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Determination of Nitrate and Nitrite Contents in Tube-Well Water in Evwreni Town, Delta State

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ABSTRACT

Ten samples of tube-well water were collected at random from Evwreni town, Delta State and sent to the laboratory. The concentration of Nitrate (NO_3^-) and nitrite (NO_2^-) in mg/L of tube-well water samples were analyzed, using spectrophotometer method. The result obtained show that nitrate values ranged from 11.8 $\pm$ 0.1 to 12.8 $\pm$ 0.2mg/L while that of nitrite ranged from 0.2 $\pm$ 0.2 to 0.4 $\pm$ 0.3mg/L and all values were within the WHO maximum acceptable concentration. The tube-well water analyzed and the results obtained are compliance with drinking water standard based on national/international guideline hat provide assurance that such tube-well water is safe for consumption.

Keywords: Nitrate, nitrite, tube-well, Evwreni Town.

I. INTRODUCTION

Nitrate and nitrite are found in nature as they are the en product of the aerobic decomposition of organic nitrogenous matter as well as the decomposition of organic micro-organisms(Jagessar et al, 2011). They are naturally occurring inorganic ions present in our environments.

Nitrate (NO_3^-) is a polyatomic ion with the molecular formula NO_3 and produced in the absence of mineral nitrate sources, by means of various fermentation processes using urine and drug nitrates (wikipedia.org.wiki/nitrate).
Nitrate is a salt or ester of nitrous acid, containing the anion NO_2^- or the group NO_2.
Nitrates and nitrites are chemicals used in fertilizers, rodenticides and as food preservatives (USEPA, 1991).

Nitrate and nitrites occur naturally in plants food as part of the nitrogen cycle between air, land and water environment (www.foodstandards.gov.au/scienceeducation).

In nature (soil), nitrate and nitrite can be found igneous and volcanic rocks.

Nitrate and nitrite salts completely dissolve in water. The common sources of sources of nitrates and nitrite ions are through municipal and industrial waste water, refuse dumps, animal feeds and septic systems (Nugent et al, 2011).

Nitrates and nitrites enter the ground water and made their into "tube-well" water through many sources such as agricultural activities (including over application of chemicals fertilizers and chemical manure) wastewater treatment through septic system or leaking sewages line, industrial processes, improperly functioning septic systems, motor vehicles and poor sanitary activities (Jacinthe et al, 2000).

In Niger Delta, tube well water now serves as one the easily accessed and sources of drinking water for a great number of its, towns and villages.

Exposure to high concentration of nitrate and nitrite has been linked to increased incidence of cancer in adults, possible increased incidence of brain tumors, leukemia and nose and throat tumor in children (USEPA, 1991).

Excessive levels of these nitrogen compounds in drinking water have caused services illness and sometimes death in infants less than six months of age (EFS, 2010). The primary health hazard from drinking water with nitrate – nitrogen occurs when nitrates are transformed to nitrites in the digestive system.

High concentration of nitrate are known to cause what is called "blue baby syndrome" in which the blood cannot bring enough oxygen to the body cell and tissue of babies less than six months of age (www.riwelltesting.org). The nitrate ion are absorbed into the blood steam where they oxidized Fe^{2+} in the hemoglobin to Fe^{3+}. Hemoglobin containing oxidized ion known as met-hemoglobin reduces the oxygen carrying capacity in the blood (George et al, 2001).

Other symptom or health effect include shortness of breath of the skin (http:desinh.gov/organization/water/dwgb/-index.htm), intrauterine growth retardation (Cedergren) and nervous system defect (Brender et al, 2004).

Nitrates are fairly stable nitrogenous compounds degradable into unstable nitrates that can combine readily with other compounds in the digestive track to form carcinogenic nitrosamines (Hill, 2002).

There was a strong relation between nitrate concentrations and reoccurring diarrhea acid, 80% cases were explained by nitrate concentration above (Gupta et al, 2010).

The total daily intake of nitrates by adults is estimated to be 51mg, which is 44.3mg from food and 6.8mg from drinking water containing nitrate at a concentration of 4.4mg/L (Kumar et al, 1993).

The World Health Organization (WHO) fixed limit of the contents of nitrates and nitrites in drinking water is 50mg/L and 3.0mg/L respectively (WHO, 2004).

The present study focuses on the assessment of nitrate and nitrite concentration in tube-well water.

II. MATERIAL AND METHODS

Location of the research: Evwreni Town is an Oil Producing Community in Ughelli North Local Government Area of Delta State. It has 14 oil wells, glow and compressor status operated by the SPDC, which produces 15,000 barrels of crude daily from the area since 1996 (31 Jan. 2000).

Evwreni is made up of six (6) major quarters: Urhevwe, Uruekpo, Uvwotie, Okpawha, Ogbudu and Uneni. There is no definite population census figure but it is one of the largest Community in Ughelli North Local Government Area.

It is 154.6 kilometers by road to Port Harcourt and 45.3 kilometers to Warri.

Sample collection and analytical process

Ten samples of tube-well water were collected from ten different sites in Evwreni Town. The samples were collect into a clean 1.5litres plastic bottles. The bottle were washed and rinsed with tube-well water before collection. The plastic battles were particularly filled with the samples of tube-well and tightly covered.

The temperature of samples were measured, recorded and labeled from 0 to 10 in triplicates, taken to the laboratory and analyzed for nitrate and nitrite contents.

