



Physio-Chemical and Microbial Screening of Selected Potable Water Sold in the Nnamdi Azikiwe University, Nnewi Campus

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ABSTRACT

Adequate supply of potable table water is a basic necessity for all mankind. Unfortunately, this basic necessity of man has been grossly deprived especially in the developing countries. Water meant for consumption must be potable: free from contamination by microorganisms and possess stable physicochemical parameters. And this is the essence of this research study. In this study, physico-chemical parameters such as colour, pH, odour, temperature and microbial indices: Escherichia coli, Klebsiella pneumonia, Salmonella typhmuri and Streptococcus aureus were investigated in potable

packaged water sold in Nnamdi Azikiwe University, Nnewi Campus, Anambra State, Nigeria. Six different bottled and sachet water samples obtained from different manufacturers labeled B1, B2, B3, B4, B5, B6 and S1, S2, S3, S4, S5, S6, respectively were examined physically, chemically and microbiologically. Physical examination of the samples showed that they were colourless and odourless. Chemical examination of the samples showed they were within the WHO standards for temperature and pH except for water samples S1, B4 and B5 whose pH (8.6; 6.2 & 6.0) deviated from the standard. Water samples S4, B3, B4

and B5 indicated presence of *E. coli* whereas S6 indicated presence of *Klebsiella pneumoniae*. *Streptococcus aureus* was present in B3. From our study, it is suggestive that the packaged water analyzed were not chemically and microbiologically fit for consumption though this needs to be further investigated.

Key words: Potable water, *Escherichia coli*, *Klebsiella pneumoniae* and *Salmonella typhimurium* and *Streptococcus aureus*.

INTRODUCTION

Adequate supply of potable table water is a basic necessity for all mankind. Unfortunately, this basic necessity of man has been compromised and neglected over the decades by successive government administrations at the expense of quality life. In many developing countries, availability of potable water has become a critical and urgent problem hence a matter of concern to families and communities (Adekunle *et al.*, 2004). Water is an essential part of human nutrition and is required for maintenance of personal hygiene, food production and prevention of diseases (Thliza *et al.*, 2015). It is the most abundant substance in nature and occupies about 70% of the earth's crust (Anyamene and Ojiagu, 2014; Thliza *et al.*, 2015). Water is a biological medium which exists as solid, liquid and gas (Thliza *et al.*, 2015). Colourless, odourless and tasteless water is vital for all known life forms. It's the major constituent of the fluid of organisms. In a recent estimate based on WHO reports suggests that 80% of all human illnesses in the developing world are caused by biological contamination (WHO, 2008). The majority of the population in developing countries is not adequately supplied with potable water, and thus obliged to use unsafe water for domestic purposes. (Ajayi, *et al.*, 2008). Water should be clear, without disagreeable taste, color or odour for it to be deemed fit for human and animal consumption. If otherwise, then it needs to be treated, cleaned or filtered to meet established drinking standards (Aroh *et al.*, 2013; Isikwue and Chikezie, 2014). Water can be sourced from surface such as river, streams or ground such as spring, well and borehole (Aroh *et al.*, 2013). Agencies that regulate water quality worldwide is the World Health Organization (WHO). They determine standards and guidelines for water quality (WHO, 2001 and 2002). So as to ensure the highest quality of potable water in order to safe guard public health (Anunobi *et al.*, 2006; Isikwue and Chikezie, 2014).

There are various water treatment processes, the major procedures are aeration, coagulation, flocculation, sedimentation, slow sand filtration, rapid filtration and disinfection (Ibemesim, 2014).

To minimize the risk of bacterial growth in drinking water, (WHO, 2004) reported that chlorination, ozonation, ultra violet radiation and advanced oxidation processes are widely accepted for disinfection of drinking water.

