International Journal of Basic and Applied Chemical Sciences ISSN: 2277-2073 (Online)
An Online International Journal Available at http://www.cibtech.org/jcs.htm
2012 Vol. 2 (3) July-September pp.21-24/Waziri and Bomai
Research Article

THE PHYSICOCHEMICAL QUALITY OF SACHET WATER IN DAMATURU, YOBE STATE, NIGERIA

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ABSTRACT
The physicochemical qualities of fourteen 500ml sachet water samples vended for drinking in Damaturu were investigated. The parameters analyzed include; pH, temperature, conductivity, total dissolved solids, turbidity, alkalinity, hardness, Al, As, Cu, Fe, Mn, Si, Zn, NO_3^- Cl^-,SO_4^{2-}, Br^-, F^- and PO_4^{3-} using the WAGTECH international physicochemical water analysis kit. The results obtained indicated that there are considerable variations among the examined samples with respect to their chemical constituents which occasionally fell above the Nigerian drinking water standards as stipulated by the National Agency for Food and Drug Administration and Control (NAFDAC). However, Fe which ranged between 1.00±0.001 mg/l to 7.00±0.01 mg/l was much higher than the acceptable limit of 0.3 mg/l in all the examined samples. There is therefore the need to enforce the NAFDAC drinking water regulatory guidelines and frequent monitoring should be ensured to safeguard human lives in the area of study.

Key Words: *Acceptable Limit, Physicochemical Quality, Regulatory Guidelines, Sachet Water*

INTRODUCTION

A number of people in the developing countries lack access to potable water though the provision of clean potable water is essential for human consumption and it is a right and not a privilege to all human beings more than any other environmental factor. However, in Nigeria, though much has been achieved since independence but the quality and quantity of safe drinking water is still grossly inadequate. Since life is impossible without water people were compelled to accept and use water from whatever source despite the devastating consequences of polluted water on human health (Steiner *et al.* 1997).

Yobe State like quite a number of states in Nigeria is faced with inadequate supply of qualitative potable water though provision of potable water is always considered to be a priority in the state's yearly budget. The widespread and long lasting water shortages in many areas are as a result of rising demand, unequal distribution of usable fresh water and increasing pollution of existing water supplies. The rural people have less access to good quality water and rely on the available groundwater sources and use local purification methods to get clean drinking water in order to prevent health problems.

The introduction of sachet water in Yobe State in 1999 was happily accepted by the people because it is handy, ready to drink, affordable and assumed to be 'pure'. The quality of sachet water has been questioned based on research findings (FAO, 1997; Adekunle *et al*. 2004 and Dada, 2009), and NAFDAC has been monitoring the production and quality of sachet water. However, most manufacturing factories abandon NAFDAC's guidelines on quality soon after they get registered.

In order to attain the provision of safe sachet drinking water for human consumption in Nigeria, NAFDAC recommended that potable water should not contain any pathogen and the physicochemical properties of the water should also not exceed the NAFDAC recommended limits (NAFDAC, 2001). Production outfits should of such drinking waters should also adhere strictly to the NAFDAC guidelines (NAFDAC, 2004).

The objective of this study is to determine the levels of physicochemical parameters of the sachet water produced in Damaturu, the Yobe state capital. The result is expected to provide information to the consumers on the need to drink sachet water which satisfied NAFDAC's requirements for safe drinking water.

MATERIALS AND METHODS

Sample Collection

Fourteen different brands of 500ml sachet water samples were purchased from different vendors in Damaturu, Yobe State capital. The samples were coded and include WW, BW_1, RW, MS, ZW, RS, BW_2, ND, SW, LW, SY, HW, KC and MK. (coded 1-14 respectively). Duplicate samples were collected per brand and all analyses were conducted within 8 hours of sample collection.

Physicochemical Analysis

The pH of the water samples were determined using pH meter (Jenway model 350) while all the other parameters were determined using the WAGTECH international physicochemical water analysis kit. The procedures employed in these determinations were as contained in the manufacturer's manuals for the determination of each parameter using the designated equipment for the parameter.

RESULTS AND DISCUSSION

The results of the physicochemical properties of the sachet drinking water from Damaturu the Yobe State capital examined in this study are presented in Figures 1-3.

