Physico – Chemical and Bacteriological Analysis of Well Water at Crescent Road Poly Quarters, Kaduna.

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--**ABSTRACT**--

Twenty five (25) well water samples from Crescent Road, Poly Quarters were collected and analyzed for five (5) physico –chemical Parameters (BOD, pH, Conductivity, Temperature, and Turbidity,) using standard procedures at the KRPC PPQC (Planning, programming and quality control) Laboratory. The bacteriological quality assessment of the well water samples were carried out using the five tube Most Probable Number (MPN) technique at the water Laboratory, National Institute for Water Resources (NIWR), mando, Kaduna. Well 32 has the highest BOD of 295mg/l. All the well water samples analyzed have high coliform counts and none of them met the World Health Organization Standard of <10 coliforms/100ml of water. Wells 15, 32 and 50 had MPN Index/100ml values ranging between 1600 - ≥ 2,400. Wells 3, 6, 21 and 23 had relatively low coliforms ranging from 17 to 21. However wells 20, 34 and 49 had MPN Index/100ml values of 280,220 and 350 respectively.

Key words: *Most Probable Number (MPN) drinking water, bacteria, analysis Biochemical Oxygen Demand (BOD)*

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I.   Introduction

Water cover 71% of the Earth surface.[1] Biochemically, water is regarded as a "life sustainer". The continuous biochemical reaction that take place in living things are made possible in the presence of water and without it the cell collapses.[2] Well water has long been considered as one of the purest form of water in nature and meets the overall demand of rural and semi-urban people. Large scale industrial growth has caused serious concern regarding the susceptibility of well water contamination due to waste materials. [3] Well water is a reliable source of water supply because it is often unpolluted due to restricted movement of pollutants in the soil profile. However, shallow and permeable water aquifers are most susceptible to contamination. [4] Water pollution results in transmission of infectious diseases such as cholera, diarrhea and typhoid.[5] Thus contamination of drinking water from any source is of primary importance due to the danger and risk of water diseases. In 1997, the World Health Organization (WHO) reported that 40% of deaths in developing nations occur due to infection from water related diseases and estimated 500 million cases of diarrhea occurs every year in children below 5 years in parts of Asia, Africa and Latin America.[6] Biological contamination is generally due to the introduction of organic waste material into the aquifer system e.g. bacteria. Such micro organisms are responsible for diseases such as typhoid, dysentery, cholera, diarrhea, gastroenteritis and some undesirable characteristic such as taste and odours and sometime corrosion and encrustation in borehole delivery pipes.[7] The bacterial qualities of ground water and other natural water supplies in Nigeria have been reported to be unsatisfactory with coliform count far exceeding the level recommended by the World Health Organization – [8]

II.   Materials and methods

Study Site – The study site is Poly quarter crescent road, Kaduna, Kaduna North local Government Area, Kaduna State. The top soil consist of clay soil and beneath the soil consist of coarse dry soil.

Sample Collection – The collection, handling and analyses of the well water samples were carried out using the procedures given by[9]. A total of 25 well water samples were collected using sterile sample bottles from 25 wells, each from different flats in the quarters. The samples were labeled immediately after collection and were transported to the laboratory for analysis.

Physical analysis of water samples: Turbidity, Electrical conductivity and Temperature was carried by methods described by [10],

Chemical analysis: Biological oxygen demand (BOD), and pH was carried out by methods described by [10] while bacteriological quality assessment of the well water samples was carried out using the five tube Most Probable Number (MPN) technique as described by [11]

Bacteriological Analysis

Bacteriological characteristics were determined using the multiple tube fermentation procedure [8] where nine tube and inverted vials containing lactose broth were incubated and at 35^0C for 48 hours for the presumptive test, and at the confirmation test, a sterile wire loop was used to transfer a drop of culture from each positive tube to a tube containing brilliant green lactose bile broth to determine gas formation in any vial within 48 hours and at 37^oC to be positive test, while a typical colony from an EMB plate was transferred on to a nutrient agar, and into a tube with inverted vial containing lactose broth to perform the complete test. Presumptive colonies were confirmed by gram staining and biochemical reactions and each plate was given a positive or negative score. Isolates were confirmed by some conventional biochemical test SCA, (2002).Descriptive statistical analyses were used to establish relationship and variation among the data.

