

Physicochemical Analysis of Groundwater Samples in Gezawa Local Government Area of Kano State of Nigeria

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Abstract: The physico-chemical parameters of Groundwater from various locations in Gezawa Local Government Area of Kano State were analyzed using standard methods. The samples taken from ten different locations revealed that the study area has a mean of Alkalinity 79.0 mg/l, temp. 21.64°C, turbidity 5.9NTU, total hardness 65.54 mg/l, pH. 7.13, total dissolved solid 56.54 mg/l, conductivity 111.31 us/cm and total suspended solids 5.2mg/l. As the results indicated all the physicochemical parameters are within the maximum contaminant levels set by standard organization of Nigeria (SON), Nigerian Standard for Drinking Water Quality (NSDWQ) and world health organization (WHO) except for turbidity level in Babawa and Dansarai sampling sites which are close to Wase Dam. However, since some of the results indicate high levels above the standard set by WHO, NSDWQ and SON safe limits there is the tendency of high potential health hazards to the inhabitants of the areas that uses these water sources for drinking and other domestic purpose without treatment. As the results indicated, some of the parameters analyzed showed higher concentration above the WHO, SON and NSDWQ contaminant level especially the sampling sites very closer to Wase Dam which is believed to be contaminated, the following steps are recommended for lowering the concentration, heating the water before used can remove the temporary hardness. Domestic and industrial waste should be properly disposed or recycled. Relevant agencies should make concerted effort to control, regulate and educate the community on indiscriminate waste disposal from domestic and industries within the study area and also further research should be carried out to assess the level of some other parameters.

Keywords: Physico-chemical, Ground Water, Turbidity, Hardness, Conductivity

1. Introduction

Water as a universal solvent has the ability to dissolve many substance be it organic or inorganic compound. With this outstanding property, nevertheless it is almost impossible to have water in its pure form since it cannot be held up in a vacuum. Water which occurs below the water table is referred to as groundwater, it supports; drinking water supply, livestock needs, irrigation industrial and many other

commercial activities. The quality of Groundwater depends on various chemical constituent and their concentration which are mostly derived from the geological data of the particular region. Groundwater is generally less susceptible to contamination and pollution when compared to surface water bodies [1].

In Gezawa, groundwater is one of the main sources of water used intensively for domestic and agricultural purposes, uncensored human activities in developing

countries including Nigeria Contribute immensely to the poor quality of groundwater. The problems of water quality are much more acute in areas which are densely populated with localization of industries. Importantly, groundwater can also be contaminated by naturally or curing sources. A number of chemical contaminants have been shown to cause adverse health effects in humans as a consequence of prolonged exposure through drinking-water from various source much of ill health which affects humanity, especially in the developing countries can be traced to lack of safe and whole some water supply. [2, 3]

Water for human consumption must be free from living and non-living organisms, toxic elements and chemical substances in concentration large enough to affect health. [4, 5]. the addition of various kinds of pollutants through sewage, industrial effluents agricultural run-off etcetera, into the water main team brings about series of change in the physicochemical characteristic of the water, which have been the subject of several investigations [5, 6, 7] in northwest Nigeria the pollution of groundwater was traced to shallow water table that intercepts pit latrines and soaks away pits [8]. The water used for drinking purpose should be free from toxic elements, living and non-living organisms and excessive amounts of minerals that may be harmful to health. Pollution caused by fertilizers and pesticides used in agriculture, often dispersed over large areas, is a great threat to fresh groundwater ecosystems. [1].

The water supply for human consumption in Gezawa is often directly sourced from groundwater without any chemical treatment and the fair of pollution has become a cause for major concern. The aims and objectives of this study is to evaluate some of the parameters that can cause contamination and in what concentration if present, and comparing it with set standards of world health organization and standard organization of Nigeria.

