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DETERMINATION OF NITRATE CONCENTRATIONS IN DUTSIN-MA FADAMA LAND USING SPECTROPHOTOMETRIC METHOD

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ABSTRACT
Chemical analysis of water from Dutsinma Fadama Land was conducted for ten consecutive months (January to October) using Spectrophotometric measurement, to determine the level of nitrate in the water. The result of the study showed that the level of nitrate exceeded WHO recommended value in all the sampling sites. Similarly, mean monthly variation of the nitrate showed remarkable increase in the level of nitrate higher than the WHO maximum limit of 10mg/l in months of June (11.25±1.08mg/l), July (15.54±3.17mg/l) and September (14.79±2.14mg/l). Generally, the values were observed to be higher during the rainy season compared to the dry season. This point to the possibility of increasing nitrate concentration as a result of run offs from farm lands due to application of chemical fertilizers. It was concluded that the Dutsin-ma Fadama water is not potable for drinking due to the high nitrate content of the water, particularly during the rainy season.
Keywords: Water, Nitrate, Chemical fertilizers, Dutsinma Fadama land and WHO limits

INTRODUCTION

Health problems from nitrate in drinking water sources are generating serious concern in almost all countries, particularly in urban and rural communities where agricultural activities are intense (Adelana *et al*., 2003). In the United States more public water supplies have been closed due to the violation of drinking water standards for nitrate than from any other contaminant (Adelana *et al*., 2003). The current public health standards for safe drinking water require that maximum contaminant level (MCL) should not exceed nitrate concentrations of 10ppm as nitrate or 45ppm as nitrate-N (Adelana *et al*., 2003). Nitrate in water is present as highly soluble salts. Standard water treatment practices, such as sedimentation or pH adjustment with lime application do not affect nitrate concentration (Adelana *et al*., 2003).

Elevated concentrations of nitrate are becoming noticeable in Nigeria, for instance, Jimoh, (2003), discussed the seasonal variation in the level of nitrate in the surface water of Tunga – Kawo irrigation scheme and found that the concentrations of nitrate in the surface water exceeded the (WHO, 1985) safe limit of 10mg/L. Recent investigation by Ado, (2002) on Industrial activities on soil, water and vegetation of Chikaji Industrial Layout – Zaria, indicated that the concentration of nitrate in the water was as a result of agrochemicals and decayed organic matter etc. The Fertilizers applied to the farm lands in the area are washed away as runoff into the surface water bodies during the rainy season. Similarly, refuse and wastes from houses are also channeled into the water surface through gutters and all these find their ways into the water and thus, leading to an increase in the turbidity and eutrophication of the surface water.

Independent study also showed a significant level of nitrate as reported by Adelana *et al*., (2003) in the Kware areas of Sokoto State. Oladejo, (2003) also investigated the pollution risk to nitrate in Ogbomosho farm areas and found that the drinking water from well sources in the area generally contained nitrates in excess of the WHO limit of 10mg/L. This therefore renders the water in the area as non – potable. In another findings, Nwachukwu, (2003), also determined nitrates in water sources located in Rivers State, and realized that higher concentration were obtained in December (12.17mg/L). Ibe and Onu, (1998) determined the nitrate pollution of ground water in Owerri, Imo State, and showed that the water is polluted with nitrate. Nsi and Odin, (2004) carried out a pollution studies on River Benue to assess the water quality and found out that the concentration of nitrate were by far below (between 2.50 – 2.60mg/l) the (WHO, 1985) standard limit of 10mg/l.

The presence of nitrate in the water is of serious concern, because the presence of nitrate in human digestive system can be converted to nitrosamines, a compound suspected of inducing cancer. High concentration of nitrates in drinking water may lead to a disease called "mathaemoglobinaemia" in babies fed with such water. The nitrates then may stop the blood from carrying Oxygen (Groen *et al*., 1988).

