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Full Length Research Article

AN ASSESMENT OF THE HEALTH AND SOCIAL ECONOMIC IMPLICATIONS OF SATCHET WATER N IBADAN NIGERIA: A PUBLIC HEALTH CHALLENGE

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The inadequacy of pipe borne water in Ibadan Metropolis is almost endemic. This inadequacy is both in quantity and quality of the public water supply. As an alternative to the water supply, small scale industrial concerns came up with 'PURE WATER': 0.5Litre water in nylon sachets, which are electrically heated, sealed at both ends and widely patronized by both low and middle class Nigerians. The objective of the study was to find out the quality of such pure water. Stratified, simple random sampling procedures were used to select 78 samples from 20 brands of sachet water from important hawkers/vendors. The samples were subjected to physical, chemical and bacteriological analysis. For chemical analysis, Hanna's 100 spectrophotometer plus chemical reagents were used. The water samples were assessed for coliform and other intestinal bacteria using MKC cowkery broth (MM) and Brilliant Green Bile Broth (BGBB). Multiple tube method was employed. The result showed that the physical parameters were within W.H.O limits for drinking water quality guidelines except for pH which ranged from 6.6 - 9.7. Some chemical parameters were also within the W.H.O guideline values. However; aluminum which concentration ranged from 0.00 — 0.34 mg/l, fluoride concentration ranged from 0.01 — 1.87 mg/l and cyanide concentration ranged from 0.000 — 0175 were not. Bacteriological analysis, showed that five (5) or 6.4% of the samples tested fielded bacterial growth. Bacteria produced included: Klebsiella sp., Streptococcus faecalis and Pseudomonas aeruginosa. The enforcement of the regulation guiding water quality before the National Agency for Food and Drug Administration Control (NAFDAC) to comply with the drinking water qualities guideline values as recommended by W.H.O, becomes urgent.

Key words: Water quality, Bacteria, Sachet water, Socio economic class Water supply.

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INTRODUCTION

Accessibility and availability of fresh clean water is a key to sustainable development and an essential element in health, food production and poverty reduction. However, an estimated 1.2 billion people around the world lack access to safe water and close to 2.5 billion are not provided with adequate sanitation (Third World Water Forum on Water, 2003). In Nigeria, especially in Ibadan and the metropolis as a whole, pipe borne potable water is inadequate both in quantity and quality.

Consequently, water borne diseases such as Cholera and Typhoid often have their epidemic during the dry season. Typhoid is commonly seen in areas with its accompanying overwhelming septicemia and peritoneal sepsis. Over 80% of the patients seen at the University College hospital, Ibadan, Nigeria with typhoid were between 10-30 years with cases of mortality between 20% to 28% (Adesunkami and Ajao, 1986; Olurin and Ajayi, 1972). Typhoid fever remains a great socio-economic problem in developing countries, Nigeria inclusive. Perforation of intestines is associated with high mortality with wound infection occurring in 50 — 75% of survivors (Archimpong, 1976). Controlling wound sepsis or wound infection with various complication also affected mortality (Ajao, 1984; Badejo and Arigbabu, 1980) and unsafe drinking water had been the major source of this infection.

Since this health problem was largely traceable to unhygienic water supply, an alternative to the seemingly inadequate water supply was found in bottled water, introduced into Nigerian market. Its price is within the reach of the tautology — that is elite and upper socio economic class. However, some small scale entrepreneurs introduced small nylon sachets which are electrically heated and sealed at both ends to the market, these small nylon contain about 0.5L water and is popularly called 'Pure-

Water". The production of sachet water has increased tremendously such that there are one hundred and seventy brands of this type of packed water in Ibadan metropolis at the time of this study. This so called pure water finds patronage from middle class and members of low socio-economic class. Though it is easy to serve and the price is affordable, however people still complain and ask questions on the purity of the sachet water. It has been observed that majority of the water in sachets in the markets are produced in areas of questionable hygienic environment and conditions (Abdulahi, 1981; Ademoroti, 1996; Agada, 1998). Besides, majority of the water sachets do not carry the National Food and Drugs Administration and Control (NAFDAC) approval number. This means that they are either not registered or the producers have not completed the registration of their products with NAFDAC. Even those who were registered have been observed to fall below expected standard once registration had been approved. It was therefore, considered desirable to assess the health and socio-economic implication of sachet water.

MATERIALS AND METHODS

The study area

The study area was in the municipal area of Ibadan City which is made up of five Local government areas. Ibadan is the State capital of Oyo State, South Western Nigeria. It lies on the longitude 305" East of Greenwich meridian and Longitude of 7.23 North of the equator. Ibadan is the largest indigenous city in Africa of the South Sahara. The area is an important educational center. It also houses one of the largest and foremost Teaching Hospitals in Africa. However, the area is characterized by low level of environmental sanitation, poor housing, lack of portable water and improper management of water especially in most of the high density and low income areas.

