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Physico-chemical Evaluation of Selected Bottle Waters Produced in Nnewi North Metropolis, Nigeria

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Abstract Evaluation of physic-chemical characteristics of water quality of some bottle waters produced in Nnewi-North metropolis was carried out with the intent of establishing the portability and quality of these bottle water supplied to the public. Water samples were purchased from those shops around Nkwo Nnewi and Okpunoegbu. The physico-chemical parameters were analyzed using various standard methods. The range of values obtained from the parameters were: pH (6.53-7.01), conductivity (0.16-1.07μcm^{-1}), TDS (ND-0.08mg/l), TSS (ND-0.11mg/l), TS (ND-0.19mg/l), chloride (10.00-100.00mg/l), sulphate (89.00-100.00mg/l), nitrate (1.00-10.00mg/l), nitrite (ND-0.07mg/l), magnesium (ND-0.19mg/l), iron (0.09-0.28mg/l), zinc (1.99-4.88), copper (ND-0.98mg/l), cadmium (ND), lead (ND), methyl red alkalinity (8.00-19.00mg/l), residual chloride (ND-0.10mg/l), and hardness (10.00-112.0mg/l). All the parameters so determined were within or slightly above the Nigeria Industrial Standard(NIS) 2008. The hardness value of (112mg/l), though higher than the NIS standard do not pose a health hazard. In fact, the National Research Council (National Academy of Science) states that hard drinking water generally contributes a small amount towards total calcium and magnesium human dietary needs.

Keywords Evaluation, Water quality, Nnewi-North, NIS standard, Trace metal

Introduction

Water is one of the most common substances known in our planet, vital to all life forms. It is by far most abundant component in man. Water occupies about 70% of the body mass of human beings. Various anthropogenic activities involve the use of water. Water in the environment is indispensible to man as it is required for domestic, agricultural and industrial uses. Adversely, water if contaminated, has a great potential of transmitting disease and illnesses [1]. The amount of drinking water required is variable. It depends on physical activity, age, health issues and environmental conditions [2]. Water makes up about 60% of weight in man and 55% of weight in women [3]. Infants are about 70% to 80% water while the elderly are around the 45% [4]. In developed countries, tap water meets drinking water quality standard, though only a limited portion is actually consumed or used in preparation of food. Other uses include washing, toilets, and irrigation. Use of grey water for toilets or irrigation may however be associated with risks [5]. Water may be unacceptable due to levels of toxins or suspended solids. Reduction of water borne disease and development of safe water resources is a major public health goal in developing countries like Nigeria. Bottle water is sold for public consumption in most parts of the world, Nigeria inclusive.

Drinking water contribution to mineral nutrients intake is unclear. Inorganic minerals generally enter surface water and ground water through storm runoff or through the Earth's crust. Treatment process equally leads to the presence

of some minerals. Example include calcium, zinc, manganese, phosphate, fluoride, and sodium compounds[6]. There are a variety of trace elements present in virtually all portable water, some of which play a role in metabolism. For instance sodium, potassium and chloride are elements that are commonly found in small quantities in most water and they play a role in body metabolism. Some elements are beneficial in low concentration, but can cause problem at higher concentrations like fluoride which can cause dental problem if present at high levels.

Contaminated water is estimated to result in more than half a million death per yea [5]. Contaminated water together with lack of sanitation was estimated to cause about one percent of disability adjusted life years worldwide in 2010[7]. Chemical parameters tend to pose more of a chronic health risk through buildup of heavy metals although some components like nitrate/nitrite and arsenic can have a more immediate impact. Physical parameters affect the aesthetics and taste of the drinking water and may complicate the removal of microbial pathogens.

Nnewi-North is a local government Area in Anambra state, South-East Nigeria. Nnewi is the second largest city in Anambra state in Southeastern Nigeria and encompassed four local government area; Nnewi-North, Nnewi-South, Ekwusigo and Ihiala Local Government Areas . Nnewi-North is commonly referred to as Nnewi central, and comprises four autonomous quarters: Otolo, Uruagu, Umudim, and Nnewichi. Nnewi-North also includes Ichi, an autonomous neighboring town.

Geographically Nnewi falls within the tropical rain forest region of Nigeria. Though it surfers from soil leaching and erosion which has reduced the soil in some areas to a porous and sandy terrain, it remains an area of rich agricultural produce and the epicenter of business trade. Industries are dotted around the city and adjoining towns. Palm oil, cosmetics, water, and motorcycle spare parts, books, and stationeries, textiles, electric cables, and so on are produced in commercial quantities in the area[8]. The impacts of the industries have on the water produced in this region necessitated the need for this study, in view of the dense population of the community. More so there are no recorded studies on the water quality in this area.

