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WATER QUALITY ASSESSMENT OF SELECTED DOMESTIC WATER SOURCES IN DUTSINMA TOWN, KATSINA STATE

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ABSTRACT
Dutsinma town is the administrative headquarters of Dutsinma Local Government. The town is witnessing rapid urban expansion with increasing demand in water use, without expansion in the existing water facilities. The research assessed water quality of selected water sources in Dutsinma town. Five (5) categories of water sources (well, tap water vendors, dam, and borehole) were sampled, in which two samples from each of the water sources were collected in clean sterilized plastic bottles in the rainy season and taken for laboratory analysis. Furthermore, field interview was conducted to supplement the water sample information. The World Health Organization standard (WHO) and the Standard Organization of Nigeria (SON) for domestic water quality assessment were adopted in the study. ANOVA-F (One way) was adopted in testing the hypothesis. The results indicated that the major sources of water contamination are from urbanization effects such as irrigation/ farming activities around the dam, dumping of refuse in drainage channels, and exposed wells respectively. There is no significant variation in the water quality of selected domestic water sources in Dutsinma town. Laboratory analyses of water samples from the different sources reveals that tap water has pH value (4.61) which is acidic while the rest are within the approved standard. Dam had the lowest electrical conductivity (50.25µ/cm) and 56.15mg/l for total dissolve solute. Nitrate ion appears relatively lower in tap water (0.70mg/l), and sulphate was generally low. Water sourced through water vendors had the lowest chloride (37.28mg/l), and relatively low magnesium concentration in most of the water sources. However, calcium concentration appears lower for all water sources when compared to the WHO and SON standards for water quality. Copper concentration is within tolerable limits with the lowest being 0.27mg/l for both dam and tap sources. However, lead ion appears higher than the approved WHO and SON standard for water quality in all the sources except that of water vendors which is 0.04mg/l. It is therefore recommended that periodic monitoring of water quality, effective waste management system to improve the general water quality in the town, and further research on lead elements was among some of the key recommendations made.

Keywords: Water quality, Water demand, Dutsinma town, Standards, World Health Organization (WHO), Standards Organization of Nigeria (SON)

Background to the Study
Water plays a vital role in the development of a stable community and society, since human being can exist for days without food, but absence of water for a few days may lead to death (Yusuf & Shuaib, 2012). The essential nature of water to man's daily usage vis-à-vis quantity and quality right from time immemorial has been on the increase (Jidauna *et al.,* 2014). Unfortunately, drinking water in developing countries especially in Nigeria in particular is susceptible to toxins as a results of effluents and pollutants (Dabi & Jidauna, 2010; Odoh & Jidauna, 2013). As the human population and development in modern technology increase, the risk for water contamination also increases. However, two major sources of water whose quality are assessed by chemists are the surface (Dams, streams, rivers, ponds, lakes) and ground waters (wells, boreholes). The reason is that surface waters are prone to contamination and it was reported that surface waters are generally poor in quality (Okeola *et al,* 2010). Ground waters on the other hand are more reliable for domestic and agricultural (irrigation) needs (Okeola *et al*, 2010).
Dutsinma is one of the Local Government Areas (LGA) in Katsina State that is confronted with the challenges of poor waste management system and fast urban sprawling that is evident within the township. Indiscriminate waste disposal coupled with bad land practices are common scene that can easily pollute surface water, and consequently degrading the water quality (Ndabula & Jidauna, 2010; Dabi & Jidauna, 2010).

The town depends on both surface and ground water sources for the different water uses. The most dependable sources observed include dam, water board, water vendors, wells, and sometimes riverbed are sometimes used as sources of water supply. These sources are often contaminated pollutants that are categorized as heavy metal that are often associated to human activities and further exacerbated by urban sprawling and poor waste management (Odoh & Jidauna, 2013). Therefore, the need to access a reliable, secure, safe, and sufficient source of fresh water is a fundamental requirement for the survival, well-being, and socio-economic development of all humanity (Tebbutt, 1990). Hence, the desire and the need for portable water supply cannot be over emphasized. Irrespective of sources, domestic water supply should be water of high quality, while water for other uses can be of moderate quality. Moreover, most people in the urban centers often depend on the water vendors for domestic water supply, and in many cases, the water accessed is used directly without treatment. Drinking water is water of highest quality, while water of good quality can be put into any other use (Jidauna et al.,