Sample Selection: A sample of twenty brands of sachet water was selected randomly from a total of one hundred and twenty seven brands on the market. A total of seventy-eight (78) out of 2540 water sachets were selected from the brands. These were obtained from water vendors in markets and motor parks in Ibadan municipal.

Laboratory Experiment: Bacteriological analysis by multiple tube method was used; the culture media used were MB and BGBB. After inoculations of the media with the samples, the BGBB cultures were incubated at 37^0C for two hours before being transferred into 44^0C incubator for eighteen hours. The MB cultures were incubated at 37^0C for eighteen hours,. After the incubation period, the cultures were inspected for changes in colour and gas production. Those showing growth (i.e changes in colour) with or without gas production were noted. Those showing no changes in colour were counted in full coliform showed growth were also sub-cultured on MacConkey agar plates to obtain discreet colonies, this was to facilitate easy isolation and identification of the organisms produced.

Each sample was also subjected to both physical and chemical tests according to standard methods described by the American Public Health Association (APHA). The physical tests included pH, temperature, total dissolved solids (TDS), oxidation-reduction potential (ORP) and electrical conductivity. Chemical parameters analyzed included anion constituents namely, aluminum, calcium, chromium IV, iron, , magnesium and zinc, while the cation constituents included chloride, cyanide, fluoride, nitrate, nitrite total alkalinity, total and free chlorine and total hardness.

Statistical analysis: Data was analysed using EPI-Info 6 and SPSS statistical packages. The means and the corresponding standard deviation were used to summarize the characteristics of the packaged water in the study.

RESULTS

The results showed that for physical parameters (Table I), pure water had pH which ranged from 6.6 - 9.7, (8.2 ± 0.23). The TDS ranged 39.0 - 362.0 mg/l with a mean of 198.1 ± 21.30, while ORP ranged from 80 - 178mV, (113.4 ± 44.1) and electrical conductivity ranged from 0.11 — 0.49 mS/cm (0.29 ± 0.02).

Table 1:
Physical characteristics of Pure Water samples N = 78

Parameters	Range	Mean ±SD
Temperature (°C)	26.1 - 32.4	30.7 ± 0.25
pH value	6.6 - 9.7	8.2 ± 0.43
Conductivity (mS/cm)	0.11 - 0.49	0.29 ± 0.02
Oxidation-reduction potential (mV)	80.0 -178.0	113.4±44.09
Total dissolved solids (mgd)	39.0 - 362.0	198.1±21.29

The anion constituents of the sachet water samples (Tables 2) in this study were aluminum (range: 0.00-0.34mg/l; mean: 0.06 ± 0.04mg/l), calcium hardness level (range: 10 - 107 mg/l; mean: 57.55 ± 7.14mg/l) and magnesium hardness level (range from 12.0 - 36.0mg/l; mean: 18.25 ± 2.68mg/l). Chromium VI concentration ranged from 0.00 - 42 mg/l (mean: 25.4 ± 1.19mg/l), while the iron content ranged from 0.00 — 0.26mg/l (mean: 0.11 ± 0.03mg/l). The zinc concentration ranged from 0.00— 1.19

mg/l the mean was 0.43 ± 0.35. The cation constituents are also shown in Table 2.

The bacteriological analysis showed that five of the seventy eight samples produced bacterial growth. The MPN of coliform count ranged from 1 - 5 organisms per 100ml of water samples. The organisms isolated included *Escherichia, coli*, *Klebsiella sp*. *Pseudomonas aeruginosa* and *Streptococcus faecalis.* (Fig. 1). More importantly in this study, out of 20 brands selected, only six were found to have carried NAFDAC approved number.

Table 2: Characteristics of chemical constituents of Pure Water Samples N = 78

Parameters	Range	Mean ±SD
Calcium hardness as $CaCO_3$ (Mg/l)	10.00 - 107.00	57.55 ± 7.14
Magnesium hardness as $MgCO_3$ (Mg/l)	2.00 - 36.00	18.25 ± 2.68
Iron (Mg/l)	0.00 - 0.26	0.11 ± 0.03
Zinc (Mg/l)	0.00 - 0.11	0.43 ± 0.35
Aluminum (Mg/l)	0.00 - 0.34	0.06 ± 0.04
Chromium VI (Mg/l)	0.0 - 42.00	25.40± 1.19
Nitrite as NO_2 (Mg/l)	0.00 - 1.00	0.51 ± 0.06
Nitrate as NO_3 (Mg/l)	0.01 - 6.60	2.25 ± 0.09
Fluoride (Mg/l)	0.01 - 1.87	0.94 ± 0.01
Chloride (Mg/l)	7.00- 33.00	19.20±4.35
Cyanide (Mg/l)	0.00- 0.175	0.087± 0.00
Total Chlorine	0.02 - 0.10	0.07 ± 0.03
Free Chlorine	0.00 - 0.10	0.04 ± 0.02
Total alkalinity (as $CaCO_3$)	14.0- 260.00	108.00± 64.24
Total hardness (as $CaCO_3$)	16.00 - 124.00	70.00 ± 13.41

