

Water Quality Assessment of Some Selected Well Waters of Sabo Yeregi in Katcha Local Government of Niger State

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Abstract: Water quality assessment of some selected well waters of Sabo Yeregi in Katcha Local Government Area of Niger state was carried out using standard analytical methods. Water is a valued natural resource for survival of all living things; the importance of assessing the quality of this valued resource cannot be overemphasized. In this study, the physical, chemical and microbial values were analyzed from six well water samples collected from Sabo Yeregi, Katcha Local Government Area of Niger State using standard methods. The pH ranges 6.30 ± 0.04 to 7.15 ± 0.07 . Nitrite ranged from 0.03 ± 0.02 to 0.11 ± 0.01 mg/L. Well 1 (85.45 ± 0.64) has the highest total dissolved solids (TDS). Iron recorded 0.24 ± 0.02 mg/L as the highest and 0.07 ± 0.00 mg/L as the lowest in well 5 and 6 respectively. The hardness for well 1, 2, 3, 4, 5 and 6 were 113.50 ± 0.71 , 38.00 ± 1.42 , 63.00 ± 0.00 , 27.50 ± 0.71 , 31.50 ± 0.71 and 38.00 ± 1.42 mg/L respectively. The sulphate concentration is 64.68 ± 0.06 , 89.22 ± 0.09 , 92.74 ± 0.09 , 29.01 ± 0.09 , 102.27 ± 0.41 , and 77.25 ± 0.11 mg/L for well 1, 2, 3, 4, 5 and 6 respectively. The highest temperature recorded was 29.06 ± 0.09 °C and the lowest was 27.92 ± 0.02 °C well 5 and 3 respectively. The turbidity was 4.42 ± 0.06 , 0.50 ± 0.04 , 0.36 ± 0.08 , 2.06 ± 0.06 , 2.37 ± 0.21 and 2.47 ± 0.05 NTU for well 1, 2, 3, 4, 5, and 6. All the parameters were within the NSDWQ and WHO standard except pH in well 1, 2, 6, hardness, nitrate in (well 4) and manganese (in well 3). All the samples contain coliform with the exception of well 5 but there is no present of E.coli in any of the sample.

Keywords: Physical, Chemical, Microbial, Sabo Yeregi, Katcha

1. Introduction

Recent research carried-out by Yisa *et al.*, [1] reported that there has been increment in the interest for fresh water because of expansion in development of populace and in addition the rate of industrialization in the most recent couple of decades. The extensive scale industrial development has brought about genuine concerns with respect to the helplessness of groundwater sully because of release of waste materials. Waste materials close manufacturing plants are subjected to response with permeating precipitation water and along these lines achieve the aquifer framework and in that capacity corrupt the groundwater quality. Mining is one of the occupations of people leaving in Sabo Yeregi in Katcha local government of Niger state, so there is every tendency that the water in this community may be contaminated. Therefore it is become very necessary to

determine the levels of the contaminants in the water due to this activity to ascertain the safety of the local people whose lives totally depend on this water.

In the last two decades, there has been a tremendous increase in the demand for water due to rapid increase in population and in industrialization [2]. This demand for water has led to the use of groundwater, the desire for underground water is not only for its wide spread occurrence and availability but also for its constituent good quality which makes it ideal for drinking [3]. Water quality refers to the physical, chemical and biological attributes of water [4]. It is the measure of the condition of water in relation to the requirements of one or more biotic species and any human need or purpose [5]. Safe drinking water is fundamental to people and different types of life. Access to safe drinking

water has enhanced in the course of the most recent decades in all aspects of the world, however more or less one billion individuals still need access to great drinking water [6]. Direct pollution of surface waters with metals in releases from mining, refining and mechanical assembling is a long-standing phenomenon. On the other hand, the outflow of airborne metallic toxins has now come to such extents that long-extend environmental transport results to pollution in the region of industrialized locales, as well as in more remote ranges. Similarly, moisture in the atmosphere combines with some gases produced when fossil fuels are burnt and causes acidification of surface waters, falling as acid rain, especially lakes [7].

Groundwater has long been considered as one of the purest types of water accessible in nature and takes care of the general requests for provincial and semi-rural people [8]. Individuals around the globe have utilized groundwater as a wellspring of drinking water and even today more than a large portion of the world's populace relies on upon groundwater for survival [9].

