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Assessment of Heavy Metals Concentrations in Well Waters in Dakingari Community of Kebbi State, Nigeria

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Abstract:- The research was aimed at carrying out assessment of heavy metals concentrations in well waters in Dakingari community of Kebbi State, Nigeria, was conducted successfully. Ten (10) samples (S1, S2, S3, S4, S5, S6, S7, S8, S9 and S10) from ten (10) different parts of the study area were collected using simple random sampling, in each sample; five (5) elements were investigated and analyzed usingMP-AES, Agilent, with model number: MY 19479002. From the results obtained, the concentration levels of all the elements in all the samples are within the safety limit recommended by both Nigerian Industrial Standard (NIS) and World Health Organization (WHO) and the water is concluded to be safe except for one element (Fe) in six samples (S2, S6, S7, S8, S9 and S10) with the Mean ± SD values of 1.090 ± 0.005, 1.970 ± 0.018, 1.400 ± 0.003, 1.160 ± 0.014, 6.060 ± 0.035 and 1.500 ± 0.027 respectively, which is found to exceed the safety limit recommended by both Nigerian Industrial Standard (NIS) and World Health Organization (WHO). This may not be unconnected to either natural Geological source and/or domestic discharge. Further investigation for other heavy metals is recommended to ascertain the safety of the water people are using in the study area. People of the study area are advised to maintain good environmental hygiene and sanitation, also to covering their wells whenever not in use.

Keywords:- *Heavy metals, Congratulations, Well Waters, Dakingari.*

I. INTRODUCTION

Water remained an essential tool for all living creatures on the surface of the earth. It is used in domestic, industrial and agricultural purposes. As the world population increases, the need for the supply of safe water for drinking, domestic, industrial and agricultural purposes remained crucial. The activities of man have resulted in the contamination and pollution of its natural supply, it is necessary to increase the rate of water development and to ensure its efficient use [1]. Heavy metals are among the water pollutants and therefore a stumbling block to all living creatures as they cannot do without water. Heavy metals occur in the earth's resources such as soil (land), water and air. water being a universal solvent makes it vulnerable to contamination and polluted water is not suitable for use in all ramifications [2]. The importance of water in our daily living makes its thorough examinations necessary before consumption. As a result of the increasing demand for water and shortage of geological structures, and can therefore enter water resources through natural processes. For example, heavy rains or flowing water can leach heavy metals out of geological formations [3].

Metals are elements that exist in chemical compounds as positive ions, or in the form of cat-ions (+ ions) in solution. Metallic elements with high atomic weight and density much greater (at least 5 times) than water are known as heavy metals. The term ''heavy metal'' refers to any metal and metalloid element that has a relatively high density ranging from 3.5 to 7 g cm^{-3} and is toxic or poisonous at low concentrations, and includes mercury (Hg), cadmium (Cd), arsenic (As), chromium (Cr), thallium (Tl), zinc (Zn), nickel (Ni), copper (Cu) and lead (Pb) [4]. Heavy metals are members of a loosely defined sub set of element that exhibit metallic properties. It mainly includes the transition metals, some metalloids, lanthanides and actinides. They are mostly defined based on their densities, atomic numbers or atomic weights and their chemical properties or toxicity. Their toxicity gives them an alternative term toxic metals. Heavy metals occur naturally in the ecosystem with large variations in concentration.

In Nigeria, the major sources of heavy metals pollution are industrial discharged substances from various processing industries. Human activities such as metal processing, oil exploration, mining and agriculture have contributed to water pollution. This increases the influx of metals, which can be transported by wind and water and thus become available to plants, animals and even human. These heavy metals attain higher concentrations and accumulate in dangerous quantity in plants and soils and finally pose serious health hazards to human beings and the animals [5]. Their multiple industrial, domestic, agricultural, medical and technological applications have led to their wide distribution in the environment; raising concerns over their potential effects on human health and the environment.

Their toxicity depends on several factors including the dose, route of exposure, and chemical species, as well as the age, gender, genetics, and nutritional status of exposed individuals. Because of their high degree of toxicity, arsenic, cadmium, chromium, lead, and mercury rank among the priority metals that are of public health significance. The rapid development of these industries particularly chemical industries along with the discharge of a variety of industrial and urban wastewaters into the environment cause the contamination of surface and groundwater resources and hence pose several environmental problems [6]. Generally, humans are exposed to heavy metals by ingestion (drinking or eating) or inhalation (breathing). Working in or living near an industrial site which utilizes these heavy metals and their compounds increases ones risk of exposure, as does living near a site where these metals have been improperly disposed. Subsistence lifestyles can also impose higher risks of exposure and health impacts because of hunting and gathering activities.

Most environmental contamination and human exposure result from anthropogenic activities of human such as mining and smelting operations, industrial production, domestic and agricultural use of metals and metal-containing compounds [7]. A recent review of a number of individual studies that addressed metals interactions reported that co-exposure to metal/metalloid mixtures of arsenic, lead and cadmium results to more severe effects at both relatively high and low dose levels in a biomarker-specific manner. These effects were found to be mediated by dose, duration of exposure and genetic factors [8]. Arsenic as one of the heavy metals is found in paints, dyes, metals, drugs, soaps and semi-conductors. Animal feeding operations and certain fertilizers and pesticides can also release high amounts of arsenic to the environment. Heavy metals like arsenic, lead, mercury, barium, silver and cadmium can cause cancer of the skin, lungs, liver and bladder and low level exposure of arsenic and selenium can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of “pins and needles” in hands and feet [9].

There are about thirty chemical elements that play a vital role in various biochemical and physiological mechanisms in living organisms, and are recognized as essential elements for life. In fact, for many food components, the intake of metal ions can be a double edged sword. However majority of the known metals and metalloids are very toxic to living organisms including those considered as essential if present in excess [10]. Concentrations of these toxic metals and metalloids have been largely increased as a result of human activities. These toxic metals can affect some important biochemical processes in humans and thereby becoming a threat for the health of the humans. Humans, animals and plants can absorb these elements from soils, sediments, and water by direct contact with their external surfaces, through ingestion and also from inhalation of airborne particles and vaporized metals. The metals forms an essential aspects of human food thus for instance the requirement for ingestion of Fe and Cu ions to maintain normal body functions such as the synthesis of metallo-proteins is well established [7].

However, cases of excess intake of these trace metal ions are credited with pathological events. In addition to aiding neurological depositions, these redox active metals ions have been credited with enhancing oxidative damage, a key component of chronic inflammatory disease and a suggested initiator of cancer. As inflammation is a characteristic feature of a wide range of diseases, further potential pathological roles for metal ions are emerging as exemplified by premature ageing [9]. Water remains an essential component of life for without it no creature will continue breathing on earth. There is a scientific saying that “Earth is the only planet in this universe where life is possible because of the availability of water and oxygen”. As humans we need clean water for consumption and other domestic activities. These heavy metals daily distributed in our environment as a result of human activities majorly affects the cleanness of the water we use particularly in rural areas where the inhabitants use well or river water for drinking and other domestic activities. Poverty, lack of awareness and government’s inability to provide clean water are the contributing factors for using contaminated water as drinking water.

