IOSR Journal Of Pharmacy And Biological Sciences (IOSR-JPBS)
e-ISSN:2278-3008, p-ISSN:2319-7676. Volume 14, Issue 6 Ser. I (Nov –Dec 2019), PP 42-45
www.Iosrjournals.Org

Heavy Metal Profile of Sachet WaterSamples in Anambra State, Nigeria

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Abstract: *Access to potable water is a public health challenge in developing countries; Nigeria by no means an exception. Over one third of deaths in most developing countries are caused by water pollution with heavy metals being recognized as one of the most important contaminants of water. The concentrations of four heavy metals were determined in sachet water samples sold in Anambra State, Nigeria using Atomic Absorption Spectrophotometer (AAS). 10 samples (25%) have Zinc with concentration ranging from 0.000176 to 0.000439mg/L. No detectable amount of Iron was found in all (100%) of the samples. 0.00001mg/L of Lead was detected in only 2 (5%) of the samples respectively. 97.4% of the samples contained Calcium with their concentration ranging from0.00012 to 0.00696mg/L. The concentrations of the metals in all the samples were found to be below the WHO Maximum Permissible Limit in drinking water for each of the respective metal. Prolonged consumption of water contaminated by heavy metals may lead to bio-accumulation of these metals in the exposed individuals with hazardous effects on their health. Regulatory agencies should enforce the utilization of modern methods of water purification on sachet water producing companies to make them safer for human consumption.*

Date of Submission:02-11-2019 Date of Acceptance:18-11-2019

I. Introduction

Water in its purest form is odorless, tasteless, colorless, significantly free from micro organisms and turbidity and can be taken with no risk of harm [1]. It is a life sustaining drink which plays a crucial role in most biological and metabolic processes. However, access to potable water is a public health challenge in developing countries; Nigeria by no means an exception. This is largely due to contamination from inadequately controlled anthropogenic and industrial activities and by lesser extent natural conditions [2].

Consumption of water containing toxic chemicals leads to damages in the human body. The metals can accumulate in the human body over time, posing serious health risks to humans. Various authors [2], [3] reported that over one third of deaths in most developing countries are caused by water pollution with heavy metals being recognized as one of the most important contaminants of the water.

Heavy metals are defined as those metals with higher density than 5mg/ml[4] but the collective term now include arsenic, cadmium, chromium, copper, lead, nickel, molybdenum, vanadium, zinc, cobalt, aluminum, strontium and other rare metals. Though physiological roles are known for iron, copper, zinc and chromium in minute quantities but are most often linked to human poisoning when recommended limit is exceeded. Other heavy metals are not believed to be essential to health even in trace amounts [5], [6].

Lead is a neurotoxin, responsible for the most common type of human metal toxicosis; low-level lead exposure has been associated with reduced IQ and with attention deficit disorders in children [7], [8].

Surface water like streams, rivers, lakes and rain water form the ready sources of potable water in most rural communities in Nigeria while underground water (which is largely untreated and usually harnessed through bore holes and wells) and tap water are the potable water types for urban and semi urban cities[8]. Previous studies[9], [10], [11] have reported exceptionally high levels of heavy metals in ground water which exceeded the minimum contaminate levels specified by the World Health Organization (WHO).

In the last two decades, packaging of groundwater in sachets popularly referred to as "pure water," has become a thriving business in Nigeria. Improper purification and packaging by the production companies may lead to heavy metal contamination of these processed sachet water [12], [13].

[12] opined that despite these water packaging companies obtaining certification and number from the National Agency for Food, and Drugs Administration Control (NAFDAC), sachet water samples containing various concentrations of heavy metals including lead (Pb), chromium (Cr) and cadmium(Cd) which could lead to adverse health conditions if consumed for prolonged period, have found their way into circulation.

Considering the extensive consumption of sachet water, a greater number of the populace is exposed to heavy metal toxicity. This study therefore seeks to assess heavy metal contamination in sachet drinking water(the predominant source of drinking water) available to the Nigerian populace in Anambra State and compare the values obtained with the permissible limits established by WHO. This will aid to demonstrate the possible hazard to which Nigerians consuming sachet water may be exposed to and also provide evidence based information for regulatory policies and sensitization of the populace about the health implications of prolonged consumption.

II. Material And Methods

Study Area: Anambra is the 10th most populous Nigeria state with a population of 4,177,828[14]. The study covered three major cities and their neighboring towns in the state. These include Awka, Onitsha and Nnewi. Awka is the State capital and hosts 2 universities with the university community comprising 15% of her population. Onitsha is one of Nigeria's most significant market towns, with its market being one of the largest markets in West Africa. Nnewi is part of Eastern Nigeria's industrial axis. About 20 medium-to-large-scale industries have been established across a variety of sectors in the city and it is home to many major indigenous manufacturing industries[15].