2. Methods and Materials

2.1. Sampling Techniques

Ten samples of well water were collected from different areas of Gezawa Local Government of Kano State using clean new polythene plastic containers (10L) which were covered with black polythene bags to prevent growth of algae. The temperature was determined immediately after sampling and the sample was stored at a cold temperature, this is to prevent the growth of microorganism. However, the sampling was conducted between the hours of 12pm to 5pm. [9]

2.2. Study Area

Gezawa Local Government geographically lies between 12.22°N and 12.33°S and between 10.00°N and 10.00°E. It is located about 37km from the northern part of Kano city (state capital) and with population of 282,328 comprising of 138,948 females and 143,380 males. The local government occupies an area of 477km² which comprise of one district of 59 towns and villages [10]. Gezawa has a population of

14,192 inhabitants and average rainfall for the area is 8.42km². Gezawa Local Government is bordered with Gabasawa local government to the east, Nassarawa local government to the west, Minjibir local government to the north and Warawa local government to the south [11].

Table 1. Sampled Areas and their Codes.

S/N	Sampling Site	ID – Code
1	Babawa	B ₁
2	DanladiGezawa	D ₁
3	DuruminShura	D ₂
4	Dan Sarai	D ₃
5	GidanTsamiya	G ₁
6	Gadan	G ₂
7	Janariya	J ₁
8	KwarinDage	K ₁
9	Malamai	M ₁
10	UnguwarUmmati (Danja)	U ₁

2.3. Physicochemical Analysis

2.3.1. Temperature

The temperature of the samples was measured at the point of collection using mercury in glass thermometer. [9]

2.3.2. Turbidity

The turbidities of the water samples were measured using a digital colorimeter (DR/890 Harch model). The meter was standardized, and was introduce into the water sample. The turbidity reading of each sample was then recorded. [9]

2.3.3. Conductivity

Conductivities of the water samples were measured using a digital conductivity meter (session 5 Harch model). The meter was switched on and then standardized using 0.1N KCl. The electrode was then immersed into the water sample and conductivity reading of each sample was recorded. [9]

2.3.4. Total Dissolved Solid

The total dissolved solid was determined using a conductivity meter, the programme menu of the conductivity meter was switched to total dissolved solid 100cm³ of the samples was measured into the beaker and the electrode was introduce into the sample. The results of total dissolved solid were displayed and recorded. [9]

2.3.5. pH

The pH was measured using a digital pH meter (Harchsension). The meter was switched on and was allowed to warm for 5 minutes. It was then standardized with a buffer solution. The meter was then immediately introduced into the water sample and measurement was taking after a stable reading was taken. The electrode was then rinsed with deionized water before taken another measurement. [9]

2.3.6. Total Hardness

100ml of water sample was pipette into a conical flask. 2ml of buffer solution (NH₄Cl) of pH = 10 and 3 drops of Erichrome black indicator were added to the flask. The

mixture was then titrated with 0.01M EDTA until the color changed from wine red to blue. [9]

2.3.7. Alkalinity

100ml of sample was taken followed by 2-3 drops of phenolphthalein indicator and the color changed was observed followed by titrating with 0.1N HCl until the color changed from pink to colorless. [9]

3. Results

People are increasingly concerned about the safety of their water as of now the main source of our drinking water in urban and rural areas are mainly boreholes and open wells current improvements of analytical methods which allow for the detection of impurities even at lower concentrations make it easier to ascertain the quality of the water we drink.

The results of some physicochemical parameters analyzed in well drinking water samples from sampling sites across Gezawa LGA of Kano are presented below:-

Table 2. Physiochemical Parameters of Water Samples.

S/N	Samples	Alkalinity (mg/l)	Conductivity ($\mu\text{S/cm}$)	Turbidity (NTU)
1	Babawa	60	73.7	53
2	DanladiGezawa	40	63.5	2
3	DuruminShura	125	177.1	0
4	DanSarai	120	204	0
5	GidanTsamiya	25	66.5	3
6	Gadan	105	291	0
7	Jannariya	55	17.07	0
8	KwarinDage	75	66.9	0
9	Malamai	90	55.0	1
10	UnguwarUmmati	95	98.3	0

Table 3. Physiochemical Parameters of Water Samples.