Bacteriological analysis of the well water sample:

The bacteriological analysis of the well water samples are analysed for total *coliforms.*This was carried out using the Most Probable Number (MPN) technique as described by American Public Health Association –.[11]

A combination of positive and negative tubes and the MPN index each of the water samples were determined using the Most Probable Number (MPN) Standard Table.

Results

The results of the Physico-chemical analysis of the well water samples are as illustrated in Figures 1 to 5. Figure 1 represents the Biochemical Oxygen Demand(BOD) results of the 25 well water samples analyzed, while Figure 2 is pH, Figure 3-Conductivity, Figure 4-Temperature, and Figure 5-Turbidity

The result of the bacteriological (*coliform*) quality assessment of the twenty five well water samples is as illustrated in Figure 6.
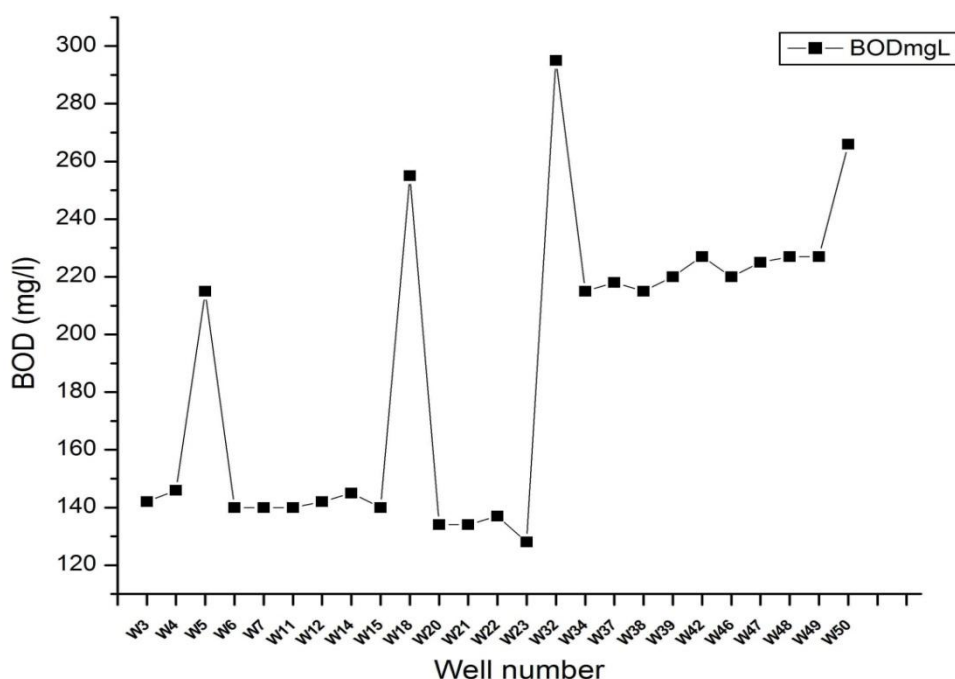

