Advances in Science and Technology, Vol. 11, No. 2, September / October 2017, pp 68 - 71

Assessment of Physicochemical Parameters and Level of Toxicants in Some Bottled Water Sold in Owerri

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(Submitted: October 5, 2017; Accepted: October 25, 2017)

Abstract

The quality of bottled water sold in Owerri, Imo State of Nigeria was investigated in March, 2015. Water samples obtained from a total of six bottled water companies within Owerri were analyzed for their physicochemical and microbial contents. Results were compared with international water quality standards (WHO, NAFDAC and SON). The physicochemical data obtained for the heavy metals (Hg, Fe, Pb, Cr and Zn) were in conformity with the international standards. However, the pH of two of these bottled water samples namely sample C (5.55 ± 0.1) and sample D (6.13 ± 0.1) were not in tandem with the recommended value (pH 6.5 – 8.5) and are therefore not suitable for human consumption. Microbial assay on the water samples randomly purchased in the market gave data which were indicative of the absence of coliform, E.coli, feacal streptococci, clostridia and other coliform family of bacteria.

Keywords: bottled water, assessment, physicochemical parameters, Owerri.

1.0 Introduction

In recent times, there has been an increase in the proliferation of large scale industries which specialize in water packaging popularly known as bottled water. This is very rampant in major cities in the country where young people of school age are seen amidst heavy traffic flow hawking and selling bottled water (Editorial (1998).

Bottled water is processed water, packaged in plastic bottles for drinking. The global demand and consumption of this packaged water has increased significantly over the past decades and majority of these packaged water are sold in the streets of Owerri. The source of this bottled or sachet packaged water in some cases are polluted and processed and packaged under unhygienic conditions. In some cases, the persons packaging the water may not be properly dressed by putting on their hand gloves and head gears as the case may be (Akim 1991).

Recently, there has been a serious monitoring and regulation by the National Agency for Food and Drug Administration and Control (NAFDAC) over the producers of bottled water (NAFDAC, 2000). This is to ensure good quality standard of bottled water in the markets. Despite the enormous existing laws governing water packaging and bottling in the country, several poor quality bottled water are sold in our streets, motor parks and market places to unsuspecting population. The decree of 1993 established NAFDAC as the regulatory body mandated to promote, protect and guarantee the health and well being of Nigerians through effective implementation of various laws controlling and regulating the manufacture, advertisement, distribution, sale and use of drugs, foods, cosmetics, bottled water and chemicals to ensure that quality pure and wholesome drinking water is made available at all times (Melnick 1998).

Everybody needs fresh quality water so as to ensure the sustenance of life. Human beings need a constant supply of fresh waters if they are to stay alive and healthy. The human body is a conglomeration of chemicals and two-thirds is water. In the total supply of water on earth, only about three percent of it is fresh (see Acholonu and Jenkins 2007). In nature water is stored as ice and snow deep under the earth.

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Despite so much of the water being out of reach, we still have a million of it we can use, that's about 4,300,000 cubic kilometers of fresh water to share between plants, animals and people as well as plants (NAFDAC, 2000).

In recent years, a growing interest has emerged for a study into the purity of bottled water produced for human consumption. This is because many of these bottled or sachet packaged water producers do not pass the mandatory regulatory standards. As a result, some water-borne diseases like cholera, typhoid, diarrhea and other health effects manifest in the body of consumers as soon as they consume this poor quality water (see International Water Management Institute, 2010). A call has been made to help checkmate whether the producers meet up to the standard of the parameters prescribed for good quality drinking water by the World Health Organization (WHO) and the internal monitoring agencies (World Health Organization 2003). It is for this reason that this research was designed to investigate and analyze the quality of the randomly selected water samples, we shall also determine if the samples contribute to any of the water borne diseases and the level of purity of the bottled water samples sold in Owerri.