Majority of the people in rural areas such as Dakingari are consuming contaminated water out of knowledge. Such people might be suffering from different diseases without knowing the source. This research will be of benefit to the community by providing information regarding the water they take. It can be included in the existing literatures and therefore an additional knowledge. The results of the research will also give the community, Kebbi State Government, Federal and State Ministries of health, NGOs and other stakeholders, academic researchers and insight of the level of contamination of well water by heavy metals within the community.

The need for clean water for human consumption cannot be overemphasized and its pollution remained a great challenge. As a result of the increasing demand for water and shortage of its supply, it is necessary to look into ways of its adequate supply and quality. Heavy metals are among the pollutants of water and they occur as a result of human activities. Metal ions such as iron, copper and some other heavy metals are among the key nutrients that must be provided by dietary sources but nevertheless have some negative effects on human health due to their toxicity. This research is aimed at determining the level of these heavy metals in well waters consumed by Dakingari community of Kebbi State, Nigeria. And recommend possible ways of overcoming the challenges.

Plate 1: Pictures of some of the hand dug wells in the study area

II. MATERIALS AND METHOD

A. STUDY AREA

Dakingari town in Suru Local Government Area of Kebbi State Nigeria is the study area (Figure 1). Dakingari town falls within latitude 11^{0}38'53" N and longitude 4^{0}3'42"E of the globe. The area has flat topography with few elevated areas and is the headquarters of Suru Local Government, people of Dakingari are mostly farmers and one of their water sources for drinking and other domestic activities include open dug well. Suru Local Governmentis one of the twenty one (21) Local Government Areas of Kebbi State, Nigeria. It was created in 1991 out of Bunza Local Government Area. The major ethnic groups include Fulani, Hausa and Zarma with scattered small villages around the Local Government Area.

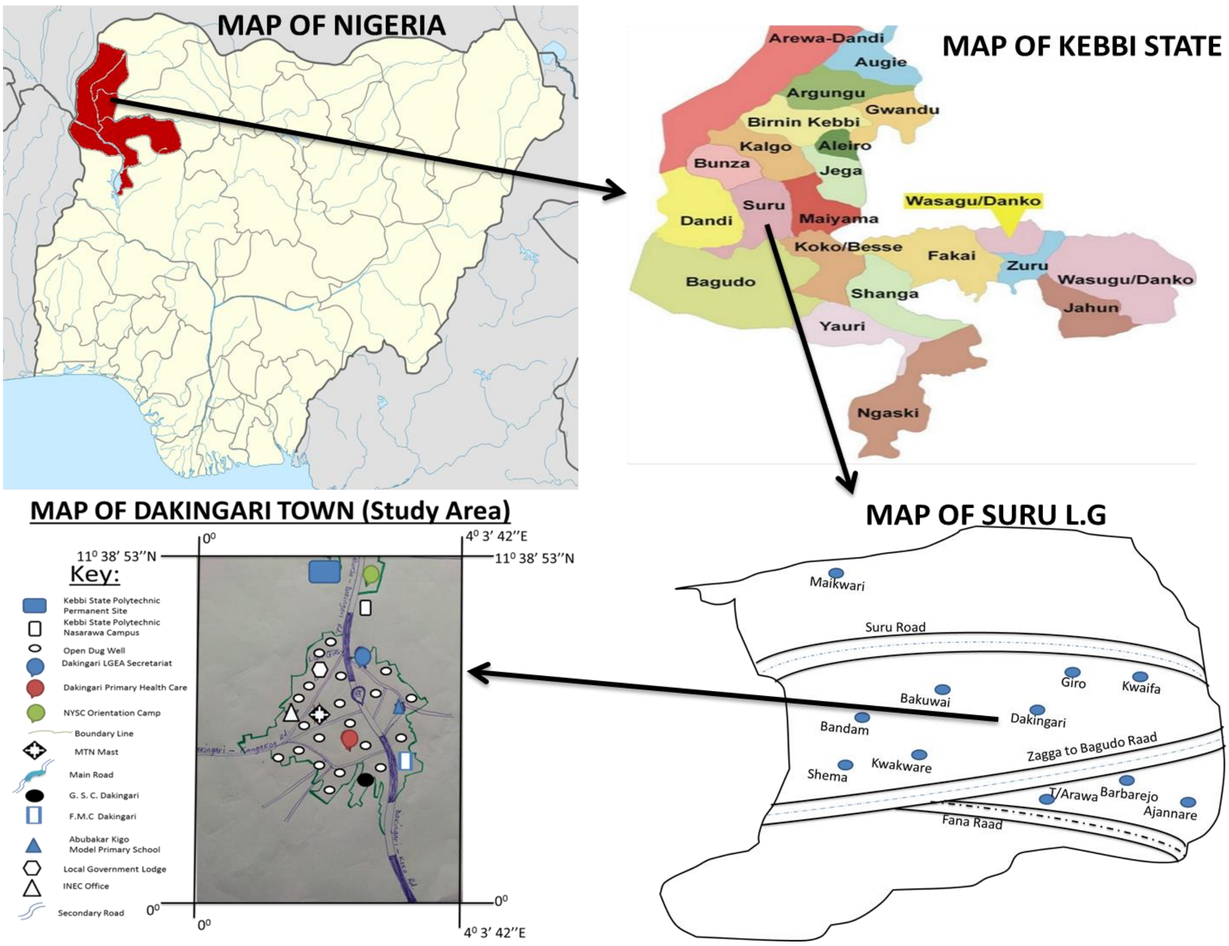

Plate 2: Maps

B. SAMPLING

Dakingari town was divided into ten (10) major segments considering the spread of the wells namely 1. Sabon Birni, 2. Bundu Bago, 3. Otoke, 4. Millonaires Quarters, 5. Secretariat, 6. Nasarawa, 7. Habe, 8. Roundabout, 9. Fada and 10. Nomare. In each area, one (1) open dug well was selected at random and 1 liter water samples were collected in a clean dried polyethylene bottles and was labeled. Samples from the wells were obtained by direct immersion of plastic containers into the well handled by 10 m rope and the fetched water was poured immediately into the plastic sample containers. Finally, all the collected samples from the study area were labeled S1, S2, S3, S4, S5, S6, S7, S8, S9 and S10 respectively. The bottles were immediately acidified with 1 ml Nitric acid, for later analysis of metal concentrations, the purpose of which was to keep the metals in solution and to avoid adsorption to the container walls.

C. SAMPLE DIGESTION

To the sample, 5 mL of 65 % HNO_3 was added, and then the mixture was boiled gently over a water bath (90 °C) for 2 hrs when a clear solution was obtained. Later, 2.5 mL of 65 % HNO_3 was added, followed by further heating until total digestion [11]. The concentrations of heavy metals were determined usingMP-AES, Agilent with model number MY 19479002 at Usmanu Danfodiyo University Research Laboratory, Sokoto, Sokoto State, Nigeria.

