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ASSESSMENT OF HEAVY METALS FROM DIFFERENT SOURCES OF WATER IN ZONE C OF YOBE STATE

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ABSTRACT

Water is one of the most important and most precious natural resources, it is essential in the life of all living organisms, plant and microorganisms. It is significant due to its unique chemical and physical properties. Access to safe drinking water is a key to a sustainable development, quality health and essential to food production. Within the scope of this research water sample (Tap, handpump & well water) were collected for assessing the heavy metal content, from the seven Local Government area of zone C of Yobe state, Nigeria. The elemental parameters, Copper, Cobalt, Nikel, Cadmium Arsenic and Lead were examined using Atomic Absorption spectrophotometer (AAS). The result obtained were compared with the standard values as given by WHO and NAFDAC. The result obtained for the heavy metels, shows the concentration of Copper are within the limit in all the samples within the zone, for Ni, As and Cd are within the limit and above in Cobalt and Lead in two Local Governments i.e Karasuwa and Yusufari. However, for Bade, Machina, Nguru and Jakusko samples have higher concentration of Cobalt, Nikel, Cadmium Arsenic and Lead when compare with standard as given by WHO and NAFDAC. There is need for construction of water treatment plants within the zone to treat the water for portable uses.

Keywords: *Water, Treatment, Elemental, Parameters, Concentration, Chemical.*

INTRODUCTION

Water is formed through the chemical combination of hydrogen and oxygen in the ratio of 2:1and is the most abundant compound which covers about ¾ of the earth crust. Hydrogen and Oxygen makes up the body of the oceans, seas, rivers and springs, pure water containing about 0.001% solid impurities(Magdalena., et al 2001). The properties of water

vary, this variability depends on the source of water, some waterisnaturally more corrosive than another depending on the place where the water comes from. There are several factors that causes the corrosion in copper pipe, which include low pH (less than 8.0), high temperature, low total dissolved solids (TDS) content and high amount of dissolved oxygen or carbon dioxide (Darren and Mallikarjuna, 2010).

Water is one of the most important and most precious natural resources, it is essential in the life of all living organisms, plant and microorganisms (Onifade et al 2008).It is significant due to its unique chemical and physical properties (Akinsola, 2005).Access to safe drinking water is a key to a sustainable development, quality health and essential to food production. Safe drinking water is essential to life and a satisfactory safe supply must be made available to consumers, water thus becoming a crucial factor for development and the quality of life in the world (Ann, 2004).Water supplied system for human consumption neither must nor contain pathogens, germs, or harmful chemicals because water which is contaminated with microorganisms is the causes of epidemics. That is good drinking water is not a luxury but one of the most essential requirements of life itself (WHO, 2006).

According to World Health Organization (2000), 75% of all diseases in the developing countries such as Nigeria arise from polluted drinking water. Therefore, water quality concerns are often the most important components for measuring access to improve water sources.Acceptable quality shows that, safety of drinking water is in terms of its physical and chemical parameters. The most common problem in household water supplies may be attributed to the presence of pH, Hardness, Iron, Sulfide, Sodium, Chloride, Acidity or Alkalinity and Pathogens, such as viruses and bacteria in the water (Noakes et al., 2005).

In addition, American Water Works Association (AWWA) and American Public Health Association (APHA) report that, the use of chemical disinfectants in water treatment or constructing materials such as in water supply system usually results in the formation of the chemical by product some of this are potentially hazardous. This makes drinking water a vehicle for disease transmission (Sadiq at al.,2003). Portable water is now recognized as a fundamental right of human beings. Around 780 million peoples do not have access to portable water and around 2.5 billion people do not have proper sanitation, as a result around 6.8

million people die each year due to water related diseases and disasters (United Nation, 2013).

The amount of drinking water required is variable it depends on physical activity, age, health issue and environmental condition. it is estimated that average drinking water for adults is about three liter per day. For those working in a hot climate is up to 16 liters a day may be required, water makes up about 60% of weight in men and 55% of weight in women (Miller, 2006). Heavy metals are defined as metals (inorganic micro pollutants) having density greater than 5g/cm^3. This classification includes transition metals and higher atomic weight metals of group III to V of the periodic table. Example of some micro pollutants are zinc, nickel, chromium, lead and cadmium. Our entire earth is an oasis of chemical substance. Metals in the earth crust vary greatly in abundance, metals like aluminum and iron are found at abundant level of about 5%. (Ademoroti, 2003).