Figure 1:BOD of Well Water Samples

Typically highest BOD (295 mg/l). were recorded from well 32 and the lowest BOD (128 mg/l), from well twenty – three (23)
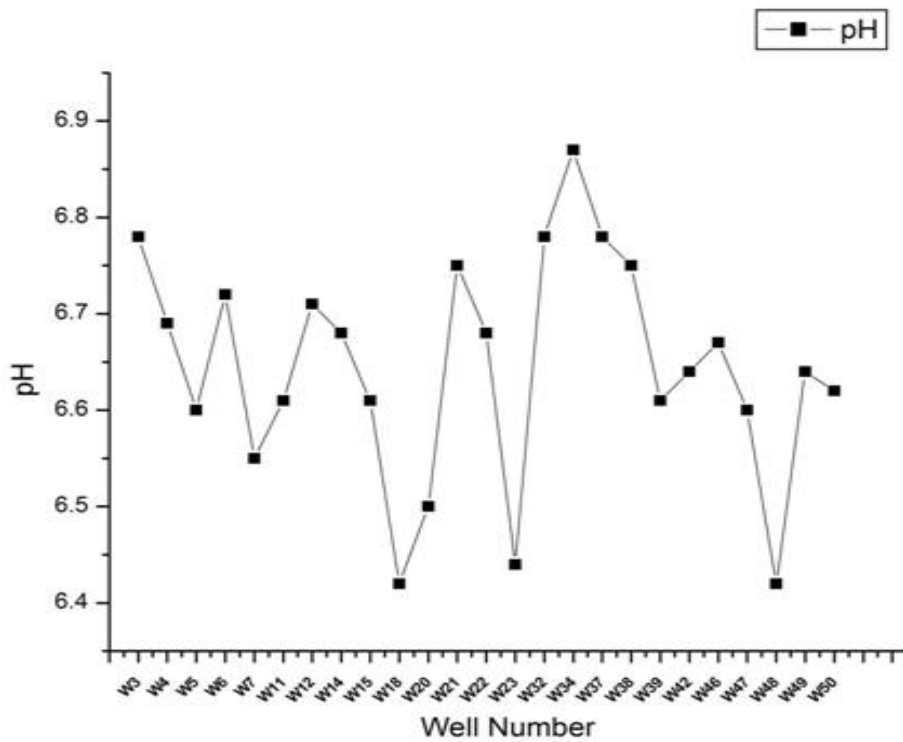
Figure 2: pH of Well Water Samples

The pH of the well water samples analyzed ranged between 6.42 – 6.87. This indicates that the pH of all the well waters were within the WHO Standard or permissible limit.
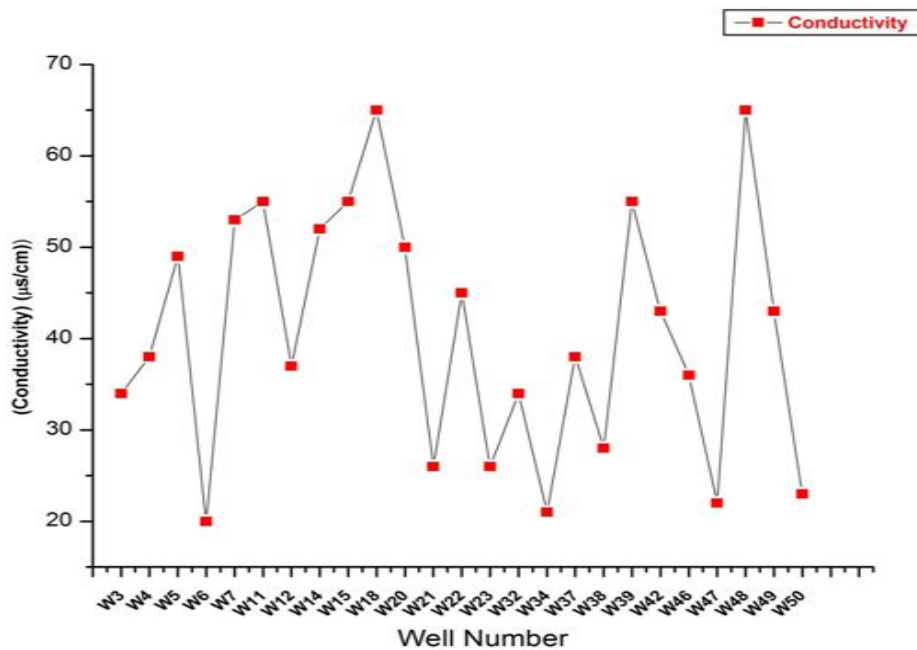

