 shows concentration of heavy metals (mg/I) of drinking in Akwanga

Table5

Element	SN	A	B	Mean	NIS
Fe	2	0.09	0.320	0.205	0.30
Zn	2	0.05	0.127	0.090	3.00
Mg	2	0.27	0.140	0.205	2.00
Mn	2	0.24	0.100	0.170	0.20
As	2	0.004	0.003	0.004	0.010
Pb	2	0.009	0.011	0.010	0.010
Cu	2	0.04	0.180	0.110	0.010
Hg	2	0.002	0.002	0.002	0.010
Cr	2	0.001	0.001	0.001	0.010
Cd	2	0.003	0.002	0.003	0.003

Fig.2 Shows variation(mean) of heavy metal content (mg/l) of drinking in Keffi



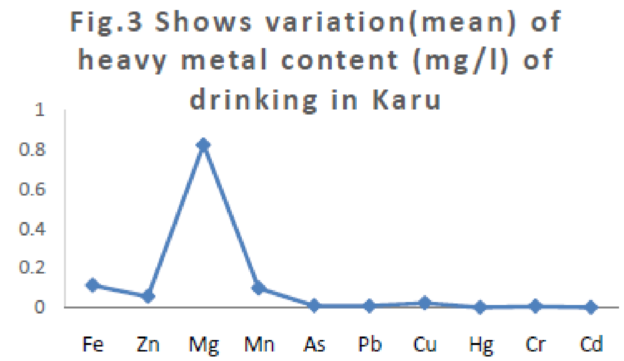


Fig.3 Shows variation(mean) of heavy metal content (mg/l) of drinking in Karu

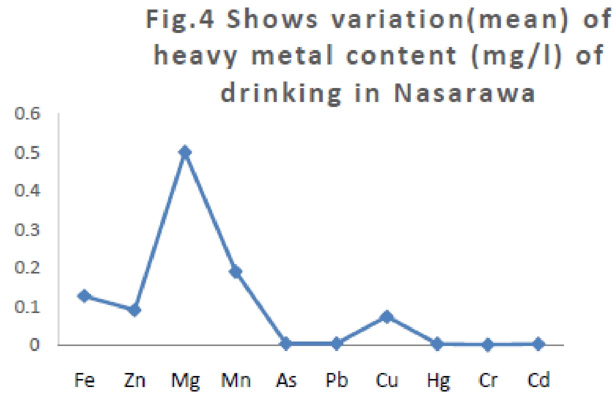


Fig.4 Shows variation(mean) of heavy metal content (mg/l) of drinking in Nasarawa

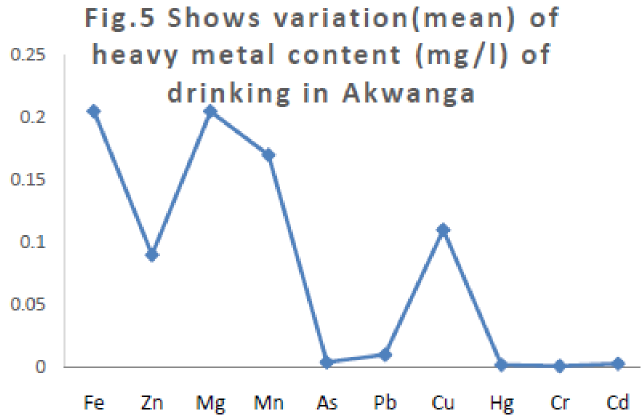


Fig.5 Shows variation(mean) of heavy metal content (mg/l) of drinking in Akwanga

4. Conclusion

Drinking unsafe drinking water may lead to several water borne diseases and other long and chronic health problems, therefore provision of safe drinking water is a basic need to human development, health and well-being and this called for proper treatment and monitory of those available in the market to ensure it conform to the required standard. Government should also come in with the aid of helping hand to provide proper treated water to it populace not leaving it in the hand of businessmen alone for so many people cannot afford the price.

Finally other aspect of the analysis like the physic chemical properties and microbiological status should also be carried out to be able to establish whether the water meet the specified standard from WHO and SON as the Heavy metal alone cannot be used to justified the suitability of the water.

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