Nitrate Determination

10ml of nitrate stock solution was pipette into a beaker, 5ml of HCl and 2ml of Zn/NaCl granular mixture were added and allowed to stand for 30 minutes, with occasional stirring to form nitrite. Then the solutions were filtered into 100ml standard flask using Whatman No 1 filter paper and diluted up to mark.

Aliquot of stock solution containing 0.26-10.7µg/ml of reduced nitrate were transferred into series of 10ml standard flask, 1ml of 0.5% Sulfanilic acid 1ml of 2mol/HCl solution were added and shaken thoroughly for 5 minutes. (Diazotization). Then 1ml of 2 mol/l NaOH solution was added to for an azo dye. The contents were diluted to 10ml with water and the absorbance of the red colour dye was measured at 540nm against the corresponding reagent blank, using Jenway 754 UV-visible spectrophotometer.

Nitrite Determination

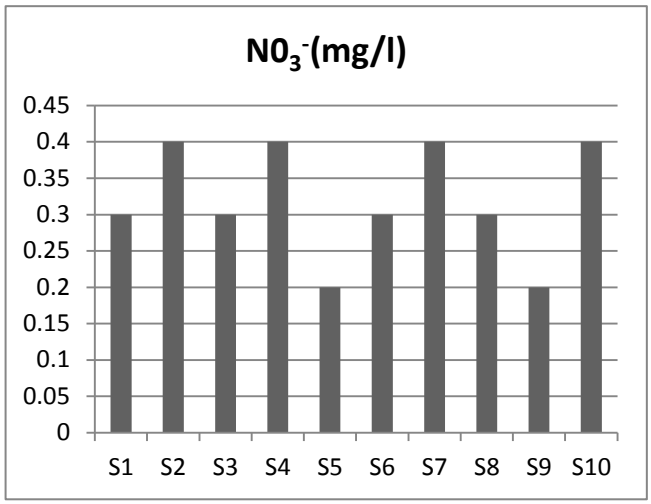
Aliquot of stock solution containing 0.2-8.0µg/l of nitrite were transferred into series of 10ml calibrated flask. To each flask 1ml of 0.5% sulfanic acid and 1ml of 2mol/l HCl solution were added and the solution was shaken thoroughly for 5 minutes. (Diazotization reaction). Then 1ml of 0.5% methyl anthranilate and 2ml of 2mol/l NaOH solution were added to from azo dye and the contents were diluted with 10ml using water. Then absorbance of the red coloured dye was measured at 540nm against the corresponding reagent black, using Jenway – UV-visible spectrophotometer.

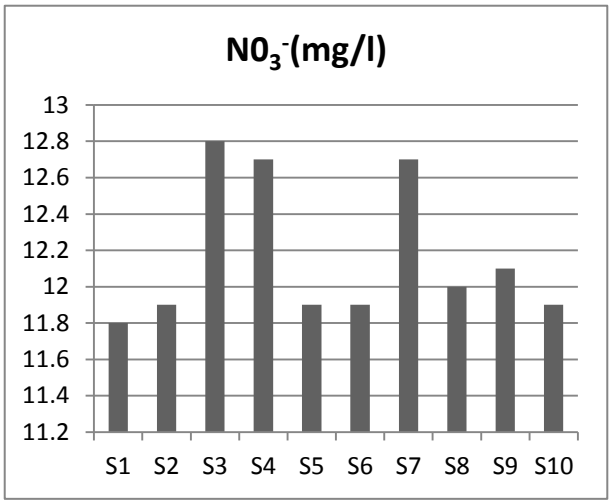
III. RESULT AND DISCUSSION

Table 1: Nitrate and nitrite content of tube-well water sample.

S/N	Samples	NO_3^-(mg/l)	NO_3^-(mg/l)	
1	S1	0.3 ± 0.2	11.8 ± 0.1	
2	S2	0.4 ± 0.3	11.9 ± 0.2	
3	S3	0.3 ± 0.4	12.8 ± 0.2	
4	S4	0.4 ± 0.1	12.7 ± 0.2	
5	S5	0.2 ± 0.2	11.9 ± 0.2	
6	S6	0.3 ± 0.2	11.9 ± 0.2	
7	S7	0.4 ± 0.1	12.7 ± 0.2	
8	S8	0.3 ± 0.3	12.0 ± 0.1	
9	S9	0.2 ± 0.5	12.1 ± 0.1	
10	S10	0.4 ± 0.3	11.9 ± 0.2	
		PL:WHO SID	3	50

Results are expressed in mean +STD test were carried out in triplicates





The nitrate values obtained ranged from 11.8 + 0.1 to 12.8 + 0.2. The highest contents of nitrate was 12.8 + 0.2mg/L for samples S3 while the lowest was 11.8 + 0.1 for sample S5 and all were below the maximum acceptable concentration (50mg/L). The nitrite levels ranged from 0.2 + 0.2 to 0.4 + 0.3mg/L for sample S5 and sample S2 / S10 respectively. The highest contents of nitrite was 0.4 + 0.3mg/L while the lowest was 0.2 + 0.2mg/L and all were within the WHO maximum acceptable concentration (3.0mg/L).

IV. CONCLUSION AND RECOMMENDATIONS

The nitrate and nitrite concentration from this research work provided data about the quality of the tube-well water quality in Evwerni town. The concentration of nitrate and nitrite were below the maximum acceptable concentration set by WHO.

The fact that the level of both nitrate and nitrite in the tube-well water was below most international standards, authority should not stop water quality assessment and monitoring in regular basis. There is need for home treatment system to be installed in order to remove nitrate and nitrite from tube-well water.

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