ChemSearch Journal 4(1): 47 – 50, June, 2013
Publication of Chemical Society of Nigeria, Kano Chapter

Received: 28/02/2013 Accepted: 09/04/2013

Spectrophotometric Determination of Nitrate and Phosphate Levels in Drinking Water Samples in The Vicinity of Irrigated Farmlands of Kura Town, Kano State - Nigeria

Sa'id, M. D. and Mahmud, A. M.
Department of Pure and Industrial Chemistry, Bayero University, Kano, Nigeria
Email: dayyibmds@yahoo.com

ABSTRACT

Twelve drinking water samples from boreholes were collected from various sampling sites around the vicinity of Kura irrigated farmlands using polythene plastic containers and were analysed for the nitrate and phosphate levels using uV – visible spectrophotometer. From the results, it was found that all the samples had Nitrate level below the World Health Organization maximum contaminant level of 50mg/l with a mean concentration of (17.84 ± 4.49) mg/l. phosphate level was also analysed and the results indicated that all the sampling sites had phosphate level above the World Health Organization maximum contaminant level of 0.03 mg/l with a mean concentration of (8.74 ± 2.56) mg/l.

Keywords: Drinking water, Irrigated farmland, Nitrate, Phosphate, UV-VisibleSpectrophotmeter.

Introduction

Water is one of the most valuable natural resources and it is essential for the maintenance of all forms of life (FAO, 1997). Surface (rivers, streams, lakes and dams) and ground (wells and Boreholes) water are the principal sources of water.

In recent years, because of rapid urbanization, industrialization and growing population, the rate of discharge of pollutants into the environment which ultimately find their way into these water bodies is higher than the rate of purification. (Reza and Gurdeep, 2009). And it is believed that surface water is generally more polluted than ground water, hence the use of ground water (borehole) as the major source of drinking water is preferred.Ground water can also be contaminated through various ways such as seepage from effluent waters, fertilizer from agricultural activities, mining activities, vehicle maintenance, sewage and domestic water etc. (Adekunle, 2009; Altman and Perizek, 1995).

Ground water has been reported to account for about 88% of safe drinking water (Reza *et al, 2009*). Safe potable water is essential for healthy living and for water to be regarded as safe for drinking, it must meet certain physical, chemical and microbiological criteria set by international organizations such as World Health Organization (APHA, 1989).

Nitrate is a family of chemical compounds containing atoms of nitrogen and oxygen occurring naturally. Nitrate is critical to the continuation of life on the earth, since it is one of the main sources from which plants obtain the element nitrogen. The element is required for the production of amino acids which in turn are used in the manufacture of proteins in both plants and animals (Townsed, 1976).

Phosphorus is essential to the growth of biological organism including both their metabolic and photosynthetic process. Phosphorus occurs naturally in bodies of water mainly in the form of phosphate (i.e a compound of phosphorus and oxygen (OAR, 2002). Phosphorus, as phosphate is usually not a concern in ground water, since it is tenaciously held by soils through both electrostatic and non electrostatic mechanism and usually does not leach in most soils. However, in sandy soils that contains little clay, phosphate can leach through the soil and impact ground water supply perhaps, the greatest concern with phosphorus is contamination of streams and lakes via surface run off and erosion (OAR, 2002).

The aim of this work is to determine the concentrations of nitrate and phosphate in drinking water sources particularly from boreholes around the irrigated areas of Kura town-Kano State Nigeria.

Materials and Methods

In the preparation of reagents, chemicals of Analytical grade purity and distilled-deionised water were used. All glass wares were cleaned with detergent and rinsed with water and acetone before drying in an oven at 105^{0}C.

Sampling

Sampling sites were identified in the surrounding settlements of Kura irrigation farm lands. Samples were collected by means of polythene bottles, the bottles were covered with black plastic bag to prevent light penetration which may help in the growth of algae (Beavington, 1977).

Determination of phosphate ion in drinking water

50cm^3 of water sample was pipetted into a 500cm^3 volumetric flask, 5cm^3 of Ammonium molybdate solution and 3.0cm^3 of ascorbic acid were added with swirling, the mixture was diluted to the mark with deionised water and was allowed to stand for 30 minutes for maximum colour development, the absorbance was then read at 660nm including the blank. This procedure was applied for the remaining samples and the standard solutions.

