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International Digital Organization for Scientific Research ISSN: 2579-0730
IDOSR JOURNAL OF BIOLOGY,CHEMISTRY AND PHARMACY 3(1)16-22, 2019.

Physicochemical Analysis of Well Water Samples from three Sample Sites at Agbani Road, Abakpa and Obiagu

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ABSTRACT

The physico-chemical properties and heavy metal contamination of ground water (well water) from three location within ftnugu metropolis ("Abakpa, Agbani Road and Obiagu) were analyzed. The result of the physicocheimcal anlysis of \vdl water from Agbani Road, and Obiagu are: Temperature (24.2, 25.9 and 25.4°C), pH (6.65, 6.60, 60.6), conductivity (324, 992, 508 us/cm), turbidity (48.75, 27.39, 58.32 FTU), total solid (100,200 l40mgL^{1}), total dissolved (20, 100, 20 mg/L), COD (98, 154, 120mg/L), chloride (0. 25, 0.18, 0.32mg/L), sulphate (7.6, 8.9, 9.4mg/L), alkalinity (12.2, KM7, 12.8mg/L), Hardness as $CaCO_3$ (60.2, 75.6, 65.9mg/L), nitrate (3.03, 3.65, 2.74mg/L) respectively. The heavy metal analysis of the three well water samples A, B and C are: Pb 10.0001015, 0.000091, 0.000082Mg/L, Cu (0.0000630, 0.00008803, 0.0000725Img/L), Manganese (0.00001660, 0.0000235, 0.00001210mg/L), P (0.0000102, 0.0000110, 0.000010mg/L and Fe (0.0004049, 0.0000397, 0.0000400mg/L) respectively. The heavy metal concentrations of the three well water sample sites were less than the permissible limits by world health organization (WHO) and standard organization of Nigeria (SON) which had indicated (hat the three well water samples were not polluted

Keywords: Well water, physicochemical, Agbani, Abakpa and Obiagu

INTRODUCTION

Water is a transparent fluid which formed the world's streams, lakes, ocean and rain, and it is the major constituent of the fluids of organisms. Water has a chemical formular of H_2O, as a chemical compound it contain one oxygen and two hydrogen atoms that are connected by covalent bonds. Water is a liquid at standard ambient temperature and pressure, but it often co-exists on earth with its solid state (ice), and gaseous state (steam or water vapour). Water also exists as snow, fog, dew and 'loud. Water covers 71% of the Earth's surface (CIA, 2008).

Water is vital for all known forms of life. On earth, 96.5% of the planet's water is found in seas and oceans, 1 .7% in ground water, 1.7% in glaciers and the ice caps of ant erotica and Greenland, a small fraction in other large water bodies and 0.001% in the air as vapour, clouds and precipitation [1]. Only 2.5% of the earth's water is fresh water, and 98.8% of that water is in ice and groundwater. Less that 0.3% of all freshwater is in river, lakes and the atmosphere, and an even smaller amount of the earth fresh water (0.003%) is contained within biological bodies and manufactured products' [2]. Water is a universal solvent essential to man for various activities such as drinking, cooking, industrial and agricultural processes, water disposal and human recreation. The two main problems man contends with arc f ho quantity (source and amount) and quality of water in Nigeria [3]. In view of its occurrence and distribution pattern, water is not available to man in the desirable amount and quality. This is a problem experienced in Enugu metropolis as well as the villages located in Enugu State of Nigeria. These factors have led lo the growing rate of water borne diseases like' typhoid fever

and cholera experienced in different part of Enugu state and Nigeria as a whole [4]. Even in the developed nations like the United State of America (USA), cases of outbreak of diseases associated with contaminated portable water was reported [5].
[6], highlighted that the desirable qualities and properties of water should include; Adequate amount of dissolved oxygen at all time, a relatively low organic-content, pH value nearly neutral, moderate temperature, and freedom from excessive amount of infectious agents, -toxic substances and mineral matters.

Various factors are responsible for water pollution , which makes it quite undesirable for portability Such factors include: sewage discharge, which contributes to high oxygen demand and nutrient loading to a destabilized aquatic system, agricultural practices ad industrialize ion.

Water is of course absolutely essential to life, not only human life but all life, animal and vegetable. Most biochemical reactions that occur in metabolism and growth of living cells involves water, [7]. Water is broadly divided into three types viz, surface water, ground water and atmospheric water, surface water include streams, lakes, river, seas and oceans [8]. The ground water include well and bore holes. The ground water include well and bore holes. The atmospheric water include rainfall, snow mists dew and log [9].

