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(Research Article)

An assessment of the underground water collected from Ogbete Area Enugu State, Nigeria

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Abstract

Water contamination has become a global challenge which must be tackled. This study examined the contamination level of water in four locations at Ogbete area Enugu state. Carters street had the highest pH of 5.23 which is below the WHO standards limits for drinking water. The conductivities ranged from the highest conductivity 1445 µs/cm, which is below the WHO limits (8-10,000 µs/cm), TDS (1000 mg/l., TSS (WHO (500 mg/l). For alkalinity, the four locations were all below the (150 mg/l) standard set by World Health Organisation. Results showed that most of the physicochemical, biological and heavy metals parameters considered in this study were significantly above the permissible or allowed by WHO. It is therefore recommended that the water should be treated before use.

Keywords: Heavy Metal; Water samples; Conductivity; Contamination; Physicochemicals

1. Introduction

Water is very essential for life. Water is very essential to man and living things, required for sustenance of life (Al Nahyan, 2012) on earth as it has ranges of application- drinking, cooking, washing, as well as irrigation (Rimrukeh et al;2010). The quality of drinking water is a good indicator of environmental status (WHO, 2010). Ample supply of standard drinking water is universally seen as a basic human need and an element of civilization. Large numbers of people in the third world countries have limited access to ample and standard water supply. Urbanization, and population increase hinders governments from meeting the increasing demand for portable drinking water. According to (Majuru et al; 2011), it is projected that 65 million Nigerians have limited access to safe drinking water. As an alternative, a lot of communities globally are increasingly turning to groundwater for their water needs. Metallic elements with an atomic density greater than 4 g\cm3 or 5 times or more greater than water are known as heavy metals (Fergusson, 1990). Heavy metals problems predates industrialization, it has been in existence since the processing and the use of ores by man. Since then the use of metals and their negative effects on the environments have increased, particularly during the 19th and 20th centuries.

A variety of heavy metals are present in the environments. Some occur naturally, while others anthropogenic causes. Some, in small amount, have vital functions in the body, while others have no beneficial purposes in terms of health. Elevated concentrations of heavy metals in the body, both the beneficial and non beneficial ones can lead to heavy metal toxicity with its numerous adverse health problems (Jaishankar et al., 2014). The most commonly encountered heavy metals include ones that the body needs, such as, iron, manganese. While they enhance health in trace amount, they can

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become toxic at high levels. Food is a majour source of these metals, a route by which it is extremely rare for toxicity to occur (Tchounwou et al., 2012). Exposure to toxic levels of these metals typically arises through prolonged use of dietary supplements, industrial/workplace exposure or medical issues that impair metabolism, such as liver and kidney diseases (He et al., 2005). Drinking water contaminated by these heavy metals is another majour source of heavy metals him humans

2. Material and methods

The samples were obtained from Moore house, Caters street, Redcross way and Prison training school. The samples were collected directly from the ground water (well).The samples were collected in sterile bottle washed and rinsed with distilled water before collection.

2.1. Description of sample collection area

The water samples were collected from Moore house, Caters Street, Redcross way and Prison training school. The samples were collected directly from the ground water (well).The samples were collected in sterile bottle washed and rinsed with distilled water before collection.

2.2. Collection of water samples

The water samples of ground water were collected using a bucket and kept in a sterilecontainer. The samples were collected in April, 2018.

2.3. Determination of acidity

The acidity was measured by titration method as described by Zobel *et al* (1989). A volume, 10 mls of the water samples was pipette into a conical flask and 3 drops of phenolphthalein indicator was added and titrated against 0.1 N NaOH, until it changes to pink. Acidity was calculated mathematically using the formula

$$\text{Calculation: } \frac{\text{Tv x 5000} \times \text{N}}{\text{vol of sample used}}$$

2.4. Determination of alkalinity

The total alkalinity was measured by the method described by Trivedy and Goet (1986). A volume, 10 mls of the sample was pipetted into a conical flask and 3 drops of methyl orange indictor was titrated with 0.1 N HCL until the color changed from yellow to orange. The total alkalinity was calculated using the equation.

$$\text{Alkalinity(CaCo3 (mg/l)\}} = \frac{\text{B x N x 5000}}{\text{ml sample}}$$

Where,

B = total ml of titrant used to bromcresol green end point., N = normality of titrant

2.5. Determination of pH

The pH was measured using an electronic pH meter. pH is the intensity of the acidic or basic character of a solution at a given temperature. pH is the negative logarithm of hydrogen ion concentration.