2. Materials and Method

2.1. Sample Collection

Six well samples were randomly collected in Sabo Yeregi community of Katcha Local Government Area of Niger State. The samples were taken in polyethylene bottles. These bottles were washed with 10% HNO_3 and were rinsed thoroughly. The temperature and the pH of the samples were taken on site using thermometer and pH meter respectively. The bottles were clearly labeled with site location and were taken to laboratory for analysis [10].

2.2. Conductivity Determination

The conductivities of the samples were determined using Conductivity Meter (JENWAY MODEL 4520). The probe of the conductivity meter was submerged in the test sample contained in plastic beaker to avoid electromagnetic interferences. This was followed by the measurement of the sample after the stability symbol on the top left the Control Display appears. The COND mode was selected with the READ button (JENWAY MODEL manual). The measurements were then taken.

Turbidity and Total Alkalinity was determined was analyzed through the method as described by Dawodu and Ipaieda, [7]

2.3. Total Hardness Determination (Titrimetric Method) and Chloride Ion

Total Hardness Determination (Titrimetric Method) and Chloride Ion was calculated as described by Trivedy and Goel, [11].

2.4. Temperature Determination

The temperature measurements were carried out on site

using Hannah HI935005 microprocessor- based thermometer on the degree centigrade (0°C) scale.

2.5. Determination of Nitrite, Nitrate, Sulphate, Phosphate, Manganese, Iron, Zinc by Colorimetric Method

- The stored programmed number was entered from the colorimeter
- Mg/l and zero icons were displayed by pressing the ENTER button
- 10ml of the sample was measured into one sample cell and the other sample cell was filled (10cm^3) with distilled water as the blank
- The appropriate reagent was added to the sample cell containing the water sample and was thoroughly shaking to dissolve the reagent
- TIMER button was pressed to begin a reaction period
- A cell containing the sample was placed into the sample holder and 0.00mg/l was displayed by pressing ZERO button and the blank was removed from the cell holder
- The sample cell containing the water sample was then placed into the sample cell holder and the reading was taken by pressing READ button (HACH 895 DR Colorimeter Manual)

2.6. Microbial Analysis

2.6.1. Media Preparation

26g of lactose broth was measured into 1litre of distilled water and was mixed thoroughly using a magnetic stirrer, and also 10cm^3 of the solution was measured into McCartney bottles containing Durham's tube (5 bottles represented one sample). The bottles were arranged inside an autoclave and were sterilize for 15 min at 120°C to destroy the microorganisms present. After sterilization, the lactose broths were then cooled [12].

2.6.2. Presumptive Test

10cm^3 of the sample was poured into the lactose broth solution (prepared media) and were then incubated for 24hours. After the 24hours, the bottles were checked for contamination which may appear in the form of cloudiness in the samples or bubbles trapped by the Durham tubes [12].

2.6.3. Confirmatory Test

37.5g of EMB was weighed into 1litre of distilled water and was stirred using magnetic stirrer then was sterilized using the autoclave at 120°C for 15minutes and after and was brought out and allowed to cool. The Petri dish was sterilized and 20cm^3 of EMB was dispensed into each dish. The contaminated solution is streaked using an already sterilized wire loop on the EMB plate and were incubated for another 24hours [13].

2.7. Statistical Analysis

All determinations were performed in triplicates. The results obtained were subjected to statistical analysis using means and standard deviations.

3. Result and Discussion

3.1. Result

Table 1. Result of the Physico-Chemical Analysis of the 6 Samples.

