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(RESEARCH ARTICLE)

Lack of potable water and the need for water quality analysis of commercially available Satchet water in EPE metropolis of Lagos-Nigeria

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Abstract

This study was purely experimental, and the goal is to ascertained if produced water is fit for a specific purpose. Water is mostly purified for human consumption (drinking water,) but water purification may also be designed for a variety of other purposes, including meeting the requirements of medical, pharmacology, chemical and industrial applications. Hence variety of commercially hawk water were sampled and exposed to laboratory chemical analysis and the results indicated that majority of this water were not good for human consumption. The samples tested in Epe metropolis did not meet the standards for drinking water quality that are typically set by governments or by international standards. These standards will typically set minimum and maximum concentrations of contaminants for the use that is to be made of the water, and lastly recommendations were made.

Keywords: Portable; Water quality; Analysis; Sachet water

1. Introduction

The importance of water to all biological life cannot be over-emphasized. Little wonder then that men built most of their early communities near rivers to ensure a ready supply of water to support all their economic, social and most especially body mechanisms. Three-quarters of' our body is made up of water and next to oxygen. Owning to the presence of water in cells and body fluids such as blood, human body composed approximately 60% water. Nearly all the processes essential for life depend on reactions that take place in an aqueous solution. be it the division of deoxyribonucleic acid (DNA) in a cell, the digestion of foodstuffs in the stomach, or the transport of oxygen around body. Thus the body need clean and healthy water supply in order to maintain healthy body. However, progress in modern medicine has indicated the significant role of water in the transmission of diseases such as cholera, diarrhea, typhoid and other diseases. Ahuja e tal.(2020) Opined that water quality and purity is extremely important because water is an essential material for human survival. Without water, life would not be possible. Rain is nature's way of providing fresh water; however, rain is usually contaminated with various pollutants that we now put into the atmosphere. Our civilization has managed to pollute our surface water, and even groundwater; this necessitates purification of water for drinking.

Here are some important facts about the availability, quality, and purity of our water supplies:

- Earth is a "water planet," with 71% of its surface covered by water. However, fresh water comprises only 3% of the total water available to us. Of that, only 0.06% is easily accessible.
- Over 80 countries in the world suffer from a water deficit.
- Nearly 1.2 billion people worldwide drink unclean water today. • The United Nations estimates that 2.7 billion people will face a water shortage by 2025.
- Water-related diseases kill 510 million people, mostly children, around the world (Ahuja, 2021).

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At this juncture it should be emphasized that any water supply scheme should not only aim at providing sufficient quantity of water, it must also ensures that the water is well treated so as to eliminate the organisms carrying the various diseases. The provision of water is one of the basic infrastructural facilities for the upliftment of the standard of living of people, as well as rapid industrialization of any nation. Hence potable water must be taken into the citizenry body system in order to produce a healthy population for the nation's development. Today, many countries are unable to provide safe drinking water and sanitation services to their populations – the challenge and cost of scaling up the infrastructure required, as well as operational and maintenance costs, are too great. Yet despite these challenges, in the past many countries that were not economically developed were able to ensure access to safe drinking water for everyone. How? The strategy was to guarantee, above all, a free, safe, public water supply, close to everyone's home, in the square of each town and each neighborhood(UNICEF,2018).

In a developing country like Nigeria, it is expected that portable water requirement for both the rural and urban communities be meant, but it is so disheartening that the government established water works are not doing enough by providing clean and adequate water for the masses, they only succeeded in providing the populace treated water that is passing through rusted and busted pipes along the stinking gutters. Little wonder then that, in the home of some well to do, individuals prefer to produce their own untreated domestic water by constructing bore-hole or well. Some philanthropists or non-government organisations also constructed bole-hole to supply also untreated water for minute number of the population and greater number of the population put their faith into trial by opting for sachet water (popularly called pure water) and table water (bottle water) that they are not sure of the level of portability.

Today, however, in the 21st century, an estimated 2.2 billion people in the world do not have access to safe drinking water and 4.2 billion people do not have access to safe sanitation. The reasons are diverse and depend on multiple factors and circumstances. In extreme semiarid territories, subject to climatic changes that threaten their habitability, the problems are most often due to physical water shortages. However, the vast majority of these 2.2 billion people are not thirsty people without water in their living environments, but impoverished people living next to rivers or on polluted aquifers (UNICEF, 2018). Billions of people lack accesses to an improved drinking water supply, 88% of the 4 billion annual cases of diarrhea disease are attributed to unsafe water and inadequate sanitation and hygiene, and 1.8 million people die from diarrhea diseases each year (Hutton. e tal. 2014).