Unsafe water is a global public health threat, placing persons at risk for a host of diarrhea and other diseases as well as chemical intoxication (Ashaye, 2001). The exposure to this microbial contaminant can lead to microbial infections like cholera, typhoid fever and dysentery. Varieties of microorganisms are water borne and due to this fact, conformation with microbiological standard is of special interest because of the capacity of water to spread diseases within a large population (Omezuruike *et al.*, 2008). Whenever water is submitted for testing, it will also be analyzed for the bacteriological property. Microbial character of bottled and sachet potable water can be influenced by certain factors like handling, treatment and expiry. Packaged water is one of the main sources of water supply in most Nigerian institutions and since it is used for human consumption, it should meet required microbial standards. Hence, microbial analysis of packaged water sold at tertiary institutions must be carried out to monitor the effectiveness of treatment process. And this is the essence of this research. To determine presence of pathogenic microorganisms such as *E. coli*, *Klebsiella pneumoniae*, *Salmonella typhimurium* and *Streptococcus aureus* in potable table water (sachet and bottled) sold in the Nnamdi Azikiwe University, Nnewi Campus, Anambra State, Nigeria.

MATERIALS AND METHOD

The materials used in this research work were sachet and bottled water, bought from vendors located within the Nnewi Campus, of Nnamdi Azikiwe University, Anambra State, Nigeria. The water samples were produced from six different manufacturers labeled S1 – S6 and B1 – B6. The letters S and B indicate sachet and bottled water respectively. The names of these manufactures of the table water were withheld and labeled with letters in accordance with best practices.

The physical properties of the table water used in this study were visually determined, however the chemical property (pH) were determined using pH meter. The pH meter was standardized using phosphate buffer of pH 7.0. Microbial screenings were carried out using standard microbiological methods by the method of US Environmental Protection Agencies 2002 and Hanaor and Sorrelli 2004.

BACTERIOLOGICAL WATER ANALYSIS

The water sample was first mixed properly, about 50µl of water sample was aseptically collected directly from each of the water containers using a sterile wire loop, it was cultured on two neutral agar media. One set of the agar was incubated at room temperature, 25⁰C and the other at 37⁰C for 48hours in an incubator. At the end of this incubation, the agar media were visually examined for bacterial growth, count and cultural characteristics. Bacterial colony forming units (CFU) of 30 and above were considered significant growth. Grams stain and cultural characteristics on the selective medium were used to identify the cultured bacterial organisms.

RESULTS AND DISCUSSION

From table 1.0, the sachet water samples were colourless and odourless, and were within the WHO standard. It was observed that the water temperature fell within the WHO acceptable level. Chemical examinations (pH) of the sachet water samples: S2, S3, S4, S5 and S6 were within the WHO acceptable range while the pH of water samples S1 fell outside the WHO acceptable range. In table 2.0, the bottled water samples were colourless and odourless, and were within the WHO standard. It was observed that the water temperature of the six different bottled water samples had a constant value of 29⁰C and that was within the range of WHO acceptable level. The pH of bottled water samples: B1, B2, B3, and B6 had the WHO acceptable range whereas the B4 and B5 had values slightly acidic, which were outside the WHO limit. In table 3.0, sachet water samples: S4 and S6 indicated presence of *Klebsiella pneumoiae* and *E. coli* respectively while S1,S2,S3 and S5 showed absence of microorganism under study. In water samples B3,B4 and B5 indicated presence of *E. coli* while B1,B2, and B6 indicated absence of microorganism under study. In addition, streptococcus aureus is present in B3 and its not seen in any other bottled water samples.

Discussion:

In human cultural evolution, the importance of water cannot be overemphasized, such that settlement was preferred along areas where there were water sources (streams and rivers). This is to depict that adequate supply of potable table water is a basic necessity for all mankind. Unfortunately, this basic necessity of man has been compromised and neglected over the decades by successive government administrations at the expense of quality life. In many developing countries of the world, drastic potable water scarcity has become critical and compulsory threat to all life forms especially the human beings. It has been reported that drinking of unhygienic water in poor countries has resulted in the death of 2.2 million people per annum, 99 percent of these are children under the age five (WHO, 2004). This threat of water scarcity demand declaration of state of emergency to any sensible government. Water meant for consumption must be potable: free from contamination by microorganisms and possess stable physiochemical parameters.

