PHYSICOCHEMICAL AND BACTERIOLOGICAL ANALYSIS OF WELL WATER SAMPLES FROM SELECTED LOCAL GOVERNMENT AREAS OF OSUN STATE.

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ABSTRACT

Physicochemical and bacteriological analyses were carried out on residential well water samples from Ila Orangun and Esa Oke in Osun State. Six (6) well water samples were subjected to physicochemical analysis like temperature which ranges between 26.8 and 29.0^{0}c, pH ranges between 7.0 - 7.8, total hardness ranges between 86 - 175 mg/l, total chloride ranges between 6.75 - 10.65. These properties of the water samples were compared with WHO (World Health Organization) standard for drinking water and it was within the safe range. The bacteriological analyses were carried out to detect viable bacteria count ranging between 2 x 10^2 - 5.4 x 10^3 .cfu/100ml and Escherichia Coli count ranging between 0-20 cfu/ml. The presence of pathogens in water for drinking purpose is of health significance, considering the presence of bacteria and the possibility of protozoa and enteric viruses that are implicated in gastrointestinal water-borne diseases and the low infectious dose for these waterborne pathogens. The data suggest the need for treatment of the water samples by government authority and by simple boiling by consumers.

Introduction

Water is most important or essential for the existence of life on earth. It is a major component of all forms of life, from micro-organism to man. Besides this fact, water is used for diverse purposes ranging from industrial to domestic. Domestic uses include cooking, drinking, and washing. Water for domestic use needs to be potable and safe for humans. According to the World Health Organization(WHO,2011), safe and wholesome drinking water is a basic need for human development, health, and well-being. It is internationally acceptable that everybody must have potable water. Potable water is the water that is free from disease-producing micro-organisms and chemical substances toxic substances, an excessive amount of minerals and organic matters that are dangerous to health. Water is vital to our existence in life and its importance in our daily life makes it imperative that a thorough microbiological and physicochemical examination be conducted on water. (Akenroye and Opawale, 2012) Various physicochemical parameters have a significant role in determining the portability of residential good water. The burden of population pressure, unplanned urbanization, unrestricted exploration and dumping of polluted water at inappropriate places cause the

infiltration of harmful compounds to the ground water. Application of fertilizers, prolonged discharge of industrial effluents, domestic sewage and solid waste dump also add to ground water pollution. All these cause adverse health effects on human beings and animals.("Drinking Water Quality Standards" 2016)(Shittu et al,2008).

Only a small fraction, about 2.5% of earth's water is fresh and suitable for human consumption. Approximately 13% of this water is ground water and an important source of drinking water for people worldwide. The addition of various kinds of pollutants through improper handling of urban sewage, industrial effluents, agricultural run-off into the water bodies bring about series of changes in the physicochemical quality of water. (Shittu, et al,2008) The ground water crisis is not the result of natural factors, it has been caused by human activities. The discharged chemicals interact with groundwater and affect the pH and other water qualities.

The quality of ground water is affected by the processes and reactions that act on the water, right from the time it condenses in the atmosphere to the time it is discharged by a well. (Shittu, et al, 2008). These interactions vary from place to place and with the depth of the water table. Both surface and sub-surface water source get polluted due to developmental activities. In southwestern areas of Nigeria, particularly in Ila Orangun and Esa Oke, there are numerous dyeing pits and small scale industries. The effluents from these industries greatly distress the geochemistry of the soil. The discharge chemicals interact with ground water and alter the pH and other water quality parameters. The public health significance of water quality cannot be over emphasized. Many infectious diseases are transmitted by water through the faecal-oral route. Diseases contracted through drinking water kill about 5 million children annually and make 1/6th of the world population sick (Kadave, et al, 2012), (Reddy and Reddy 2011) (Akenroye and Opawale, 2012)

The need to determine the suitability of water for drinking and bathing purposes has been recognized since 1855 when snow and bud related outbreaks of typhoid, fever, and cholera to water contaminated with faecal wastes (Ajewole, 2005). It is estimated that up to 80% of the health problems in developing countries are water and sanitation related (Ibrahim et al 2013). In the year 2000, the estimated global burden of diseases associated with poor water supply is more than 2 billion cases of diseases with an annual death of 2.2 billion (WHO, 2004). Presently, the United Nations (UN) reported that more than 5 million people die annually from diseases caused by unsafe drinking water and lack of sanitation.(WHO. 2011, Shy Amala, Shanthi and Lalitha (2008), Divya, Sunil & Latha (2011) , Mustafa et al (2013), Akenroye and Opawale (2012)

In Southwestern areas of Osun State, particularly Ila Orangun and Esa Oke, there are cases of dunghills located close to sources of community water wells, which results in polluting the residential well water. The study was conducted therefore to determine the potability of water samples from the selected sources and to identify the microbes in the selected water samples

Procedure

Sample site

The site of samples consisted of 2 towns in Osun state; (a) Ila orangun and (b) Esa Oke. Ila Orangun is an urban area with a population ranging from 500,000 - 700,000 people. Esa oke has a transient population (it hosts a tertiary institution). The sample sites are located in Osun state in southwestern Nigeria is located 40^0 and 140^0 North of the equator and between longitude 200 and 1500 east of the Greenwich meridian (Wikipedia 2012).