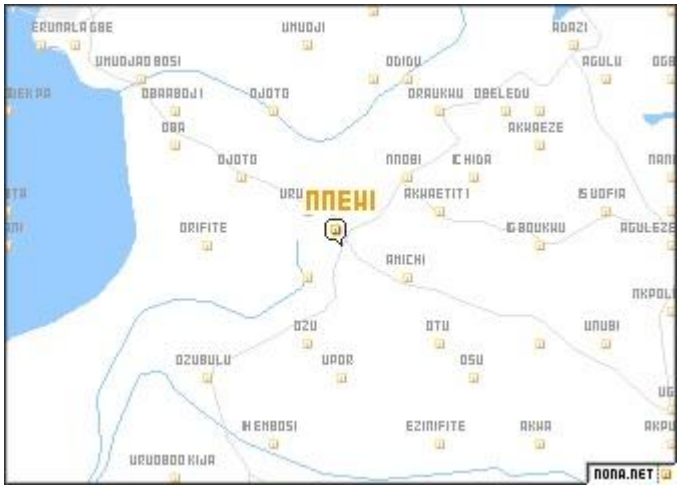

Figure 1: Map of Nnewi

Materials and Methods

Five bottle waters were selectively sampled. Each bottle was purchased in duplicate from two different whole sellers at Okpunoegbu market and Nkwo market.

The appearance, odour, taste, conductivity and pH were determined on getting to the laboratory using methods described by Gaines and Greenberg [9-10]. The pH and conductivity were determined using Consort digital pH meter and Consort conductometer respectively. The remaining samples were preserved in a refrigerator. Various standards methods [9-11] were adopted to determining total dissolved solid (TDS), total suspended solid (TSS), total solids (TS), methyl red alkalinity, and hardness. Measurements of other physico-chemical characteristics of the

water samples were carried out using standard methods [12]. Concentrations of a number of trace and heavy metals; magnesium, iron, zinc, copper, lead, and cadmium were measured using the Atomic Absorption Spectrophotometer - Rayleigh, WFX-320.

Results and Discussion

The mean values of the physico-chemical parameters of the bottle waters from Nnewi –North Metropolis are represented in Tables 1 and 2 respectively.

Table 1: Results of physico-chemical parameter of some bottle waters produced in Nnewi-North Metropolis

Parameter	NIS 306:2008 standard	BW 1	BW 2	BW 3	BW 4	BW 5
Net volume (ml)	Labeling	500.00	500.00	500.00	502.00	510.00
	Conformity to labeling	Failed	Passed	Passed	Failed	Failed
Appearance		Clear liquid				
Odour		Unobjectionable				
Taste		Unobjectionable				
pH	6.50-8.50	6.57	7.01	6.53	6.59	6.69
Conductivity (μcm^{-1})	1000.00	0.21	0.51	1.07	0.16	0.27
TDS(mg/l)	250.00	0.08	ND	0.02	ND	ND
TSS(mg/l)	250.00	0.11	ND	ND	ND	ND
TS(mg/l)	500.00	0,19	ND	0.02	ND	ND
Chloride (mg/l)	100.00	81.00	95.00	100.00	10.00	98.00
Sulphate (mg/l)	100.00	89.00	89.00	100.00	100.00	95.00
Nitrate (mg/l)	10.00	10.00	8.16	10.00	1.00	10.00
Nitrite (mg/l)	0.02	0.01	0.04	0.07	ND	0.02
Methyl red alkalinity (mg/l)	100.00	19.00	10.00	12.00	8.00	10.00
Residual chloride (mg/l)	0.10	0.10	0.10	0.10	0.10	ND
Hardness (mg/l)	100.00	112.00	60.00	10.00	80.00	80.00

ND=Not detected.

Table 2: Results of Metal Concentrations (mg/l) in the bottle waters

Metal	Concentration(mg/l)					
	BW1	BW 2	BW 3	BW 4	BW 5	WHO Standard
Magnesium	ND	0.19	0.15	0.17	0.5	0.20
Iron	0.21	0.25	0.27	0.09	0.28	0.30
Zinc	4.00	4.53	3.89	1.99	4.88	5.00
Lead	ND	ND	ND	ND	ND	0.01
Cadmium	ND	ND	ND	ND	ND	0.03

ND=Not Detected; BW=Bottle Water. ;

The appearance, odour, and taste were in conformity with the NIS standard for drinking water. The range of the pH values were 6.53 - 7.01 and conductivity 0.21 - 1.07μcm^{-1} and are, however within the permissible limits of 6.5 - 8.5 and 1000.00μcm^{-1} respectively. This indicated low level of some ions[13]. The linear relationship between electrical conductivity and Total Dissolved Solid was clear here. While the TDS of other samples were not within the detectable limit of the equipment used, it was only one sample (BW3) that had value of 0.02mg/l. The greater the electrical conductivity, the greater the TDS[14]. The low value recorded could depict nil or low corrosion potential.

