International Research Journal of Advanced Engineering and Science
ISSN (Online): 2455-9024

Determination of Nitrate and Nitrite in Surface Water in Evwreni Town, Delta State

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Abstract*—Ten samples of surface water were collected at random from in and outskirt of Evwreni town, Ughelli North Local Government Area, Delta State. The concentration of nitrate (NO_3^-) and nitrite (NO^-_2) in mg/L of the surface water were analyzed, using spectrophotometer method. The results obtained showed that the nitrate value ranged from 11.7 ± 0.1 to 12.8 ± 0.2 while that of nitrite ranged from 0.2 ±0.1 to 0.4 ±0.3mg/L and all values were within the maximum acceptable concentration by WHO.*

From the result obtained, the surface water samples analyzed were in compliance with drinking water standard based on national/international guidelines that provide assurance that such surface water is safe for consumption.

***Keywords*—** *Nitrate, nitrite, surface water, Evwreni town*.

I. INTRODUCTION

Nitrates and nitrites are naturally occurring ions that are part of the nitrogen cycle (Fanyana et' al, 2013).

The nitrate ion (NO_3^-) is the stable form of the combined nitrogen for oxygenated system. The nitrite ion (NO_2^-) contain nitrogen in a relatively unstable oxidation state.

Nitrates and nitrites are found in nature as they are end product of aerobic decomposition of organic nitrogenous matter as well as the decomposition of organic micro-organism (Jagessor et' al, 2011), they are also formed endogenously in animals including humans.

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

Nitrate in drinking water usually comes from contamination of surface water and is caused by fertilizer, animals or human waste (Ward et' al, 2005).

Water is a very good solvent, hence it dissolves some toxic and hazardous substances producing water pollution problem posing many public parameters of interest for water quality assessment and nitrate and nitrite are out of them (Kaemi et al, 2005).

Nitrate can reach surface water as a consequence of agricultural activity (including excess application of inorganic nitrogenous fertilizers and manures), from waste water treatment and from oxidation of nitrogenous waste products in human and animal excreta, including septic tanks.

Nitrite can also be formed chemically in distribution pipes by Nitrosoma bacteria during stagnation of nitrate-containing and oxygen-poor drinking water in galvanized steel pipes or if chlorination is used to provide a residual disinfectant and the process is not sufficiently well controlled. (WHO, 2011).

The primary health hazard from drinking water with nitrate and nitrite occurs when nitrate is transformed to nitrite in the digestive system. The nitrite oxidizes the iron in the hemoglobin of the red blood cell to form methemoglobin, which lacks the oxygen-carrying ability of hemoglobin. This creates the condition known as methemoglobinemia (sometimes referred to as "blue-baby syndrome") in which blood lacks the ability to carry sufficient oxygen to the individual body cell causing the veins and skin to appear blue. (Oram, 2018).

In the stomach, nitrite reacts with amines and amides: therefore stomach is exposed to the risk of endogenous N-nitroso compound synthesis as stomach acid reaction with catalyses nitrosation. Nitrosation is the nucleophilic substitution reaction between secondary amines and nitrosating agent (Du et al, 2007).

High nitrate intake has been found to be associated with gastric cancer in England, Columbia, Chile, Denmark, Hungary and Italy (Forman et al, 1997).

Several authors have suggested that the risk for the development of stomach cancer is positively correlated with three factors: the nitrate level of the drinking water, the urinary excretion of nitrate and the occurrence of atrophic gastritis. (Santamaria, 2006).

This study is aimed at determining the nitrate and nitrite concentration in some selected surface water in and around Evwreni town, Delta State.

II. MATERIALS AND METHODS

Location of Research: The research was conducted in Evwreni, Ughelli North Local Government Area, Delta Stae. Evwreni town has 14 oil wells, glow and compressor statues operated by the SPDC, which produces 15,000 barrels of crude oil daily from the area since 1996.

The town is made up of six quarters: Urhevwe, Uruekpo, Uvwotie, Okpawha, Ogbudu and Uneni. There is no definite population census figure but it is one of the largest communities in Ughelli North Local Government Area. It is about 154.6 kilometers by road to Port-Harcourt and 45.3 kilometers to Warri.

Sample Collection and Analysis

Ten samples of surface water used for analysis were collected randomly from ten different sites in and around Evwreni town. The samples were collected in 75 litre plastic bottles. The bottles were thoroughly washed with the surface water and then collected. The plastic bottles were partially filled with samples of surface water, the temperature of samples were measured, recorded and tightly covered.

Sawere B.T. and Uwague A., "Determination of Nitrate and Nitrite in Surface Water in Evwreni Town, Delta State," *International Research Journal of Advanced Engineering and Science*, Volume 3, Issue 3, pp. 94-96, 2018.

International Research Journal of Advanced Engineering and Science
ISSN (Online): 2455-9024

The samples were then labeled from 1 to 10, in triplicates and taken to the laboratory for analysis of Nitrate (NO_3^-) and nitrite (NO_2^-) contents within 6 hours of sample collection.

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/1 NaOH solution was added to form 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.