Statement of Problem

Availability of portable water had possed a serious problem to man over decade and guest to make water available has make it possible for people to resort to using well as the only alternative. Most of the well water used within Enugu metropolis were unkept, this encourages the indiscrimate deposition of toxic substances into the well water, which can in turn upset the physicochemical composition of the water, which can as well lead to growth of water borne diseases such as diahrrea cholera, tvphoid fever etc, this has prompted for this research work on the determination of the: physic-chemical composition of well water from Agbani road, Obiagu and Abakpa, in Enugu metropolis.

Objectives of the Study

1). To compare the physio-chemical composition of well water in Enugu metropolis a case study of Obiagu Abakpa and Agbani Road.
2). To use the data obtain to recommend to the public whether to continue using the water or to quit and find alternative.
3). To use the data to ascertain the level of pollution among the three well samples.
4). To compare the data collected with world Health Organization (WHO) and standard organization of Nigeria (SON) standards for drinking water.

Scope of the Study

Due to financial constraints this project work is limit tied to the comparison of the physicochemical Composition of well water in Obiagu, Abakpa and Agbani Road area of Enueu State.

Significance of the Study

The results of this analysis would be useful in the determination of the physicochemical composition of well water, it will also disclose the pollution level of the three well samples from these areas. The data collected will help to enlighten the public using the water whether in continue or desist from using the well. It will also be a guild to Enugu state environmental, protection Agency to constantly monitor this well water to prevent the users from being exposed to water born diseases.

MATERIALS AND METHOD

Sample Collection and Treatment

A total of three well water samples were collected from different location within Enugu metropolis and labeled A, B, C, respectively. Sample A is the well water collected from Agbani Road, Sample B is the well water collected from Abakpa (No 11 convent Avenue), while sample C is the well water collected from Onuasata Obiagu, Enugu. All the samples were

stored in a refrigerator overnight and transported to the laboratory with ice chip surrounding the sample contains in a. cooler.

METHODS

Sample Collection

The following parameters and procedure were used to access the individual component of 3 well water sample A, sample B and sample C, which were collected from Agbani Road, Abakkpa and Obiagu Enugu.

The plastic containers used were wash with detergents rinsed with distilled water respectively. The three samples were collected and labeled A, B and C. After being obtained directly from the well, we allowed people to draw the well in morning hour before we deeped the probe properly inside the well before collecting the sample and each sample container rinsed with the well water sample without being exposed to heat. Immediately the sample were collected we insert the thermometer in it and allowed to stand for 10 minutes, and the readings were recorded before taking into the refrigerator to be preserved for analysis.

Sterilization of Glassware

To avoid contamination, polyethienic storage container and all the glasswares used for this analysis were soaked overnight with 10% HC1 solution and washed thoroughly with water and detergent; then rinsed with deionized water, dried in oven and cooled n a desiccator before use.

Physicochemical Analysis

a) **Temperature**

The temperature of the water samples were measured at the point of collection using mercury in glass thermometer.

b) Conductivity

The conductivity of the samples was determined using Jen way 4520 model conductivity meter.

c) pH

The pH of the samples were determined using pH meter, Jen way 3510 model pH meter

d) Turbidity

A turbidimeter of model HI 93703 model microprocessor turbidity meter was used to determine the turbidity of the samples

e) Odour

The odour was determined with nose

f) Total hardness

It was measured using EDTA as titrant with ammonium chloride and ammonium hydroxide buffer and Enchrome Black as indicator.

g) Chloride content

It was determined by Mohr's method using silver nitrate as titrant and potassium chromate solution as indicator.

h) Total Alkalinity

It was determine by titritnetric method using standard solution of 0.1N Hcl and methyl orange as indicator.

i) Total Dissolved solid (TDS)

This was determined by evaporation method in an oven at 200°C for 2hrs.

j) Total solid (TS)

Total solid was determined gravimetrically

k) Total suspended solid (TSS)

TSS was determined by subtracting the value of TDS from TS

TSS = TS - TDS

TO I O

I) Sulphate determination

The analytical method for the determination of sulfate is based on the reaction of sulfate with-barium chloride to form a suspension of barium sulfate which is stabilized by gelatin and thyme (equation 3).

Hydrochloride acid is present to prevent the precipitation of barium carbonate, phosphate and sulphite. The turbidity is measured spectrophotometrically n(49 5nm. The determination was done according to APHA, AWWA and WEF, 2012.

$SO_4^{2-}(aq) + Ba^{2+}(aq) \rightarrow BaSO_4(s)$ (equation 3)

The reagent chemical were prepared and the determination done as follows:

a. 0.01m hydrochloric acid solution 0.9 ± 0.02mL of HC1 (d2o 1.18 was added to about 800 mL of water.

