Book of Proceedings, 14th Nigeria Association of Hydrological Sciences Conference (Okitipupa 2024) held at Olusegun Agagu University of Science and Technology, Okitipupa, Ondo State, Nigeria, November 5 - 8, 2024

ASSESSMENT OF GROUND WATER QUALITY IN FEDERAL POLYTECHNIC, DAURA, KATSINA STATE, NIGERIA

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ABSTRACT

Worldwide, 667 million people lack access to portable municipal water, with almost half of those people living in sub-Saharan Africa (WHO, 2013). Population health is impacted by an inadequate water supply both directly and indirectly, which can result in illnesses such diarrhea and those linked to poor personal cleanliness (Hunter et al., 2010). The main goal of drinking water monitoring is to guarantee that it is safe to consume, safeguarding community health and halting the development of illnesses that are transmitted via the water. The World Health Organization's (WHO) and the Nigerian Standard for Drinking Water Quality (NSDWQ) standards are frequently used to evaluate and compare the quality of subterranean water. This study examines factors in comparison to WHO and NSDWQ criteria with a focus on Federal Polytechnic Daura's subsurface water quality evaluation. The results show notable variations in bacteriological counts and physicochemical properties between the several school sample locations. Government officials and interested parties must move quickly to provide water filtration solutions in order to protect public health and safety.

Key words: water quality, physicochemical parameters, bacteriological amount.

INTRODUCTION

In many developed countries, the availability of potable water becomes a concern when supply interruptions and shortages occur frequently (Popoola et al., 2007). Access to clean, drinkable water is vital for maintaining good health. However, approximately 667 million people globally lack access to potable municipal water, with about half of this population residing in sub-Saharan Africa (WHO, 2013). Deficient water supplies directly and indirectly affect population health, often causing diarrhea-related diseases or illnesses linked to poor hygiene (Hunter et al., 2010). This project examines the quality of underground water in various schools by comparing its parameters with WHO and NSDWQ potable water guidelines. Significant differences were found in the physicochemical parameters and bacteriological counts across different sampling points in these schools. Furthermore, 17% of deaths among children under five in developing countries are due to

diarrhea, often caused by consuming contaminated water (Pruss et al., 2016).

Water plays an essential role in human life, as both safe drinking water and clean air are fundamental rights (Lenton *et al*., 2015). The physiology of human existence heavily depends on water availability (Lamikanra, 2011). According to Nikoladze and Alkastal (2016), water must meet specific physical, chemical, and microbiological standards before it can be deemed municipal. Municipal water should be free from disease-causing organisms and harmful chemicals (Tabutt, 2012), but most water sources require treatment before consumption (Roymend, 2009).

Increasing domestic water demand has led to the indiscriminate use of underground water sources, such as wells, without adequate consideration of their safety for human consumption. In Daura metropolis, many water sources, including boreholes, are constructed using materials like iron rods, which may introduce toxic chemicals into the water due to corrosion. Microbial contamination of underground water occurs when septic tanks and latrines are poorly constructed, making nearby communities vulnerable (New Zealand, 2010). Pollution is also caused by the indiscriminate dumping of waste and inadequate sewage systems, resulting in harmful microorganisms entering the water supply (Wilcox, 2010).

In addition to chemical pollutants, biological contaminants, such as bacteria, protozoa, and viruses, are common in drinking water. When underground water is contaminated by intestinal discharges, coliform bacteria and other pathogenic organisms like Vibrio cholerae and Salmonella can be present (UNEP-WHO, 2011). These contaminants pose severe health risks, particularly in rural areas where water sources are not treated adequately.

Bacteria are a diverse group of microorganisms, found in nearly all environments, including soil, water, and even extreme habitats like acidic hot springs. They play vital roles in various ecosystems and exist in symbiotic or parasitic relationships with plants and animals (Fredrickson *et al.,* 2004). While many bacterial species remain uncharacterized, their significance in the environment and human health cannot be understated (Rappe and Giovani, 2003).

MATERIAL AND METHODS

Types of data

- physicochemical and microbiological parameters of sample water
- WHO and NSDWQ standard

Sources of data

- WHO
- NSDWQ

Method of data analysis

Data was analyzed using descriptive statistic and presented informed of table

Study area

The study was conducted at federal polytechnic Daura katsina state, Nigeria. Daura is the name of town and headquarter of a local government area situated in the extreme northern part of Katsina State. The town is located on latitude 130 01’ North of the equator and longitude 8019’East of GMT. The town lies at the intersect of roads from Katsina, the State capital (79km), Kano (73km), Zango

(18km) and Zinder in Niger Republic (Encyclopedia Britannica, 2018). Daura as a local government has a total population of 224,884 comprising 115,576 males and 109,308 females according to the 2006 final census released by the National Population Commission (Bawa, 2012). The 2006 population projection stood at 303,600 in the local government which indicate a rising population. The occupation of the inhabitants is farming of food and cash crops while o their people engage in trading activities with other traders from Kano, Katsina, and others (NBS, 2017).