Determination of Nitrate ion in drinking water

10 cm^3 of the water sample was pipetted into a 50 cm^3 volumetric flask. 10cm^3 of 13N sulphuric acid was added and mixed with swirling, the flask was allowed to come to a thermal equilibrium in cold water bath (0 - 10)^{o}C. 0.5cm^3 of brocine-sulfanilic acid was added and diluted to the mark with deionised water, the solution was then placed on the 100^{0}C hot water bath for about 25 minutes for maximum colour development, the flask was then cooled to room temperature. The absorbance was read at 410nm including the blank. This procedure was repeated on the other samples including the standard solutions for making standard calibrations.

Results and Discussion

The results obtained from the analysis of drinking water samples collected from Kura irrigated farmlands are presented in Figs 1and 2.

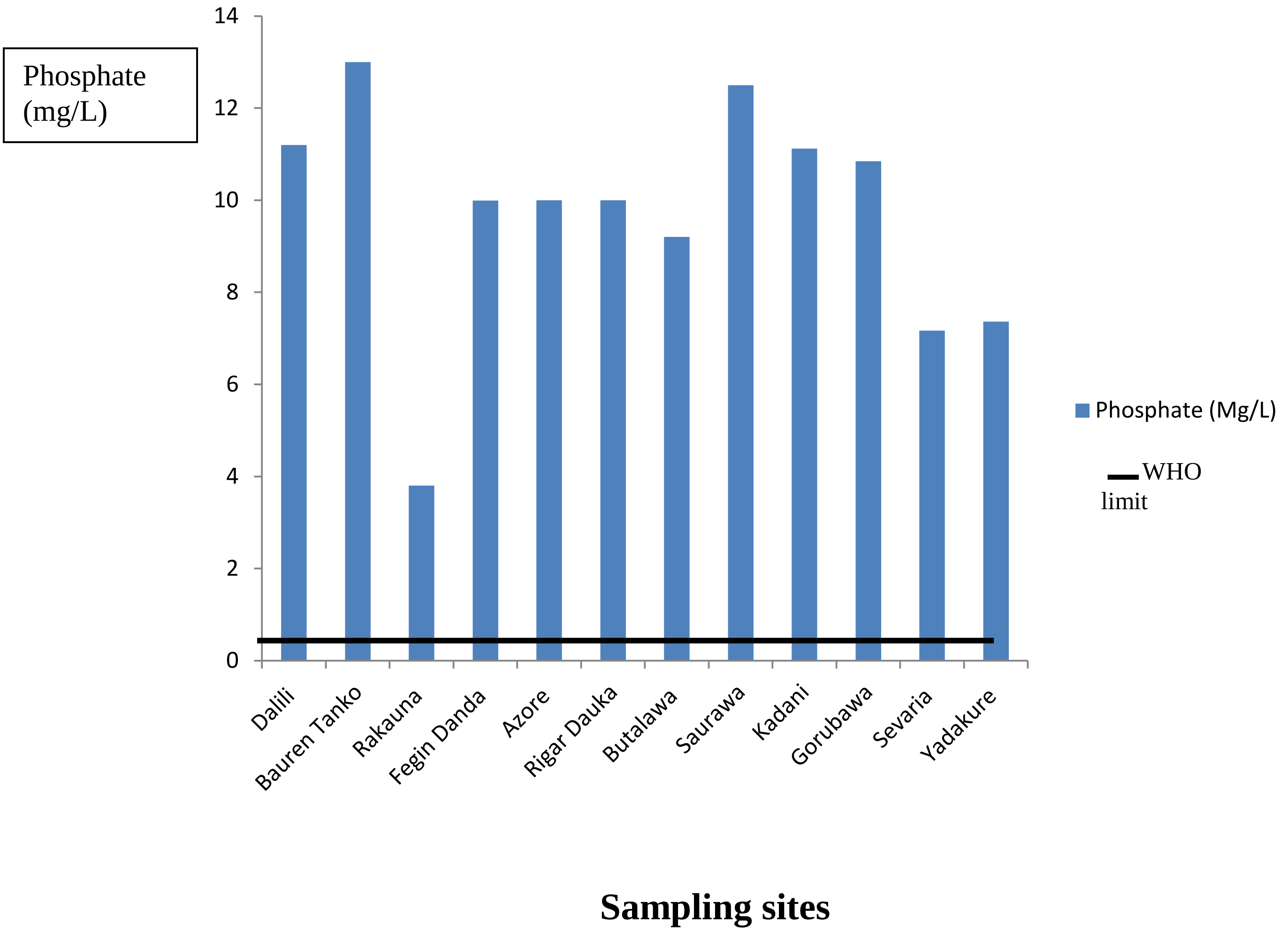

Fig 1: Phosphate level in drinking water samples from the boreholes

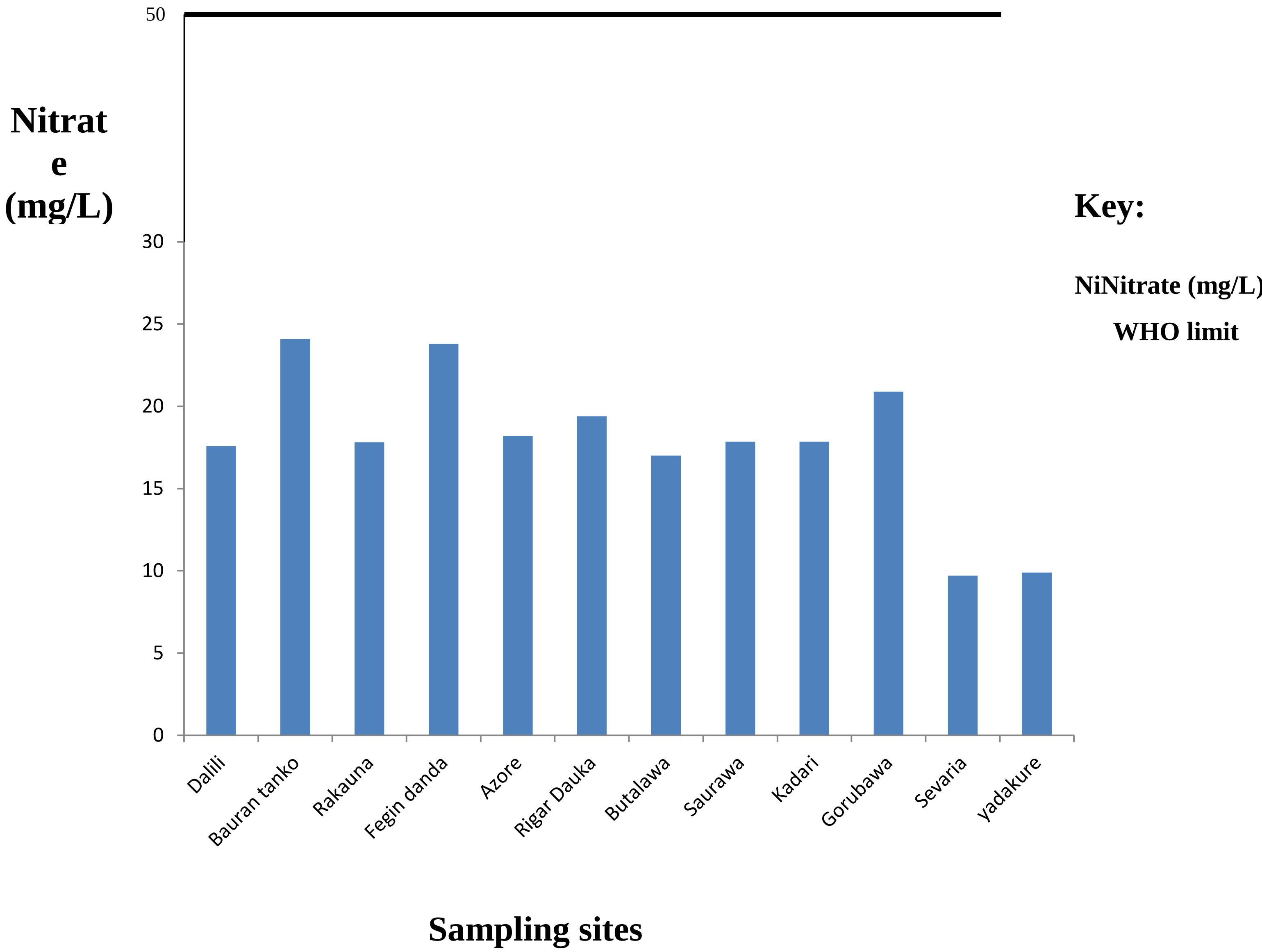

Fig 2: Nitrate levels in drinking water samples from the boreholes

The results of phosphate levels in drinking water samples obtained from various sampling sites around the vicinity of Kura irrigated farmlands is presented in Fig 1. With the mean value of (9.73 ± 1.56) mg/l From the results it shows that all the sites had phosphate level above the recommended level set for drinking water by World Health Organization i.e. 0.03mg/L (WHO, 2010). The high level of phosphate ion in the drinking water is attributed to the proximity of the settlements to those places where farming activities is taking place all year around be it during the rainy season or the dry season, as suggested by (Bausch and Lomb, 1974 and OAR, 2002). Another reason for the high concentration of phosphate ion in the drinking water is due to the fact that agricultural activities is the major source of income in these communities and this activity is only made possible through the application of both natural and synthetic fertilizers, and as a result, the residential areas closer to these farmlands are prone to this high level of phosphate particularly where leakage of waste water takes place, this produces drinking water that is enriched in phosphate and nitrate ion, as suggested by (Pucket, 1995). Ayodele (1995), observed that the concentrations of phosphate and nitrate ions might increase during the wet season when agricultural activities are at their peaks and thus the health hazards such as algal bloom that is harmful to aquatic animals and blue baby syndrome in the case of excess phosphate and nitrate ion respectively.