2013 & 2014). The paper assessed the quality of selected domestic water sources in Dutsinma town Water plays a vital role in the development of a stable community and society, since human being can exist for days without food, but absence of water for a few days may lead to death (Yusuf & Shuaib, 2012). The essential nature of water to man's daily usage vis-à-vis quantity and quality right from time immemorial has been on the increase (Jidauna *et al*., 2014). Unfortunately, drinking water in developing countries especially in Nigeria in particular is susceptible to toxins as a results of effluents and pollutants (Dabi & Jidauna, 2010; Odoh & Jidauna, 2013). As the human population and development in modern technology increase, the risk for water contamination also increases. However, two major sources of water whose quality are assessed by chemists are the surface (Dams, streams, rivers, ponds, lakes) and ground waters (wells, boreholes). The reason is that surface waters are prone to contamination and it was reported that surface waters are generally poor in quality (Okeola et al, 2010). Ground waters on the other hand are more reliable for domestic and agricultural (irrigation) needs (Okeola et al, 2010).

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MATERIALS AND METHODS

Study Area

Dutsinma area comprise of Safana, Batsari, Kurfi and Dan-musa LGAs respectively. Now Dutsinma Local Government has only one district head. Presently, it is made up of eight (8) village heads, Katawa, Dan Bawa, Shema, Baggadi, Kuki, Karufi, and Makera, with the central district head in Dutsinma town. Dutsinma LGA is located at the central part of Katsina state, and lies on Latitude 12^0 26' and longitude 07^0 29' E (Abaji, Ati & Iguisi 2012). With estimated area of 552,323 km, and it is bounded in the North by Kurfi, Charanchi and Kankia LGAs. Matazu in the South-east, Safana and Dan-musa from the west (Fig 1.). According to 2006 National Population Commission census (NPC, 2006), Dutsinma has an estimated population of about 169,829.

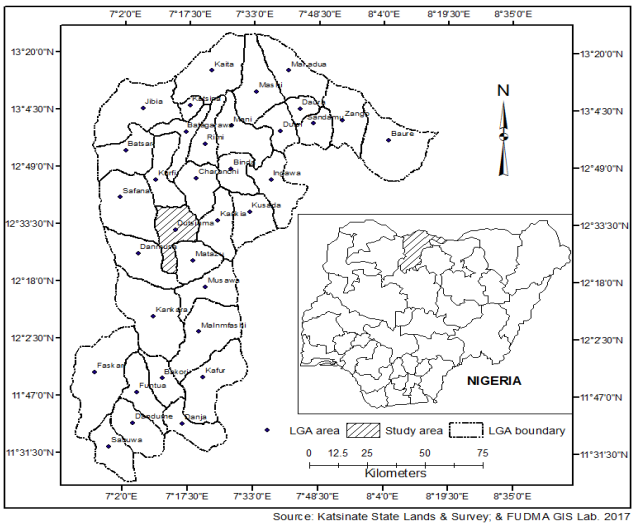

Fig 1. Katsina State showing Dutsinma Local Government Area

The climate of Dutsinma is as classify by the Koppens classification is semiarid, tropical wet and dry climate (AW). The climate patterns of Dutsinma signify two main alternative seasons: that is the dry season and wet season. The rainy season is between April to September every year, which a times fluctuates in terms of onset and cessation. The average annual rainfall is about 700mm, and the pattern of the rainfall in the area is highly variable. This can result in a severe wide spread drought that can pose serious economic constrain (Abaji, Ati, & Iguisi 2012).

The mean annual temperature ranges from 29^OC to 31^OC, April and May is the highest temperature and the lowest in December - February. Evapotranspiration is generally high throughout the year. The highest amount of evaporation occurs during the dry season. The vegetation of the study area is the Sudan- Savanna type which combines the characteristics and species of both Guinea and Sahel Savanna (Tukur *et al*., 2013).

The relief of the region can be described as consisting of low land plain that are undulated. These plains are dotted with Granite rock out-crops known as Inselbergs. There are also low valleys or channels which are wide and full of sand material (Bako, 2007). Drainage basins are local open systems. A drainage basin is an area of land that drains by a river and its tributaries (river system). It includes water found in the water table and surface runoff. All rivers are joined by several other smaller rivers which are called tributaries are known as river basins. The main river and all its tributaries are known as River basin. The main river and all its tributaries together is form a river system pattern (Ajayi, 2003).

