# *Original Research Article*

# HEAVY METAL AND PHYSICOCHEMICAL ANALYSIS OF WELL WATER FROM SELECTED AREAS IN WAMAKKO COMMUNITY, SOKOTO STATE, NIGERIA

## ABSTRACT

Well water is a source of potential exposure to environmental contaminants. This research is aimed at investigating the heavy metals levels and physicochemical properties of well water from Wamakko community, Sokoto state, Nigeria. Twelve (12) well water samples were collected from four different areas (A,B,C and D) in Wamakko community (n=3). Heavy metals concentrations (Cr, Cd, Fe and Pb) were determined using AASand physicochemical analysis (pH, Temperature, Cl-, CO3, HCO3 and TDS) were carried out using standard analytic procedures. The levels of heavy metals investigatedin all samples fell within the permissible limit approved by WHO and SON, with the exception of Fe and Pb. The physicochemical parameters investigated fell within the recommendable limit set by WHO and SON. Therefore, well water from the studied areas contain higher than normal levels of Pb& Fe, which can be toxic and may pose risk to human health. Therefore, awareness and periodic monitoring of well water from these areas are required since it's the major source of drinking water for the people.

**Keywords;**Heavy metals, Physicochemicals, Wamakko, sokoto and Nigeria

## 1.0 INTRODUCTION

Rapid population growth, increasing living standards in urban areas and industrialization have resulted in greater demand of quality water on one hand, while on the other hand, pollution of water sources is increasing steadily Therefore the ground water is getting polluted and among which wells are generally considered as the worst type of ground water sources in the term of physico-chemical contamination due to the lack of concrete plinth and surrounding drainage system (Reza and Singh, 2009)Ground and surface water are important ,major sources of drinking water in both urban and rural areasAnd determination of water quality is one of the most important aspects in groundwater studies. Groundwater is highly valued because of certain properties not possessed by surface water (Prasad *et al.,* 2011).People around the world have used groundwater as a source of drinking water, and even today more than half the world's population depends on groundwater for survival. The value of groundwater lies not only in its widespread occurrence and availability, but also in its consistent good quality, which makes it an ideal source of drinking water(Haloiand Sarma, 2011). In recent times, increasing focus is being given to studies on groundwater contamination. Since groundwater is directly in contact with soil, rocks, and plants, the constituents of these sources might contaminate the groundwater (WHO, 2011).

Heavy metal refers to any metallic chemical element that has a relatively high density which is toxic or poisonous at low concentration to human health and in some casesto plants(Abdulmojeed and Abdulrahman, 2011).Metals are found naturally in the earth's crust and their compositions vary among different localities, resulting in spatial variations of surrounding concentrations. Heavy metals can enter water supply by industrial and consumers waste, and can result in damaged or reduced mental and nervous function, lower energy levels and damage to blood composition of lungs, kidneys, liver and other vital organs (Gueguen, 2011). Long term exposure may results in slow progression of physical, muscular and neurological degenerative process that mimics Alzheimer's diseases, Parkinson diseases, muscular dystrophy and serious health diseases with many of them affecting the brain (Gueguen, 2011).

Data on heavy metal and physicochemical composition of the major drinking water source (i.e well water) from wamakko community, Sokoto state, Nigeria are scarce. This research is an attempt to determine the concentration of heavy metals and physicochemical properties of well water from four different areas in wamakko community, in order to ascertain their safety.

## 2.0 Methodology

### 2.1 Samples collection

The samples of well water were collected in Wamakocommunity from four different areas in polyethene bottles each containing two liters. All samples were collectedsameday. The samples were earlier soaked with 10% of $HNO_3$ for about 3days to avoid loss of metals. The rubber bottles were labeled as sample A, sample B, sample C, and sample D.