III. RESULT AND DISCUSSION

Elements	Mean Conc. (ppm)	Mean ± SD	Nigerian Industrial Standard (ppm) [12].	World Health Organization Standard (ppm) [13].
Zn	0.030	0.030 0 ± 0.003	3.000	3.000
Fe	0.100	0.100 ± 0.001	0.300	0.300
Cu	0.020	0.020 ± 0.000	1.000	2.000
Ni	0.000	0.000 ± 0.000	0.020	0.020
Pb	0.010	0.010 ± 0.001	0.010	0.010

Table 1: Level of Heavy Metals in Sabon Birni water Sample(S1)

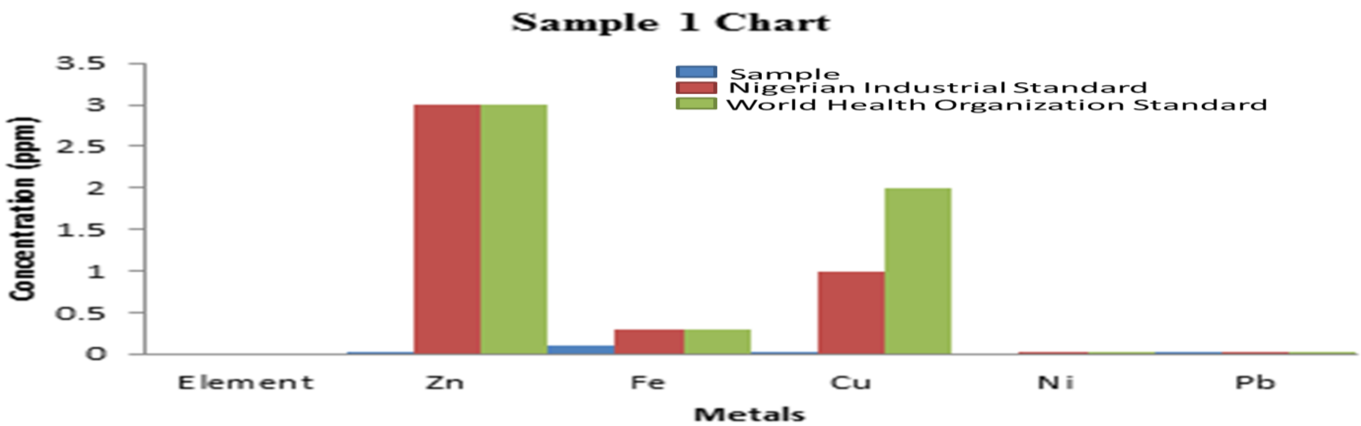

Fig 1: Mean concentration of Heavy Metals in Sabon Birni water Sample(S1), Nigerian Industrial Standard and World Health Organization Standard

Table 1 Shows the different concentrations of the heavy metals in Sabon Birni water sample (S1) of the present study and compared to that of regulatory bodies' permissible limits, Nigerian Industrial Standard (NIS) and World Health Organization (WHO). It is however indicated that none of the elements in sample one (S1) exceeded permissible limits of both NIS and WHO. All fall below the maximum limits which rendered it safe. Element with the highest value happen to be Iron (Fe) with the Mean ± SD value of 0.100 ± 0.001and the element with the lowest value is Lead Pb with the Mean ± SD of 0.010 ± 0.001. Nickel is absent in the sample. The result is similar to that obtained by Beyene & Berhe (2015) where he studied level of heavy metals in potable water in two areas; Dawhan town and Erope area where he obtained mean concentrations of 0.01 and 0.01 for Iron (Fe) respectively, also obtained 0.02 and 0.01 for Cupper (Cu) as well as 0.03 and 0.01 for Zinc (Zn). All fall below the maximum limits set by the World Health Organization with no trace of Nickel (Ni). [13]

Mean Conc. (ppm)	Mean ± SD	Elements	Nigerian Industrial Standard (ppm) [12].	World Health Organization Standard (ppm) [13].
0.030	0.030 ± 0.001	**Zn**	3.000	3.000
1.090	1.090 ± 0.005	**Fe**	0.300	0.300
0.010	0.010 ± 0.000	**Cu**	1.000	2.000
0.000	0.000 ± 0.000	**Ni**	0.020	0.020
0.010	0.010 ± 0.000	**Pb**	0.010	0.010

Table 2: Level of Heavy Metals in Bundu Bago water Sample (S2)

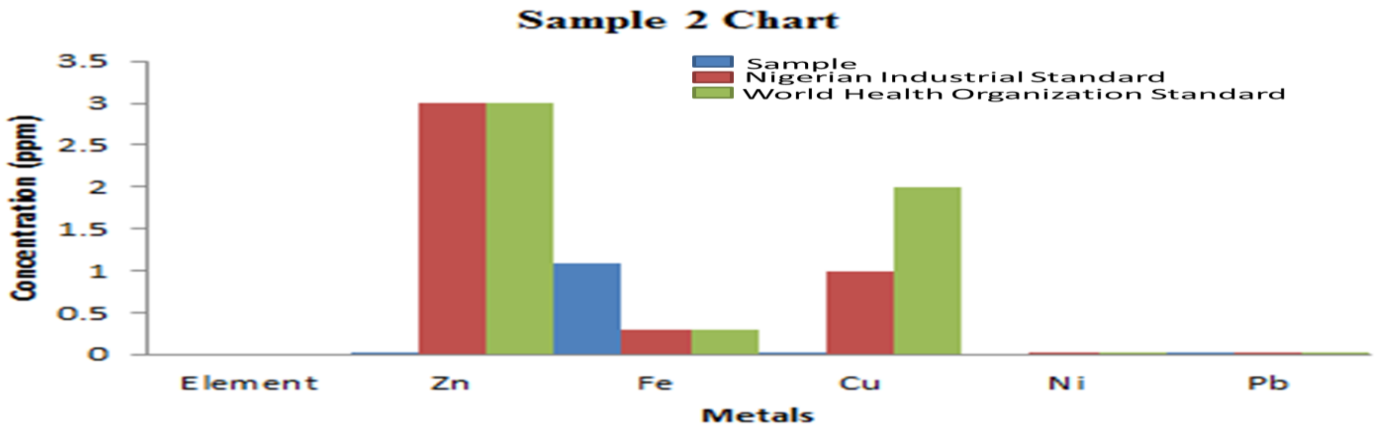

Fig 2: Mean concentration of Heavy Metals in Bundu Bago water Sample(S2), Nigerian Industrial Standard and World Health Organisation Standard

From table 2, with the exception of Iron (Fe) having the Mean ± SD of 1.090 ± 0.005 in Bundu Bago water sample (S2) of the present study, other metals in the sample are below the regulatory bodies' permissible limits, Nigerian Industrial Standard (NIS) and World Health Organization (WHO). This is similar to result obtained by Nazir et al., (2015), where 13 water sample were analyzed and all the 13 samples were found to exceed permissible limits of the World Health Organization (WHO), with the least of all the 13 values for Iron (Fe) been 1.711±0.31, Nickel is also not detected in most of the water samples [14]. Nickel is also not detected in this sample.