The geology of Dutsinma region is largely made up of basement complex rocks which are predominantly metamorphic rocks. The oldest rocks are the igneous types which are later converted into metamorphic rocks as a result of heat and pressure. In some parts of the area, the rocks have changed over time as a result of weathering and erosion effects. The rocks which later leads to the formation of granites hills and inselbergs such as the one found in the center of Dutsinma town. This is a foundation of lateritic capping as well as formation of river valleys and undulating plains (Abdulkareem, 2007)

Data requirements and sources
The data requirement for the study was largely field based, and comprises of sampled water from wells, pipe born (tap), water vendors, dam, and borehole respectively. The secondary sources is from the different published works: World Health Organization (WHO) and Standard Organization of Nigeria (SON) water quality values were used to compare the results of the selected elements and samples analyzed. For the assessment of water quality in Dutsinma LGA, the World Health Organization (WHO), and Standard Organization of Nigeria (SON) respectively was considered for the assessment of water quality in the study area (Table 1).

Table 1. Selected Chemical Parameters and Standard for Water Quality

S/N	Parameter	UNIT	WHO	SON
1	pH	-	6.5 – 8.5	6.5 – 8.5
2	E. Conductivity	µ/cm	1,500	1,000
3	TDS	mg/l	500	500
4	Nitrate ion (NO_3)	mg/l	50	50
5	Sulphate ion ($S0_4$)	mg/l	200	100
6	Chloride ion (CL)	mg/l	400	250
7	Magnesium (Mg)	mg/l	50	20
8	Calcium (Ca)	mg/l	75	75
9	Copper ion $(Cu)^2$	mg/l	1	1
10	Lead ion (Pb)	mg/l	0.05	0.01

Source: Adapted and modified from Jidauna *et al*., (2013)

The major data source for the study was largely drawn from primary sources, which comprises of the field samples that was collected from the different water sources. Eventually, the samples were taken and analyzed in the laboratory and the results discussed.

METHOD OF DATA COLLECTION

Water Sampling Procedure
Most geographic field research problems are sample studies in the sense that it is not possible to obtain information for the spectrum of a given area, usually only certain phenomena are selected for the study from a range of hundreds of possibilities (Wunbury & Aldried, 1986 as cited by Jidauna *et al.,* 2014).

The samples that were taken from the study area (Dutsinma town) covered only the rainy season, and the water samples were taken on the 29th of June, 2016 in the morning. A total of ten (10) samples were collected, and two for each sampled identify. Two samples were randomly taken from each of the water sources: wells, pipe-born (tap), water vendors, dam, and borehole respectively. Samples from wells were taken within the urban area around Hayingada and Yan Daka; Pipe-born from Abuja road; Water vendors around Angwan Katangaru and FUDMA campus; dam form the upper and lower courses of the stream/ river; and borehole from Angwan Kuddu and Angwan Katangaru respectively. All the samples were taken in the rainy season. The traditional grab sampling method involving the spot collection of water samples were used and water collected stored in clean plastic bottles. Sterilized plastic bottles were used for the collection of water samples; and the covers of the bottle were aseptically removed. The bottles were then filled with water, leaving small air space and simultaneously covering back with the cap.

Measurement of Water Quality
The complexity of quality as a subject is reflected in the many types of measurements of water quality indicators. Some of the simple measurements can be made on-site as temperature, pH, dissolved oxygen, and conductivity, in direct contact with the water source in question. More complex measurements are made in a laboratory setting which requires water samples to be collected, preserved, and analyzed at another location. Making these complex measurements can be expensive, because measurements of water quality are expensive. For the purpose of this study, only some elements were examined. These include: pH, Chloride, Iron, Nitrite, Calcium, Sulphate, Magnesium, Copper, and Lead.

The Method of Data Analysis
The descriptive statistics and inferential statistics were used for the analysis of the data generated. The descriptive statistical tool was used to summarize the laboratory results of the analyzed samples through the use of graphs, charts, and frequency tables. The Analysis of Variance (ANOVA) for hypothesis using MS Excel.