**Sample A:** water sample collected from well at Kasarawa area

**Sample B:** water sample collected from well at Tunganliman area

**Sample C:** water sample collected from well at Sabongarinmadorawa area

**Sample D**: water sample collected from well at Nufawu area

### 2.2 Heavy metal Analysis

**Method:** AA model 306 (AAS) (Reddy *et al.,* 2012).

50cm$^3$of each water sample were transferred into evaporating dish, 10cm$^3$ concentrated nitric acid $HNO_3$ were added for each sample which were placed on stem bath to evaporate to 25cm$^3$. The samples were transferred to sample bottle, followed by addition of deionized water (distilled water) up to 50cm$^3$ mark before taking to AAS machine for analysis. Heavy metals were determined in water samples using AA model 306 (AAS) .

### 2.3 Physicochemical Analysis

#### 2.3.1 Determination of pH

**Method:** pH meter (AOAC,2005).

**Procedure:** Instantly after collecting the samples the pH of the samples were first measure in laboratory using pH meter, the pH meter was deep into each samples of water to determine the level of pH .

**2.3.2 Determination of temperature**

**METHOD:** Thermo analytical method ( AOAC,2005).

**Procedure:** Temperature of water samples were also measured using thermometer, the thermometer was deeped into each water sample to take the reading.

**2.3.3 Determination of total dissolved solid (TDS):**

**Method:** Gravimetric method (Sam, 2013)

**Procedure:** 1 liter of sample was taken into a clean polyethene carboy. The container was labeled. The contents of the container were shaken thoroughly before drawing the sample for testing. Volume of sample was measured quickly from the container, and transferred to a clean and a pre-weighted evaporating dish, and evaporated to dryness in an oven at 180 $^{0}$C. The dish was cooled in desiccators to an ambient temperature and re-weighted. The TDS in mg/lit was calculated using formula as shown below.

CALCULATIONS:

Total dissolved solid/TDS (mg/lit) = (Final weight of dish – initial weight of dish) × 10ˆ6sample volume (ml).

**2.3.4 Determination of chloride**

**METHOD:** Mohr titration method (Prasad *et al.,* 2011)

**Procedure:** 50cm$^3$ of each water samples were poured into 150cm$^3$ beakers, followed by 1 drop of phenolphthalein indicator in the beakers. The solution were titrated using 0.1% sulphuric acid ($H_2SO_4$) till the pink color was observed, 1 drop of methyl orange was added again, the titration continues without refilling the burette to the end point of methyl red, 1 drop of potassium chromate indicator ($K_2CrO_4$) was also titrated using 0.05% solution of silver nitrate ($AgNO_3$) till shade was obtained at end point, this was done for the blank titration and for all samples in triplicate.

**2.3.5 Determination of bicarbonate**

**Method:** Magnis method (Omolaoye*et al.,* 2010).

**Procedure:** 50cm$^3$ of each water sample was poured in 150cm$^3$beakers, followed by 1 drop of phenolphthalein indicator in the beakers, after observing the pink color, the solution was titrated using 0.1% sulphuric acid ($H_2SO_4$) till the pink color was observed, 1 drop of methyl orange added, the titration continued without refilling the burette to the end point of methyl red, this was done for the blank titration and for all samples in triplicate.

### 2.3.6 Determination of carbonate ($CO_2$)

**Method:** Magnismethod (Fahad*et al.,* 2015)

**Procedure:** 50cm$^3$ of each water sample were poured in 150cm$^3$ beakers, followed by 1 drop of phenolphthalein indicator after observing the pink color, the solution was titrated using 0.1% sulphuric acid ($H_2SO_4$) till the pink color was observed. This was done for the blank titration and for all samples in triplicate.

### 2.4 Statistical Analysis

Values are presented as mean and Standard deviation and were compared with the maximum allowable limit for heavy metals and physicochemical parameters in water set by World Health Organization (WHO) by Abdulmajid and Mehraban (2014) and Standard organization of Nigeria (SON) by Omolaoye*et al.,* 2010.