DISCUSSION

The results for this study support an earlier observation that the sachet water being produced is of questionable quality (Ademoroti, 1996; Agada, 1998). For example, out of 20 brands selected only 6 (six) carried NAFDAC approval number. However because public water supply is inadequate both in quantity and quality in Ibadan metropolis, pure water as it seems, is an alternative to public water supply for drinking water.. The water sachets are made at an alarming rate, such that they flood the markets and motor parks in this part and many parts of the country. They are the products of middle class entrepreneurs and some small scale business ventures. The producers most often than not are those people who may not know and or care very little about the quality of water sachets they produced. Some even imitate other good products. For the price, pure water sachets are affordable, to the middle class of society and some of the lower class also. Thus this type of packaged water is now popularly and freely served at the common people parties and social functions.

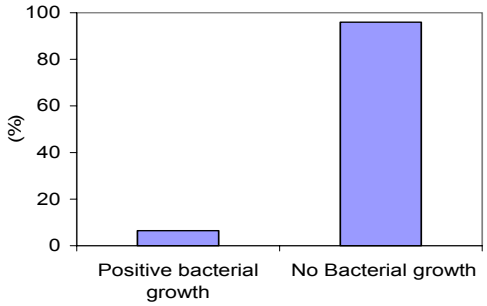

Fig. 1. Occurence of isolated organisms

As useful as sachet water is to the society, the result of the analyses raised doubts as to its quality. The pH of water sachets has an upper range of 9.7, a value higher than the upper limit of pH 8.5 recommended by W.H.O. Even though pH has no direct effect on health, its indirect action on physiology processes can not be over emphasized. The high aluminum concentration might raise health-related questions. The upper range of 0.34mg/l is above 0.2mg/l value as recommended by W.H.O. for the limit of aluminium level in drinking water. Moreso, aluminium has been associated with certain neurological disorder, such as dialysis dementia and Alzheimers diseases.

In this study also, upper limit of fluoride concentration is higher than the 1.5mg/l recommended by W.H.O. for fluoride concentration in drinking water. This was not in agreement with low flouride level found in bottled water in Saudi Arabia (The economist, 1996), and in mineral water in Brazil (Rutz D, 1996). Fluoride has been fairly conclusively demonstrated to be an essential element to animal including man's teeth and bones. Although there is good evidence to show that the presence of fluoride in water result in a substantial reduction of dental carries in both children and adults, mottling may sometime occur even to an objectionable degree, when the level rises to 1.5 - 2.0mg/l, concentrations; above this value there is an increasing risk of dental fluorosis. The upper range of fluoride concentration in pure water fell within this range which may have an indirect effect on health resulting in Alzheimer's disease (Zoctem and Brindmen, (1975)

Bacteriological analyses results showed that 5 (6.4%) of 78 samples in this study produced

bacterial growth after eighteen hours of incubation. The organisms isolated in this study (*Klebsiella sp. Streptococcus faecalis* and *Pseudomonas* has been recovered for vending machines in United States. Dan Rutz (CNN, 1996) reported that Pure water vending machine may not be so pure, after all, because investigations found bacterial like *E. coli* in the machine. Isolation of bacteria from pure water samples especially *Streptococcus faecalis* indicates possible contamination from human excreta. The bacteria isolated with the exception of *Klebsiella sp* are indicator organisms, suggesting that pathogenic organism in faecal materials might have been present initially. Most of the small scale producers of pure water may not be able to afford the price or space for a borehole in their premises, hence they still depend on the already condemned public water supply and water from other doubtful environmental sources, for the source of the water they use in packing their products, some of them under very poor environmental conditions. It should be noted that of the 20 brands selected for this study, only six brands carried the required NAFDAC approved numbers. Consequently apart from educating the consuming public in danger of patronizing sachet pure water that do not carry NAFDAC approved number,, producers should also be educated on how to disinfect their products with solar radiation.

CONCLUSION

In Ibadan municipal, like most urban centers in Nigeria, the inadequacy of the quality and quantity of public water supply is a major problem. Water sachets are handy and are sold at affordable price at least from the middle class of the society. However, this alternative drinking water source has qualities that leave much to be desired. Some of the chemical constituents have upper ranges above those recommended by the World Health Organisation. The health implications of these on the people, on immediate or on long-term basis, might not be too good to the society. The case is worsened by the isolation of bacteria, one of which is of feacal origin. Water borne diseases could be contacted and be spread through drinking of such contaminated water. The so called 'Pure water' after all may be poor water.

There is the need for the public to be properly informed of the presence of packaged drinking water of doubtful qualities on the markets. The consuming public also must be informed of the consequences of consuming packaged water, which do not carry NAFDAC approval numbers. The Environmental officers in the Local Government employment owe it a duty to the public to educate the vendors on the need to vend only NAFDAC approved pure water sachets in the markets and motor parks in their Local Government areas. It could be also recommended that producers of packaged water should endeavour to disinfect their products with solareradiation, which is simple to construct, and easy to maintain.

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