WHO estimates that 94% of these diarrhea cases are preventable through modifications to the environment, including access to safe water. Simple techniques for treating water at home, such as chlorination, filters, and solar disinfection, and storing it in safe containers could save a huge number of lives each year. Reducing deaths from waterborne diseases is a major public health goal in developing countries. This study, therefore is an attempt at contributing to safe and free from danger to healthy commercial hawking of drinking water known as "pure water" with or without approval number of Government regulatory agent called National Agency for Food and Drug Administration and Control (NAFDAC) being sold to the people of Epe metropolis.

1.1. Portable Water

Portable water refers to water that meets the standards for drinking and is safe for consumption. Naturally, water can contain different ions depending on the nature of the area in which it is found, it will also contain small amounts of organic matter, such as particle of clay and decaying vegetation suspended in it. The particles are often of a colloidal size and can be precipitated by the addition of aluminum salts. And, if the addition is not controlled properly, the aluminum can itself end up in the water supply as pollutant. Therefore, portable water does not exist in a natural state, but it is prepared in order to meet human consumption requirements in respect of free from chemical substances and micro-organisms in amount which would constitute health hazard. It should be noted that in the United States, two agencies control water quality: the Environmental Protection Agency (EPA) responsible for protecting human health and environment ensures drinking water quality from the faucet, and bottled water is controlled by the Food and Drug Administration (FDA). At the federal level, bottled water must comply with the Federal Food, Drug, and Cosmetic Act (FFDCA) (21 USC. yy 301 et seq) and several parts of Title 21 of the Code of Federal Regulations. Section 410 of FFDCA requires that FDA bottled water regulations be as stringent and protective of the public health as the EPA tap water standards. The FDA has also established bottled water Standards of Quality for more than 90 substances (21 C.F.R. y 165.110. (b)). Most FDA bottled water quality standards are the same as EPA's maximum contaminant levels (MCLs) for tap water systems. The few differences are usually the result of the substance's not being found in bottled water, or the substance is regulated under another provision of law such as the FDA's food additives program. Regulation of bottled water is managed through the FDA's Center for Food Safety and Applied Nutrition, College Park, Maryland. Enforcement and inspections are coordinated through the FDA's state and regional field offices. Additionally, the health and safety departments of all 50 states and the District of Columbia regulate the bottled water industry at the state level. In fact,

regulatory oversight is such an important issue that during inspection and enforcement activities, state regulatory authorities act with the full federal legal authority of the FDA (Ahuja, 2021).

The chemists described water to be pure if the water contains no dissolved material, beside being odourless, tasteless and colourless. This is different from what water companies means by pure water; they mean that the water contain no harmful substances. Safe drinking water contains dissolved salts. Water which contained substances that are bad for health is polluted water. Almost all substances dissolved in water to some extent, that is a good solvent. Since water is such a good solvent, it is difficult to obtain pure water. The standards for drinking water quality are typically set by governments or by international standards. These standards will typically set minimum and maximum concentrations of contaminants for the use that is to be made of the water.

Distillation is one method of purifying water. In some countries distillation is used to obtain drinking water from sea water. The technique is called desalination (desalting). Hong Kong has a large desalination plant which has never been used because the cost of importing the oil needed to run it is very high. In nature, water exists in liquid, solid, and gaseous states. It is in dynamic equilibrium between the liquid and gaseous states at standard temperature and pressure. At room temperature, it is a nearly colourless with a hint of blue, tasteless, and odourless liquid.

Table 1 Properties of Water

Molar mass	18.01528(33) g/mol
	1000 kg/m3, liquid (4 °C)
Density	(62.4 lb/cu. ft)
	917 kg/m3, solid
Melting point	0 °C, 32 °F (273.15 K)
Boiling point	99.98 °C, 212 °F (373.13 K)
	15.74
Acidity (pKa)	˜35—36
Basicity (pKb)	15.74
Refractive	
index (nD)	1.3330
Viscosity	0.001 Pa s at 20^0C

Many substances dissolve in water and it is commonly referred to as the universal solvent. Because of this, water in nature and in use is rarely pure and some of its properties may vary slightly from those of the pure substance. However, there are many compounds that are essentially, if not completely, insoluble in water. Water is the only common substance found naturally in all three common states of matter and it is essential for life on Earth. Water usually makes up 55% to 78% of the human body.

In order to improve the quality of water, some public drinking water supplies are chlorinated so as to reduce the number of coliform bacteria. The bacteriological quantity of water is often quantified in terms of the most probable number of the organisms in 100ml of water or what is called the MPN index. Sample from treated water can be expected to have MPN index not greater than 1, while it is not unusual to find samples of untreated water with MPN index greater than 20. It is also desirable that the water does not contain some compounds like carbonates and bicarbonates of calcium and magnesium in excess of 100mg per litre of water which is regarded as hard water. Hard water has several unwanted properties. In the first place, it gives a scum with soap . soaps are ionic compounds containing a long hydrocarbon chain with a —COO- group on the end. This group is a remnant of an organic acid that has its hydrogen removed. High concentration of fluoride leads to brown-stained and pitted teeth. Hydrogen sulphide, dissolved oxygen and carbon dioxide cause acidity which leads to a rapid corrosion of pipes and containers, iron in water, most especially from wells, causes unpleasant taste, discolouration of fabrics and growth of bacteria.