RESULTS AND DISSCUSSION

Sources of water contamination
The major sources of domestic water in Dustinma town include dam, River channels, wells, water vendors, tap, and boreholes respectively. However, most of the residents interviewed accessed water directly or through of any of the above listed sources. Majority of the residents interviewed believed that most of tap and borehole sources (Plate 2) have minimal risk of contamination when compared to dams, wells, and rivers. Thus, the contamination of Dustinma dam was expressed to be through the farming activities around the dam that is capable of polluting the dam (fertilizer and herbicides) and effluent from urban area at the upper cause that drain into the dam (Plate 1). Wells that are not covered are easily polluted by refuse or dirty water that can easily drain into the well (Plate 4). Moreover, refuse dump at river channel easily pollute and contaminates such sources (Plate 3) which most often people dig below the river-bed to scoop water for domestic use at the peak of water stress (dry season).

However, in verifying the hypothesis that states that there is a significant variation between the selected domestic water sources in Dutsinma town, using ANOVA (Appendix), the results shows that the calculated F = 0.58 whereas, the Critical F = 2.58 at α 0.05 level of significance. Thus, the null hypothesis which states that there is no significant variation between the selected domestic water sources in Dutsinma town is accepted. Perhaps the reasons amongst others could be attributed to the level of education, income, social status, and family size which often push people to make do with whatever they have at their disposal.

RESULTS OF SAMPLED ELEMENTS

The pH Concentration from water sources
The results of the samples taken from the selected water sources

is presented in the table 2. Based on the results above, pH is the measure of the active hydrogen ion (H^+) concentration in water, and it represents the relative alkalinity or acidity of water. The pH scale lies between 0 and 14. On a typical pH scale, the medium is increasingly more acidic from pH of 0 to 7, and more alkaline from pH of 7 to 14. At pH of 7, the medium is neutral.

Plate 1. Rice Pady field & settlement close to the Dam

Plate 2. A Functional Borehole

Plate 3. Refuse dump in a River Channel

Plate 4. An exposed well

The normal range for pH for surface water is 6.5 to 8.5. Water with acidity less than 6.5 could be considered acidic, soft and corrosive, while water with pH of more than 7 is alkaline. The pH helps in the removal of waste product from the body. Water that ranges from 6.5 to 8.5 are good for domestic uses as recommended and standards by World Health Organization (WHO) and Standard Organization of Nigeria (SON). From the field work, Sample collected from Borehole, Dam, Water Vendors and Wells has an average pH value 6.9 to 7.2 which falls within the standard recommended for drinking and domestic uses while

Tap water has a pH value of 4.61 outside or below the acceptable standards (WHO and SON) as presented in figure 2.1. Thus, borehole, dam, well and water vendors are good for domestic uses while tap water is not good for domestic uses.

Table 2. Results of water quality and World Health Organization (WHO) Standard

Water Source	pH		E. Conductivity		TDS		Nitrate ion		Sulphate ion	
	WHO	Average	WHO	Average	WHO	Average	WHO	Average	WHO	Average
Vendors	6.5 – 8.6	7.29	1,500	126.25	500	75.45	50	1.05	200	0.04
Borehole	6.5 – 8.6	6.95	1,500	774.50	500	474	50	1.05	200	0.39
Dam	6.5 – 8.6	7.19	1,500	50.25	500	30.2	50	1.05	200	0.71
Tap	6.5 – 8.6	4.61	1,500	93.95	500	56.15	50	0.70	200	0.36
Well	6.5 – 8.6	7.19	1,500	683.15	500	413.1	50	1.05	200	0.46
Total		**33.24**		**1728.10**		**1048.9**		**4.90**		**1.95**
Water Source	**Chloride ion**		**Magnesium**		**Calcium**		**Copper ion**		**Lead ion**	
	WHO	Average	WHO	Average	WHO	Average	WHO	Average	WHO	Average
Vendors	400	37.275	50	0.40	75	1.67	1	0.32	0.05	0.04
Borehole	400	163.3	50	0.30	75	9.17	1	0.41	0.05	0.09
Dam	400	31.95	50	0.40	75	0.75	1	0.27	0.05	0.09
Tap	400	39.05	50	0.30	75	1.17	1	0.27	0.05	0.11
Well	400	150.875	50	1.80	75	4.33	1	0.45	0.05	0.13
Total		**422.45**		**3.20**		**17.08**		**1.73**		**0.46**