Sampling locations and corresponding habitats

Table 1

Sampling location	Samples	Habitat	Water source
Takiti (Ila Orangun)	A	Residential area	Deep Well
Adeniji (Ila Orangun)	B	Residential area	Deep Well
Aladoogbe (Ila Orangun)	C	Residential area	Deep Well
Tema (Esa Oke)	D	Residential area	Deep Well
Chevron (Esa Oke)	E	Residential area	Deep Well
Bola Ige (Esa Oke)	F	Residential area	Deep Well

The culture media for isolation, stocking and some biochemical characterization of bacteria isolates were Eosine Methylene Blue (EMB), nutrient agar, nutrient broth and Triple sugar iron agar.

Physicochemical Parameters

Determination of temperature-Mercury in glass thermometer with the calibration of 0 – 100^0c was used.

Determination of pH. The hydrogen ion concentration (pH) was determined with the use of glass electrode (Denver model 20).

Determination of total chloride-The chloride content of water sample was determined by measuring 100ml of the water sample into a clean conical flask and 2ml of 5% potassium chromate was added as indicator. It was then titrated with 0.1ml Silver Nitrate ($AgNO_3$) until the initial yellow colour changed to faint pink was noted .The total chloride was calculated as follows; Titre value x 3.55 in mg/l

Determination of total hardness-The total hardness was determined by measuring 100ml of water sample into a clean conical flask, 10 drops of 25% ammonium was added while Erichrome Black T was added as an indicator. It was then titrated with 0.1N EDTA until the initial purple colour changed to light blue was noted, and the total hardness was calculated using; - Titre value x 100mg/l

Determination of well water sanitary score

Sanitary score was determined by dividing the number of parameters with yes score with the total number of parameters examined.

Sanitary score (%) = numbers of yes score/ total number of parameters x 100

Bacteriological Analysis

Determination of viable bacteria count

The viable bacteria count was determined by diluting the water samples up to 10^{-5}, 0.1ml. from $10^{-2}$to 10^{-5} dilution was taken and was introduced into the sterile petri dishes inside the inoculating chamber with the methylated spirit lamp on. Pour plate method was used after when the agar was poured into plates containing serially diluted water samples. It was swirled and allowed to set before incubating at 37°c for 24 hours. Colonies that grew on the plate were counted and recorded.

Determination of faecal coliform

The faecal coliform count was determined by inoculating 0.5ml of the raw water sample into a sterile Eosine Methylene Blue agar plate and a sterile spreader was used to spread the water sample evenly on the agar plate. It was then incubated at 44°c for 48hours. Colonies with green metallic sheen were counted after 48 hours.

Purification and preservation of isolates

This was done by picking distinct colonies unto another sterile nutrient agar plates and was incubated at 37°c for 24 hours of incubation, the colonies were inoculated unto an agar slant and was re- incubated. The agar slants were preserved in the refrigerator at 4 – 8°C.

Characterisation and identification of bacterial isolates

The identification of the bacterial and fungal isolates was carried out using the laboratory procedures described by (Fawole and Osho, 2002)

Discussion

The table contains the sanitary score for the various well, sample, and location.

Table 1;

Sample	Not close to gutter	No grasses or vegetation around the well	Used for drinking purpose	Raised above the ground	Covered	Ringed	Sanitary score (%)
A	Yes	Yes	Yes	Yes	Yes	Yes	100
B	Yes	Yes	Yes	Yes	Yes	Yes	100
C	No	Yes	Yes	Yes	Yes	Yes	83.33
D	No	Yes	Yes	Yes	No	Yes	66.67
E	Yes	No	Yes	No	Yes	No	50
F	Yes	No	Yes	No	Yes	No	50

The result of the physicochemical analysis of the residential well water in Ila orangun and Esa oke are reported in table 2.

Table 2; comparison of physicochemical parameters of residential well water in Ila orangun and Esa oke with standard values.

Parameters	A	B	C	D	E	F	WHO
Temperature	27.5	27.2	28.3	26.8	27.8	29.0	30
pH	7.5	7.0	7.7	7.4	7.6	7.8	7 - 8.5
Total hardness (mg/l)	86	175	90	110	165	79	200
Total Chloride (mg/l)	8.88	8.63	7.46	6.75	7.46	10.65	250
Colour	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless
Odour	odourless	odourless	odourless	odourless	odourless	odourless	odourless
Taste	agreeable	agreeable	agreeable	agreeable	agreeable	agreeable	agreeable

Temperature: The temperature of well water ranged from 26.8°C(minimum) to of 29.0°C (a maximum) in Table 2, with samples from Bola Ige house having the highest temperature of 29.0°C, while Tema hostel has the lowest temperature of 26.8°c. It is noted that high water temperature enhances the growth of microorganisms and may increase taste, odor, color and corrosion problem.

pH: pH values of samples range from 7.0 to 7.8 which conform to WHO standard for drinking water. Although pH usually has no direct impact on consumers, it is one of the most important operational water quality parameters.