Thus, it is necessary to determine the quality of the raw water supply and make concerted effort at reducing the various contaminations to acceptable level(Andres, e tal, 2020).

1.2. Purpose of the study

Water is the most important of our needs. It is of equal necessity with the air we breathe in maintaining the vital processes necessary to life and growth. As a matter of fact, the role of water in survival of plant and animal life cannot be quantified, it is indeed the basis of life and this necessitated the need to regularly monitor the quality of water people in Epe metropolis are consuming. Epe, an old division in Lagos state is below the sea level and the availability of water free from salt and other minerals call for concerns; and many functional bore-holes have traces of salts and thereby tasty, though there have not been outbreak of water borne disease in Epe, an indication of minimal or absence of pathogenic bacteria, but there is no data to effectively identify the medical complaints of most residents in the area viz-a-viz the presence of chemical pollutants in the water bodies. Therefore, this work is a preliminary study into the aquifer state of Epe, in Lagos state.

Aim

To carry out water quality analysis of sampled sachet water

1.3. Material

The materials are in two categories:

1.3.1. Reagents

Chlorine, nitrate, colorimetric comparator

1.3.2. Equipments

Centrifuge (Water Quality Analyzer, USA, Model:412B) Water Quality

1.3.3. Monitoring, COD Test

water quality monitor, pH meter, conductivity meter, turbidity meter, thermometer, graduated cylinder, pipettes, test tube.

1.3.4. The Sample

Five sachet water samples were randomly collected across Epe metropolis of Lagos state of Nigeria.

1.4. Procedure

Sachet water samples popularly sold in Epe metropolis of Lagos state, Nigeria were collected for water quality analysis. All the 5 water samples have NAFDAC approval which signifies that they are good for human consumption. pH and temperatures were determined for each sample using digital —ANAH 180L4 pH meter at 25°C, while titrimetry method of analysis was used to quantify the degree of hardness. Generally, waters are examined for four types of characteristics viz-a-viz: physical, chemical, bacteriological and biological. The main physical characteristics for which water is examined include: appearance, colour, turbidity, odour, taste and temperature. Colour and turbidity are capable of being measured instrumentally. The determination of appearance, and taste on the other hand, depends on human sense, perception, odour and judgment. Chemical characteristics deal with physicochemical measures such as: pH value, electrical conductivity and main mineral constituents.

2. Results and discussion

The domestic use of water necessitates certain standards of quality of water in many cases, water of the standard of public supplies is quite satisfactory, having fulfilled the characteristics expected of such. The result of the comprehensive Physico-chemical sample water is contained in the table below:

Table 2 Analysis of Water Quality of Jive different Brands of Water Sachets and World Health Organisation (W.H. O) standard

PARAMETERS	**SAMPLE A Ppm**	**SAMPLE B Ppm**	**SAMPLE C Ppm**	**SAMPLE D Ppm**	**SAMPLE E Ppm**	**W.H.O Standard Ppm**
Physicochemical						
Appearance	Clear	Clear	Clear	Clear	Clear	Clear
Turbidity	6.12	5.20	3.91	2.72	3.10	7
Odour	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless
Electrical conductivity (uS//cm)	93	86	95	49	61	45
Ph	5.8	5.2	6.0	6.9	6.0	6.5-8.5
Total dissolved solid	102	93	109	63	92	-
Calcium (Hardness)	202	39	45	20	36	200
Iron	Nd	Nd	Nd	Nd	Nd	40
Magnesium	Nd	Nd	Nd	Nd	Nd	70
Microbiological						
Coliform	-	-	-	-	-	0
Yeast/moulds					-	-
Total plate count						100

2.1. pH

The Alternative Water Quality Index Using FLDM method described by (Roy, 2018). By definition, pH is the negative logarithm of the hydrogen ion concentration. It is in effect an index of the amount of hydrogen ion present in a substance and is used to categorize the latter as acidic, neutral or alkaline (base). Most natural waters will have pH values from pH 5.0 to 8.5, fresh rainwater may have a pH of 5.5 to 6.6. The carbon dioxide (CO_2) produced by respiration of animals and plants in water have the effect of lowering pH . CO_2 and bicarbonate removed from the water (H_2O) by the photosynthetic process alter the Dissolved Oxygen (DO) content drops during respiration and decomposition, it rises with photosynthetic activity.