PARAMETER	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	NSDWQ	WHO
Temperature ($^{\circ}\text{C}$)	28.89 \pm 0.01	28.63 \pm 0.04	27.92 \pm 0.02	28.00 \pm 0.14	29.06 \pm 0.09	28.35 \pm 0.07	AMBIENT	30.00
pH	6.41 \pm 0.08	6.30 \pm 0.04	6.53 \pm 0.04	7.15 \pm 0.07	6.53 \pm 0.04	6.43 \pm 0.04	6.5 - 8.50	6.50 - 8.50
Conductivity ($\mu\text{S}/\text{cm}$)	132.81 \pm 0.01	89.63 \pm 0.04	91.68 \pm 0.04	68.95 \pm 0.07	105.65 \pm 0.35	112.55 \pm 0.49	1000.00	1000.00
Turbidity (NTU)	4.42 \pm 0.04	0.50 \pm 0.04	0.36 \pm 0.08	2.06 \pm 0.06	2.37 \pm 0.21	2.47 \pm 0.05	5.00	5.00
Colour (TCU)	10.50 \pm 0.71	0.00 \pm 0.00	4.50 \pm 0.07	1.00 \pm 0.00	3.50 \pm 0.71	6.00 \pm 0.00	15.00	15.00
TDS (Mg/L)	85.45 \pm 0.64	36.10 \pm 0.14	67.25 \pm 0.36	44.05 \pm 0.07	40.10 \pm 0.14	69.30 \pm 0.43	500.00	1000.00
Salinity (Mg/L)	0.20 \pm 0.14	0.79 \pm 0.01	0.59 \pm 0.01	0.30 \pm 0.01	0.26 \pm 0.06	0.13 \pm 0.04	100.00	100.00
T. hardness (Mg/L)	130.20 \pm 0.14	48.50 \pm 0.71	80.50 \pm 0.71	41.00 \pm 1.42	49.00 \pm 0.94	48.50 \pm 0.71	150.00	500.00
T. alkalinity (Mg/L)	35.95 \pm 0.07	32.20 \pm 0.28	40.40 \pm 0.57	45.30 \pm 0.43	38.50 \pm 0.72	35.35 \pm 0.50	100.00	100.00
Ca ²⁺ hardness (Mg/L)	113.50 \pm 0.71	38.00 \pm 1.42	63.00 \pm 0.00	27.50 \pm 0.71	27.50 \pm 0.71	38.00 \pm 1.42	75.00	75.00
Mg ²⁺ hardness (Mg/L)	15.50 \pm 0.72	9.25 \pm 0.35	18.00 \pm 1.42	12.75 \pm 1.06	18.25 \pm 0.35	10.50 \pm 0.72	30.00	50.00

NOTE: NSDWQ = Nigerian Standard for Drinking Water Quality; WHO = World Health Organization

Table 2. Result of the Inions Analysis of the 6 Samples.

PARAMETERS	Well 1	Well 2	Well 3	Well 4	Well 4	Well 6	NSDWQ	WHO
Chloride Ion (Mg/L)	18.22 \pm 0.01	50.79 \pm 0.05	61.05 \pm 0.21	94.08 \pm 0.25	53.72 \pm 0.09	69.80 \pm 0.28	250.000	250.00
Phosphate Ion (Mg/L)	5.16 \pm 0.08	4.78 \pm 0.16	2.13 \pm 0.05	3.36 \pm 0.04	6.25 \pm 0.08	1.99 \pm 0.02	6.50	6.50
Nitrate Ion (Mg/L)	32.58 \pm 0.18	21.15 \pm 0.35	18.26 \pm 0.33	50.80 \pm 0.43	19.46 \pm 0.48	34.05 \pm 0.06	50.00	50.00
Nitrite Ion (Mg/L)	0.07 \pm 0.04	0.06 \pm 0.01	0.08 \pm 0.02	0.11 \pm 0.01	0.04 \pm 0.04	0.03 \pm 0.02	0.20	0.20
Sulphate Ion (Mg/L)	64.68 \pm 0.06	89.22 \pm 0.29	92.74 \pm 0.04	29.01 \pm 0.09	102.27 \pm 0.41	77.25 \pm 0.11	100.00	400.00

Table 3. Result of the Metal Analysis of the 6 Samples.

PARAMETERS	Well 1	Well 2	Well 3	Well 4	Well 4	Well 6	NSDWQ	WHO
Calcium (mg/L)	63.10 \pm 0.17	31.95 \pm 0.07	56.27 \pm 0.08	28.86 \pm 0.19	30.65 \pm 0.77	18.24 \pm 0.33	50.00	50.00
Magnesium (mg/L)	3.45 \pm 0.64	2.18 \pm 0.02	4.07 \pm 0.08	2.53 \pm 0.81	4.22 \pm 0.25	2.71 \pm 0.04	10.00	10.00
Iron (mg/L)	0.09 \pm 0.00	0.16 \pm 0.01	0.09 \pm 0.01	0.14 \pm 0.00	0.24 \pm 0.02	0.07 \pm 0.00	0.30	0.30
Manganese (mg/L)	0.03 \pm 0.00	0.01 \pm 0.00	0.21 \pm 0.03	0.03 \pm 0.00	0.00	0.01 \pm 0.00	0.20	0.20

Table 4. Result of the Bacteriological Analysis of the 6 Samples.