Figure 3: Conductivity of Well Water Sample

Well 6 has the lowest conductivity of $020\mu/cm$ while well 18 and 48 has the highest conductivity of $065\ \mu/cm$. Wells 11,39 has a conductivity of $055\ \mu/cm$ while wells 7, 14 and 20 has conductivities of 053, 052 and $050\ \mu/cm$ respectively
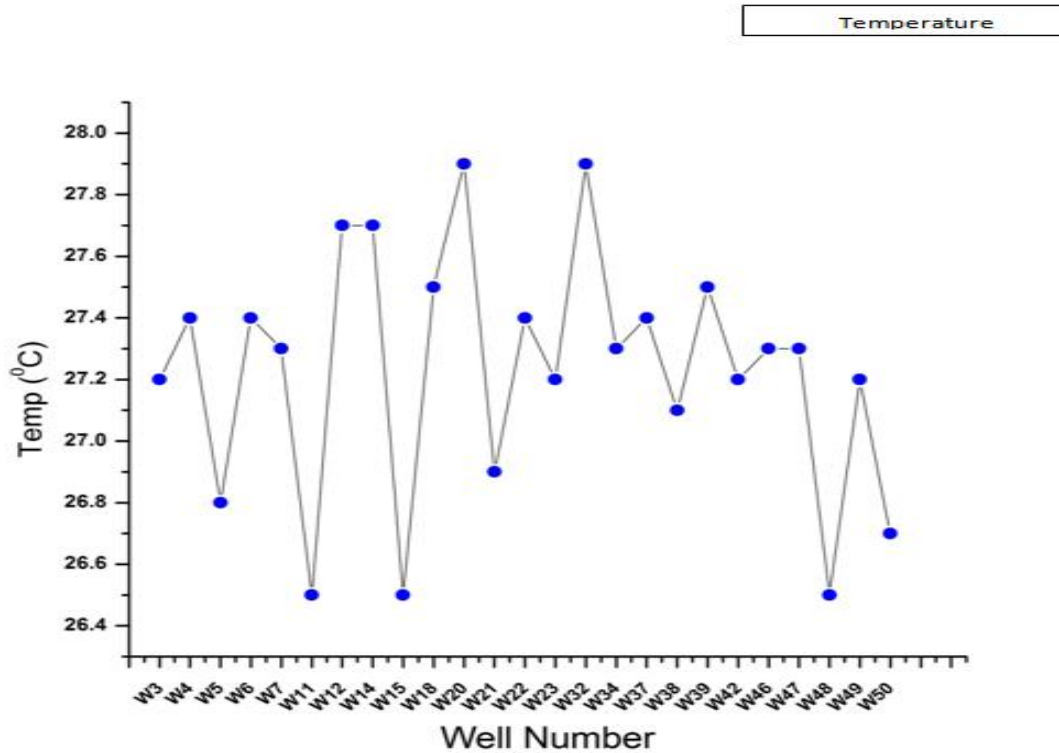
Temperature

Figure 4: Temperature of Well Water Samples

The result indicates that the temperature recorded from the well water samples were within the range of 26 - 27^0C with the highest was 6.87 from well 34 (thirty – Four) and well thirty – two (32).
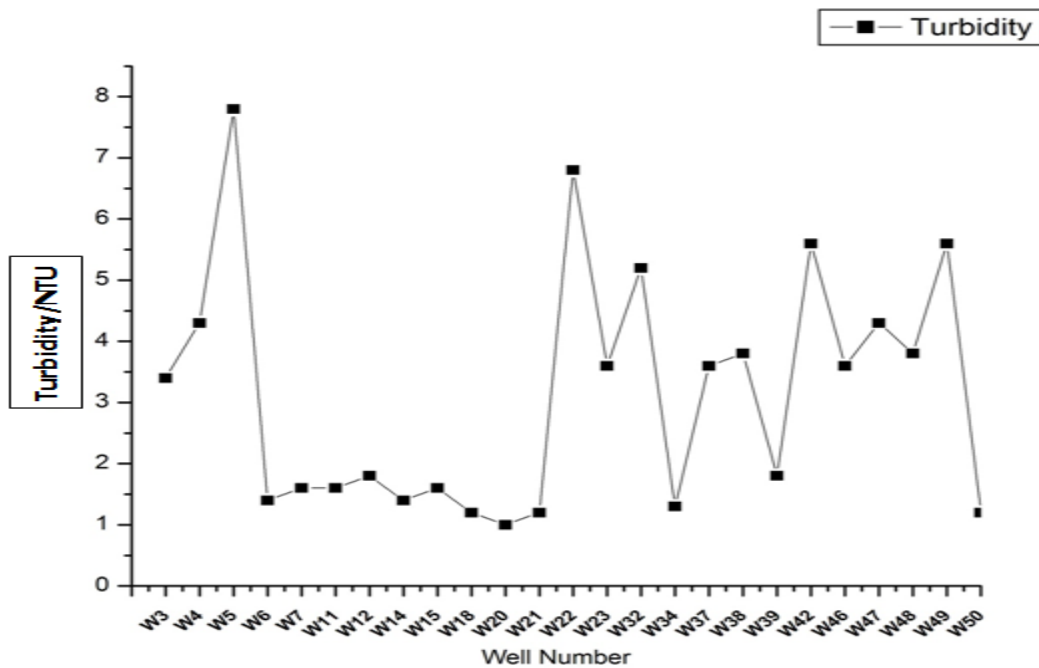