2.6. Determination of Total Suspended Solids (TSS)

Total suspended solids, a filter paper was weighed and recorded before filtering 50ml of the samples, the filter paper was oven dried at 100^0c.

$$\text{Total suspended solid (mg/l)} = \frac{(\text{A} - \text{B}) \text{ x 1000}}{\text{ml sample}}$$

Where

A=weighing of filtered plus dried residue, mg, B=weight of filtered, mg

2.7. Determination of Total Solids (TS)

The water sample was evaporated using an evaporating dish at 104±1^{0}C for 1hr, and the dish weighed and stored in a desiccators.

$$\text{Total solid (mg/l)} = \frac{(A - B) \times 1000}{\text{ml sample}}$$

Where

A = weight of dish + residue, mg, B = weight of dish, mg

2.8. Nitrate Determination

Nitrate was determined using PD303 UV spectrophotometer (APHA; 1998). A known volume (20ml) of the sample was pipette into a porcelain dish and evaporated to dryness on a hot water bath. A volume, 2ml of phenol disulphonic acid was added to dissolve the residue by constant stirring with a glass rod. A volume, 2ml of concentrated solution of sodium hydroxide and distilled water was added with stirring to make it alkaline. This was filtered into a Nessler's tube and made up of 20ml with distilled water. The absorbance was read at 410nm using a spectrophotometer after the development of color. The standard graph was plotted by taking concentration along x-axis. The value of nitrate was found by comparing absorbance of sample with the standard curve and expressed in mg/l.

$$\text{Concentration of sample:} \frac{\text{Abs of sample x conc of std}}{\text{Abs of std}}$$

2.9. Total dissolved solid (TDS)

This was described as in APHA(1992). The empty beaker was washed, dried and allowed to cool in desiccators, 50ml of the sample was measured and filtered into the weighing beaker, the filtrate was heated to dryness using hot plate and the beaker was allowed to cool in a desiccators. The beaker was reweighed again.

$$\text{Dissolved solids (mg/L)} = \frac{(A - B) \times 1000}{\text{ml sample}}$$

Where

A= weight of dried residue + dish, mg, B= weight of dish, mg.

2.10. Conductivity

Conductivity measurement can be used to calculate the total dissolved solids by multiplying conductivity (in N3/cm) by an empirical factor, which varies between 0.55 to 0.9, depending on the soluble component o the water and the temperature of measurement

2.11. Determination of heavy metals in water

A volume, 5ml of HCl was mixed 100ml of water and heated for 15 minutes in an oven at 100^{o}C. the filtered solution was allowed to cool and the heavy metals content determination using atomic absorption spectrophotometer.

2.12. The research design for the questionnaire

The design in this was descriptive survey**.** This is because the questionnaire will elicit the appropriate responses from the respondents on the sources of the heavy metals, the uses of the underground water and the health implication of the heavy metals.

2.13. Sampling Techniques

The sample size of the healthy respondents were selected randomly across the four sampling areas.

2.14. Instrument for Validation

Thirty (30) item structured questionnaire prepared to elicit opinion from respondents were used.

2.15. Validation of Instruments

The instruments for the study was validated by our experts, three lecturers and my supervisor.

2.16. Administration

The instrument were administered individually to the respondents, their responses were collected and analyzed using suitable statistical method.

Table 1 Research question 1: What are the sources of the heavy metals in the underground water?

Sources of heavy metals	Frequency Yes	Frequency no	No of respondents
Waste waters close to the underground water	15 (75%)	5 (25 %)	20
Is the well water within a residential area	17 (85%	3 (15 %)	20
Do you keep waste close to theunderground water	7 (35%)	13 (65 %)	20
Is the underground water close to a septic tank	6 (30%)	14 (70 %)	20

Table 2 Research question 2: What are the uses of the underground water?

Uses of the underground water	Frequency yes	Frequency no	No of respondents
Do you have eczema	7 (35%)	13 (65 %)	20
Do you drink the water	10 (50%)	10 (50 %)	20
any deposits on cooking pots	12 (60%)	8 (40 %)	20
Have you ever experienced any reactions of any form on your body.	14 (70%)	6 (30 %)	20

Table 3 Research question 3: What are the health implication of the heavy metals?