Study Design: Prospective analytical study

Sampling:

Sachet water brands were purposively selected through the convenience sampling method. Thirty nine different samples were purchased from nineteen different towns categorized into three broad sites in Anambra State Nigeria:

Site A (Awka Area) - Nawfia, Abagana, Agulu, Awka, Amawbia, Nimo

Site B (Nnewi Area) - Nnewi, Nnobi, Oba and Ozubulu, Ihiala, Oraifite, Osumenyi.

Site C (Onitsha Area) - Nkpor, Ogidi, Obosi, Nsugbe, Ogbunike, Umudioka, Onitsha

These samples were subjected to analysis for heavy metals.

Sample Analysis

100 ml of each water sample were acidified with 20 ml of nitric acid. The mixture was digested in a fume cupboard for one hour at 100ºC until a clear solution was seen and the volume reduces to 20 ml. The mixture was transferred to 100 ml volumetric flask and diluted with deionized water and the mixture made up to 100 ml mark. The mixture was filtered with filter paper after cooling and analyzed for Lead, Iron, Calcium and Zinc using the Atomic Absorption Spectrophotometer.

III. Result

The results in tables 1-3 showed that 10 samples (25%) contain Zinc with concentration ranging from 0.000176 to 0.000439mg/L. No detectable amount of Iron was found in all (100%) of the samples. 0.00001mg/L of Lead was respectively detected in only 2 (5%) of the samples. With the exception of one, the rest (97.4%) of the samples contain Calcium with their concentration ranging from0.00012to 0.00696mg/L. The concentrations of the metals in all the samples were found to be significantly lower ($p<0.05$) than the WHO Maximum Permissible Limit in drinking water for each of the respective metal [16].

Table1: Heavy Metal levels of Sachet water samples along Awka Area (mg/L)

Water Samples	Zinc	Iron	Lead	Calcium
O' Polar	0.00031	—	—	0.00106
Dove	0.00044	—	—	0.00583
Kana	0.00026	—	—	0.00103
Gina	0.00031	—	—	0.00048
Rainbow	0.00030	—	—	0.00139
Lekmor	—	—	—	0.00123
Len	—	—	—	0.00305
Bevinas	—	—	—	0.00696
Mel	—	—	—	0.00221
Marvel	—	—	—	0.00065
Royal	0.00035	—	—	0.00182
Divine Grace	—	—	0.000009	0.00173
Ocean Royal	0.00031	—	0.000009	0.00187
Olek	—	—	—	0.00086
Purmer	—	—	—	0.00149
WHO MPL	3.00000	0.30000	0.01000	75.0000

Table2: Heavy Metal levels of Sachet water samples along Nnewi Area(mg/L)

Water Samples	Zinc	Iron	Lead	Calcium
Delight	—	—	—	0.00014
Kostal	—	—	—	—
Ogoo	—	—	—	0.00024
Good Life	—	—	—	0.00014
WHO MPL	3.0000	0.30000	0.0100	75.00000

Table3: Heavy Metal levels of Sachet water samples along Onitsha Area(mg/L)

Water Samples	Zinc	Iron	Lead	Calcium
Lucky	—	—	—	0.00051
Nwaziki	—	—	—	0.00247
Paani	—	—	—	0.00540
UTESC	—	—	—	0.00526
Daddy	—	—	—	0.00077
Destiny	—	—	—	0.00065
Alive	—	—	—	0.00154
Sylvers	—	—	—	0.00055
Winners	—	—	—	0.00019
Canada	0.00018	—	—	0.00223
Madona	—	—	—	0.00043
Sofana	—	—	—	0.00283
Nation	—	—	—	0.00017
Galaxy	—	—	—	0.00230
Mountain	0.00022	—	—	0.00129
Nature	0.00026	—	—	0.00063
Hygiene	—	—	—	0.00046
Legend	—	—	—	0.00034
Linas	—	—	—	0.00065
Royal Queen	—	—	—	0.00012
WHO MPL	3.0000	0.3000	0.0100	75.000

IV. Discussion

The results obtained from this study clearly indicated that the heavy metal contamination of the water samples is below the WHO Maximum Permissible level. This observation agrees with the view of [12], who reported the presence of heavy metal in sachet water in quantities below WHO Permissible Levels.

Presence of these metals in the drinking water can be as a result of unorganized distribution of industries close to residential areas, farmlands and water sources; Untreated effluents from these industries leach into the surroundings, possibly contaminating the ground water and other water sources [15]. Studies have reported exceptionally high levels of heavy metals in ground water which exceeded the minimum contaminate levels specified by the World Health Organization WHO [10], [11], [17], [18]. It is a well-known fact that most sachet water producing companies depend on ground water or bore holes for their water source [8], [12], [13].