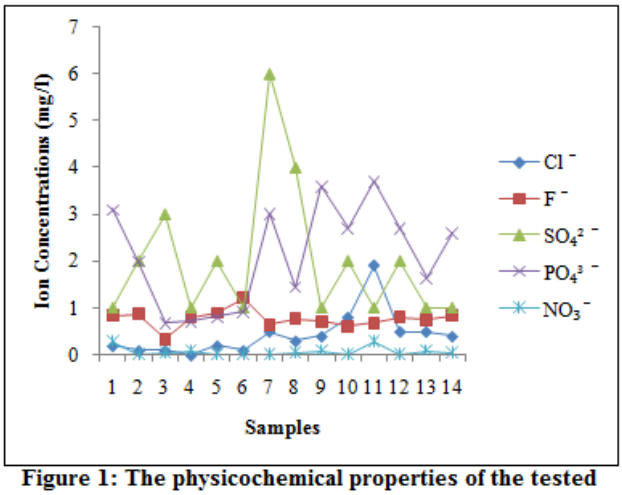

Figure 1: The physicochemical properties of the tested sachet water samples

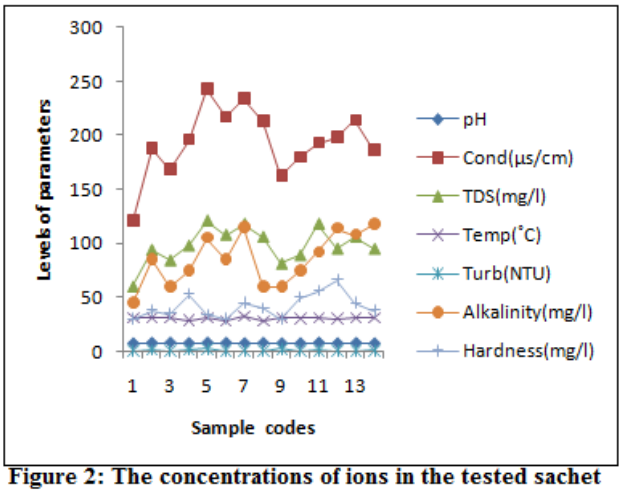

Figure 2: The concentrations of ions in the tested sachet water samples

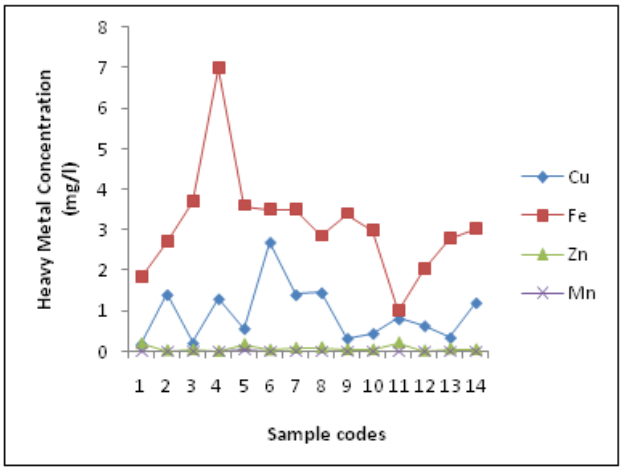

Figure 3: The concentrations of heavy metals in the tested sachet water samples

Figure 1 shows the levels of the physical parameters investigated. The temperature ranged from 29.00±0.8˚C-32.6±2.0˚C. Though there is no recommended value for temperature (Howard, 2009), but variations in temperature were observed in all the samples, which may be attributed to the sampling

locations. The mean values for pH ranged from 7.4±0.5 to 8.0±1.0. All the samples gave pH values within the recommended limit of 6.5-8.5 for drinking water (NAFDAC 2001, WHO 2006), indicating that all the samples are safe for human consumption. Conductivity and TDS were within the recommended limits of 1000µs/cm and 500 mg/l respectively. The high levels of TDS in samples BW_2 (121mg/l) compared to other samples may be attributed to high levels of chloride and sulphate in the sample. TDS affects palatability if the value exceeds the WHO/NAFDAC recommended limit of 500 mg/l. Turbidity ranged between 0.05±0.01 – 1.81±0.15 NTU while alkalinity in terms of mg/l $CaCO_3$ ranged between 45.0±2.4 - 118.50±17.2 mg/l $CaCO_3$ all satisfied the recommended limit of 150mg/l for drinking water. Total calcium hardness ranged from 30.12±1.3 to 66.0±4.5 mg/l which was below the maximum allowable limit of 150 mg/l.

The concentrations of F^-, NO_3^-, Cl^-, SO_4^{2-} and PO_4^{3-} ranged from 0.61±0.001 mg/l to 1.22±0.002 mg/l, 0.003±0.001mg/l to 0.29±0.006 mg/l, 0.1±0.001 mg/l to 1.90±12.2 mg/l, 1.0±0.001mg/l to 6.0±0.02 mg/l and 0.68±0.01mg/l to 3.10±0.01mg/l respectively (Figure 2). All the samples satisfied the recommended ion content values for drinking water.

Heavy metal contents of the tested sachet water samples are shown in Figure 3. As and Al were tested but not detected and their absence indicate that all the samples are free from the toxic effects of As and Al. However, the concentrations of Fe in all the samples were noticed to be higher than the NAFDAC permissible limit of less than 0.3mg/l. Though iron is needed by the body to satisfy its nutritional requirements, but only minute quantities are required as high doses lead to health hazards which are sometimes lethal.

The importance of physicochemical studies of drinking water with respect to portability status has been highlighted by many researchers (WHO, 1985; Edema *et al*. 2001; Eddy and Ekop, 2007). The regulatory guidelines should therefore be adhered to; in order to prevent water related diseases and safeguard lives of the consumers.

CONCLUSION

Generally, the physicochemical properties investigated in this study fell within the NAFDAC permissible limits with few exceptions. The levels of iron in all the samples should be checked to avoid health effects associated with high levels of iron in drinking water such as vomiting, cardiac depression and metabolic acidosis and hepatic cirrhosis in severe cases. Metal toxicity could be cumulative and by the time the effect manifest, it may be lethal. The popularity of sachet water is increasing and establishment of new sachet water factories is also increasing at alarming rate. Furthermore, consumers are usually very careless as they hardly care to check for NAFDAC registration or expiry date on the products, therefore enforcement of NAFDAC laws and guidelines is about the only option in order to safeguard the health of the consumers.

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