Total Chloride: Chloride in drinking water originates from natural sources, sewage and industrial effluents, urban run-off containing de-icing salt saline intrusion. No health-based guideline value is proposed for chloride in drinking water by WHO standard of drinking water. However, Chloride concentrations in excess of about 250mg/l can give rise to detectable taste in water and the observed range is 6.75 to 10.65mg/l (WHO,2011).

Total hardness: The range of total hardness analyzed is 79 to 175mg/l and fell below WHO standard of drinking water. Hardness caused by calcium and magnesium usually results in excessive soap consumption and subsequent "scum" formation. In some instances, consumers tolerate water hardness in excess of 500mg/l. Depending on the interaction of other factors, such as pH and alkalinity, water with hardness above approximately 200mg/l may cause scale deposition in the treatment works, distribution system and pipe work and tanks within buildings. Soft water with a hardness less than 100mg/l may have a low buffering capacity and so be more corrosive for water pipes. (WHO, 2011).

Table 3. Result for bacteriological analysis of the residential well water samples.

Sample	Bacteria count (cfu/100ml)	Escheriachia coli (cfu)
A	39×10^{-2}	0
B	2.0×10^{-2}	0
C	5.4×10^{-3}	0
D	3.5×10^{-3}	0
E	4.3×10^{-3}	0
F	4.8×10^{-3}	20

Table 3 shows the bacteriological quality of residential well water in Esa Oke and Ila Orangun. The viable bacteria count ranged between $2x10^2$ to 5.4×10^3cfu/ml, while Escherichia coli ranged between 0 to 20cfu/ml. The relatively high viable bacteria counts of

the well samples implies that majority of the wells are faecally polluted. The mouth of some of the wells were not raised high enough and so rain splashes and some human activities including sweeping the compound, washing by the side of the well may have been possible means of introducing the faecal matter of both human and animal origin into the wells.

MORPHOLOGICAL AND BIOCHEMICAL CHARACTERISTICS OF THE BACTERIAL ISOLATES

	Morphological characteristics of the isolates (shape size Edge colour elevation)	Gram rxn	Arrangement	Catalase	coagulase	Indole	Sugar fermentation					Probable organism
							Lactose	Sucrose	glucose	H_2S production	Gas production	
A	circular, cream, large, Lobate, Raised	+ve cocci	Cluster	-	-	-	+	-	+	-	-	*Micrococcus spp.*
B	Circular, cream, large, Undulate, Raised	+ve cocci	Cluster	+	-	+	+	-	-	-	-	*Staphylococcus sp*
C	Irregular, cream, large, Lobate, Flat	-ve rod	Pair	-	-	+	+	+	-	-	-	*Pseudomonas spp.*
D	Irregular, cream, large entire, Raised	+ve rod	Single	-	-	-	+	+	-	-	-	*Corynebacteriumxerosis*
E	Circular, cream, large, entire, Flat	-ve cocci	Chain	-	-	+	+	+	-	-	-	*Streptococcus spp.*
F	rhizoid, cream, large, dentate, Raised	+ve rod	single	-	-	-	+	+	+	-	-	*Bacillus spp.*

Keys: + = positive; - = negative

A total of six species were isolated. The isolated bacteria include *Lactobacillus sp., Staphylococcus aureus, Pseudomonas sp., Corynebacterium xerosis, Streptococcus sp. and Bacillus sp.* bacteria species such as Staphylococcus sp. were isolated indicating contamination by human activities such as laundry and bathing around the well. Pseudomonas sp. isolated could be from the soil in the well since the organism is a common inhabitant of the soil, hardly of the human body. Inadequate and unhygienic handling of solid wastes in the rural area could have generated high concentration of microbial organisms

RECOMMENDATION AND CONCLUSION

The principal aim of monitoring drinking water is to prevent the spread of water-borne disease and to protect the health of the community. The importance of access to good quality water cannot be overemphasized. Proper well location and construction, control of human activities to prevent sewage from entering water body is the key to avoiding bacteria contamination of drinking water. It is evident that water-borne diseases are due to improper disposal of refuse, contamination of water by sewage, surface runoff.

The present investigation has led to conclude that the quality of water samples subjected to this study was acceptable from the majority of the physicochemical parameters while based on the bacteriological analysis, the water needs to be treated or heated before its domestic application because it exceeds the standard limit.

It is recommended that the settlers or inhabitants can use their well water for domestic purposes. It is advisable that analysis should be carried out on the well at least once in a year. Proper sanitary survey, design, and implementation of water and/or sanitation project,

regular disinfections, maintenance and supervision of water sources for drinking should be planned and should also involve health workers in giving awareness to the inhabitants on the use of safe water.

It is also recommended that waste treatment and handling should be done in an environmentally sustainable way or manner. This is to prevent underground water contamination and to enlighten the public on its negative effects

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