Technique of sample collection

Water samples ware collected in clean polypropylene sample bottles with leak proof lids from 25/09/23 to 31/09/23. A total of 5 composite samples was collected, 1 samples per school. A sample is however a composite of 1 samples was collected in a different times of the day. The sample collected was keep on ice at a temperature of 1- 40C and then was transported to the Biology laboratory of Federal polytechnic Daura in school of science, engineering and technology Laboratory department, where bacterial analysis was carry out within 6 hours of collection. The physicochemical parameters ware measured before the bacterial analysis begin.

Physicochemical analysis

Physicochemical parameters such as pH, conductivity (C),specific conductivity, dissolved (DO), temperature, and pressure was measured at the Biology laboratory of Federal polytechnic Daura in school of science, engineering and technology Laboratory department, using standard methods.

Bacteriological analysis by MPN Method

The procedure for testing bottled drinking water was done aseptically. MPN Method was conducted in three steps:

Presumptive test

Confirmed test

Completed test

Presumptive test

Presumptive test functions as the primary presumption for the presence of Gram negative coli form bacteria in the samples. In this test, Mac Conkey broth is commonly used for lactose fermentation for the presence of the indicator bromocresol purple. The inverted Durham's tube is used for the detection of gas formation by Gram negative coli form bacteria. The color changes of media into yellow and on collection of gas in Durham's tube can be assumed that coliform bacteria are present in these samples. 15 ml of water samples was inoculated into each of presumptive broth (double strength) . After 48-hour incubation at 37ºC, the number of positive tubes ware recorded from each set and compared with standard chart to give presumptive coli form count per 100ml water sample.

Confirmed Test

In the confirmed test, positive samples from presumptive test was selected to determine the coliforms are of indicator bacteria of fecal origin Escherichia coli. Eosine Methylene Blue (EMB) media was use to differentiate Escherichia coli from Gram negative coliform bacteria by the production of greenish metallic sheen that confirms the presence of indicator bacteria E.coli. The

production of color indication from colonies can be observed after 24hours incubation at 37ºC by streaking loopful sample from positive tubes.

Complete Test

The bacterial colonies on EMB media from confirmed test was inoculated in the laboratory both at 44.5oC with Durham's tube and subculture the colony on Mac Conkey agar plate. Presence of fecal indicator E. coli is expected to be coli form by the production of gas and color changes in media. For further completed confirmation, a satisfactory differentiation within the coliform group was done by in dole, methyl red, Voges-Proskauer and sodium citrate tests which are commonly recommended for such differential determination according to Bergey's Manual of Systematic Bacteriology.

Physio-chemical parameters

Temperature

The temperature was determined by dipping of the environmental thermometer, inside the sample and allowed to stand for 1-5 minutes before taking the reading.

PH

The pH of the samples was determined using pH-parameter, the machine was calibrated before taking the reading and samples was analyzed separately by dipping of the electrode, until the maximum pH value reached, before taking the reading according to manufactures guide.OskinB(14 March, 2013).

DISSOLVED OXYGEN (DO)

This can be determine using this method

Using D-O meter: - The water sample was collected in a plastic beaker carefully to avoid aeration. The D-O meter was dip into the sample and shake for few minute and was allowed reaching equilibrium after which a value of the dissolved oxygen concentration will display on the scale; read and recorded accordingly.

RESULT AND DISCUSSION

This chapter focuses on the results and discussions of the data collected from the federal Polytechnic, Daura schools. The Physico-Chemical parameters analyzed included pH, turbidity, conductivity specific, pressure, conductivity, temperature and Dissolve oxygen(DO). The Micro-biological parameter was E. coli.

RESULTS

Table 4.1: Result of Water Quality Parameters for the Samples

Samples	pH	DO(mg/)	SPC(ms/m)	MPN (CFU/ml)	C(ms/m)	TEMP(ºc)	Pr(mmh)
CST	7.8	6.66	5.58	4	0.0518	32.4	721.8
CVS	7.4	5.37	6.16	17	0.0679	31.9	721.8
CBSM	7.9	3.55	0.017	7	0.019	31.4	721.6
NSDWQ	**7.6**	**5.0**	**4.81**	**7**	**0.06**	**25**	**80**

WHO	**7**	**5.1**	**5**	**7.2**	**0.05**	**20**	**60**

Key : CST= school science, engineering and technology, CVS= school of vocational study, CBMS= school of business and management study, CEE= school of electrical engineering, PH= potential of hydrogen, DO= dissolved oxygen, SPC=specific conductivity, MPN=most probable number, C=conductivity, TEMP= temperature, and PR=pressure.

DISCUSSION

PH OF THE WATER SAMPLES

Table 1 showed the distribution of the measured water quality parameters across the study area. The distribution of pH ranged from 7.9 – 7.4 in which school of vocational study having the highest PH value while school of science and technology with lowest pH value. This indicated that the pH was above the standard permissible limit of 7 (WHO, 2017). This implies that the water is not encouraged for domestic used especially consumption. Musa et al., (2018) obtained similar results from sachets water around Gumel. However, in a similar research, Garba et al., (2018) obtained contradicting results from borehole water around Daura. The similarities and dissimilarities in results might be due to same sources of water and the same treatment method respectively (Jidauna et al., 2017, Ruma et al., 2014).