Source: Fieldwork, 2016

The Results of Electrical Conductivity from Water Sources

The results obtained for electrical concentration from the sample collected in Dutsinma town are presented in the figure 2.2. Conductivity of a substance is defined as the ability or power to conduct or transmit heat, electricity, or sound. Its units are Siemens per meter (S/m). In water and ionic materials or fluids, a net motion of charged ions can occur. This phenomenon produces an electric current and is called ionic conduction. Pure water is not a good conductor of electricity. Ordinary distilled water in equilibrium with carbon dioxide of the air has a conductivity of about 10 x 10^{-6} $W^{-1}*m^{-1}$ (20 dS/m). Because the electrical current is transported by the ions in solution, the conductivity increases as the concentration of ions increases. Results of samples collected shows that Borehole in Dutsinma town has the highest electrical conductivity of 774.50µ/cm which is below what is recommended standard (WHO and SON), Dam water in Dutsinma town has the lowest electrical conductivity of 50.25 µ/cm, these means that all the sample sources in Dutsinma town has an electrical conductivity below the acceptable standard for water quality (WHO and SON).

The Results for Total Dissolve Solute from Water Sources

The concentration of total dissolve solute in water, for the five samples collected in Dutsinma town is presented figure 2.3. A total dissolved solute in water originates from natural sources, sewage, industrial waste water, urban run-off, and chemicals used in water treatment processes. Total dissolved solids are a combination of organic salts and little quantity of organic matter that are dissolved in water.

Problems associated with high TDS concentration is more of an aesthetic problem rather than a health hazard. An elevated TDS is an indication of elevated levels of ions that above the primary or secondary drinking water standards. High concentrations of Total Dissolved Solids can as well lower the water quality and cause water balance problems for individual aquatic organisms.

According to World Health Organization (WHO) and Standard Organization of Nigeria (SON) water should have TDS concentration of 500mg/l, sample tested for borehole has the highest concentration of TDS 474mg/l and dam has the lowest concentration 56.15mg/l (Table 2). From the five sources of water sample analyzed, TDS in the water samples are within the acceptable Standards (WHO & SON), these means that the water from the selected sampled sources can be into domestic usage.