The high concentration of Iron in the sample can be due to either natural Geologicalsource and/or domestic discharge. The excess amount of Iron can cause staining in clothes and impart a bad taste. Too much amount of Iron (more than 10mg/kg) can cause rapid increase in pulse rate and coagulation of blood vessels [14].

Elements	Mean Conc. (ppm)	Mean ± SD	Nigerian Industrial Standard (ppm) [12].	World Health Organization Standard (ppm) [13].
Zn	0.040	0.040 ± 0.001	3.000	3.000
Fe	0.100	0.100 ± 0.001	0.300	0.300
Cu	0.040	0.040 ± 0.000	1.000	2.000
Ni	0.010	0.010 ± 0.000	0.020	0.020
Pb	0.020	0.020 ± 0.003	0.010	0.010

Table 3: Level of Heavy Metals in Otoke water Sample (S3)

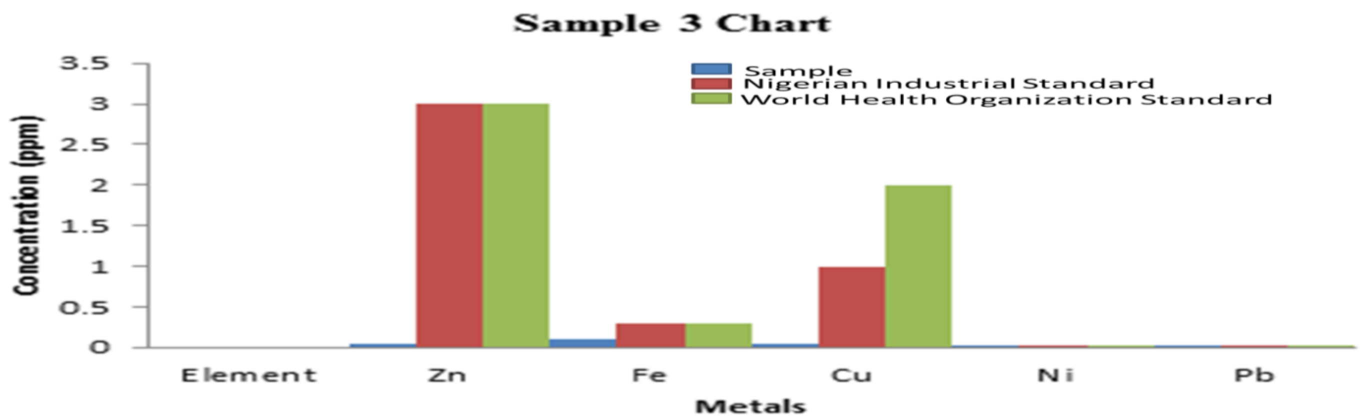

Fig. 3: Mean concentration of Heavy Metals in Otoke water Sample(S3), Nigerian Industrial Standard and World Health Organisation Standard

Table 3 Shows the different concentrations of the heavy metals in Otoke water sample (S3) of the present study and compared to that of regulatory bodies' permissible limits, Nigerian Industrial Standard (NIS) and World Health Organization (WHO). It is however indicated that none of the elements in sample one (S3) exceeded permissible limits of both NIS and WHO. All fall below the maximum limits. Element with the highest value happen to be Iron (Fe) with the Mean ± SD of 0.100 ± 0.000.The result is similar to that obtained by Beyene & Berhe (2015) where he studied level of heavy metals in potable water in two areas; Dawhan town and Erope area where he obtained mean concentrations of 0.01 and 0.01 for Iron (Fe) respectively, also obtained 0.02 and 0.01 for Cupper (Cu) as well as 0.03 and 0.01 for Zinc

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(Zn). All fall below the maximum limits set by the World Health Organization with no trace of Nickel (Ni). [13]

Elements	Mean Conc. (ppm)	Mean ± SD	Nigerian Industrial Standard (ppm) [12].	World Health Organization Standard (ppm) [13].
Zn	0.070	0.070 ± 0.002	3.000	3.000
Fe	0.090	0.090 ± 0.001	0.300	0.300
Cu	0.050	0.050 ± 0.001	1.000	2.000
Ni	0.000	0.000 ± 0.000	0.020	0.020
Pb	0.010	0.010 ± 0.001	0.010	0.010

Table 4: Level of Heavy Metals in Millonaires Quarters water Sample(S4)

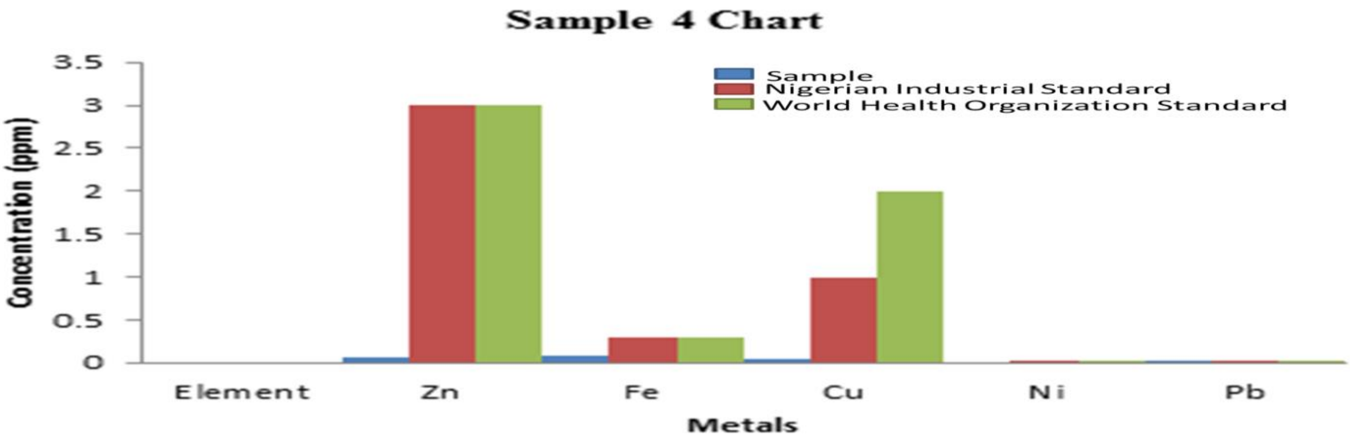

Fig. 4: Mean concentration of Heavy Metals in Millonaires Quarters water Sample(S4), Nigerian Industrial Standard and World Health Organization Standard

Table 4 Shows the different concentrations of the heavy metals in Millonaires Quarters water sample (S4) of the present study and compared to that of regulatory bodies' permissible limits, Nigerian Industrial Standard (NIS) and World Health Organization (WHO). It is however indicated that none of the elements in sample one (S1) exceeded permissible limits of both NIS and WHO. All fall below the maximum limits. Element with the highest value happen to be Iron (Fe) with the Mean ± SD of 0.090 ± 0.001, and the element with the lowest value happen to be Pb with the Mean ± SD of 0.010 ± 0.001.The result is similar to that obtained by Beyene & Berhe (2015) where he studied level of heavy metals in potable water in two areas; Dawhan town and Erope area where he obtained mean concentrations of 0.01 and 0.01 for Iron (Fe) respectively, also obtained 0.02 and 0.01 for Cupper (Cu) as well as 0.03 and 0.01 for Zinc (Zn). All fall below the maximum limits set by the World Health Organization with no trace of Nickel (Ni)[13].

