AN ASSESSMENT OF QUALITY OF SACHET WATER PRODUCED IN MUBI METROPOLIS, ADAMAWA STATE, NIGERIA

Maitera O.N.[1], Onen A.I.[1], Yusuf K.A.[1]
Department of Chemistry, Adamawa State University Mubi, Nigeria.

Abstract
This work was designed to check the quality of sachet water produced in Mubi town. Seven specimen samples of brands of sachet water produced in Mubi metropolis were analyzed to ascertain their portability. The physiochemical properties examined includes; pH, temperature, total hardness, total chloride, conductivity, total nitrate, dissolved oxygen and heavy metals such as Fe, Cd, Pb, Cu, and Mn. DR 2010 Spectrophotometer was used to determine the physical parameters, while the EXDO600 meter was used to determine the DO and the AAS was employed in the determination of the heavy metals. The parameters measured were found to be within the recommended limits of the WHO and NAFDAC except pH, DO which were low and nitrate content in F and A samples which were above the recommended standards.

Keywords: Sachet water, assessment, quality

Introduction

Water is the most abundant chemical substance in the world. It covers 70% of the surface of the earth. It is the most useful liquid on earth. Water plays a vital role in the life of plants and animals. According to Nobel laureate Sizentgyory defined water as the matrix of life. In order for it to be used as a healthful fluid for human consumption, water must be free from organisms that are capable of causing disease and from mineral substances that could produce adverse physiological effects.

It serves as medium in which nutrients and other minerals are transported round the body. Hence the necessity to establish the purity level of water before consumption (Lorch *et al*, 1987).

It is also very important to ascertain the potability of water before human consumption for health reasons. The nature of the treatment given to water depends upon the kind of impurities that the water contains. Water treatment includes physical, chemical and biological processes that can transform raw water into potable water which is acceptable for human and domestic use.

Water pollution occurs when a body of water is adversely affected due to addition of large amounts of materials to the water, making it unfit for intended use, such water is considered to be polluted. Two forms of water pollution exist; point source and non-point source. Point sources of pollution occur when harmful substances are emitted directly into a body of water. This includes effluent sewage treatment works, or of waste from factories. While non-point source delivers pollutants indirectly through environmental changes, for example fertilizer or herbicide application is carried into streams by rain in form of run-off which in turn affects aquatic life. Technology exists for point sources of pollution to be monitored and regulated although political factors may complicate matters. Non-point sources are much more difficult to control. Pollution arising from non-point sources account for majority of contaminants in streams and lakes (Maitera and Shinggu, 2010).

By the definition given above almost everything produced by man can be considered as a potential pollutant. These can be toxic or non-toxic pollutants. Some of these may be acid or alkali, anions (e.g. sulphides, cyanides, sulphites), detergents, domestic sewage and farm manures, food processing wastes, gases (e.g. chlorine, ammonia), heat, metals, plant nutrients (phosphates and nitrates), organic toxic wastes (e.g. formaldehyde and phenols), pathogens, pesticides, polychlorinated biphenyls, radionuclide, and organic pollutants (Torrans, 1982).

pH is the measure of hydrogen ion activity of a solution and is defined by the equation pH = - log $[H^+]$. It is an important characteristic of water. Extreme pH values cause stress to fish, especially at gill surfaces. It affects the degree of ionization of toxic substances such as ammonia (Stirling, (1985).

Temperature is a measure of the degree of hotness or coldness of a substance. It is usually better to take the temperature of a stream or river water to the nearest half degree. The degree of hotness of a water sample affects the aquatic organisms living in it. Many portable digital temperature meter are now available for both laboratory and field work.

Electrical conductivity of water refers to its ability to conduct electric current, which in turn is related to the total concentration of ions. This relationship depends on the geometry of the electrodes, temperature and to some extent on the nature of the major ions in solution. Conductivity meters are available for field use.

This work is used to assess the quality of sachet water samples produced in Mubi town based on the analysis of some physiochemical parameters such as pH, temperature, total hardness, total chloride, conductivity, total nitrate, dissolved oxygen and heavy metals in the samples.