The range of nitrate values was 1.00-10.00mg/l. Though within the NIS permissible limit of 10.00mg/l, may be considered to be cumulative toxin[14]. High level of nitrate in water may give rise to cyanosis and "blue-baby syndrome" in infants. The ranges of chloride concentration 10.00-100.00mg/l, methyl red alkalinity 8.00-19.00g/l, and residual chloride ND-0.10mg/l are all within the WHO permissible limit for drinking water[15]. The level of

hardness indicated high value (112mg/l) for one of the samples (BW1). The hard water in Nigeria can be generally classified into soft water (0.55ppm) slightly hard water (0.56-100ppm) and moderately hard water (101-200ppm) on the basis of Sawyer and McCarty[16]. Based on the classification, the bottle waters produced in Nnewi-North local Government Area may be soft or moderately hard water.

Metal analysis gave the range of values as follows: magnesium ND - 0.19mg/l, iron 0.09 - 0.27mg/l, zinc 1.99 - 4.88mg/l, while lead and cadmium were not detected by the instrument used. The values are within the permissible limit for drinking water and prove the water free from any toxic metal determined.

Conclusion

The results from studied bottle waters have shown that most bottle water produced in Nnewi-North metropolis are safe for drinking. However, the bacteriological aspect of the bottle waters should be done to confirm the water free from any form of contamination.

References

1. Okeola, F.O., Kolawole, O.D., & Ameen, O.M., (2010). Comparative Study of Phsico-chemical Parameters of Water from a River and its Surrounding Wells for Possible Interactive Effect. *Advances in Environmental Biolgy*.4(3),336-340
2. Grandjean, C.A., (2004).”3”. *Water Requirement, Impinging Factors, and Recommended Intakes* (pdf). World Health Organization. Pp25-34.
3. Miller, T.A., (2006). *Modern Surgical care physiologic foundations and clinical applications. 3rd ed.* New York: Informa Healthcare.p34.
4. Jones and Bartlett Learnin. (2002). *Nancy caroline’s emergency care in the streets.07ed*. S.I. p340.
5. ^abcdef “Water Facts Sheet Ni371” July 2014. Retrieved 24 May 2015.
6. Donolue, J.M., Abernathy, C.O., Lassavszky, R., & Hallberg, G., (2004). *The contribution of drinking water to total dietary intake of selected trace mineral nutrients in the United States*. World Health Organization (WHO) Geneva, Switzerland.
7. Eugell, R.E., Lim, S.S., (2013).”Does clean water matter? An updated meta-analysis of water supply and sanitation interventions and diarrheal diseases”. The Lancet 381:344.
8. Nnewi Union Atlanta.”*Introduction to Nnewi*. Retrieved 08-05-2015.
9. Gaines, B.J., (1993). *Applied Water and Spent Water Chemistry*. A Laboratory manual. Van Nostrand Reihold-New York, Pp168-172.
10. Greenberg, A.E., Clescari, L.S., & Eaton, A. D., (1992). *Standard Methods for the Examination of Water and Waste Water.1st ed.,* APHA-AWWA-WEF: Washington D.C. pp2-134.
11. Larson , T.E. & Henley , L.M., (1955). “*Determination of Alkalinity or Acidity in Water*” Analytical Chemistry. 27, 851.
12. APHA (American Public Health Association), (1998). *Standard Method for the examination of water and waste water, 21st ed*. Washington D.C.
13. Adepelumi , Ako , A., B., & Ajayi , I.T., (2001).Ground water contamination in Basement-complex area of Ile-Ife, Southwestern Nigeria: A case study using the Electrical-Resistivity of Geographical Method. *Hydrology Journal*, 9(6):611-622.
14. Nkasah , M.A., Boidi , N.O., & Badu, M., (2010). Assessment of the quality of water from hand-dug well in Ghana. *Environmental Health Insight*. 4,7-12.
15. WHO (World Health Organization), (1996). Guidelines for drinking water quality, 2nd Edition.Pp2-971. Sawyer, C.N. & McCarty, P.I., (1993). *Chemistry for Sanitary Engineers*, McGraw-Hill, New York, 68-91.