Health implication of heavy metal	Frequency yes	Frequency no	No of respondents
Do you at times have short breath	4 (20%)	16 (80 %)	20
Do you have irritation of the eye	2 (10%)	18 (90 %)	20
Do you have diarrhea after using the water	13 (65%)	7(35 %)	20
Have you noticed any pain within your body system.	1(5%)	19 (95 %)	20

3. Results and discussion

Table 4 Physicochemical parameters of the water samples

Sample Location	pH (m±SD)	Cond(m±SD)	TDS(m±SD)	TSS(m±SD)	TS(m±SD)	Nitrate(m±SD)	Acidity (m±SD)	Alkalinity (m±SD)
Caters	5.23± 0.282	285± 21.21	0.07± 0.184	0.74±0.212	0.81±0.212	124±26.29	2.4±0	7±1.414
Prison Tr. Sch	4.705 ± 0.071	1445±7071	0.37±0.0141	0.52±0.028	0.89±0.042	0±0	14±0.565	12±0
Moore House	4.755±0.035	295±7.071	0.36±0	0.93±0.297	1.29±0.296	185±34.026	2.4±0	4±0

Red cross way	4.73±0.042	340±0	0.06±0.028	0.48±0.057	0.54±0.085	19.69±12.373	2.4±131	4±0

Table 5 Concentration of heavy metals (mg kg) at various sampling points

SamSples	Ag	Fe	Co	Mn
Carters street	0.36	0.06	0.18	0.01
Red Cross way	0.45	0.02	0.63	0.01
Prison training school	1.08	0.18	0.28	0.01
Moore House	0.68	0.07	0.69	0.23

An analysis using Atomic Absorption Spectrophotometer was used to find the concentration of the heavy metals, silver, iron, cobalt and manganese in the four sampling points. Prison training school has the highest concentration of silver (Ag) and Carters street has the lowest concentration of silver. Prison training school has the highest concentration of iron and Redcross way has the lowest concentration of iron. Moore house has the highest concentration of cobalt and Carters has the lowest concentration of cobalt. Moore house has the highest concentration of manganese and carters, Redcross way and prison training school has the same concentration of manganese.

4. Discussion

An adequate supply of standard and portable water will help in the stopping of gastrointestinal diseases, supports domestics and personal hygiene, and enhance the standards of living(Hunter, 2010). Currently, human activities are contributing to industrial, domestic and agricultural wastes to groundwater reservoirs at alarming rate (Aremu *et al;* 2011). The standard and amount of water are affected by an increases in anthropogenic activities and any contamination either physical or chemical causes changes to the quality of the receiving water body (Aremu *et al;* 2011). Chemical contamination occurs in drinking water throughout the world could possibly threaten human health. Assessing the health impact of these contaminants is difficult, especially researching and learning how different chemicals react in the body to damage cells and causes illness (Hornsby, 2009). This research was carried out to analyze underground water collected from Ogbete area of Enugu State. Four major locations were sampled during the time of this research and in all the places, Carters street had the highest pH 5.23 which is below the WHO standards limits for drinking water. For conductivity in the four location sampled, the results showed that the prison training school had the highest conductivity 1445 µs/cm, which is below the WHO limits (8-10,000 µs/cm). The other three locations were below the WHO limits for conductivity, Carters Street (285 µs/cm), Moore house (295 µs/cm) and Redcross way (340 µs/cm). For TDS (Total dissolved solids) of the four location sampled, it was discovered that all the four sample were within the standard set by WHO (1000 mg/l. For TSS (Total suspended solids), all the four locations, carters street, prison training school, Moore house and Redcross way were within the standards set by WHO (500 mg/l). For Nitrate, Prison training school was not detected and the other three location, carters street(1247.839 mg/l), Moore house(185.918 mg/l) and Redcross way (19.685 mg/l) were above the standards set by WHO (5.0 mg/l). For alkalinity, the four locations were all below the standards set by WHO (150 mg/l).The results of the microbiological contamination of the water shows that water from the Ogbete residential area are polluted. The pathogen were monitored in this work and cannot be ruled out as a large number of people are dependent on the water for livelihood, The bacteria contamination could be considered as a definite health hazard to the regular users of the groundwater for drinking and other activities.In a similar research (Ujah *et al*, 2021), contamination of the underground well water has been recorded.

5. Conclusion

This study was conducted to assess the quality of the groundwater and to determine their conformity with the standards set by the national and international Regulatory Agencies. Results shows that most of the physicochemical, biological and heavy metals parameters considered in this study were significantly above the permissible or allowed by WHO.

Compliance with ethical standards

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Disclosure of conflict of interest

There is no conflict of interest.

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