The results of nitrate ion levels in the sampling sites of Kura irrigated farmlands are presented in Fig 2.with the mean value of (17.84 ± 4.03) From the results it is evidently clear that all the sampling sites had nitrate level below the World Health Organization maximum contaminant level of 50mg/L (WHO, 1998), this could however give a reflection of the nitrate level in the drinking water around the vicinity of irrigated farmland in Kura town. However, the current results may not likely be a land mark for safety because while nitrate is a common nitrogenous compound due to natural processes of the nitrogen cycle, anthropogenic sources could greatly increase the nitrate concentration of nitrogen-rich fertilizers and manure (USEPA, 2002).

Levels of nitrates in ground water in some instances may be above the WHO safe limit of 50mg/l, particularly in rural areas where there's continuous application of nitrate rich-fertilizers in the farmlands for so long, private wells, mostly in our homes, the residential areas and industrial areas, when this situation happens, then the fear of methemoglobinemia or blue-baby syndrome that robs the blood cells of their ability to carry oxygen could be a possibility (Lukens, 1987).

Conclusion

The results of the study showed that all the sampling sites had high phosphate level in the drinking water sources particularly borehole and thus there's a possibility of the production of algae and aquatic plants increase and thus may create excessive algae growth, reduced water clarity, unpleasant odour and taste, low dissolved oxygen, and production of toxins from blue green algae.

Due to the detrimental biological effects of high nitrate level in drinking water, treatment and prevention methods must be considered to protect ground water aquifers from nitrate leaching . Treatment through ion-exchange, reverse osmosis, etc can rehabilitate the already contaminated water, while prevention through reduced dependence on nitrogen rich fertilizers can lower the influx of nitrates into our underground water.

References

Adekunle, A. S. (2009): Effects of Industrial Effluents on Quality of Well Water within Asa Dam Industrial Estate, Ilorin-Nigeria. Natural and Scince. 7(1) 26-29.

Altman, S. J and Parizek, R. R., (1997): Dilution of Non-point Source Nitrate in Ground Water. J. Environ. Quality 2(4) 707-717.

APHA; (1989): American Public Health Association. Standard Method for Examination of Water and Waste Water. American Public Health Association, 22nd ed, Academic Press, Washington, D. C. Pp 90-94

Ayodele, J. T; (1995): Chemical Composition of Rain Water in Semi-arid Region, Kano-Nigeria. International Journal of Environmental Education and Information. 4 (15) :185-192.

Bausch,C and Lomb, N; (1974): Water Technology: Analytical Div, New York 14625. Bausch and Lomb Inc Pp 101-103.

Beavington, F; (1977): Trace Element and Dry Deposition around Smelting Complex Journ. Env. Poll 3(1): 127-131.

FAO; (1997): Food and Agricultural Organization. Chemical Analysis Manual for Food and Water; FAO Rome. 1(2) 20-26.

Lukens, J. N; (1987): The Legacy of Well-water Methemoglobinemia. Journal of the American Medical Association 257, (23) : 2793-2795

O.A.R, (2002): Organization of Assabet River. OAR Nutrient Project. Damon mill Square, Concord M. A. 01742 Pp 73-75

Puckett, L. J; (1995): Identifying the Major Sources of Nutrient Water Pollution. Journal of Env. Sci and Tech. 2 (3) :408A-414A.

Reza, J and Gurdeep, S; (2009); Pre and Post Monsoon Variation of Heavy Concentration of Ground Water of Angul Talcher Region of Orissa, India Natural and Science. 7(6) 52-56.

Townsed, W. N, (1976) : An introduction to the scientific study of soil. Macmillan Pub. Co. N.Y. 2nd ed. Pp 188 - 194

USEPA (2002): United States Environmental Protection Agency for Water Quality Treatment Principle; Published by American Water Quality Control Dept. Washington D.C. Pp68-70

WHO (1998): Guideline for Drinking Water Quality. Geneva Pp40-43

WHO (2010): Guideline for Drinking Water Quality. Geneva Pp22-23