Elements	Mean Conc. (ppm)	Mean ± SD	Nigerian Industrial Standard (ppm) [12].	World Health Organization Standard (ppm) [13].
Zn	0.020	0.020 ± 0.004	3.000	3.000
Fe	0.070	0.070 ± 0.002	0.300	0.300
Cu	0.010	0.010 ± 0.000	1.000	2.000
Ni	0.000	0.000 ± 0.000	0.020	0.020
Pb	0.020	0.020 ± 0.001	0.010	0.010

Table 5: Level of Heavy Metals in Secretariat water Sample(S5)

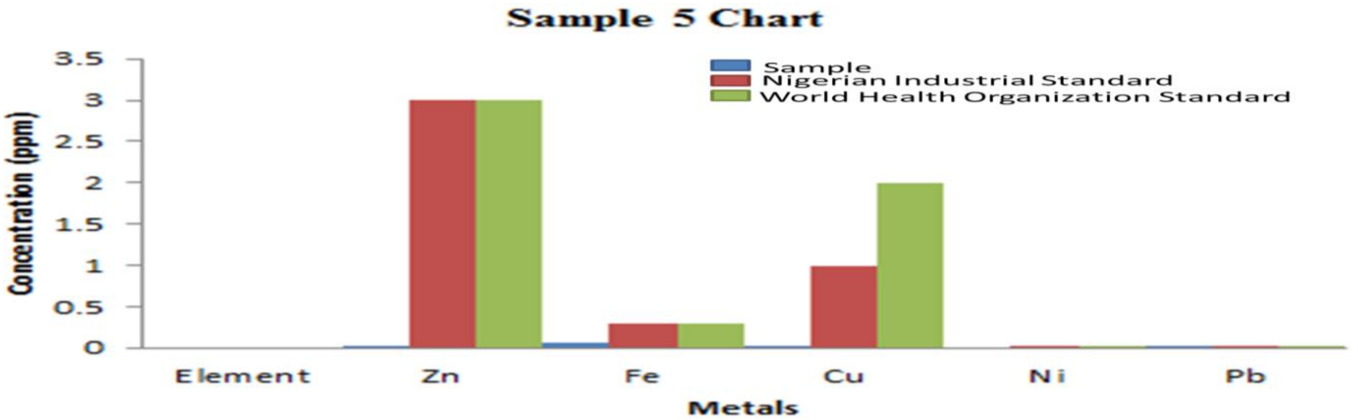

Fig. 5: Mean concentration of Heavy Metals in Secretariat water Sample(S5), Nigerian Industrial Standard and World Health Organization Standard

Table 5 Shows the different concentrations of the heavy metals in Secretariat water sample (S5) of the present study and compared to that of regulatory bodies' permissible limits, Nigerian Industrial Standard (NIS) and World Health Organization (WHO). It is however indicated that none of the elements in sample (S5) exceeded permissible limits of both NIS and WHO. All fall below the maximum limits. Element with the highest value happen to be Iron (Fe) with the Mean ± SD of 0.070 ± 0.001, and the element with the lowest value happen to be Cu with the Mean ± SD of 0.010 ± 0.001.The result is similar to that obtained by Beyene & Berhe (2015) where he studied level of heavy metals in potable water in two areas; Dawhan town and Erope area where he obtained mean concentrations of 0.01 and 0.01 for Iron (Fe) respectively, also obtained 0.02 and 0.01 for Cupper (Cu) as well as 0.03 and 0.01 for Zinc (Zn). All fall below the maximum limits set by the World Health Organization with no trace of Nickel (Ni)[13].

Elements	**Mean Conc. (ppm)**	**Mean ± SD**	**Nigerian Industrial Standard (ppm)** [12]**.**	**World Health Organization Standard (ppm)** [13]**.**
Zn	0.020	0.020 ± 0.004	3.000	3.000
Fe	1.970	1.970 ± 0.018	0.300	0.300
Cu	0.010	0.010 ± 0.001	1.000	2.000
Ni	0.000	0.000 ± 0.000	0.020	0.020
Pb	0.010	0.010 ± 0.002	0.010	0.010

Table 6: Level of Heavy Metals in Nasarawa water Sample(S6)

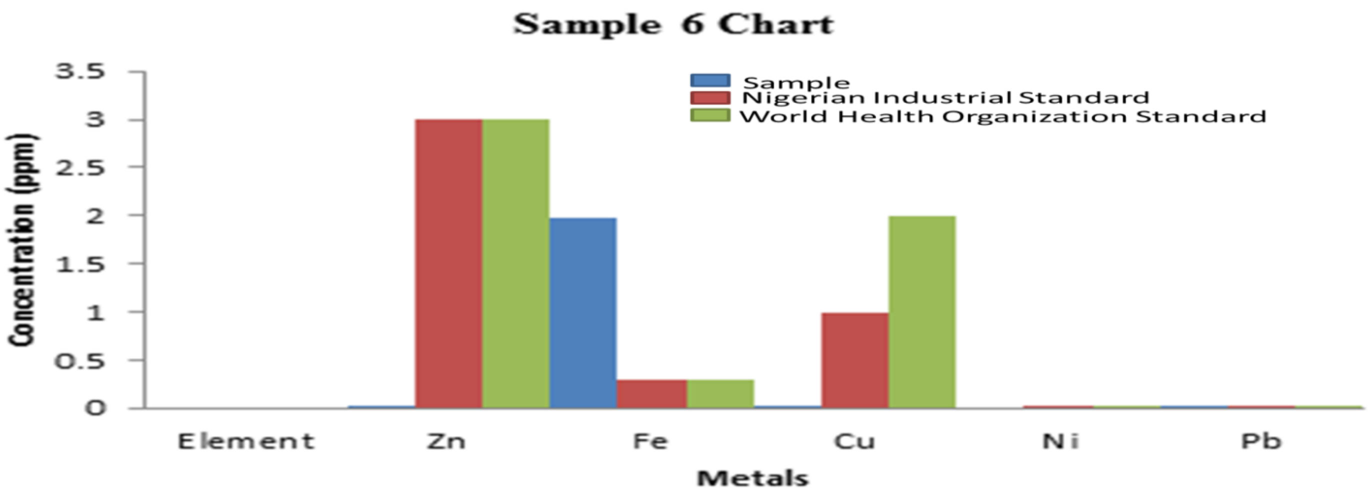

Fig. 6: Mean concentration of Heavy Metals in Nasarawa water Sample(S6), Nigerian Industrial Standard and World Health Organization Standard

Table 6 also shows that; with the exception of Iron (Fe) having the Mean ± SD of 1.970 ± 0.018in Nasarawa water sample (S2) of the present study, other metals in the sample are below the regulatory bodies' permissible limits, Nigerian Industrial Standard (NIS) and World Health Organization (WHO). This is similar to result obtained by Nazir et al., (2015), where 13 water sample were analyzed and all the 13 samples were found to exceed permissible limits of the World Health Organization (WHO), with the least of all the 13 values for Iron (Fe) been 1.711±0.31, Nickel is also not detected in most of the water samples [14]. Nickel is also not detected in this sample.