5. Barium chloride reagent 0.29 ± 0.02g of thymol crystals was dissolved, in about 500 mL of 0.01M HC1 with stirring at a temperature of 80 ± 10°C. The resulting solution was cooled to 40 ± 5°C and then diluted to 1000 ± l0mL with 0.01M HC1 acid solution and mixed properly. 4.0 ± 0.lg of [powdered gelatin was added slowly. Once it was dissolved 20 ± 0.lg of barium chloride dehydrate was added with continuous stirring until all had dissolved. The solution was filtered for use.

6. Stock standard which sulphate (l000g/L-SCM) 1.479 ± 0.001 g of anhydrous $NaSO_4$ (dried at 105°C for 3 hrs was dissolved in about 500 mL of distilled water.- The solution was quantitatively transferred to a 1 litre, flask and made up to mark with distilled water and mixed properly. The solution was stable for several months. Different series of working standards of 20, 40, 60, 80 and 100mg/L-SO_4^{2-} was prepared by proper dilution.

7. Spectrophotometer determination sulfate ($SO4^{2-}$) To 7.5mL of sample or standard in a test tube was added 7.5rnL of $BaCl_2$ reagent and swirled properly. The light absorption of the solution was measured at 495nm against water as the blank.

m) Dissolved oxygen (DO) Determination

The dissolved oxygen was determined by titration, using sodium thiosulphate ($Na_2S_2O_3$) as titrant, starch as indicator.

n) Chemical oxygen Demand (COD)

Titrimetric method was to determine the COD, ferrous Ammonium sulphate was used as titrant, and indicator used was phenanthropline ferrous sulphate.

o) Metal Determination (The Cationics)

The cationic determination were done with UV-visible spcctrophotometer at their respective λ_{max} wavelength.

RESULTS

Table 1: Result of Physicochemical parameters of well water sample from Agbani Road, Abakpa and Obiagu in Enugu as compared with standard

Parameter	A	B	C	WHO	SON
Temperature (^{0}C)	24.2	25.9	25.4	Ambient	Ambient
pH	6.65	6.60	6.67	6.5-8.5	6.5-8.5
Conductivity (us/cm)	324	992	508	1000	1000
Turbidity (FTU)	48.75	27.39	58.32	5.00	5.00
Total solid TS (mg^{-1})	100	200	140	-	-
Total Dissolved Solid (mg/L)	80	100	120	<500	<500
Total suspended solid (mg/L)	20	100	20		
Dissolved oxygen (DO) (mg/L)	8.26	6.29	7.18		
COD (mg/L)	98.00	154.00	120.00		
Chloride (mg/L)	0.25	0.18	0.32	250	250
Sulphate (mg/L)	7.6	8.9	9.4	250	100
Odour	UN	UN	UN		
Alkalinity (mg/L)	12.2	13.17	12.8		
Hardness as ($CaCO_3$) (mg/L)	60.2	75.6	65.9		
Nitrate (mg/L)	3.03	3.65	2.74	<50	50

Table 2: Result of the concentrations of heavy metals in the analyzed well water samples as compared to standards

Parameter	A	B	C	WHO	SON
Lead (Pb) (mg/L)	0.00001015	0.000091	0.000082	0.05	0.02
Copper (Cu) (mg/L)	0.0000630	0.00008803	0.00007251	1.00	1.00
Manganese (Mn) (mg/L)	0.00001660	0.0000235	0.00001210	0.10	0.20
Iron (Fe) (mg/L)	0.00004049	0.0000397	0.0000400	<0.3	0.3

Key: UN – Unobjectionable

A = Well water sample from Agbani Road
B = Well water sample from Abakpa
C = Well water sample from Obiagu
(P) = Provisional value

DISCUSSION

The results of the physicochemical analysis of well it.cr samples collected from three different locations (areas) within Enugu metropolis were presented in Table 1, followed by table 2 for heavy metal analysis.

The temperature ranges from 24.2 - 25.9°C.

The well water sample from Abakpa has the highest temperature (25.9°C), followed by well water from Obiagu (25.4°C) and water- from Agbani road has the least temperature (24.2°C). High temperature in water enhances the growth of micro organisms, it also increases odour, taste, colour and corrosion problem in water. The result of this analysis based on temperature reveals that water sample from Abakpa will likely favour microbial growth than other water sample analyzed. The temperature of ail the three sample were ambient to standards The pH values of the samples ranges from 6.60 = 6.67. The pH value for drinking water according to WHO is 6.5 -8.5, and that of son is 6.5 - 8.5. The pH values of the three water samples had shown that they were not acidic, hence it was ideal, for domestic and industrial purposes.