High nitrate levels in drinking water may cause a lot of health implications which may turn into a number of complicated diseases. It was generally believed that the direct source of nitrate in ground water originates from wastes as nitrate in ground water or chemical fertilizers applied to farms. Generally, at concentrations greater than 10mg/l, nitrate in water may be associated with some health hazards, among which include the risk of human babies developing mathaemoglobinaemia, known as "blue baby" syndrome (Carter, 1996).

Human babies are extremely susceptible to acute nitrate poisoning because of certain bacteria that may live in their digestive system during the first few months of life. These bacteria change nitrate into nitrite (NO_2^-). The nitrite reacts with haemoglobin (which carries oxygen to all parts of the body) to form methemoglobin, which does not carry oxygen.

The level of oxygen being carried throughout the body decreases, and the baby is suffocated. This condition is called mathemoglobinemia. The most obvious symptom of nitrate poisoning is a bluish colour of the skin, particularly around the eyes and mouth. This is called Cyanosis (Colvin, 1999).

Around the age of three months, an increase in the amount of hydrochloric acid in a baby's stomach kills most of the bacteria that convert nitrate to nitrite. By the time a baby is six months old, its digestive system should be fully developed, and none of the nitrate – containing bacteria remains. However, children under one year of age and pregnant women are at risk for adverse effects. Records have shown that infants are typically exposed to unsafe levels of nitrate in drinking water when it is used to make up formula milk or other types of feeds. In older children and adults, nitrate is absorbed and excreted, and methemoglobinemia is no longer a concern (Colvin, 1999).

Nitrate was also believed to have some health implications on ruminant animals such as cows and sheep because they contained nitrate – converting bacteria in their digestive systems. The symptoms of nitrate poisoning in animals include a bluish or brown discoloring of non pigmented areas around the mouth and eyes. Rapid heartbeat, frequent urination and labored breathing followed by death in one to three hours after the first signs appear (Self and Waskom, 2013).

It has also been suggested that chronic exposure to high levels of nitrate in drinking water may have adverse effects on the cardiovascular system. The WHO (1985), reported that an inverse relationship between cardiovascular mortality and nitrate concentration in water supplies have been demonstrated.

The World Health Organization has estimated that as many as 80% of all the diseases in the world are associated with water in one way or the other. This support Oyegun and Ibikunle, (1998) findings, that reports from hospital in Ibadan and Lagos indicated that about 12% of 15% death in children are due to diarrhea. Thus, the need for the determination of nitrate in Dutsin-ma Fadama water necessitate this study to ascertain the quality of the water with respect to nitrates as the water is used for drinking and other domestic activities.

The Study Area

Dutsin-ma is a local government head quarter in Katsina state. It is centrally located in the state within longitude 70 30'E and latitude 120 27'N. The vegetation of the area is the Sudan savanna type. The temperature varies between 27°C -35°C. Although the area is highly populated with rocks, the major activity in the area is farming, and irrigation. A preliminary investigation has shown that the farmers in the area apply Nitrogen, phosphorus and Potassium (NPK) fertilizers and Urea fertilizers to their crops for maximum yield. The water from the FADAMA is mainly used for irrigation and domestic activities.

Experimental

All the samples of water were collected and treated in line with the American Public Health Association (APHA, 1989) procedure. The absorbances were measured using a spectrophotometer (Buckmann Model 4) at 410nm. All reagents used were of analytical grade. Five sampling sites labeled as A, B, C, D and E were considered for the random sampling. Water samples were taken at mid depth and transported to the laboratory for further analysis. The water samples were taken for a period of ten months January to October, 2005.