PARAMETERS	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	NSDWQ	WHO
Coliforms	1.001	4.00	2.00	5.00	0.00	4.00	0/100ml	0/100ml
<i>E. coli</i>	-	-	-	-	-	-	0/100ml	0/100ml

3.2. Discussion of Results

The results of the Physico-Chemical analysis of the 6 samples well water is shown in table 1. The temperature recorded in this work ranged from 27.92 to 29.06 \pm 0.09 $^{\circ}\text{C}$. The result is slightly lower than 30.83-31.7 $^{\circ}\text{C}$ as reported by Olalekan *et al.*, [14]. This values are within the WHO accepted value of 30.00 $^{\circ}\text{C}$ for temperature of drinking water. This result disagrees with the work of Olatunji *et al.*, [15] which reported 6.43 \pm 0.25 as maximum and 6.32 \pm 0.26 $^{\circ}\text{C}$ as minimum. The variation in the temperature may be attributed to the difference in the depth, location and season of analysis. The deeper the well the colder the water [16]. The pH of the samples were 6.41 \pm 0.08, 6.30 \pm 0.04, 6.60 \pm 0.08, 7.15 \pm 0.07, 6.53 \pm 0.04 and 6.43 \pm 0.04 for Well 1, 2, 3, 4, 5 and 6 respectively. These values are similar to NSDWQ and WHO pH standard of between 6.50 to 8.50. An abnormal pH can lead to corrosion, and also has effect on mucous membrane as reported by Narasinha *et al.*, [17]. This result is similar to those of Ajibare,

[18] and Olatunji *et al.*, [15]. The highest electrical conductivity recorded was 132.81 \pm 0.01 $\mu\text{S}/\text{cm}$ while the lowest value was 68.95 \pm 0.07 $\mu\text{S}/\text{cm}$ in well 1 and 4 respectively. This result is higher than NSDWQ and WHO limit of 1000 $\mu\text{S}/\text{cm}$ and 1250 $\mu\text{S}/\text{cm}$ respectively.

The turbidity ranged from 0.36 \pm 0.08NTU (well 3) to 4.42 \pm 0.04NTU (well 1), and the values fall within the NSDWQ and WHO turbidity limit of 5.0NTU. The range is not in correlation with the work of Yisa *et al.*, [19]. This variation may be due to the difference in the level of algae, erosion into the water as well as the dissolved substance in the water. The turbidity above 5.0NTU is health threat because the contaminant like bacteria or virus can be attached the material that is responsible for the turbidity as reported by Higgins *et al.*, [20].

The colour of the samples ranged from 0.00 TCU (well 2) to 10.50 \pm 0.71 TCU (well 1). Well 2 showed the best colour unit among others in relation to colour attribute of water because the smaller the colour unit the better the colour. Well 1 has the highest colour unit but still within the NSDWQ and WHO

colour limit of 15TCU. The total dissolved solids (TDS) of the samples are 85.45 ± 0.64 , 36.10 ± 0.14 , 67.25 ± 0.07 , 44.05 ± 0.07 , 40.10 ± 0.14 and 69.30 ± 0.04 mg/L respectively. The values fall within the NSDWQ and WHO limit of 500mg/L and 1500mg/L respectively. The values are similar to that of Tyagi *et al.*, [8].

The salinity of the samples ranged from $0.13 \pm 0.04\%$ (well 6) – $0.79 \pm 0.01\%$ (well 2) and the values are suitable in comparison with the NSDWQ and WHO limit of 100%. The values are not in correlation with the values obtained by Yisa *et al.*, [19]. The highest value recorded for total hardness was 130.20 ± 0.14 mg/L and the lowest value was 41.00 ± 1.42 mg/L which are still within the NSDWQ and WHO standard of 150mg/L and 500mg/L respectively. According to Higgins *et al.*, [20], individuals typically report aesthetic problem whenever the level of total hardness of water is 160 mg CaCO_3 /L and above. From this, well 4 with low hardness are more aggressive than well 1 with higher value. The values of the hardness obtained were also similar to those in the work of Anshu *et al.*, [21]. The total alkalinity of the samples was recorded to be 32.20 ± 0.23 mg/L as the highest and 43.30 ± 0.43 mg/L as the lowest which fall within the NSDWQ and WHO limit of 100mg/L. The result is not in correlation with Rathose *et al.*, [22]. This may be due to the differences in pH values since the higher the pH value the higher the alkalinity of the water as reported by Wilkies University [16].