Figure 5 : Turbidity of the well water samples

Well 5 have the highest turbidity of 7.8NTU followed by well 22 with turbidity of 6.8 NTU. Well 20 have the least turbidity of 1.0 NTU.
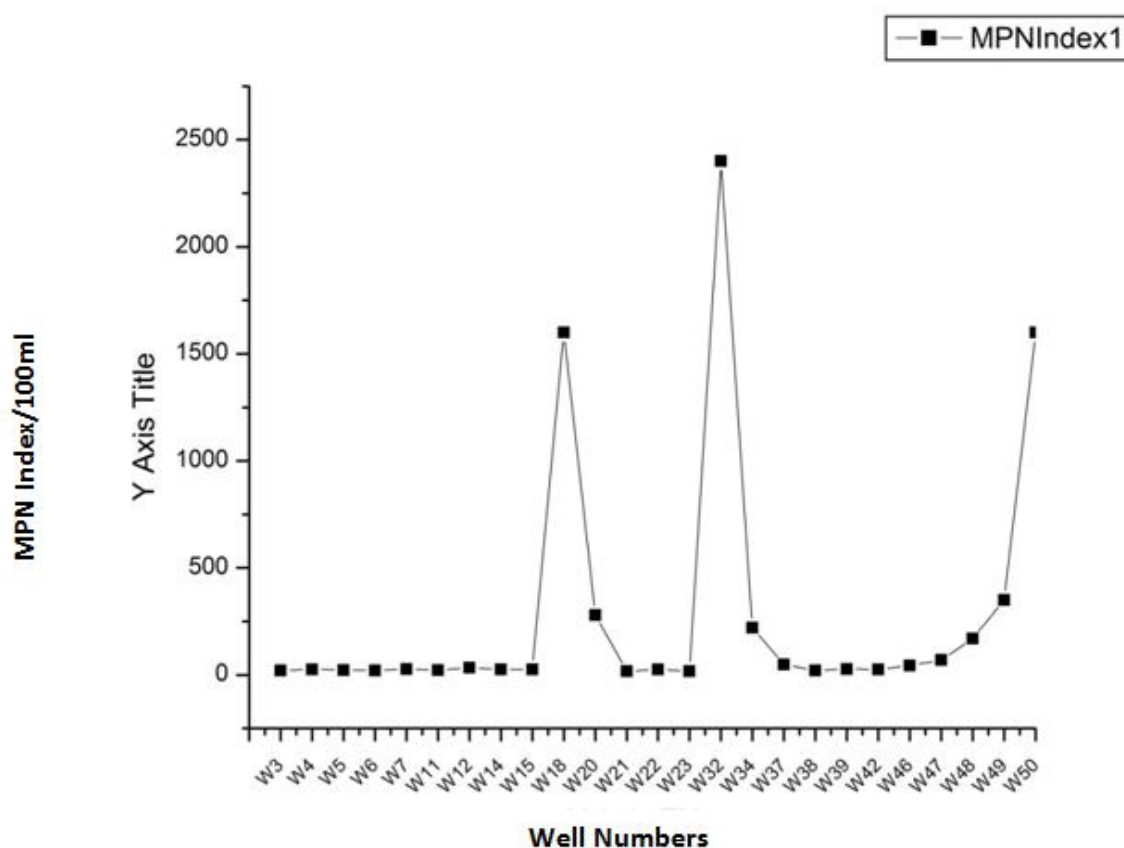
Figure 6: MPN Index of Well Water Samples

The results of presumptive test indicating MPN of well water from Crescent Road Poly Quarters were presented in Figure 8. The results revealed that, all the well water samples analyzed from the Twenty – five (25) wells have high MPN values. Wells thirty-two (32), fifty (50) and fifteen (15) had higher MPN values ≥ 2,400/100ml and 1600/100ml. The water sample from wells twenty-one (21), twenty-three (23), three (3) and six (6) have relatively low MPN values compared to other wells from wells twenty (20), l thirty-four (34) and forty-nine (49) with MPN values of 280/100ml, 220/100ml, and 350/100ml respectively.