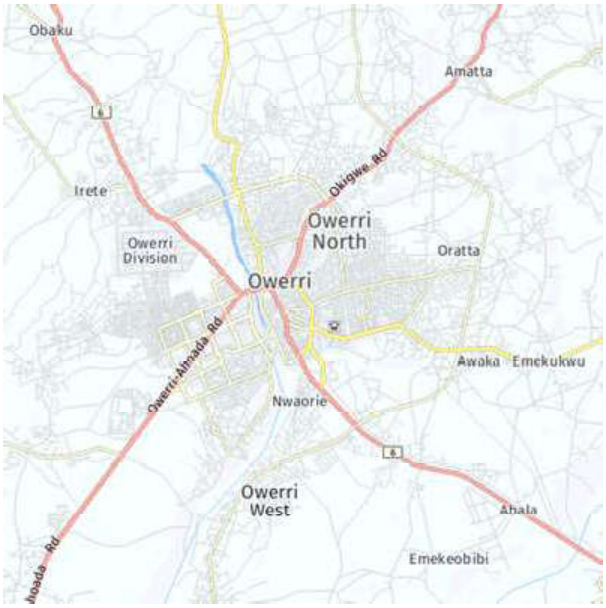

Figure 1: Map of Owerri Showing Sampling Locations

2.0 Materials and Method

2.1 Description of study area

Half a dozen of the water samples were bought from selling shops at Ihiagwa Market (Owerri West), Ekeukwu Market (Owerri Municipal) and OrieObibi Market (Owerri North), all in Owerri.Owerri is the capital of Imo State, South East Nigeria and its geographical coordinates are latitude $6^0$45'E and longitude $5^0$45'N.

2.2 Water Sample Collection, Preparation and Analyses

The water samples were randomly collected at shops where bottled water is sold in three local government areas within Owerri. Standard buffers were prepared for the standardization and calibration of the pH meter before the pH of the samples were determined. Other physicochemical parameters that were determined in the laboratory include; total hardness chloride, Bicarbonate, TDS (using HM Digital TDS meter 4) and electrical conductivity (using Hanna EC Conductivity meter). Heavy metals (Hg, Pb, Cr, Fe, Zn) analyses were performed as described by Egereonu *et al*. (2012) using S Unicam Solar 969 Atomic Absorption spectrophotometer.

2.3 Data Analysis

Analysis of variance (one-way ANOVA) was employed to determine the difference between the values of physicochemical parameters of the various bottled water samples. SPSS (Statistical Package for the Social Science) software was used for data analysis as data were presented as arithmetic mean and standard deviation. However, the F-test was used to observe for significance in Physicochemical values between bottled water samples.

3.0 Results and Discussion

3.1 Results

The results are presented in Tables 1 and 2.

3.2 Discussion

Table 1 shows the mean values of physiochemical parameters, organoleptic paramaters and heavy metal contents of the six bottled water samples.

The F-test between sample a and b was used to determine significance with values of physicochemi-