S/N	SAMPLES	Total hardness (mg/l)	Total suspended solid (mg/l)
1	Babawa	40.40	44
2	DanladiGezawa	44.89	5
3	DuruminShura	103.25	3
4	DanSarai	134.67	0
5	GidanTsamiya	22.45	0
6	Gadan	112.23	0
7	Jannariya	31.42	0
8	KwarinDage	35.91	0
9	Malamai	67.34	0
10	UnguwarUmmati	62.85	0

Table 4. Physiochemical Parameters of Water Samples.

S/N	SAMPLES	PH	Temperature ($^{\circ}\text{C}$)	Total dissolved solid (mg/l)
1	Babawa	7.40	15.1	36.8
2	DanladiGezawa	7.20	19.4	32.6
3	DuruminShura	7.20	23.0	88.1
4	DanSarai	7.00	23.0	103.5
5	GidanTsamiya	7.10	22.8	33.3
6	Gadan	7.00	23.2	145.7
7	Jannariya	7.20	22.9	8.5
8	KwarinDage	7.10	23.1	35.6
9	Malamai	7.00	21.9	27.2
10	UnguwarUmmati	7.10	22.0	49.3

4. Discussion

The results of pH levels in the various water samples are presently in table 4, from the result it can be seen that all the sampling sites had pH level falling with the world health organization (WHO) recommended range value of 6.5– 8.5.

For conductivity, measurement were conducted in the water samples and the results revealed that 100% of the sampling sites had conductivity level below WHO, maximum contaminant level of 1200 UScm^{-1} as shown in table 2.

The turbidity level in all the sample sizes determined showed that they are within the recommended levels of 5NTU except in sampling site at Babawa in which the turbidity level was found to be 53NTU which is higher than the recommended range set by WHO and SON.

The total dissolved solid was also analyzed and it can be observed that water from all the sampling size had total dissolved solid levels below WHO maximum contaminants levels of 1000mg/l. The higher TDs reduce water clarify which could contribute to the decrease in photosynthetic activities that might lead to an increase in water temperature as observed by.

The alkalinity levels were assessed in the water samples and presented in table 2. The results indicates that all the sampling size have alkalinity levels below the WHO maximum contamination levels of 500mg/l. The alkalinity values in water provide an idea of natural mineral salt present in the water. The main species that contribute to the alkalinity include bicarbonates, hydroxides, phosphates and borates.

The total hardness levels were also analyzed and presented in table 3. Based on classification of water conducted by in term of softness and hardness in the following order in term of mg/l, 0 – 60 soft, 60 – 120 moderately soft 121 – 180 moderately hard and above 180 is hard. Thus, considering this classification, it can be deduced that 50% of the water sample analyzed are soft 40% of the water samples analyzed moderately soft and 10% of the water samples are moderately hard, but all are safe for drinking and other domestic purposes.

5. Conclusion

Physicochemical assessment of well water samples from Gezawa Local Government Area of Kano was conducted. Most of the physical parameters are within the World Health Organization (WHO) and standard organization of Nigeria (SON) safe limit.

Similarly, the results of the analysis indicated that most of the physical parameters are related to one another. This can be seen in the table 2 tables 3 and table 4 respectively which show that higher conductivity is related to higher total dissolved solids and total hardness which rise as a result of the presence of Ca^{2+} and Mg^{2+} ions respectively. Also, it was observed that turbidity and total suspended solid are also related to one another as the TSS level was high the turbidity was also high.

However, since some of the results indicate high levels above the standard set by WHO and SON safe limits there is the tendency of high potential health hazards to the inhabitants of the areas that uses these water sources for drinking and other domestic purpose without treatment.

Recommendation

As the results indicated, some of the parameters analyzed showed higher concentration above the WHO contaminant level especially the sampling sites very closer to Wase Dam which is believed to be contaminated, the following steps may lower the concentration, heating the water before used can remove the temporary hardness. Domestic and industrial waste should be properly disposed or recycled. Relevant agencies should make concerted effort to control, regulate and educate the community on indiscriminate waste disposal from domestic and industries within the study area and also further research should be carried out to assess the level of some other parameters.

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