RESULTS AND DISCUSSION

Mean and standard deviations of the concentration of nitrate for this study is shown in Table 1.The values obtained range from 10.86±0.52mg/l at site A, to 11.31±1.03mg/l at site D. These values were above the WHO limits of 10mg/l for drinking water. The values were close to the values obtained by Ezeribe *et al.*, (2012); for nitrates (9.78±0.84, 24.2±0.15 and 10.15±0.15 mg/l) in Dass, Kaltungo areas of Gombe State and Langtang area of Plateau State respectively. The values however, were observed to be lower than the values reported by Adakole *et al.*, (2010) (43.24mg/ l); in Hand Dug wells in Samaru-Zaria. Nitrates affects haemoglobin in the blood and reduces the babies' ability to transport oxygen; infants so affected are said to have 'blue baby syndrome' (Ayantobo *et al.*, 2012). There is also a 'suspected link between exposure to nitrate and cancer in human (WHO, 2004). Furthermore, all the mean values obtained from the five sampling sites were above the (WHO,1985) safe limit of 10mg/l .Although the mean values at sites A and C were lower than the values obtained in sites B, D and E. The lower values at sites A and C may be attributed to their positions away from the agricultural areas.

Furthermore, the concentration of the nitrate at site B was slightly higher than that of site A. The low value observed at site A, may be associated to its location away from the farm land. This corroborate with Ado's (2002) findings that the concentration of nitrate obtained from a residential area away from agricultural land was lower than the values obtained from agricultural areas. The result of this analysis was also compared with the work of Ibe and Onu, (1998), where the concentration of nitrate was much higher in the agricultural areas than areas devoid of agricultural activities. However, the mean monthly concentration indicated that the values range between 8.78±0.12mg/l in February to 15.54±3.17mg/l in July. Elevated values greater than the (WHO, 1985) safe limits of 10mg/l were also obtained in the months of June (11.25±1.08mg/l), July (15.54±3.17mg/l), August (14.79±2.14mg/l), September (11.98±1.08mg/l) and October (10.69±0.38mg/l).

It is clear that the contribution of anthropogenic activities from the farm lands contributed to the high level of nitrate in the water during the wet season than in the dry season. This correlate with Jimoh, (2003) findings that the rise in the concentration of nitrate in the surface water was attributed to the application of chemical fertilizer in addition to the other decayed organic matter.

As a result of this, there is a need for proper management and precautionary measures in Dutsin-ma as well as other Nigeria's villages where majority of the populace are agrarians leaving in remote areas with inadequate potable drinking water.

Table 1: Mean monthly concentration of the nitrate at the different sampling points

Months/Sites	A	B	C	D	E	Monthly mean
January	8.97±0.08	9.62±0.05	9.230.07	9.72±0.06	8.64±0.03	9.24±0.43
February	7.23±0.25	8.90±0.30	9.25±0.02	9.33±0.42	9.17±0.05	8.78±0.12
March	8.64±0.06	9.23±0.07	8.73±0.10	9.52±0.05	9.49±0.08	9.12±0.54
April	9.72±1.05	9.57±0.12	9.48±0.03	9.72±0.06	9.53±0.12	9.60±0.67
May	9.81±0.62	9.29±0.10	9.70±0.05	9.64±0.08	8.92±0.02	9.47±0.13
June	10.68±1.02	10.92±0.72	11.53±0.23	11.47±0.54	11.67±0.47	11.25±1.08
July	14.50±2.52	14.82±1.27	14.36±1.54	16.80±2.73	17.26±4.27	15.54±3.17
August	14.60±2.49	14.72±1.30	13.85±0.93	15.92±3.14	14.84±2.10	14.79±2.14
September	13.68±1.60	12.13±0.95	12.64±0.86	10.28±0.57	11.17±0.79	11.98±1.08
October	10.73±0.72	11.20±0.98	10.56±0.59	10.25±0.28	10.72±0.62	10.69±0.38
Mean/site	10.86±0.52	11.04±0.64	10.94±0.67	11.31±1.03	11.14±1.27	

CONCLUSION

From this study, it is evident that the Dutsin-ma FADAMA water is not potable for drinking due to the high nitrate content of the water, particularly during the wet/ rainy season.

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