Physicochemical And Microbiological Profile Of Drinking Water Sold In Abeokuta, Ogun State, Nigeria

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Abstract: The trend of producing sachet water is now on the increase with Abeokuta, Ogun State, South West Nigeria, having lots of these manufacturers. Outbreaks of major epidemics throughout the world have implicated water as major sources of infection. In this study, bacteria present in a total of 120 sachet and bottle water samples were isolated and characterized. The physicochemical parameters of the sachet water showed a pH range of 6.0 - 6.9, turbidity of 0.30 - 0.45 NTU, temperature of 28 - 29^{o}C, calcium, magnesium, phosphate and chloride were 2.0mg/dl, 1.20 mg/dl, 1.46 mg/dl and 21.30 mg/dl respectively. The physicochemical parameters of the bottle water showed a pH range of 6.5 - 7, turbidity of 0.10 - 0.35 NTU, temperature of 27 - 29^{o}C, calcium, magnesium, phosphate and chloride were 0.72mg/dl, 0.43 mg/dl, 1.00 mg/dl and 12.64 mg/dl respectively. Bacteria isolated from sachet and bottle water samples include *Escherichia coli, Klebsiella* sp and *Pseudomonas aeruginosa* while *Enterobacter* sp was isolated in only sachet water. The result from this study revealed a high level of bacterial contamination in sachet water samples. This showed poor sanitary standard of operation in the production line of sachet-water.

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1. Introduction

Many people who are especially vulnerable to infection (such as the infirm elderly, young infants, people living with HIV/AIDS, people on immunosuppressive chemotherapy, transplant patients, etc.) use bottled water as an alternative to tap water out of concern for their safety. Some leading public-health experts, therefore, argue that bottled water should be of higher microbiological quality than most foods (Warburton, 1993). In fact, health-care providers and other professionals often recommend that people who are immunocompromised or who suffer from chronic health problems drink bottled water. Indeed, FDA's guidance for immunocompromised people (posted on the FDA Web site) recommends that people with lowered immunity should "drink only boiled or bottled water (Farley, 1997).

A reliable supply of clean wholesome water is highly essential in a bid to promoting healthy living amongst the inhabitants of any defined geological region (Mustapha and Adam, 1991). The standard industrialized world model for delivery of safe drinking water and sanitation technology is, however, not affordable in much of the developing world (Gadgil and Derby, 2003).

Consequently, given the renewed global commitments towards the Millennium Development Goals (MDG) marked for 2015, the importance and contribution of locally sourced low-cost alternative drinking water schemes to sustainable access in rural and peri-urban settings of developing nations cannot be over-emphasized (UNDESA, 2004). One such local intervention in Nigeria, where public drinking water supply is unreliable (Egwari and Aboaba, 2002), is drinking water sold in polythene sachets.

The production, marketing and consumption of sachet water have increased tremendously. There are now several brands of these type of packaged water marketed in Nigeria and other developing nations (Kassenga, 2007). Water in sachets is readily available and the price is affordable, but there are concerns about its purity. The integrity of the hygienic environment and the conditions where the majority of the water in sachets are produced has also been questioned (C.A.M.O.N, 2007). Although nationally documented evidence is rare, there are claims of past outbreaks of water-borne illnesses that resulted from consumption of polluted water in sachets (C.A.M.O.N, 2007).

Few studies (Olayemi, 1999; Adekunle et al., 2003; Ashaye et al., 2001; Gyang et al., 2004) have

been conducted in recent years on the quality of packaged water in Nigeria. The transmission of waterborne diseases is still a matter of major concern, despite worldwide efforts and modern technology being utilized for the production of safe drinking water (Venter, 2000). Therefore, the aim of this study Is To Determine The Physicochemical And Microbiological Profile Of Drinking Water Sold In Abeokuta, Ogun State Nigeria.

2. Material And Methods

2.1. Samples Collection

A Total Of One Hundred And Twenty (Sixty Sachet Water And Sixty Bottle Water) Samples Were Collected From Four Locations In Abeokuta Metropolis. Analyses Were Usually Carried Out Within 8 Hours After Sampling.

2.2. Physico-Chemical Assessment: This Involved The Assessment Of The Water Samples, Which Includes Appearance, Specific Odour, Colour, Temperature And Turbidity. Acidity Was Determined By Method Described By Kegley And Andrews (1998).

2.3. Ph Determination: The Ph Of The Water Sample Was Determined Using A Ph Meter.

2.4. Turbidity Determination: A Two Part Calibrated Turbidity Tube Was Used, With Calibrations From 5-25 Turbidity Units. The Joined Tubes Were Held Over A White Paper, While Slowly Pouring The Water Sample Into The Tube Until The Black Cross At The Bottom Was No Longer Visible. At This Point The Reading Was Taken From The Side Of The Tube As The Turbidity Value Of The Water Sample.