DISSOLVED OXYGEN {DO}

Table 1, Showed the distribution of the various values of water quality of the schools it has indicated that, the DO of the water range between 7.43 mg/l and 3.55 mg/l and 5.0mg/l, therefore, in regard to W.H.O. standard dissolved oxygen in drinking water as shown in table 1, the water is not good for consumption. In Which school of electrical engineering having the highest DO value while school of business and management study with lowest DO value. Y.I. Garba, U.T. Gano and M.S. Yusuf have conducted almost, the same research on physiochemical and microbiological quality of borehole water in Daura metropolitan katsina state, and the values obtained are above the maximum permissible limit of the W.H.O standard and the water in that area is not advisedly for human consumption.

SPECIFIC CONDUCTIVITY

More so, Table 1 has also showed the different values of the dissolved oxygen in the sampled water, and has illustrated the {SPC} values range between 6.16 and 0.017 in which school of vocational study having the highest value of SPC while school business and management study having the lowest SPC value. Therefore according to the W.H.O standard of SPC values in a good drinking water is 5.1 ,the SPC needed to be and in comparison with the SPC values obtained from each of the sampled water , the SPC is said to be above the permissible limit of W.H.O. and indeed is not encouraged to be used for drinking purposes.

Also, Akindele and Balogun et al. (2019) have carried out similar research on assessment of water quality from selected boreholes and sachets water in maigatari, local government jigawa state. And the

result obtained from the research indicated high amount of spc beyond the W.H.O standard limit and described the water as unhealthy for human consumption, in the same vein Musa D.M. Garba Y.I et al, have also carried out research on assessment of water quality for selected boreholes and sachets water in Maigatari town, and have carried out spc analysis of the sampled water and formed the water spc beyond the maximum permissible limit of the W.H.O

MOST PROBABLE NUMBER (MPN)

Table 1 showed the distribution of the measured water quality parameters across the study area. The distribution of MPN ranged from 17 – 4. This indicated that the MPN was above the standard permissible limit of 7 (WHO, 2017). In which school of vocational study having the highest number of MPN while school of science, engineering and technology with lowest MPN value. This implies that the water is not encouraged for domestic used especially consumption. muhammad et al., (2018) obtained similar results from dam water around Birnin kudu local govt, However, in a similar research, Garba *et al.,* (2018) obtained contradicting results from borehole water around Daura. The similarities and dissimilarities in results might be due to same sources of water and the same treatment method respectively (Jidauna et al., 2017, Ruma *et al*., 2014).

CONDUCTIVITY

Table 1, Showed the distribution of the various values of water quality of the schools it has indicated that the C of the water range between 0.0679 ms/cm and 0.019 ms/cm and W.H.O. standard conductivity in drinking water as shown in table 1, the water is not good for consumption. In which school of vocational study still having the highest value of conductivity while school of business and management study still having the lowest value C.

TEMPERATURE

From the Table 1 showed The distribution of temperature ranged from 32– 30.6 oc. in which school of science and technology having the highest value of TEMP. while school of business and management study having the lowest value respectively. This indicated that the temperature was above the standard permissible limit of 25 oc (WHO, 2017). This implies that the water is not encouraged for domestic used especially consumption. Musa *et al*., (2018) obtained similar results from underground water around Ringim. However, in a similar research, Gambo *et al.,* (2018) obtained contradicting results from borehole water around kiyawa. The similarities and dissimilarities in results might be due to same sources of water and the same treatment method respectively (junaidu et al., 2017*, Ruma et* al., 2014).

PRESSURE

Table 1 has also showed the different values of the pressure in the sampled water, and has illustrated the pressure values range between 721.8 and 721.5mmhg.in which school of science and technology having the highest number of P while school of business and management study with lowest P value. Therefore according to the W.H.O standard of pressure in a good drinking water is 80mmhg ,the pressure needed to be

and in comparison with the pressure values obtained from each of the sampled water , the pressure is said to be above the permissible limit of W.H.O. and indeed is not encouraged to be used for drinking purposes.

Also, Dr. hamza, Dr. J.B. Balogun *et al.* 2019 have carried out similar research on assessment of water quality from selected boreholes and sachets water in Dutsinma local govt, Katsina state. And the result obtained from the research has indicated high amount of presure beyond the W.H.O standard limit and described the water as unhealthy for human consumption.

FAECAL QUALITY OF THE WATER SAMPLES

The results obtained in this study are in line with the report submitted by Hassan, et'al (2018) Amoo A.O *et al.,* (2018) Which concluded that unmanaged landfill site induced enormously to the ground water pollution of selected boreholes water and hand-dug wells in, North-West Nigeria. Also, the results obtained under this study is also in in the same vein with the study carried out by Omofonmwan and Esigbe (2009) which concluded that the disposal of faecal materials to the landfill site end up polluting ground water sources.

Basically, based on the results obtained in table 4.1, it has elicited that the microbiological test of the samples has mpn/100ml ranging from 17 to 4 which is contrary with the W.H.O standard limit of 0 colony forming unit, as seen in table 4.1. Therefore, this water is not suitable for human consumption.

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