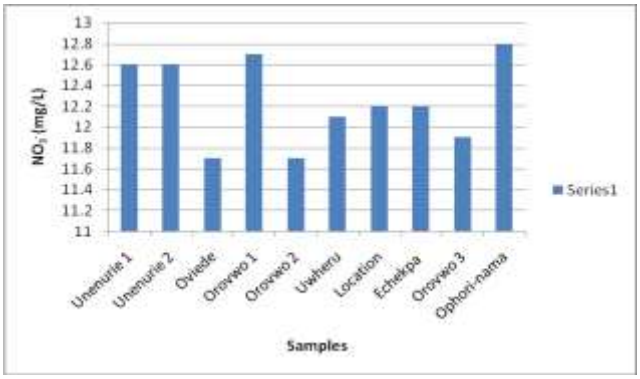
Nitrite Determination

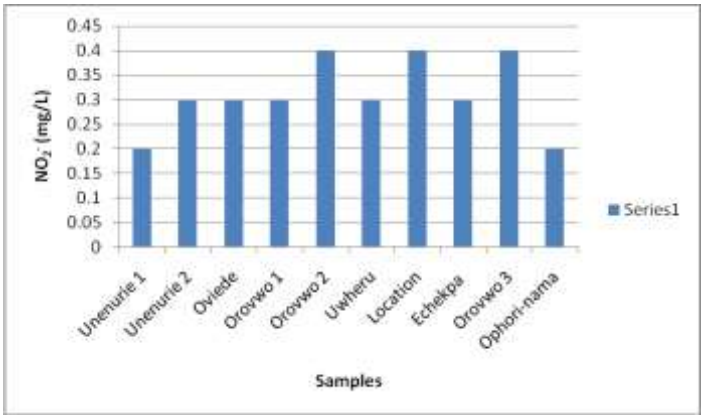
Aliquot of stock solution containing 0.2-8µg/1 of nitrite were transferred into series of 10ml calibrated flask. To each flask 1ml of 0.5% sulfanic acid and 1ml of 2mol/1 HCl solution were added and the solution was shaken thoroughly for 5 minutes. (Diazotization reaction). Then 1ml of 0.5% methyl anthranilate and 2ml of 2mol/1 NaOH solution were added to form 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. Results and Discussion

TABLE I. Nitrate and nitrite contents in surface water (mg/L).

S/N	SAMPLES	NO_3^- (mg/L)	NO_2^- (mg/L)
1.	Unenurie 1	12.6 ± 0.1	0.2 ± 0.1
2.	Unenurie 2	12.6 ± 0.1	0.3± 0.1
3.	Oviede	11.7 ± 0.1	0.3 ± 0.2
4.	Orovwo 1	12.7 ± 0.2	0.3 ± 0.1
5.	Orovwo 2	11.7 ± 0.1	0.4 ± 0.1
6.	Uwheru	12.1 ± 0.1	0.3 ± 0.5
7.	Location	12.2 ± 0.3	0.4 ± 0.3
8.	Echekpa	12.2 ± 0.3	0.3 ± 0.3
9.	Orovwo 3	11.9 ± 0.2	0.4 ± 0.3
10.	Ophori-nama	12.8 ± 0.2	0.2 ± 0.4
	PL WHO	50	3





Results are expressed in mean ± SD test were carried out in triplicates.

The nitrate values obtained ranged from 11.7 + 0.1 to 12.8 ± 0.2.

The highest content of nitrate was 12.8 ± 0.2 mg/L for sample 10 while the lowest level wsa 11.7 ± 0.1 mg/L for samples 3 and 5, and all were within the maximum acceptable concentration by WHO (50mg/L).

The nitrate level of concentration range from 0.2 ± 0.1 to 0.4 ± 0.3 (mg/L). Sample 7 and 9 have the highest level of nitrite with 0.4 ± 0.3mg/L while that of sample 1 has the least value with 0.2 ± 0.2mg/L and were all below the maximum acceptable concentration by WHO (3.00mg/L).

The low concentration of both Nitrate and nitrite on the sample of surface water analyzed is because most of the farmers rarely require the use of application of Nitrogen-rich organic fertilizers. More also, it would be due to the fact that the samples of surface water were collected at the raining season when the rain was just setting in. In warm and wet climate, increased accumulation of nitrate is possible, regardless of whether the nitrogen originates from organic or mineral sources (Zhou et al, 2000).

The low concentration of nitrite also might be due to high concentration of chloride ions as this has the tendency to make the presence of nitrite (Cedergren et al, 2002).

Those surface water with slightly increase in nitrate concentration of 12.8 ± 0.2mg/L might be associated with pesticides spraying by farmers during this time of the year since some of these streams and rivers are surrounded by farms.

IV. Conclusion and Recommendation

The result of analysis of surface water in and around Evwreni town showed that none of the water sources had higher concentration of nitrate and nitrite higher than the WHO guideline.

The maximum accepted concentration by WHO, stipulated that the concentration of nitrate and nitrite must not exceed 50mg/L and 3mg/L in drinking water respectively (WHO, 2003).

Nitrate concentration above 50mg/L can cause diverse effects in infants below three months of age while nitrate concentration above 100mg/L can cause pregnant women and

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older adults to have rare metabolic condition called congenital glucose – 6 – phosphate dehydracy (EFS, 2010).

Therefore, pregnant women and infants must avoid constant usage of some of these surface water with even a slight high level of Nitrate and nitrites. It is suggested that in the rainy seasons, the inhabitants should avoid or otherwise treat the surface water before consumption.

Farmers should also minimize the usage or application of nitrogenous organic fertilizers in their farms.

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