Advancement in technology has led to high level of industrialization leading to the discharge of effluent containing heavy metals into our environment. (Ahmed, *et al*, 2009).). The various activities by man in recent years have increased the quantity and distribution of heavy metals in the atmosphere, land and water bodies. The extent of this wide spread but generally diffused contamination has a concern about it possible hazards on plants, animals and human being. In municipal sewage, the metallic content is often absorbed on the sewage solids or to aquatic environment, the metallic contents are dissolved and taken by aquatic bodies in some amount. These amounts may have unpleasant effects on and tend to be unsuitable for human consumption. In some cases, they may have adverse effects on growth of the aquatic bodies (Ademoroti, 2003). Toxic metals are usually present in industrial, municipal and urban runoff, which can be harmful to humans and biotic life. Increased urbanization, irrigation and in industrialization are to be blamed for an increased level of trace metals, especially heavy metals, in our waterways (Zubairu, *et al*. 2016). The heavy metals in drinking water linked most often to human poisoning are lead, iron, cadmium copper, zinc, chromium etc.They are required by the body in small amounts, but can also be toxic in large doses. They constitute one important group of environmentally hazardous substances if present in water sample. Heavy metals like copper are the essential trace elements but show toxicity if in excess amounts in drinking water. Cadmium is extremely toxic even in

low concentrations, and bio-accumulate in organisms and ecosystems and it has along biological half –life in the human body, ranging from 10 to 33years Long term exposures to Cadmium also induces renal damage. So, cadmium is considered as one of the priority pollutants form monitoring in most countries and international organizations(Caroline,Carolyne and Marc, 2012).

SAMPLE COLLECTION

The samples were collected from different location in the different wards from each Local Government of zone C of Yobe State, Nigeria. However, there are six (6) Local Government in the study area, that is zone C, (Bade, Machina, Nguru, Jakusko, Karasuwa and Yusufari). Each Local Government has ten (10) wards and three samples were collected from each source of water (Tap water, Borehole Water, and well water) from each ward marking thirty (30) samples from each Local Government, and one hundred and eighty (180) samples from the zone.

METHODS

The sample water from the mapped-out locations was collected from various water sources of zone C of Yobe State, which were determined for the probable presence of heavy metal concentration using standard literatures and procedures. The methods in this research work was Atomic Absorption spectroscopy (AAS), Differential Pulse Anodic Stripping Voltammetry (DPASV), water samples acidified to 1% with nitric acid and then stored in Double capped polyethylene bottles (Skoog, Holler, and Crouch, 2007)The determination of the concentration of heavy metals were,As, Cd, Cu, Pb, Co, and Ni. The concentrations of the heavy metals determinedwas compared with the National and International organizations standard, like WHO, NAFDAC, USEPA, EUC, EPA. Our targets are to screen water qualitatively and quantitatively for probable presence of heavy metals. The adverse effects of consuming the water on human health was also be considered. Thus, the aim of this study is also to find the concentration of heavy metals in drinking water sources and if the water from these origins (region of their respective areas) are taken for drinking purposes, and see the physiological effects (damages) to human health for the people living around the study area.

RESULT

TABLE IA & IB: Showing the concentration of Cu, Co, Ni, Cd, As and Pb of Bade Local Government and their Standard limit.

BADE													
WARD	Dagona A	Dagona B	Dala A	Dala B	Fulka C	Gabarwa A	Garbawa B	GwiyoFilka A	Katuzu A	Katuzu B	LawanFannami A	LawanFannami B	Lawan Musa A
Copper mg/l	0.089	0.268	0.116	0.099	0.163	0.102	0.144	0.177	0.114	0.929	0.165	1.857	0.305
Cobalt mg/l	0.031	0.087	0.040	0.034	0.054	0.035	0.049	0.059	0.039	0.280	0.055	0.516	0.099
Nikel mg/l	0.024	0.079	0.031	0.026	0.047	0.027	0.04	0.05	0.031	0.322	0.047	0.505	0.09
Cadinium mg/l	0.003	0.088	0.007	0.004	0.021	0.005	0.014	0.026	0.008	0.909	0.021	0.47	0.137
Arsenic mg/l	0.009	0.076	0.015	0.01	0.029	0.012	0.022	0.034	0.016	0.25	0.030	0.747	0.11
Lead mg/l	0.074	0.22	0.095	0.081	0.136	0.084	0.119	0.146	0.104	0.686	0.137	1.186	0.275
pH	5	5.5	5.5	6	5	5.5	6	5.5	5	6	5.5	4.5	6
E/conductor µs	74	30	25	45	26	38	48	30	239	45	417.3	84	384.7