2.5. Characterization And Identification Of Isolates

Isolated Pure Cultures Of Bacteria Were Subjected To Various Morphology And Biochemical Tests. After Which They Were Identified Using Bergey's Manual Of Systematic Bacteriology. The Following Tests Were Carried Out: Gram Stain, Motility, Spore Staining, Oxidase Test, Urease Test, Indole, Methyl Red Test, Citrate Test, Vogue Proskauer Test, Catalase Test, Coagulase Test, Fermentation Of Glucose, Lactose And Sucrose.

3. Result

The physicochemical parameters of the sachet water showed a pH range of 6.0 - 6.9, turbidity of 0.30 - 0.45 NTU and temperature of 28 - 29^{o}C, calcium, magnesium, phosphate and chloride were 2.0mg/dl, 1.20 mg/dl, 1.46 mg/dl and 21.30 mg/dl respectively. The physicochemical parameters of the bottle waters showed a pH range of 6.5 - 7, turbidity of 0.10 - 0.35 NTU, temperature of 27 - 29^{o}C, calcium, magnesium, phosphate and chloride were 0.72mg/dl, 0.43 mg/dl, 1.00 mg/dl and 12.64 mg/dl respectively in Table 1.

Table 1: The physicochemical parameters of the sachet and bottle water samples

Parameters	Sachet water	Bottled water
pH	6.0 – 6.9	6.57 - 7.0
Temperature	28 - 29.0	27 - 29.0
Turbidity	0.30 – 0.45	0.10 - 0.35
Appearance	Clear	Clear
Odour	Odourless	Odourless
Calcium mg/l	2.0	0.72
Magnesium mg/l	1.20	0.43
Phosphate mg/l	1.46	1.00
Iron mg/l	0.00	0.00
Chloride mg/l	21.30	12.64
TDS mg/l	11.00	16.00
BOD	3.0	2.6

All the sachet water brands showed presence of microbes with a total of 4 species of bacteria detected. *Escherichia coli* accounted for 8(47.1%) of the bacteria isolated while *Pseudomonas aeruginosa, Enterobacter sp and Klebsiella sp* constituted 5(29.4%), 3(17.6%) and 1(5.9%) respectively (Table 2).

Table 2: Bacteria isolates from the three brands of sachet water examined in Abeokuta

Bacteria isolates	No. (%)
E. coli	8(47.1)
Klebsiella sp	1(5.9)
Enterobacter sp	3(17.6)
Pseudomonas aeruginosa	5(29.4)
Total	**17(28.3)**

Pseudomonas aeruginosa accounted for 4(57.1%) of the bacteria isolated from bottle water samples while *Escherichia coli and Klebsiella sp* constituted 2(28.6%) and 1(14.3%) respectively (Table 3).

Table 3: Bacteria isolates from the three brands of bottle water examined in Abeokuta

Bacteria isolates	No. (%)
E. coli	2(28.6)
Klebsiella sp	1(14.3)
Pseudomonas aeruginosa	4(57.1)
Total	7(11.7)

3. Discussion

The physicochemical analysis of most of the sachet and bottle water report in this study presents values of parameters within the WHO standards.

Turbidity was relatively high in all the tested samples. The general WHO standard set for drinking water is < 0.1 NTU. A turbidity >0.5 NTU is considered unhealthy. Its importance is highlighted by the fact that suspended solids interfere with effective chlorination/disinfection and helps to shield bacteria (Asano, 2007).

The WHO guidelines for drinking water quality states that the pH range should fall between 6.5 and 8.0. The current study found sachet water with pH 6.0 and 6.9. Generally low pH values obtained in some of the water sampled might be due to the high levels of free CO_2 which may consequently affect the bacterial counts.

Isolation of pathogenic and potentially pathogenic bacteria such as *Escherichia coli* and *Pseudomonas aeruginosa* from both sachet and bottle water in this study are of importance and indicated that some of the tested water samples are unsafe. This isolation showed water quality deterioration (Yagoub and Ahmed, 2010).

Escherichia coli is regarded as the most sensitive indicator of faecal pollution. Its presence in the water sampled is of major health concern and calls for urgent attention. According to Petridis *et al*., (2002) the presence of this pathogen in water samples was an indication of the likely presence of other enteric pathogens. *Pseudomonas sp* are very common in water systems due to their ease of colonization and they form thick biofilms which consequently have effect on turbidity, taste and odour of drinking water (WHO, 2006).

The result from this study revealed a high level of bacterial contamination in sachet water samples. This showed poor sanitary standard of operation in the production line of sachet-water. The contamination may be during storage, mechanical failure or due to human error.

In Abeokuta, Ogun State, where more than 75% of the population deriving daily water provision from water vendors and sources other than the state municipals to meet daily domestic needs. The National Agency for Food and Drug Administration Control (NAFDAC) needs to enforce compliance with internationally defined drinking water guidelines and regulate the packaged water industry.

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