Trace metals are required by the body in small amount for various metabolic activities but at high concentrations, they can cause adverse effects to the body. On the other hand, toxic metals have no beneficial effects in humans. Exposure to them leads to toxic human health effects [5]. Prolonged consumption of heavily contaminated water may lead to bio-accumulation of these metals in the exposed individuals with deleterious effects on their health. Additional consumption of canned food by these individuals can also aggravate the situation, as studies have shown that most canned foods and beverages commonly sold in Nigeria contain high levels of heavy metals [8].

Modern methods for purification of water should be employed by sachet water producing companies to make them safer for human consumption. Also, the location of bore holes for the production of sachet water should be sited far from heavy metal deposit sites or other industrial sources of contamination, to avoid heavy metal contamination.

V. Conclusion

Stringent measures should be continually enforced on the water packaging industries by the regulatory agencies to ensure quality control and increase confidence in the safety of the sachet drinking-water

References

[1]. M.F.R. Zuthi, M. Biswas, and M.W. Bahar, Assessment of supply water quality in the Chaittagong Town of Bangladesh, ARPN Journal of Engineering and Applied Sciences l 4, 2009.
[2]. O.E. Bolawa and O.S. Adelusi, Determination of Heavy Metal Profile in Bottled Water and Sachet Water Samples Obtained From Various Markets in Lagos, Nigeria Environment Pollution and Climate Change, 1(2), 2017,
[3]. T.J. Chang, D.S. Ke, H.R. Gu, The association between arsenic exposure from drinking water and cerebrovascular disease mortality in Taiwan, Water Research 44, 2010, 5770-5776.
[4]. L. Jarup, Hazards of heavy metal contamination, British Medical Bulletin 68, 2003, 167-182
[5]. J. Buschmann, M. Berg, C. Stengel, L.Winkel, M.L. Sampson, Contamination of drinking water resources in the Mekong Delta flood plains; Arsenic and other trace metals pose serious health risks to the population, Environment International 34, 2008, 756-764.
[6]. C.V. Mohood, and J. Dhate, Review of heavy metals in drinking water and their effects on human health, International Journal of Innovative Research, Science and Technology, 2(7) 2013, 2319-8753.
[7]. H.L. Needleman, The current status of childhood low-level lead toxicity, Neurotoxicology, 14, 1993, 161–166.
[8]. O.I. Orisakwe, I.O. Afonne, J.U. Maduabuchi, E.O Obi, and J.C. Nduka, Heavy metal hazards of sachet water in Nigeria, Archives of Environmental and Occupational Health , 61 (5), 2006, 209-213.
[9]. A.I. Mohammed, and S.G. Gupta, Studies on heavy metals on pollution of ground water sources as an effect of Municipal solid waste dumping in the Mumbiou and Beed, India. African Journal of Basic and Applied Science. 5(6), 2009, 117-122.
[10]. H.O. Nwankwoala, G.J. Udom, and S.A. Ugwu, Some Heavy Metals Investigations of Ground water sources in Yenegoa, Bayelsa state, Nigeria, Journal of Applied Technology in Environmental Sanitation 1(2), 2011, 163-177.
[11]. information AITBS publishers, New Delhi. 2 (2), 1999, 119-138.
[12]. S. N. Ukibe, N.R. Ukibe, L.C. Ikeako, A.N. Okpogba, A.C. Obi-Okaro and P. C. Nwankwo, European Journal of Scientific Research,139 (2), 2016,104-108
[13]. T.S. Ogutona, O.O. Adedeji, and O.C. Martins, Contamination of sachet water produced within Industrial areas of Ikeja, Lagos, Nigeria, Transnational Journal of Science and Technology, 2, 2012, 1-7
[14]. Nigerian National Population Commission (NPC) 2006 census.
[15]. I.C. Maduka, and C.O.C. Ibe, Air Pollution Tolerance Index of Some Edible Plants Exposed to Industrial Effluents at Nnewi in Anambra State, Nigeria, IOSR Journal of Science, Toxicology and Food Technology, 13 (8) 2019, 34-38
[16]. World Health Organization WHO, Guidelines for drinking water quality, World Health Organization, Geneva, 4, 2011
[17]. G.N. Njiiar, A.I. Iwara, R.A. Offong, and T.D. Deekor, Assessment of heavy metal statue in boreholes in Calabar South Local Government Area, Cross River State, Nigeria, Ethiopian Journal of Environmental Science and Management 5 (1), 2012
[18]. M.A. Momodu, and C.A. Anyakora, Heavy Metal Contamination of ground water: Surulere, Lagos case study, Research Journal of Environmental and Earth Science 2(1), 2009, 39-43.

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IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS) is UGC approved Journal with Sl. No. 5012, Journal no. 49063.

"Ndubisi A.C and Ibe C.O.C" Heavy Metal Profile of Sachet WaterSamples in Anambra State, Nigeria" IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS) 14.6 (2019): 42-45.