A pH that is too high is undesirable because free ammonia (NH_3) increases with rising pH From the results obtained from the analysis, the pH values ranges from 5.2 to 6.9, with only sample D meeting the world health standard while the other four samples fell off standard, there will be the need to further quantify the chloride level to have a vivid understanding of the contributory indexes to the low pH recorded, there is the likelihood of addition of excess chloride during the water treatment processes, or the influx of creek or sea water into the aquifer of the area is another possible source of the pH recorded.

2.2. Total Hardness

The method described by (Tyagi, et al., 2013) was adopted. The method is based upon Water Quality Assessment index. The total hardness of a H_20 represents primarily the total concentration of calcium ion (Ca^{2+}), magnesium ion (Mg^{2+}) expressed as calcium carbonate. Hardness may range from zero to hundred of parts per million depending on the origin of the 1-120 or treatment to which the H_20 has been subjected. Water containing hardness concentrations of up to 6Omg/L(ppm) are referred to as soft, those containing 120-lSOmg/l(ppm) as hard recommended level >l3Omg/L(ppm). The results generated above from the analysis, is satisfactory for samples studied except for the sample A which is slightly higher than W.H.O. standard. The likely causes of this may be that the water source (aquifer) used by the company have a high load of calcium and the filtration system (ion beds) employed to remove ions from the water might need to be replaced or reactivated.

2.3. Heavy Metal Contamination

This was not quantified in this study due to time constraint, but from the values of the electrical conductivity, ranging from 49 to 95 as against W.H.O. Standard of 45 thereby indicating a high presence of electrical conducting ions in the water samples.

2.4. Delimitation

Generally, water is examined for four types of characteristics: physical, chemical, bacteriological and biological characteristics. Since physico-chemical analysis reflect deviant of the samples indexes with W.H.0. Standard, it is pointless going on with the bacteriological and biological analysis. The study is delimited to physico-chemical analysis.

3. Conclusion and Suggestions

Results obtained in this preliminary study have been able to show the deficiencies in the portable water samples in Epe local government and her environs, and based on the results of this work, none of the water samples met the established standards for drinking water. Epe being a sub urban environment and majority of the people engage in farming, and research has shown that over the last few years the concentration of sulphate and nitrate ions in water have greatly increased in intensively farmed environment. It was concluded that due to the wide spread use of fertilizers such as ammonium sulphate and ammonium nitrate ions are known carcinogens and there is possibility of higher incidence of cancers in years to come for the consumers of such contaminated water. Some pieces, called microplastics (MPs), are too small to be seen with the naked eye. Input of micro plastics into the marine and freshwater environments is similar, but fresh waters are likely to be more susceptible to the constant influx of these non-biodegradable micro particles because of the much lower water volume (Ahuja & Loganathan, 2020). Since many freshwater bodies are sources of drinking water, knowledge of the types and quantities of micro plastics is imperative. Research has established that the most abundant micro plastic is the synthetic microfiber in both marine and fresh waters. These are tiny fibers that are released from textiles, carpeting, and many other products made from polyester, nylon, and other synthetic materials. Several studies show heavier loads of micro plastics in sediments near urban and industrial areas. Analytical techniques used in micro plastic studies, namely stereomicroscopy and spectroscopic analyses are engaged. Recent studies have shown that despite its remoteness, the Arctic region harbors some of the highest microplastic concentrations in the world (Tekman, et al.2020).

Therefore clean drinking water is essential to humans and other life forms. Access to safe drinking water has improved steadily and substantially over the last decades in almost every part of the world. There is a clear correlation between access to safe water and GDP per capita. However, some observers have estimated that by 2025 more than half of the world population will be facing water-based vulnerability. Water plays an important role in the world economy, as it functions as a solvent for a wide variety of chemical substances and facilitates industrial cooling and transportation. Approximately 70% of freshwater is consumed by agriculture.

The writers are of the view that if this situation is not remedied, the life of appreciable number of Epe people could be in danger. Therefore the following proffered solutions were suggestions:

- The existing pipe networks have over-served their usefulness; hence new rustproof pipes should be laid.
- Due to epileptic electricity light, to power the machines in the water works. There is need for standby generator as an alternative source of power supply.
- Dumping of refuse in the body of water should be prohibited and most importantly, all the canals and creeks should be cleared of debris (tiny fibers that are released from textiles, carpeting, and many other products made from polyester, nylon, and other synthetic materials).
- Based on this research finding, it was discovered that there were some brands of water sachets that were not with NAFDAC numbers or some with fake numbers, and some brands had no traceable addresses, therefore NAFDAC should be more responsive to their statutory responsibility.
- The government should provide more bore-holes with standby generators in strategic areas within the communities. And lastly, it is expected that the regulatory agencies will take more decisive steps towards ensuring potable water in order to discourage Epe people from patronising the so called pure water' vendors and it will equally discourage people from fetching contaminated water from the rivers and streams for domestic use.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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