## 3.0 Results

Table 1: Levels of heavy metals in well water samples from four different areas of Wamakko Community

| Elements | Sample A | Sample B | Sample C | Sample D | WHO LMT | SON LMT |
|---|---|---|---|---|---|---|
| **Cr (mg/l)** | 0.3280±0.0002 | 0.0470±0.0001 | 0.0193±0.0001 | 0.0371±0.0005 | 0.05 | 0.05 |
| **Cd (mg/l)** | 0.0072±0.0001 | 0.0032±0.0002 | 0.0081±0.0001 | 0.0017±0.00010.050.003 | | |
| **Fe (mg/l)** | 0.3962±0.0002 | 0.5798±0.0001 | 0.8953±0.0002 | 0.4842±0.0002 | 0.3 | 0.3 |
| **Pb (mg/l)** | 0.0402±0.0001 | 0.1809±0.0001 | 0.4081±0.0002 | 0.1944±0.0002 | 0.03 | 0.01 |

Values represents mean±SD of three replicate analysis

**Table 2: Levels of physicochemical parameters of well water samples from four different areas of Wamakko Community**

| Parameter | Sample A | Sample B | Sample C | Sample D | WHO LMT | SON LMT |
|---|---|---|---|---|---|---|
| Temperature($^0$C) | 31±2.10 | 27±2.00 | 31±2.10 | 32±2.00 | - | 25$^0$c |
| PH | 7.0±0.25 | 7.4±0.20 | 7.4±0.15 | 7.2±0.41 | 6.5-9.5 | 6.5-8.5 |
| $Cl^-$(mg/l) | 0.6±0.12 | 2.1±0.03 | 2.5±0.05 | 0.6±0.05 | 250 | 250 |

| | | | | | | |
|---|---|---|---|---|---|---|
| $CO_3$(mg/l) | 0.2±0.03 | 0.4±0.02 | 0.3±0.03 | 0.5±0.02 | 1000 | - |
| $HCO_3$(mg/l) | 1.2±0.03 | 1.4±0.05 | 0.9±0.08 | 1.1±0.08 | 1000 | - |
| TDS(mg/l) | Trace | Trace | 500 | 500 | | |

Values represents mean±SD of three replicate analysis

**4.0 Discussion**

Increasing focus is given to studies on well water due to possible contamination. Results for the heavy metal analysis of these water samples reveals, that Chromium (Cr) concentrations obtained for sample A, B, C and D are below the maximum allowable concentration of WHO and Standard organization of Nigeria (SON) of water quality, while sample A is above the maximum allowable concentration (Table 1). The present study is in line with the study of Lawal and Lohdip (2011). Exposure to high levels of chromium causes lung cancer, respiratory problems and several effects on the body immunity system (Vinuth and Wahaab, 2015).

Cadmium (Cd) concentrations obtained for sample A, B, C and D are below the maximum allowable concentration of WHO where as sample A,B and C are above the maximum allowable concentration of Standard Organization of Nigerian (SON) while sample D is below the maximum allowable concentration of Nigerian standard (0.003mg/L). Exposure to high levels of cadmium can affect or destroy the central nervous system and immune system, additionally may lead to fertility disorder, different types of cancer, severe irritation to stomach leading to vomiting and diarrhea, long term exposure to lower levels of cadmium leads to a build up in the kidneys and possible kidney disease, lung damage and fragile bones (ATSDR, 2010).

Concentrations of iron (Fe) and lead (Pb) for sample A, B, C and D (Table 1) are above the maximum allowable limit set by WHO and SON for drinking water. The study is also in line with the study of (Lawal and Lohdip, 2011). High level of iron can lead to hemochromatosis, which can lead liver and pancreatic damage (Passaic, 2017). Long term exposure of adults to lead (Pb) can results in decreased performance in some test that measure the function of nervous system, weakness in the finger, wrists or ankles, exposure to high level can severely damage the brain, kidney and also affect heme biosynthesis and ultimately causes death, high exposure can also damage the organ responsible for sperm production in men (EPA, 2010). The present study is in line with the study reported by (ATSDR, 2010).

Results of the physico-chemical parameters shows that temperature for samples A,B,C and D obtained are above the Standard Organization of Nigerian (SON). The result of the present study is in line with the study of (Adefemi*et al.,* 2007). Results of pH obtained for samples A,B,C and D fall within the normal range approved by the WHO and the SON standard. This result obtained for pHis also in line with the study of (Adefemi*et al.,* 2007).Results for chloride, carbonate and bicarbonate ionsobtained for samples A, B, C and D are below the maximum allowable concentration of WHO standard and SON standard. Total dissolve solute (TDS) were found in trace amount in all the samples.