Elements	Mean Conc. (ppm)	Mean ± SD	Nigerian Industrial Standard (ppm) [12].	World Health Organization Standard (ppm) [13].
Zn	0.010	0.010 ± 0.001	3.000	3.000
Fe	1.400	1.400 ± 0.003	0.300	0.300
Cu	0.010	0.010 ± 0.000	1.000	2.000
Ni	0.000	0.000 ± 0.000	0.020	0.020
Pb	0.010	0.010 ± 0.001	0.010	0.010

Table 7: Level of Heavy Metals in Habe water Sample(S7)

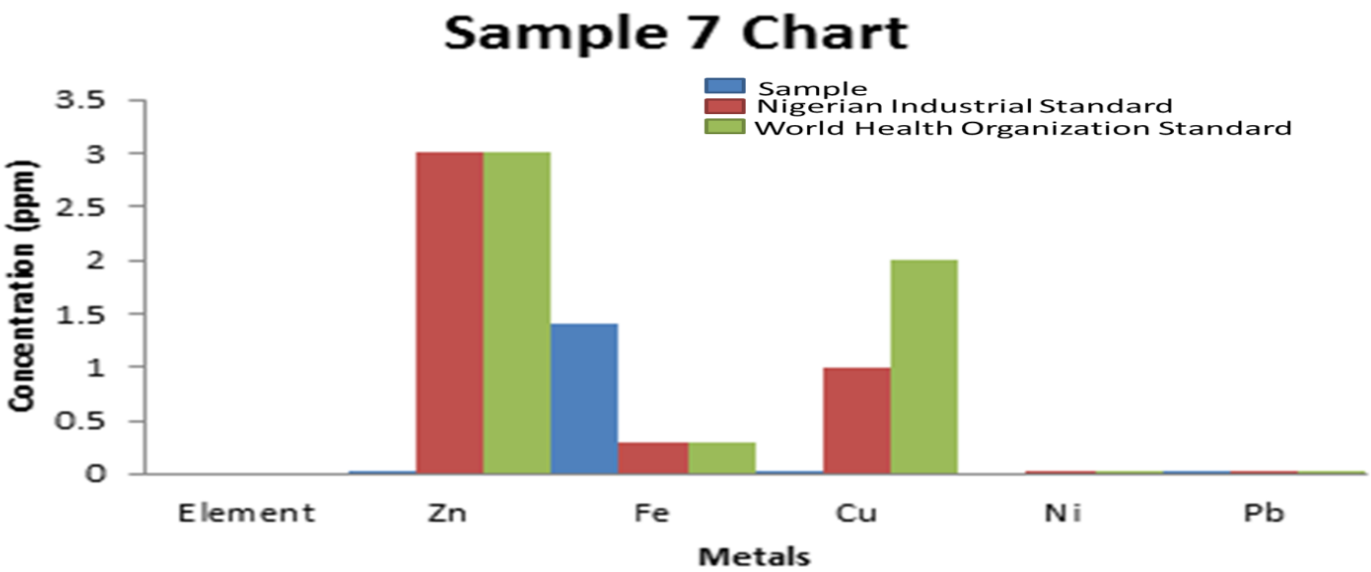

Fig. 7: Mean concentration of Heavy Metals in Habe water Sample(S7), Nigerian Industrial Standard and World Health Organization Standard

Table 7 also indicated that; with the exception of Iron (Fe) having the Mean ± SD of 1.400 ± 0.003in Habe water sample (S7) of the present study, other metals in the sample are below the regulatory bodies' permissible limits, Nigerian Industrial Standard (NIS) and World Health Organization (WHO). This is similar to result obtained by Nazir et al., (2015), where 13 water sample were analyzed and all the 13 samples were found to exceed permissible limits of the World Health Organization (WHO), with the least of all the 13 values for Iron (Fe) been 1.711±0.31, Nickel is also not detected in most of the water samples [14]. Nickel is also not detected in this sample.

Elements	Mean Conc. (ppm)	Mean ± SD	Nigerian Industrial Standard (ppm) [12].	World Health Organization Standard (ppm) [13].
Zn	0.050	0.050 ± 0.004	3.000	3.000
Fe	1.160	1.160 ± 0.014	0.300	0.300
Cu	0.020	0.020 ± 0.000	1.000	2.000
Ni	0.000	0.000 ± 0.000	0.020	0.020
Pb	0.090	0.090 ± 0.001	0.010	0.010

Table 8: Level of Heavy Metals in Roundabout water Sample(S8)

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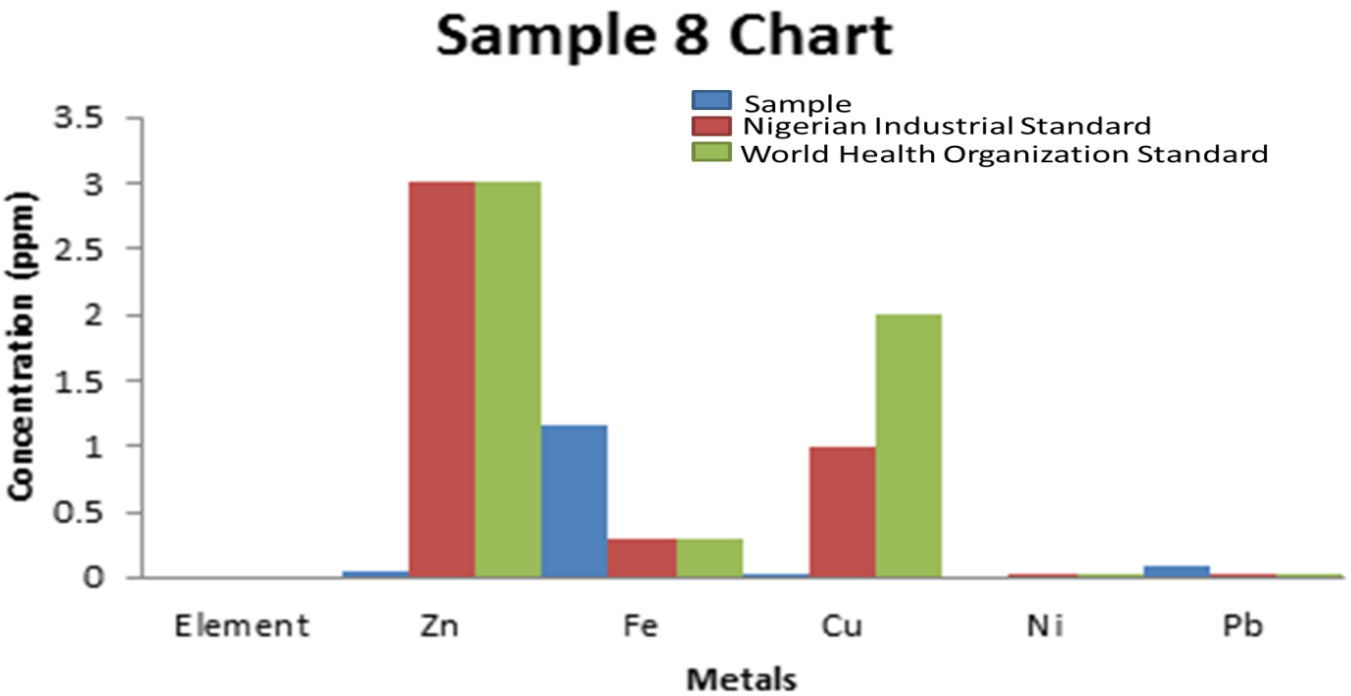

