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± 0.01mg/L. Well 1(85.45 ± 0.64) has the highest total dissolved solids (TDS). Iron recorded 0.24 ± 0.02mg/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 ± 0.71and38.00 ± 1.42mg/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 ± 0.11mg/L for well 1, 2, 3, 4, 5 and 6 respectively. The highest temperature recorded was 29.06± 0.090C and the lowest was 27.92± 0.02 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 ± 0.05NTU 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 sulllying 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-delay 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% HNO₃ 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 Ipaiyeda, [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 (10cm³) 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 10cm³ 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 sterile 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

10cm³ 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 20cm³ 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>
<thead>
<tr>
<th>PARAMETER</th>
<th>Well 1</th>
<th>Well 2</th>
<th>Well 3</th>
<th>Well 4</th>
<th>Well 5</th>
<th>Well 6</th>
<th>NSDWQ</th>
<th>WHO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°C)</td>
<td>28.89±0.01</td>
<td>28.63±0.04</td>
<td>27.92±0.02</td>
<td>28.00±0.14</td>
<td>29.06±0.09</td>
<td>28.35±0.07</td>
<td>AMBIENT</td>
<td>30.00</td>
</tr>
<tr>
<td>pH</td>
<td>6.41±0.08</td>
<td>6.30±0.04</td>
<td>6.53±0.04</td>
<td>7.15±0.07</td>
<td>6.53±0.04</td>
<td>6.43±0.04</td>
<td>6.5 8.50</td>
<td>6.50-8.50</td>
</tr>
<tr>
<td>Conductivity (µS/cm)</td>
<td>132.81±0.01</td>
<td>89.63±0.04</td>
<td>91.68±0.04</td>
<td>68.95±0.07</td>
<td>105.65±0.35</td>
<td>112.55±0.49</td>
<td>1000.00</td>
<td>1000.00</td>
</tr>
<tr>
<td>Turbidity (NTU)</td>
<td>4.42±0.04</td>
<td>0.50±0.04</td>
<td>0.36±0.08</td>
<td>2.06±0.06</td>
<td>2.37±0.21</td>
<td>2.47±0.05</td>
<td>5.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Colour (TCU)</td>
<td>10.50±0.71</td>
<td>0.00±0.00</td>
<td>4.50±0.07</td>
<td>1.00±0.00</td>
<td>3.50±0.71</td>
<td>6.00±0.00</td>
<td>15.00</td>
<td>15.00</td>
</tr>
<tr>
<td>TDS (Mg/L)</td>
<td>85.45±0.64</td>
<td>36.10±0.14</td>
<td>67.25±0.36</td>
<td>44.05±0.07</td>
<td>40.10±0.14</td>
<td>69.30±0.43</td>
<td>500.00</td>
<td>1000.00</td>
</tr>
<tr>
<td>Salinity (Mg/L)</td>
<td>0.20±0.14</td>
<td>0.79±0.01</td>
<td>0.59±0.01</td>
<td>0.30±0.01</td>
<td>0.26±0.06</td>
<td>0.13±0.04</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td>T. hardness (Mg/L)</td>
<td>130.20±0.14</td>
<td>48.50±0.71</td>
<td>80.50±0.71</td>
<td>41.00±1.42</td>
<td>49.00±0.94</td>
<td>48.50±0.71</td>
<td>150.00</td>
<td>500.00</td>
</tr>
<tr>
<td>T. alkalinity (Mg/L)</td>
<td>35.95±0.07</td>
<td>32.00±0.28</td>
<td>40.40±0.57</td>
<td>45.30±0.43</td>
<td>38.50±0.72</td>
<td>35.35±0.50</td>
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<td>100.00</td>
</tr>
<tr>
<td>Ca²⁺ hardness (Mg/L)</td>
<td>113.50±0.71</td>
<td>38.00±1.42</td>
<td>63.00±0.00</td>
<td>27.50±0.71</td>
<td>27.50±0.71</td>
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<td>75.00</td>
<td>75.00</td>
</tr>
<tr>
<td>Mg²⁺ hardness (Mg/L)</td>
<td>15.50±0.72</td>
<td>9.25±0.35</td>
<td>18.00±1.42</td>
<td>12.75±1.06</td>
<td>18.25±0.35</td>
<td>10.50±0.72</td>
<td>30.00</td>
<td>50.00</td>
</tr>
</tbody>
</table>

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

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± 0.09°C. The result is slightly lower than 30.83-31.7°C as reported by Olalekan et al., [14]. This values are within the WHO accepted value of 30.00°C for temperature of drinking water. This result agrees with the work of Olatunji et al., [15] which reported 6.43±0.25 as maximum and 6.32±0.26 °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± 0.08, 6.30 ± 0.04, 6.60 ± 0.08, 7.15 ± 0.07, 6.53 ± 0.04 and 6.43 ± 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 ± 0.01µS/cm while the lowest value was 68.95 ± 0.07µS/cm in well 1 and 4 respectively. This result is higher than NSDWQ and WHO limit of 1000µS/cm and 1250µS/cm respectively.

The turbidity ranged from 0.36 ± 0.08NTU (well 3) to 4.42 ± 0.04NTU (well 3), 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 ± 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...
The phosphate level greater than 6.5 mg/L can lead to kidney problems, as reported by Olasehinde et al. [23]. The similarities in the values were observed whenever the level of total hardness of water is 160 mg CaCO₃. This is due to the high level of nitrate recorded in the sample. The result is similar to that obtained by EPA, [25]. Water hardness decreases lather forming capacity of soap and increases the formation of scale in water heater as reported by Olasehinde, [23]. The salinity of the samples ranged from 0.13 ± 0.04 mg/L (well 6) to 0.79 ± 0.01 mg/L (well 2) and the values are suitable in comparison with the NSDWQ and WHO limit of 100%. The values obtained were 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 100 mg/L. This 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 75 mg/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) to 18.25 ± 0.35 mg/L (well 5) and the values are within the NSDWQ and WHO limit of 30 mg/L and 50 mg/L respectively. The result of calcium ion is 63.10 ± 0.17, 31.50 ± 0.71, 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 the NSDWQ and WHO limit of 50 mg/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 250 mg/L. Above this limit can readily react with proteins in human hair and can cause health problems.

The phosphate levels of the sample ranged from 1.99 ± 0.02 mg/L (well 6) to 6.25 ± 0.08 mg/L (well 5) and the range is within the NSDWQ and WHO permissible limit of 6.50 mg/L. Phosphate level greater than 6.5 mg/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 50 mg/L. This high level of nitrate may be attributed to the use of fertilizer containing nitrate and leaching of sewage rich in nitrate as reported by Paul, [26]. Nitrate above 50 mg/L causes neurological disorder (blue-baby syndrome) in infants less than 40 years as reported by Blaurock, [32].

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 0.30 mg/L. Iron level greater than 0.3 mg/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 Dhanaanjay et al., [29].

The sulphate concentration is 64.68 ± 0.06, 89.22 ± 0.09, 92.74 ± 0.09, 29.01 ± 0.41, 102.27 ± 0.1, 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 100 mg/L but still within the WHO permissible limit of 400 mg/L. The high level may be attributed to improper discharge of waste containing sulphate and drainage of mine [30].

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 protozoa 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.

References