III.   Discussion
All the well water samples from Crescent Road Poly Quarters did not meet the World Health Organization (WHO) BOD standard of 125mg/l.[12] The BOD of the well water samples ranged between 128mg/l and 295mg/l (Figure 1). The high BOD is an indication that all the water samples might have been polluted with organic matter due to human activities such as keeping of animal husbandry and farming. Well number 32 has the highest BOD of 295mg/l followed by well Number 50 with a BOD of 266mg/l, while well number 18 has BOD of 255 mg/l, well number 5 has BOD of 215mg/l, well number 23 has the least BOD of 128mg/l. The high BOD of well water samples reported in this work is in agreement with that of .[13]According to the World Health Organization Standard [12] standard for pH values ranges between 6.5 – 8.5. The pH of the well water samples analyzed ranged between 6.42 – 6.87. This indicates that the pH of all the well waters were within the WHO Standard permissible limit. (Figure 2). This result is in agreement with the report of [13] in which the pH of the well water samples they analyzed ranged from 5.53 to 8.16. However, 75% of their well water samples fell outside the range of 6.5 to 8.5 and 20% of the water samples had a pH above 7. This could be due to the presence of total dissolved solids and heavy metals. The results of the pH of well water samples from Crescent Road Poly Quarters is in total agreement with the report of [14] for well waters in Ahmadu Bello University (Main Campus), Zaria, Nigeria.

The [15] reported a pH range from 6.40 to 8.59. This is almost the same as this result from water sample from Akunjba - Akak Ogun State, Nigeria.

The conductivity (us/cm) of the well water samples ranged between 20.0 us/an – 65 us/an. These meets the World Health Organization Standard of <125 us/cm.[12] Figure 3. This range in conductivity of 20.01 - 65 μs/cm agrees with the work of [13] who reported a conductivity range of 26 to 51 μs/cm for the well water samples from dug wells and the lagoon in Lagos, Nigeria. The World Health Organization Standard for temperature of potable water is 25^0C. The temperature of the Crescent Road Poly Quarters well water ranged between 26.5 – 27.9 (Figure 4).The temperatures of the well water samples were slightly above the World Health Organization Standard. This could be due direct exposure of the wells and their water contents to sunlight that heats up the water from 26.5 to 27.9 ^{0}C. The temperature range for the water samples in this work is in partial agreement with the work of[15] that reported a temperature range between 28.0 and 28.9 ^{0}C for water sources in Akungba – Akoko, Ondo State, Nigeria. The Word Health Standard (WHO, 2006)[12] for turbidity is 5.00 NTU while those of Department of Petroleum Resource – DPR (1991) and Federal Environmental Protection Agency, FEPA (1992) are <15 and 20-3,000 respectively. The turbidity of the well water samples ranged between 1.000 NTU – 7.80 NTIS. All the well water samples were within WHO and DPR limits and far less than the minimum limit by FEPA of 20NTU (Figure 5). The turbidity of the well water samples could be due to presence of dissolved solids and high organic matter content and high organic matter content and B.O.D of the water samples. This is in agreement with the reports of [16] [17], [18],[14] The bacteriological quality of the well water samples was determined using the most probable Number (MPN) technique. The permissible MPN index by world Health Organization is 10 coliforms/100ml of water sample. The MPN index of the well water samples ranged between 17 – 72,400 figure 8, this indicates that all of the well water samples are above the permissible limit of WHO. This is in agreement with the work of [19] who reported that all the bore well water samples they analyzed were contaminated with high amount of bacterial population. The reason for high number of total *coliforms* might be due to inadequate maintenance of the well water as many of the wells are uncovered. This might also be due to the percolation of sewage into the ground water sources.

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IV. Conclusion
The physicochemical and bacteriological assessment of the well water samples indicated that none of the water samples met the set standards by World Health Organization, DPR and FEPA (NESREA)

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