KEY: A= Tap water B = Handpump water C = Well water

TABLE IB

	BADE CONTINUES										
WARD	Lawan Musa B	S Hausawa A	S Hausawa B	Tagali A	Tagali B	Usur A	Usur B	Zagon Musa A	Zagon Musa B	NAFDAC	WHO
Copper mg/l	1.672	0.200	0.588	0.083	0.104	0.097	0.097	0.129	0.107	1..0	1..0
Cobalt mg/l	0.472	0.066	0.184	0.029	0.036	0.034	0.034	0.044	0.037	0.01	0.01
Nikel mg/l	0.694	0.058	0.187	0.022	0.027	0.025	0.026	0.035	0.029	0.02	0'07
Cadinium mg/l	0.952	0.037	0.914	0.003	0.036	0.004	0.005	0.01	0.007	0.003	0.003
Arsenic mg/l	0.164	0.043	0.375	0.007	0.012	0.01	0.012	0.018	0.015	0.01	0.01
Lead mg/l	1.106	0.165	0.508	0.068	0.085	0.079	0.089	0.106	0.098	0.01	0.01
Ph	5.9	5.5	6	5	5.9	6	5.5	5.5	5	6.5-8.5	7.0-8.5
E/conductor µs	55	159	21	26	24	25	25	34	28	No limit	No limit

KEY: A= Tap water B = Handpump water C = Well water

TABLE IIA & IIB: Showing the concentration of Cu, Co, Ni, Cd, As and Pb of Jakusko Local Government and their Standard limit.

JAKUSKO													
WARD	Gid gid A	Jakusk o A	Buduw a A	Buduw a B	Dachiy a B	Dumbur i A	Dumbur i B	GidGi d A	Gway o A	Gway o B	Gway o C	Jakusk o A	Tagama A
Copper mg/l	0.309	0.327	0.151	0.180	0.384	0.205	0.715	0.104	0.131	0.116	0.102	0.066	0.174
Cobalt mg/l	0.100	0.108	0.051	0.061	0.125	0.064	0.218	0.036	0.045	0.040	0.035	0.024	0.058
Nikel mg/l	0.092	0.095	0.042	0.05	0.113	0.066	0.239	0.028	0.036	0.031	0.027	0.016	0.049
Cadinium mg/l	0.135	0.163	0.016	0.027	0.242	0.045	0.938	0.005	0.012	0.007	0.005	0.001	0.025
Arsenic mg/l	0.1	0.123	0.025	0.034	0.149	0.049	0.321	0.012	0.021	0.015	0.012	0.004	0.033
Lead mg/l	0.253	0.292	0.124	0.148	0.307	0.175	0.555	0.086	0.119	0.095	0.084	0.053	0.143
pH	5	5	6	5.5	6	6	5	5.5	6	5.5	5.5	5	6
Condutivity/µs	86	87	40	48	101.7	64	194	27	34	29.7	26	15	47

TABLE IIB

	JAKUSKO CONTINUES							
WARD	Katama A	Katama B	Lafiya A	Lafiya B	Muguram A	Muguram B	NAFDAC	WHO
Copper mg/l	0.144	0.733	0.123	0.096	0.099	0.103	1..0	1..0
Cobalt mg/l	0.049	0.225	0.041	0.033	0.034	0.035	0.01	0.01
Nikel mg/l	0.04	0.243	0.034	0.026	0.026	0.028	0.02	0'07
Cadinium mg/l	0.016	0.977	0.009	0.005	0.034	0.005	0.003	0.003
Arsenic mg/l	0.025	0.329	0.016	0.012	0.01	0.012	0.01	0.01
Lead mg/l	0.131	0.56	0.102	0.087	0.081	0.085	0.01	0.01
pH	6	5	5	5	6	5	6.5-8.5	7.0-8.5
E/conductor µs	38	195	33	25	25	27	No limit	No limit

KEY: A= Tap water B = Handpump water C = Well water

TABLE IIIA: Showing the concentration of Cu, Co, Ni, Cd, As and Pb of KarasuwaLocal Government and their Standard limit.