The calcium hardness of the sample was 113.50 ± 0.71 , 38.00 ± 1.42 , 63.00 ± 0.00 , 27.50 ± 0.71 , 31.50 ± 0.71 and 38.00 ± 1.42 mg/L for well 1, 2, 3, 4, 5, and 6 respectively. Well 1 exceeds the WHO limit of 75mg/L. This high level of calcium hardness decreases lather forming capacity of soap and increases the formation of scale in water heater as reported by Olasehinde, [23]. The similarities in the values were compared with that of Hudault *et al.*, [12]. This may be due to the type of the geological rock present in the environment

The samples have magnesium hardness ranging from 9.25 ± 0.35 mg/L (well 2) – 18.25 ± 0.35 mg/L (well 5) and the values are within the NSDWQ and WHO limit of 30mg/L and 50mg/L respectively. The result of calcium ion is 63.10 ± 0.17 , 31.95 ± 0.07 , 56.27 ± 0.08 , 28.86 ± 0.10 , 30.65 ± 0.07 and 18.24 ± 0.33 mg/L for well 1, 2, 3, 4, 5 and 6 respectively as shown in table 2. These values are within NSDWQ and WHO limit of 50mg/L. The highest value of chloride ion recorded in the samples was 94.08 mg/L and 18.22 mg/L as the lowest. The result is similar to that obtained by EPA, [25]. This range is within the NSDWQ and WHO limit of 250mg/L. Above this limit can readily react with proteins in human hair and can cause health problem.

The phosphate levels of the sample ranged from 1.99 ± 0.02 mg/L (well 6) – 6.25 ± 0.08 mg/L (well 5) and the range is within the NSDWQ and WHO permissible limit of 6.50mg/L. phosphate level greater than 6.5mg/L can lead to kidney damage and osteoporosis as reported by EPA, [25].

The range of nitrate level of the samples is 18.26 ± 0.33 mg/L (well 3) to 50.80 ± 0.43 mg/L (well 4). The value obtained from Well 4 is above the NSDWQ and WHO limit of 50mg/L. This high level of nitrate may be attributed to the use

of fertilizer containing nitrogen and leaching of sewage rich in nitrate as reported by Paul, [26]. Nitrate above 50mg/L causes neurological disorder (blue-baby syndrome) in infant less the six months [2].

The nitrite concentration of the samples ranged from 0.03 ± 0.02 mg/L (well 6) – 0.11 ± 0.01 mg/L and the range is within the NSDWQ and WHO permissible limit of 0.20mg/L. higher level of nitrite has the same effect as in nitrate as reported by Mitchell and Stapp [28]. The value is similar to that of Dhananjay *et al.* [29].

The sulphate concentration is 64.68 ± 0.06 , 89.22 ± 0.09 , 92.74 ± 0.09 , 29.01 ± 0.09 , 102.27 ± 0.41 , and 77.25 ± 0.11 mg/L for well 1, 2, 3, 4, 5 and 6 respectively. The value of well 5 is above the NSDWQ permissible limit of 100mg/L but still within the WHO permissible limit of 400mg/L. the high level may be attributed to improper discharge of waste containing sulphate and drainage of mine [30].

From table 3 iron concentration of the sample was recorded for 0.24 ± 0.02 mg/L as the highest and 0.07 ± 0.00 mg/L as the lowest. The range is within the NSDWQ and WHO permissible limit of 0.30mg/L. Iron level greater than 0.3mg/L produces a sticky slime typically rusty in colour as reported by Wafaa *et al.*, [31]. These values are in agreement with the work of Dhananjay *et al.*, [29].

The manganese ranged from 0.01 ± 0.00 mg/L (well 6 and 1) – 0.21 ± 0.03 mg/L (well 3). Well 3 is above the NSDWQ and WHO limit of 0.20mg/L. Manganese above 0.20mg/L can cause stiff muscle disease and hypertension in patient older than 40 years as reported by Blaurock, [32].

From table 4, all the samples with the exception of well 5 contain coliforms. The present of coliform is an indication that pathogenic bacteria, viruses and protozoans may be present in the sample [33]. There is no present of *E.coli* in any of the samples.

4. Conclusion

From the result obtained, it will be conclude that all the physical parameters are within the NSDWQ and WHO standard with the exceptions of pH in well 1, 2, and 6 which is below the standard. Also, all the ions, mineral and metal parameters are suitable for drinking with the exceptions of calcium hardness, nitrate in (well 4) and manganese (in well 3) respectively. All the samples contain coliform with the exception of well 5 but there is no present of *E.coli* in any of the sample.

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