Fig. 8: Mean concentration of Heavy Metals in Roundabout water Sample(S8), Nigerian Industrial Standard and World Health Organization Standard

From table 8, it is indicated that; with the exception of Iron (Fe) having the Mean ± SD of 1.160 ± 0.014in Roundabout water sample (S8) of the present study, other metals in the sample are below the regulatory bodies' permissible limits, Nigerian Industrial Standard (NIS) and World Health Organization (WHO). This is similar to result obtained by Nazir et al., (2015), where 13 water sample were analyzed and all the 13 samples were found to exceed permissible limits of the World Health Organization (WHO), with the least of all the 13 values for Iron (Fe) been 1.711±0.31, Nickel is also not detected in most of the water samples [14]. Nickel is also not detected in this sample.

Elements	Mean Conc. (ppm)	Mean ± SD	Nigerian Industrial Standard (ppm) [12].	World Health Organization Standard (ppm) [13].
Zn	0.030	0.030 ± 0.001	3.000	3.000
Fe	6.060	6.060 ± 0.035	0.300	0.300
Cu	0.010	0.010 ± 0.000	1.000	2.000
Ni	0.000	0.000 ± 0.000	0.020	0.020
Pb	0.010	0.010 ± 0.001	0.010	0.010

Table 9: Level of Heavy Metals in Fada water Sample(S9)

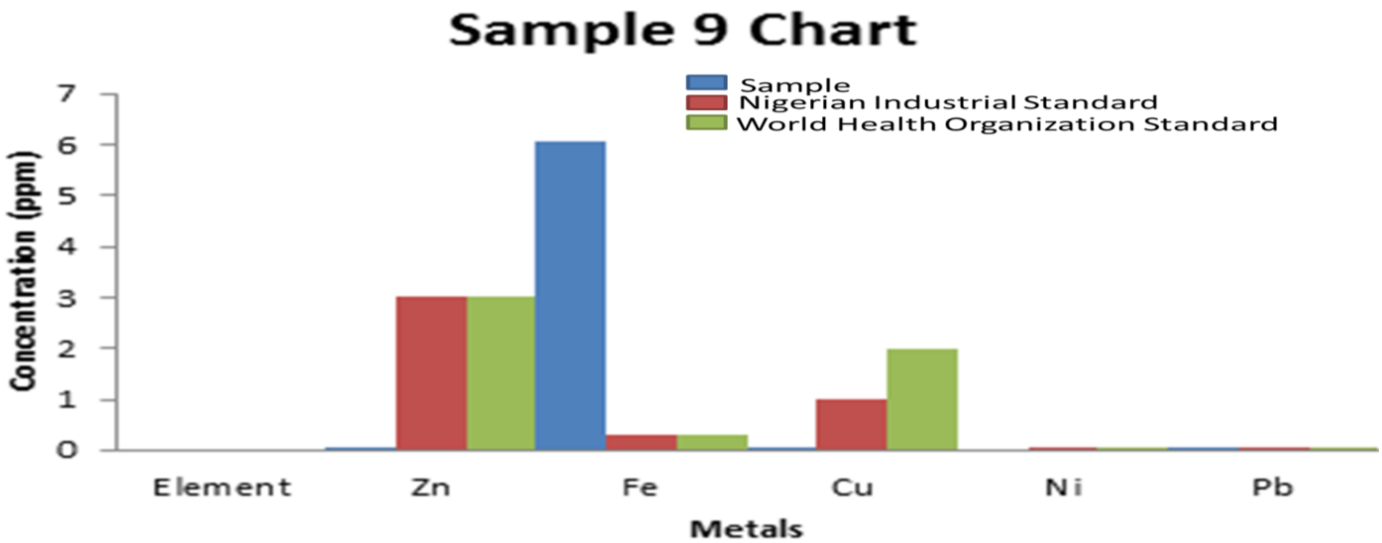

Fig. 9: Mean concentration of Heavy Metals in Fada water Sample(S9), Nigerian Industrial Standard and World Health Organization Standard

Table 8 also indicated that; with the exception of Iron (Fe) having the Mean ± SD of 6.060 ± 0.035in Fada water sample (S9) of the present study, other metals in the sample are below the regulatory bodies' permissible limits, Nigerian Industrial Standard (NIS) and World Health Organization (WHO). This is similar to result obtained by Nazir et al., (2015), where 13 water sample were analyzed and all the 13 samples were found to exceed permissible limits of the World Health Organization (WHO), with the least of all the 13 values for Iron (Fe) been 1.711±0.31, Nickel is also not detected in most of the water samples [14]. Nickel is also not detected in this sample. The high concentration of Iron in the sample can be due to either natural Geologicalsource and/or domestic discharge as earlier stated. The excess amount of Iron can cause staining in clothes and impart a bad taste. Too much amount of Iron (more than 10mg/kg) can cause rapid increase in pulse rate and coagulation of blood vessels [14].