The electrical conductivity values of water from Aghani road was 324rnS/cm, followed by water from Abakpa. which was 992mS/cm, while water from Obiagu recorded 508rns/cm. Electrical conductivity of water is the measure of the ability of the water to conduct electricity, the higher the value the more the tendency of I lie water to conduct electricity the sample from Abakpa has a higher value than the water from Obiagu and Agbani Road. The water from Agkahi road has the least electricity conduction ability. The electrical conductivity values for the three water samples were less than that of SON and (WHO) permissible limit of (1000mS/cm).

The turbidity value of well water from Obiagu was the highest (58.32 FTU), followed by that of Agbani road (48.75 FTU) and that of Abakpa was the least (27.39 KTU). High turbidity value can protect microorganisms from the effects of disinfection thereby stimulating bacterial growth. All depress photosynthesis thereby endangering the health of aquatic ecosystem. The value exceeded the permissible levels from WHO and SON .standards .This may be attributed to the fact that the water was allowed to be drawn for use before the collection of the sample.

The alkalinity of well water from Abakpa was highest nniong the three samples, its value was 13.17mg/L, followed by well water from Obiagu 12.8mg/L, and the least was from the water from Agbani road whose value was 12.2mg/L. The alkalinity of water is caused by the presence of carbonates and bicarbornates formed in the reaction in soil through which the water percolates calcium bicarbonates ions (HCO_3^-) with some hydroxides including dissolved strong bases such as sodium or potassium hydroxide, hydroxide ions were always present in water. When water has high alkalinity it is concluded lo be well buffered. It resists a decrease in pH when acidic rain, snow melt, enters it. If water, has an alkalinity below 100mg/L as $CaCO_3$, it is poorly buffered and pH sensitive. This could be harmful to the plants and animals that live there.

The range of hardness in the water analyzed was 60.2- 65.9rng/L. The value for Abakpa well water was the highest (75.6mg/L), followed /;by Obiagu well water (65.9mg/L) and the least was that of Agbarii road well water (60.2 rng/L) value of hardness for three samples were less than that of SON (150mg/L) and WHO (500mg/L) for drinking water. Hardness caused by calcium and magnesium usually results in excessive soap detergent consumption and subsequent 'scum" formation. The low values of hardness obtained from the three samples indicates that the water samples were good for household and

industrial uses , since they can easily form lather with soap, due to their low hardness value.

The amount of dissolved oxygen in the three water samples were low which inturn caused elevation on their chemical oxygen demand (COD). The Dissolved Oxygen of Agbani Road water was the highest (8.26mg/L), followed by Obiagu well water (7.18mg/L) and the least was that of Abakpa water (6.29mg/L). The amount of dissolved oxygen in water is a measure of the aeration of the water, a water with more dissolved oxygen is more aerated then the one with less Dissolved oxygen.

The TDS of Obiagu well water was higher than the other water samples (120mg/L), that of Abakpa recorded (lOOmg/L) and Agbani road was (80mg/L). TDS in water originates from natural sources, sewages, urban runoff and industrial waste water. Water with TDS greater than 1000mg/L is generally unpalatable.

The Total Solid in Abakpa well water recorded the highest (200mg/L), followed by Obiagu well (140mg/L) and the least was Agbani Road well water (100mg/L), this indicated that Abakpa well water was less clean con]pared to other well water samples which could be attributed to urbanization and run off during rainfall.

The level of the metals such as Pb, Cu, Mn, P, Fe, analyzed in the water indicated low concentration of the metals in the water samples. Since their concentration was less than the permissible limits as-recorded by WHO and SON.

CONCLUSION

Every effort should be made to achieve drinking water quality as safe as practicable. The result obtained from the analysis revealed that the quality of well water in Abakpa, Obiagu and Agbani road when compared with the standard given by WHO, SON, showed that the water is suitable for household use ,since the concentration of various parameters are within permissible limits.

RECOMMENDATION

It is recommended that public awareness should be created on the sources of heavy metal contamination to ground water so as to minimize the level of heavy metal contamination in the water. Also well construction for household uses should be located away from industrial sites, sewage effluences etc so as to avert the contamination of the water by industrial effluents. Appropriate measures must also be implemented on the sanitation of vicinity where the ground water is located, to minimize the level of waste disposal on the water. We suggest that Enugu state environmental protection agency should make bye laws that all the wells dug in the metropolis must be designed with covers so as to prevent debris and contaminants falling into the wells.

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