It refers to the ability of water to precipitate soap. Hard water is undesirable for two reasons: (a) they require a considerable amount of soap to produce lather and (b) they form scales in industrial boilers, heaters and hot water pipes. Major contributors to hard water are dissolved calcium and magnesium ions. They combine with soap to form insoluble precipitate. Thehardness of water is derived largely from the weathering of minerals such as limestone ($CaCO_3$), dolomite ($CaCO_3.MgCO_3$) and gypsum $CaSO_4.2H_2O$) and it varies from place to place depending on the nature of geological formations. Ground water is generally harder than surface water. Total hardness is the sum of calcium and magnesium concentration expressed as $CaCO_3$ in mg/l (Radojevic and Bashkin, 1999).

Water hardness is cause by the presence of calcium ion (Ca^{2+}) and magnesium ion (Mg^{2+}) salts, which are expressed in mg/l of $CaCO_3$ (ppm). Natural water contains calcium and magnesium only in significant concentration. Hardness of water is defined as a characteristic of water which represents the total concentration of just the Ca and Mg ions expressed as calcium carbonate (Nsi *et al*, 2005). It acquires this hardness when it dissolves gypsum, $CaSO_4.2H_2O$ or limestone $CaSO_4$ from the soil over which it flows even though it is sparingly soluble in water.

Eutrophication describes the variations in aquatic systems due to nutrients enrichment; the eventual consequence of that enrichment is the growth of primary production to nuisance proportions (Marsden, 1989). Although euthrophication is a natural process of aging of lakes and water bodies, human activities can greatly accelerate it. Eutrophication leads to the death of ponds and lakes. It is either nitrogen or phosphorus that control algal growth rates, where seawater is limited by nitrogen and fresh water is limited by phosphorous (Ademoroti, 1979). Apart from causing eutrophication problem, nitrogen can pose serious public health threat when found in drinking water at certain concentrations. It exist in water as NO_3, which is not dangerous, but if it is converted to NO_2 by the action of certain bacteria found in intestinal tract of infants, it can be highly toxic as NO_2 replaces O_2, a condition known as methemoglobinemia (O_2 starvation causing bluish discolouration of the infant) results (Often called blue baby syndrome). In extreme cases the baby can die due to suffocation (Ademoroti, 1996b and Craun *et al*, 1981).

The presence of chemicals in high quantity and bacteria in water may be unnoticed even in transparent sachet water and the presence of chemicals in high quantity and microorganisms may pose a potential risk to consumers. Even the consumption of such contaminated water may facilitate the widespread of infection and can ultimately lead to outbreak of epidemic (Zucato *et al,* 2000).

Water related diseases continue to be one of the major health problems globally. The high prevalence of diarrhea among children and infants can be traced to the use of unsafe water and unhygienic practice (Tortora *et al,* 2002). Therefore, maintaining a safe drinking water remains essential to human health. To attain a safe water supply to various communities, an understanding of water that is chemically and microbiologically certified is therefore imperative. Therefore the need to ensure that the chemical quantity and microbiological characteristics of drinking water is safe for human consumption.

Materials and Methods

Sample Collection

Six different sachet water samples were collected in Mubi metropolis, Adamawa State. All the samples were bought from manufacturing companies and taken to the laboratory for analysis.

Determination of pH

Portable Jenway3505 pH meter was used to measure the pH of the different water samples by switching on and testing for neutrality using distilled water. The electrode was then inserted in the water sample solution and was allowed to stay for 2 minutes and then the reading was recorded. This procedure was repeated for all the sachet water samples.

Determination of temperature

A portable temperature/conductivity meter EX600 was switched on, the electrode was rinsed with the sample and later inserted into the water sample in a beaker, and the reading was recorded. This procedure was repeated for the conductivity.

Determination of Nitrate

The UV/Visible spectrophotometer DR2010 was used to carry out this determination. The procedure is as described by Gray, 2004.

Determination of Heavy Metals

The heavy metals Mn, Cu, Fe and Pb were determined using Atomic Absorption Spectrophotometer (AAS). The procedure is as described by Harvey, 2000.

Data Analysis

Results were presented as mean ± SD. Analysis of Variance (ANOVA) and the student t-test were used for the statistical analyses of results obtained at 95% confidence level using Microsoft Excel + Analyse It package.

Results and Discussion

The results of the parameters determined are as shown in table 1. The pH values of A sample ranged between 6.8 to 7.1. That of sandy water sample ranged between 7.2 to 7.4, C samples ranged 7.2 to 7.4, D samples ranged between 7.3 to 7.5, F ranged between 7.2 to 7.4, and E ranged between 7.3 to 7.5. All the sample pH values were higher than the WHO/NAFDAC/SON standards. This may be the reason why most of the water samples have taste except for sandy water whose pH is less compared to the rest.