KARASUWA													
WARD	Gasma A	Bukami B	Jajimaji A	KKsuss A	Kukarjia A	Cumbuako B	Gana Gambo A	KJajimaji B	Karasuwa B	Gasma B	Wachakal B	NAFDAC	WHO
Copper mg/l	0.101	0.160	0.091	0.064	0.100	0.066	0.362	0.073	0.163	0.290	0.106	1..0	1..0
Cobalt mg/l	0.035	0.058	0.034	0.025	0.035	0.024	0.116	0.028	0.054	0.095	0.036	0.01	0.01
Nikel mg/l	0.027	0.049	0.026	0.017	0.026	0.016	0.109	0.02	0.047	0.086	0.030	0.02	0'07
Cadinium mg/l	0.005	0.025	0.005	0.002	0.005	0.001	0.223	0.002	0.023	0.119	0.006	0.003	0.003
Arsenic mg/l	0.011	0.033	0.012	0.006	0.011	0.004	0.136	0.006	0.033	0.089	0.012	0.01	0.01
Lead mg/l	0.083	0.143	0.09	0.056	0.082	0.053	0.293	0.064	0.15	0.237	0.089	0.01	0.01
pH	5	6.1	6	5.5	5.5	6	5.5	6	5	5.9	6	6.5-8.5	7.0-8.5
E/conductor µs	26	46.7	25	16	25	15	100	19	45	80	30	No limit	No limit

KEY: A= Tap water B = Handpump water, C = Well water

TABLE IVA: Showing the concentration of Cu, Co, Ni, Cd, As and Pb of Machina Local Government and their Standard limit.

MACHINA												
WARDS	Bogo A	Damai B	Dole A	Falmaram B	Komyonma A	Kuka Yasku B	Lamisu A	Machina A	Maskari dare B	Taganamu B	NAFDAC	WHO
Copper mg/l	0.181	0.163	0.157	0.277	0.226	0.391	0.426	0.222	0.286	0.172	1..0	1..0
Cobalt mg/l	0.060	0.059	0.052	0.090	0.076	0.135	0.137	0.073	0.101	0.058	0.01	0.01
Nikel mg/l	0.051	0.05	0.045	0.082	0.064	0.13	0.129	0.064	0.093	0.048	0.02	0'07
Cadinium mg/l	0.03	0.032	0.019	0.104	0.053	0.371	0.258	0.046	0.153	0.025	0.003	0.003
Arsenic mg/l	0.04	0.052	0.028	0.081	0.054	0.206	0.135	0.048	0.114	0.031	0.01	0.01
Lead mg/l	0.166	0.146	0.131	0.227	0.185	0.376	0.341	0.183	0.28	0.141	0.01	0.01
pH	6	5.8	6	5.5	8	5.6	7	6	5.5	6.1	6.5-8.5	7.0-8.5
E/conductor µs	49	47.3	43	77.3	60	117	116	61	85.3	46	No limit	No limit

KEY: A= Tap water B = Handpump water C = Well water

TABLE V: Showing the concentration of Cu, Co, Ni, Cd, As and Pb of Nguru Local Government and their Standard limit.

NGURU												
WARDS	Balaguwa B	Bulabulum B	Dogon Kuka B	Garbi B	Hausari A	Jabule A	Kanuri A	Kanuri B	Maja Kura A	TsohuwarNguru A	NAFDAC	WHO
Copper mg/l	0.177	0.601	0.348	0.220	0.260	0.221	0.576	0.201	0.191	0.375	1..0	1..0
Cobalt mg/l	0.059	0.200	0.125	0.073	0.085	0.073	0.194	0.067	0.068	0.120	0.01	0.01
Nikel mg/l	0.05	0.213	0.08	0.063	0.077	0.064	0.2	0.058	0.061	0.114	0.02	0'07
Cadinium mg/l	0.026	0.807	0.16	0.05	0.083	0.054	0.712	0.038	0.042	0.234	0.003	0.003
Arsenic mg/l	0.034	0.301	0.109	0.052	0.072	0.053	0.277	0.043	0.047	0.146	0.01	0.01
Lead mg/l	0.146	0.558	0.262	0.181	0.216	0.182	0.535	0.166	0.171	0.303	0.01	0.01
pH	5.5	5.8	6	6.1	5.5	5.7	6	6.2	6.1	5.1	6.5-8.5	7.0-8.5
E/conductor µs	48	177	69	50.7	72	61	167	55	58	104	No limit	No limit

KEY: A= Tap water B = Handpump water C = Well water

TABLE VIA & VIB: Showing the concentration of Cu, Co, Ni, Cd, As and Pb of Yusufari Local Government and their Standard limit.