Elements	**Mean Conc. (ppm)**	**Mean ± SD**	**Nigerian Industrial Standard (ppm)** [12].	**World Health Organization Standard (ppm)** [13].
Zn	0.010	0.010 ± 0.002	3.000	3.000
Fe	1.500	1.500 ± 0.027	0.300	0.300
Cu	0.010	0.010 ± 0.000	1.000	2.000
Ni	0.000	0.000 ± 0.000	0.020	0.020
Pb	0.010	0.010 ± 0.002	0.010	0.010

Table 10: Level of Heavy Metals in Nomare water Sample(S10)

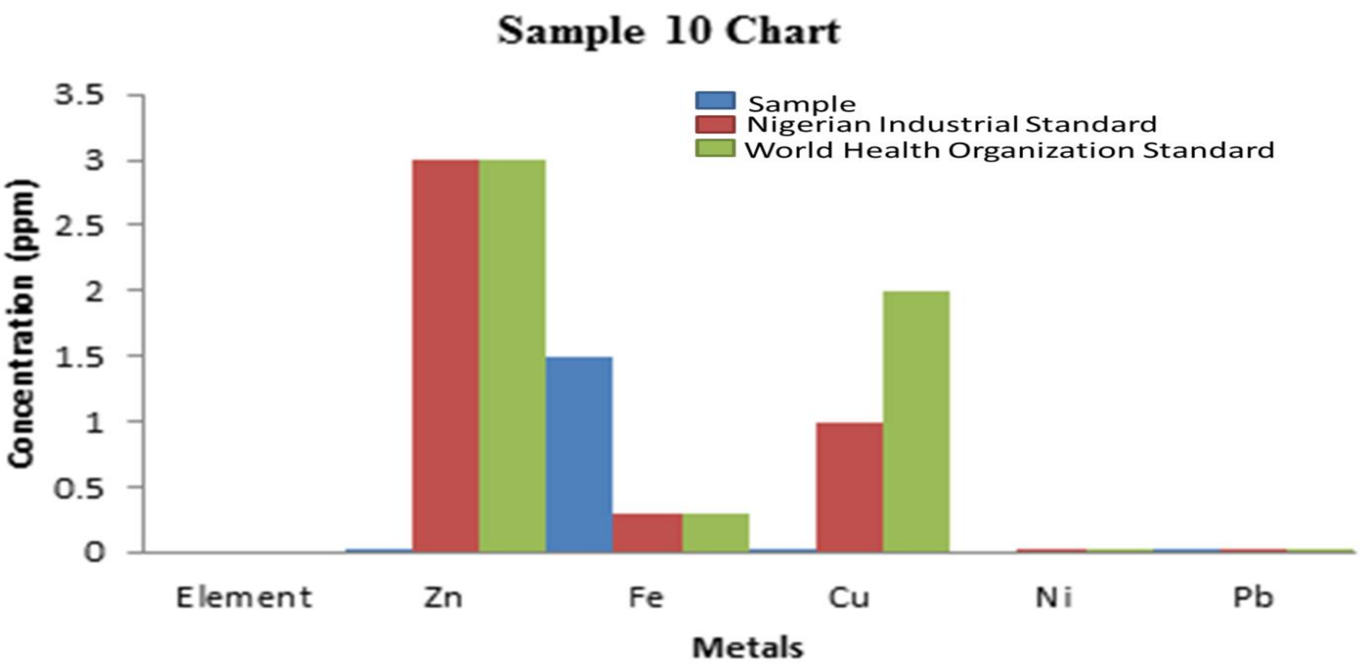

Fig. 10: Mean concentration of Heavy Metals in Nomare water Sample(S10), Nigerian Industrial Standard and World Health Organization Standard.

From table 10, it is indicated that; with the exception of Iron (Fe) having the Mean ± SD of 1.500 ± 0.027in Nomare water sample (S10) of the present study, other metals in the sample are below the regulatory bodies' permissible limits, Nigerian Industrial Standard (NIS) and World Health Organization (WHO). This is similar to result obtained by Nazir et al., (2015), where 13 water sample were analyzed and all the 13 samples were found to exceed permissible limits of the World Health Organization (WHO), with the least of all the 13 values for Iron (Fe) been 1.711±0.31, Nickel is also not detected in most of the water samples [14]. Nickel is also not detected in this sample.

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Sampling Points	Zn		Fe		Cu		Ni		Pb	
	Mean Conc. (ppm)	Mean ± SD	Mean Conc. (ppm)	Mean ± SD	Mean Conc. (ppm)	Mean ± SD	Mean Conc. (ppm)	Mean ± SD	Mean Conc. (ppm)	Mean ± SD
S 1	0.03 0	0.030 0 ± 0.003	0.100	0.100 ± 0.001	0.020	0.020 ± 0.000	0.000	0.000 ± 0.000	0.010	0.010 ± 0.001
S 2	0.030	0.030 ± 0.001	1.090	1.090 ± 0.005	0.010	0.010 ± 0.000	0.000	0.000 ± 0.000	0.010	0.010 ± 0.000
S 3	0.040	0.040 ± 0.001	0.100	0.100 ± 0.001	0.040	0.040 ± 0.000	0.010	0.010 ± 0.000	0.020	0.020 ± 0.003
S 4	0.070	0.070 ± 0.002	0.090	0.090 ± 0.001	0.050	0.050 ± 0.001	0.000	0.000 ± 0.000	0.010	0.010 ± 0.001
S 5	0.020	0.020 ± 0.004	0.070	0.070 ± 0.002	0.010	0.010 ± 0.000	0.000	0.000 ± 0.000	0.020	0.020 ± 0.001
S 6	0.020	0.020 ± 0.004	1.970	1.970 ± 0.018	0.010	0.010 ± 0.001	0.000	0.000 ± 0.000	0.010	0.010 ± 0.002
S 7	0.010	0.010 ± 0.001	1.400	1.400 ± 0.003	0.010	0.010 ± 0.000	0.000	0.000 ± 0.000	0.010	0.010 ± 0.001
S 8	0.050	0.050 ± 0.004	1.160	1.160 ± 0.014	0.020	0.020 ± 0.000	0.000	0.000 ± 0.000	0.090	0.090 ± 0.001
S 9	0.030	0.030 ± 0.001	6.060	6.o60 ± 0.035	0.010	0.010 ± 0.000	0.000	0.000 ± 0.000	0.010	0.010 ± 0.001
S 10	0.010	0.010 ± 0.002	1.500	1.500 ± 0.027	0.010	0.010 ± 0.000	0.000	0.000 ± 0.000	0.010	0.010 ± 0.002

Table 11: Showing Level of all the Heavy Metals in all the samples

IV. CONCLUSION

The research aimed at carrying out assessment of heavy metals concentrations in well waters in Dakingari community of Kebbi State, Nigeria, was conducted successfully. Ten (10) samples from ten (10) areas were collected and in each sample five (5) elements were investigated and analyzed. From the results obtained, the concentration levels of all the elements in all the samples are within the safety limit recommended by both Nigerian Industrial Standard (NIS) and World Health Organization (WHO) except for one element (Fe) in six samples (S2, S6, S7, S8, S9 and S10), where Iron (Fe) is found to exceed the safety limit recommended by both Nigerian Industrial Standard (NIS) and World Health Organization (WHO) which may not be unconnected to either natural Geologicalsource and/or domestic discharge. Further investigation for other heavy metals is recommended to ascertain the safety of the water people are using in the study area. People of the study area are advised to maintain good environmental hygiene and sanitation, also to covering their wells whenever not in use.

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