Temperature values for the water samples were in the following range; A, 29.5 to 29.7, B, 29.0 to 29.1, C, 29.0to 29.1, D, 29.0 to 29.1, E, 29.6 to 29.8 and F, 29.1 to 29.2. Total hardness values were as follows; A, 221.4 to 221.6 ppm, B, 133.4 to 133.6 ppm, C, 285.4 to 285.8 ppm, D, 148.2 to 150.4 ppm, E, 173.5 to 173.6 ppm, F, 106.2 to 106.9 ppm.

Total chloride concentrations were as follows; A, 0.31 to 0.32 ppm, B, o.21 to 0.22 ppm, C, 0.11 to 0.12 ppm, D, 0.31 to 0.32 ppm, E, 0.62 to 0.63 ppm, F, 0.11 to 0.12 ppm.

Electrical conductivity values ranges as follows; A, 189.0 to 190.1 ppm, B, 87.1 to 90.2 , C, 268 to 270, D, 12 to 14, E, 120 to 121, F, 98 to 100

The nitrate content of the water samples were; A, 50.0 ppm, B, 1.0 ppm, C, 35.0 ppm, D, 1.5 ppm, E, 1.5 ppm, and F, 50.0 ppm.

The dissolved oxygen (DO) content of all the samples were; A, 127 to 130 ppm, B, 135 to 137 ppm, C, 1.24 to 1.27 ppm, D, 1.36 to 1.39 ppm, E, 1.25 to 1.27 ppm, F, 1.30 to 1.32 ppm,

Fe, Cu, Cd, Mn and Pb were not detected in all the samples analysed

All the values of the parameters assessed are within the WHO recommended Standards, except for the nitrate value for A and F water samples, which were higher than the WHO (2006)/NAFDAC (2001)/SON (2007) standards. This implies that children whose sources for drinking water come from samples A and F may suffer from methaemoglobinemia a condition referred as blue baby syndrome, which occurs as a result of excess nitrate in infants.

Sample/ Parameters	Mugulbu (A)	Sandy (B)	Bright (C)	Sabon Dale(D)	Sahava (E)	Conclin (F)	WHO Std.
pH	7.1±0.2	7.4±0.1	7.4±0.1	7.5±0.03	7.5±0.2	7.4±0.3	6.5-6.8
Temp.(°C)	29.7±0.1	29.1±0.2	29.1±0.1	29.1±0.1	29.8±0.2	29.2±0.1	
Total hard(ppm)	221.6±0.4	133.6±2.1	256.6±3.2	150±1.3	173.6±3.2	106.4±4.2	1-500
Total chloride(ppm)	0.32±0.0	0.22±0.1	0.12±0.0	0.23±0.01	0.63±0.1	0.12±0.0	1-200
Conductivity	190±2.5	90±1.1	270±4.1	14±3.2	121±2.4	100±1.5	≤200
Total Nitrate(ppm)	50±2.1	1.0±0.2	35±2.1	1.5±0.3	1.5±0.3	50±2.1	45
DO (mg/l)	1.30±0.2	1.37±0.3	1.27±0.2	1.39±0.3	1.27±0.2	1.32±0.2	≥4
Iron(ppm)	ND	ND	ND	ND	ND	ND	0
Lead(ppm)	ND	ND	ND	ND	ND	ND	0.01
Cadmium(ppm)	ND	ND	ND	ND	ND	ND	1-1.5
Copper(ppm)	ND	ND	ND	ND	ND	ND	0.05
Manganese(ppm)	ND	ND	ND	ND	ND	ND	0.1-0.5

ND = Not detected

Table1: Mean ±SD different parameters of the various water Samples compared with WHO std.

Conclusion

The findings of the work showed that the sachet water produced in Mubi town in Adamawa State, Nigeria largely met the recommended WHO/NAFDAC/SON requirements for drinking water. However the levels of dissolved oxygen (DO), pH and total nitrate are above the recommended standards. The water samples were more of dilute acids than water for human consumption. The pH and DO values were low, while the nitrate values for A and B sachet water were high.

It is suggested that producers of sachet water in Mubi metropolis should be quality conscious, while NAFDAC should insist on checking water produced for consumption as many times as possible no matter the locality.

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