Table 1: Mean concentrations of physiochemical parameters of water samples

Water quality parameter	Sample A	Sample B	Sample C	Sample D	Sample E	Sample F	WHO 2013
pH At 29^{0}C	6.581±0.1	6.62±0.3	5.55±0.1	6.13±0.1	6.79±0.2	7.29±0.1	6.5-8.5
TDS (mg/L)	43.1±0.1	14.26±0.1	13.2±0.1	8.75±0.0	65±0.0	16.3±0.0	500mg/L
Appearance	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Conductivity (µs/cm)	93.4±0.0	31.1±0.0	28.7±0.2	18.87±0.3	56.3±0.1	35.5±0.1	1000µs/cm
Total hardness (mg/L)	3.0±0.2	7.26±0.1	3.3±0.1	2.10±0.0	4.90±0.1	16.1±0.1	100mg/lL
Hardness Index	2.2533	4.7703	5.5745	5.6334	7.0846	3.1766	
Chloride (Mg/L)	10.5±0.0	11.61±0.2	11.93±0.1	13.05±0.1	20±0.0	10.51±0.0	100Mg/L
Bicarbonate (Mg/L)	52±0.0	18±0.0	18.00±0.0	16±0.0	13±0.0	5.183±0.0	100mg/L
Nitrate (Mg/L)	18.91±0.0	64.34±0.1	22.4±0.0	12.33±0.0	0.2±0.1	13.7±0.1	10mg/L
Nitrite (Mg/L)	4.25±0.0	14.4±0.0	5.03±0.1	2.72±0.1	0.3±0.2	3.1±0.2	0.02mg/L
Sulphate (Mg/L)	2.9±0.0	0.66±0.0	2.82±0.1	0.49±0.0	22±0.0	77.0±0.0	10mg/L
Iron (Mg/L)	0.0347±0.0	0.1867±0.0	0.1555±0.2	0.1045±0.0	0.2311±0.0	0.2311±0.0	0.3mg/L
Magnessium (Mg/L)	1.0456±0.0	2.7256±0.0	2.4118±0.0	3.0152±0.0	1.0526±0.0	1.1543±0.0	0.2mg/L
Calcium (mg/L)	1.2077±0.0	2.0447±0.0	3.1627±0.2	2.6182±0.0	6.03±0.1	2.0223±0.0	7.5mg/L
Mercury (Mg/L)	ND	ND	ND	ND	ND	ND	0.02mg/L
Lead (Mg/L)	ND	ND	ND	ND	ND	ND	0.05mg/L
Chromium (Mg/L)	ND	ND	ND	ND	ND	ND	0.05Mg/L
Zinc (Mg/L)	ND	ND	ND	ND	ND	ND	5.0mg/L

ND: Not Detected

Table 2: Result for Microbial Assay

Sample	Plate Count	Dilution Factor	Orgm Per ml	Laecal Streptococci	E. coli Count	Chostridum Count	Other Coliform
Sample A	Nil	10^{-2}	Nil	Nil	Nil	Nil	Nil
Sample B	Nil	10^{-2}	Nil	Nil	Nil	Nil	Nil
Sample C	Nil	10^{-2}	Nil	Nil	Nil	Nil	Nil
Sample D	Nil	10^{-2}	$3x10^2$	Nil	Nil	Nil	Nil
Sample E	Nil	10^{-2}	Nil	Nil	Nil	Nil	Nil
Sample F	2.0	10^{-2}	2.0	Nil	Nil	Nil	Nil

cal parameters in each of the six table bottled water samples. The F-tests between sample a and b for sample A, B, C,D,E and F are 2.25, 1.57, 1.00, 1.23, 1.88 and 1.00 respectively. These values were tested at 15 degrees of freedom and $p<0.05$ indicating no significance in the values of physicochemical parameters for both samples in all six table bottled water samples.

Table 2 shows the results for the microbial load of the water samples. There were no coliform which denotes satisfactory results. However, amoebic dysentery, typhoid fever, soar throat and stomach poison are health concerns if *E. coli*, salmonella, feacal streptococci and clostridium are present respectively (Davis and Cornwell 1991).

4.0 Conclusion

This research has investigated the physicochemical parameters and heavy metals of six table bottled water samples sold in Owerri, Imo State, Nigeria. With the exception of sample C (5.55± 0.1) and sample D (6.13±0.1), other water samples investigated recorded consistent pH values and are therefore suitable for human consumption. However, the pH of sample F (7.29±0.1) was outstanding among others.

Heavy metals (Hg, Fe, Cr, Zn, Ca, Mg, Pb) were not contained in the samples. Some of the metals were not detected at all while the concentrations of those detected conformed to the WHO standards.

Microbial assay on the samples confirmed the absence of E.coli, feacal streptococci, coliform, clostridia and other coliform family of bacteria in the water samples.

Hence, the absence of microbes and heavy metals is an indication that the water samples investigated do not contribute to any of the water borne diseases in Owerri (Technical Guidance Note, 2014).

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