**5.0 Conclusion**

Well water from these four areas containhigh levels of iron (Fe) and lead (Pb), which can pose serious health challenges on humans, and they contain recommendable levels of physicochemical parameters investigated, with the exception of temperature. Therefore these areas require awareness and periodic monitoring of well water to avoid possible health complications.

**References**

1. Prasad, P.M.N., Abida, B., Hariskrishna, S. and irfanullah, K..(2011). TIDEE (TERI Information Digest on Energy and Enviroment).*International Journal of Chem Tech Research*, 1(2); 245-249.

2. WHO. (2011). Guideline for Drinking Water Quality (3$^{th}$edu.Incorporating 1$^{st}$ and 2$^{nd}$ Agenda) Vol. 1.Recommendations. Geneva,668.

3.Haloi, N. and Sarma, H.P. (2011).Ground Water Quality Assessment of some parts of Brahmaputra Flood plain in Barpeta district, Assam with special focus on Fluoride, Nitrate, Sulphate and Iron analysis.*Int. J. Chem. Tech*, 3(3); 1302-1308.

4. Reza, R. and Singh, G. (2009).Physico- Chemical Analysis of Ground Water in Angul-Talcher Region of Orissa, India, Marsland Press, *J.Am.Sci*., 5(5):53-58.

5. Abdulmojeed, O. L., and Abdulrahman, A. A. (2011). Analysis of heavy metals found in vegetables from some cultivated irrigated gardens in the Kano metropolis, Nigeria. *Journal of Environmental Chemistry and Ecotoxicology*, 3(6):142-148.

6. Gueguen, M., (2011). Rev, Environ, Contamination of Toxicology. 23-35

7. Reddy, V.K. Prasad, K.L., Swamy, M. and Reddy, R. (2009). Physic-chemical parameters of pakhallake of Warangal district Andhra Pradesh, India. *Journal of Aquatic Biology,* 24:77-80

8.AOAC, (2005). Official method of analysis Association of analytical Chemist. Wash. Dc, 15th ed. 11-14.

9. Sam,(2013). Science Analysis: Determination of Total dissolves Solids (TDS) in water and wastewater. 67-69.

10. Omolaoye J.A., Uzairu A., and Gimba C.E. (2010). Archives of Applied Science Research, 2 (5): 76-84.

11. Fahad, N.A. (2015). Assessment of the Levels of some Heavy Metals in Water in Alahsa Oasis Farms, Saudi Arabia, with Analysis by Atomic Absorption Spectrophotometer. *Arabian Journal of Chemistry*.8 240-245. Available at www.sciencedirect.com

12. Abdolmajid, F. andMehraban, S. (2014). Evaluation and Assessment of Drinking Water Quality in Shahrekord, Iran Resources and Environment, 4(3): 168-172

13. Lawal, R.A and Lohdip, Y.N (2011). Physicochemical and microbial analysis of water from mimyak river in kanke LGA of plateau state Nigeria. *African Journal of Natural Science* 14-5-7

14. Vinut h, Badawy, M.I. and Wahaab, R.A. (2015).Environmental impact of somechemical pollutants on Lake Manzala.International*Journal of Environmental Health Research,* 7: 161-170.

15. ATSDR (Agency for Toxic Substances and Disease Registry), (2010).Toxicological Profile for Cadmium Atlanta, U.S.Dept.of Health and Human Services, Public Health Service.

16. Passaic, G.J. (2017). Accumulation of cadmium in crop plants and its consequences to human health.*Advances in Agronomy*, 51:173–212.

17. EPA, (2010). Enviromental protection Agency, *African Journal of EnviromentalScience*, 7(5) 43-56

18. Adefemi, O. S., Asaolu, S.S. and Olaofe, O. (2007). Assessment of the physicochemical Status of water samples from Major Dams in Ekiti State, Nigeria. *Pak. Nut*. 6(6) 657-659.