In tables 1.0 and 2.0, the water samples under study had temperatures with the acceptable WHO range. This indicates that the potable water samples had stable room temperatures. Similarly, the colour and odour of the water samples showed that all water samples were colourless and odourless respectively, thus within the WHO requirement (not objectionable). The water samples under study can be described as being attractive and may account for its patronage by the inhabitants of the study area. Our observation is in line with works done by Anyaeze et al.,2013 and Maduka et al., 2014. World Health Organization recommended that potable water for consumption should not contain any microorganism known to be pathogenic (WHO, 1984). From our results, the sachet water samples (S4 and S6) indicated presence of *Klebsiella pneumoniae* and *E. coli* respectively where as the bottled water samples (B3, B4 and B5) indicated presence of *E. coli*. The presence of *E. coli* in a water sample according to reports of Adekunle et al., 2004, and Edema et al., 2001 is an indication of water pollution. This is because the presence of *E. coli* is most often accompanied by the presence of dangerous enteric pathogens like *Shigella*, *Salmonella* and *Campylobacter* species (Shilklomanov, 2000 and Edberg et al., 2000). However, streptococcus aureus was present in one of the bottled water samples labeled B3. The microorganism under study such as *Salmonella typhmuri*um was absent in all the water

(sachet and bottled) samples analyzed. The absence of *S.typhmuri*um in all the water samples suggests that the water samples under study is free such organism and its attendant disease causing effects specifically typhoid fever. In two separate studies of Maduka et al.,2014 and Tortora et al., 2002 absence of *S.typhmuri*um in a water samples suggests that typhoid fever may not be contacted from the water samples. The bacteriological quality of drinking water is of immense importance because several studies have attributed several disease outbreaks to untreated or poorly treated water containing bacteria pathogens that have been isolated from sachet water (Shear et al., 1995).

CONCLUSION

The presence of microorganisms: *E. coli*, *Klebsiella pneumoniae*, and *Streptococcus aureus* as well deviation in the physio-chemical properties of potable packaged table water (sachet and bottled) sold in one of the Nigerian Tertiary Institutions have been established in this study. The contamination could be as a result of unhygienic acquisition of water source, poor handling, processing and after production effects especially expiration. Water with high acidity or alkalinity as well the bacteria enumerated above (*E. coli*, *Klebsiella pneumoniae*, and *Streptococcus aureus*) is not safe or potable for human consumption, hence, water vended for public consumption need to be re-examined. And relevant agencies saddled with the responsibility of regulating standards in quality water production such as the National Agency for Food & Drug Administration Control (NAFDAC) and World Health Organisation (WHO) should be alive and dutiful.

Table 1.0 Physicochemical Properties of the Potable Sachet Water

Physical/chemical parameters	S1	S2	S3	S4	S5	S6	WHO ACCEPTABLE RANGE
Colour	Colourless						
pH	8.6	8.1	7.9	7.6	7.7	7.8	6.5-8.5
Temperature	29	30	30	29	29	28	20-30
Odour	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Unobjectionable

Table 2.0 Physicochemical Properties of the Potable Bottled Water

Physical/chemical parameters	B1	B2	B3	B4	B5	B6	WHO ACCEPTABLE RANGE
Colour	Colourless						
pH	7.4	7.0	7.1	6.2	6.0	6.8	6.5-8.5
Temperature (°C)	29	29	29	29	29	29	20-30
Odour	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Unobjectionable

Table 3.0 Microbial Screening of the Potable SATCHET Water

Microorganisms	S1	S2	S3	S4	S5	S6
Escherichia coli	-	-	-	+	-	+
Klebsiella pneumonia	-	-	-	-	-	-
Salmonella typhmurium	-	-	-	-	-	-
Staphylococcus aureus	-	-	-	-	-	-
Streptococcus faecalis	-	-	-	-	-	-

+ means presence of microbial contamination by one of the organisms under study.

- means absence of microbial contamination by one of the organisms under study

Table 4.0 Microbial Screening of the Potable Bottled Water

Microorganisms	B1	B2	B3	B4	B5	B6
Escherichia Coli	-	-	+	+	+	-
Klebsiella Pneumoniae	-	-	-	-	-	-
Salmonella Typhmurium	-	-	-	-	-	-
Staphylococcus Aureus	-	-	-	-	-	-
Streptococcus Faecalis	-	-	+	-	-	-

+ means presence of microbial contamination by one of the organisms under study.

- means absence of microbial contamination by one of the organisms under study

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