YUSUFARI													
WARD	Alanjirori B	Alanjirori C	Central A	Central B	Central C	Gumsi A	Gumsi B	Gumsi C	Guya A	Guya B1	Guya B1	Jebuwa A	Jebuwa B
Copper mg/l	0.121	0.104	0.071	0.224	0.101	0.096	0.225	0.099	0.069	0.069	0.054	0.096	0.130
Cobalt mg/l	0.041	0.036	0.025	0.074	0.035	0.033	0.074	0.034	0.024	0.025	0.022	0.033	0.044
Nikel mg/l	0.032	0.027	0.018	0.065	0.027	0.025	0.065	0.026	0.018	0.017	0.014	0.026	0.036
Cadinium mg/l	0.009	0.005	0.002	0.053	0.005	0.004	0.057	0.004	0.002	0.002	0.001	0.004	0.012
Arsenic mg/l	0.018	0.012	0.006	0.054	0.011	0.009	0.054	0.011	0.006	0.006	0.003	0.01	0.021
Lead mg/l	0.11	0.085	0.057	0.185	0.084	0.078	0.186	0.082	0.057	0.061	0.048	0.079	0.119
pH	5.5	6	5.5	5.1	5	5.5	5.6	6	5	5.5	6	5	5
E/conductor µs	31	26	17	62	26	24	62.7	25	17	16	13	25	35

KEY: A= Tap water B = Handpump water C = Well water

TABLE VIB

	YUSUFARI CONTINUES							
WARD	Jebuwa C	K M GM A	K M GM C	Simbar A	Tulotulu B	Tulotulu C	NAFDAC	WHO
Copper mg/l	0.096	0.066	0.088	0.066	0.206	0.096	1..0	1..0
Cobalt mg/l	0.033	0.024	0.03	0.024	0.074	0.033	0.01	0.01
Nikel mg/l	0.026	0.016	0.023	0.016	0.065	0.026	0.02	0'07
Cadinium mg/l	0.004	0.001	0.003	0.001	0.074	0.005	0.003	0.003
Arsenic mg/l	0.01	0.004	0.009	0.004	0.054	0.012	0.01	0.01
Lead mg/l	0.08	0.053	0.079	0.053	0.185	0.087	0.01	0.01
pH	5	6	5	6	5	5	6.5-8.5	7.0-8.5
E/conductor µs	25	15	22	15	61.3	25	No limit	No limit

KEY: A= Tap water B = Handpump water C = Well water

DISCUSSION

The experiment were conducted to determine the physical parameters, pH and electrical Conductivity, similarly, the heavy metals concentration such as copper (Cu), Cobalt (Co), Nikel (Ni),Cadnium (Cd), Arsenic (As) and Lead (Pb) in the water sample obtained from different location in Zone C of Yobe State, Nigeria.

The result obtained revealed that the pH of all the water samples in the zone turn to be slightly acidic as compare with the standard permissible limits as given by World Health Organization (WHO) and Agencies for Food and Drug Administration Control (NAFDAC). The result obtained for the heavy metels, shows the concentration of Copper are within the limit in all the samples within the zone, for Ni, As and Cd are within the limit and above in Cobalt and Lead in two Local Governments i.e Karasuwa and Yusufari. However, for Bade, Machina, Nguru and Jakusko samples have higher concentration of Cobalt, Nikel, Cadmium Arsenic and Lead when compare with standardas given by WHO and NAFDAC.

The high concentration levels of heavy metals like, Copper, Cobalt, Nikel, Cadmium Arsenic and Lead above the maximum permissible

limits for relatively short periods of time can potentially cause some effects like; nausea, vomiting, diarrhea, musle cramps, sensory disturbance, liver injury and renal failure. Exposure for long period of time can also cause the following effects; kidney, liver, bone and blood damage.

CONCLUSION

Based on the result obtained in the study area, its concluded that, the pH of all the water samples in the zone turn to be slightly acidic as compare with the standard permissible limits as given by World Health Organization (WHO) and Agencies for Food and Drug Administration Control (NAFDAC). The result obtained for the heavy metels, shows the concentration of Copper are within the limit in all the samples within the zone, for Ni, As and Cd are within the limit and above in Cobalt and Lead in two Local Governments i.e Karasuwa and Yusufari. However, for Bade, Machina, Nguru and Jakusko samples have higher concentration of Cobalt, Nikel, Cadmium Arsenic and Lead when compare with standardas given by WHO and NAFDAC.

The high concentration of heavy metals like Cobalt (Co), Nikel (Ni),Cadnium (Cd), Arsenic (As) and Lead (Pb) across the water sample in the zone shows that all the water source might have been polluted and not suitable for consumption.

RECOMMENDATION

Based on the research findings, the following recommendations were made.

- There is need for regular monitoring and evaluation of the levels of the heavy metals concentration in the water source of the zone by federal and State protection agencies.
- Water treatment plant should be constructedwithin the zone to treat the water for domestic and industrial uses, especially for Bade, Machina, Nguru and Jakusko due to the high level of heavy metals concentration from their water sources.

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