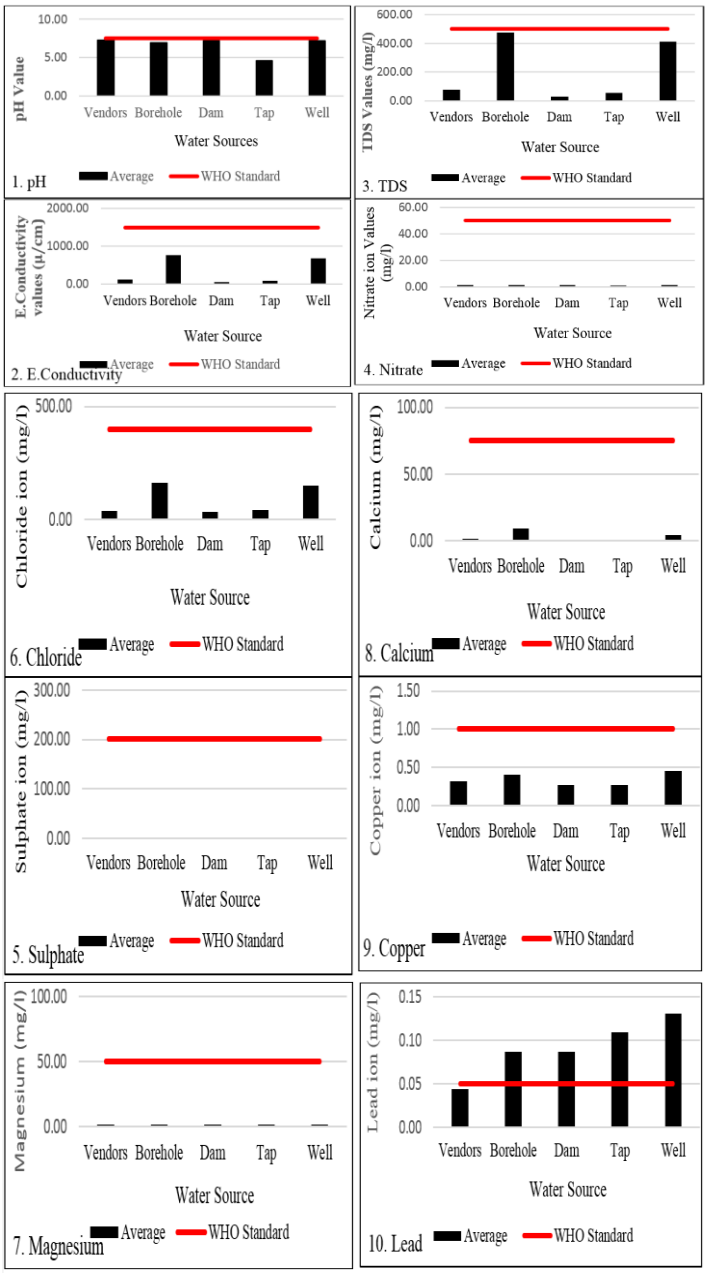

Figure 2. World Health Organization Standard and Average concentration of selected elements

The Results for Nitrates Ions Concentration from Water Sources

The results for the concentration of nitrates ion from the selected water sources is presented in fig 2.4. The results of the analyzed sample collected in study area shows that tap water has the lowest amount of nitrates ions among the others sources of sample collected which is 0.70mg/l which is less than what is recommended by WHO and SON of 50 mg/l respectively (Table

2). However, samples from water vendors, borehole, dam, and wells has the highest amount of nitrates ions with 1.05mg/l, which is also below what is recommended by WHO and SON. Consequently, tap water source is more suitable for drinking and other domestic usage. This results agrees with Jidauna et al. (2013 & 2014).

The Results for Sulphate Ion Concentration from Water Sources

The analyzed results for the concentration of sulphate in the samples of the selected water sources is presented in figure 2.5. Sulphate ions concentration from samples analyzed in Dutsinma town are below the standard recommended. WHO and SON, recommends that water should have sulphate concentration of not more than 200mg/l and 100mg/l respectively. Dam water has the highest amount of sulphate ions among the others sources of sample collected which is 0.71mg/l which is less than what is recommended by WHO and SON, while samples from water vendor has the lowest amount of sulphate with 0.04mg/l (Table 2) which is also below what is recommended by WHO and SON. These means that the concentration of sulphate in water is good for drinking in Dutsinma town

The Results for Chloride Concentration from Water Sources

Water Samples that was collected and analyzed to determine the concentration of chloride in water sources for the study area is presented in figure 2.6. Chloride is an acid-base balance, water balance, component of stomach acid (hydrochloric acid). One of three powerful electrolytes required by the body (the other two being sodium and potassium), chloride performs a number of important functions within the body. It makes up about 0.15 percent of our body weight. It stimulates the production of hydrochloric acid. Perform different functions to the body such as, Chloride is an enzyme activator and is also involved in maintaining acid-base and water balance. It allows fluids to pass in and out of cell membranes until the concentration of dissolved particles is equal on both sides. Chloride adjusts metabolic alkalosis resulting from disease or chronic use of diuretic agents. It stimulates the liver to act as a filter to separate waste and then eliminate it from the body. Chloride and the other electrolytes work with calcium and magnesium in maintaining nerve transmission and normal muscle contraction and relaxation. Chloride, as a member in the chloride-bicarbonate shift, moves in and out of red blood cells and blood plasma. This allows the plasma transport of tissue carbon dioxide as bicarbonate to the lungs for excretion, because of the importance and function perform by chloride, WHO and SON recommend that water for domestic uses should content 400mg/l and 250mg/l of chloride. From the field work and the result from the sample, Borehole water in Dutsinma town has the highest amount of chloride ions compare with other sources which is 163.30mg/l which is below the WHO and SON, while sample collected from Dam has the low concentration of chloride ions which is 31.95mg/l compare with other water sources (Table 2).

A deficiency in chloride would result in an imbalance in the normal acid-base balance, which in extreme cases could be characterized by nausea, vomiting, diarrhea, and perspiration. It is important to note that deficiencies of chloride are very rare except in certain instances where an individual is experiencing chronic vomiting, diarrhea, or excessive perspiration. Other symptoms include hair and tooth loss and impaired digestion. Infants deficient in chloride can develop loss of appetite, lethargy and failure to thrive, and muscle weakness.

Results of Magnesium Concentration from Water Sources

The concentration of magnesium in selected water sources collected and analyzed is presented in table 2. Magnesium is an active component of several enzyme systems in which thymine pyrophosphate Magnesium**,** helps to activates enzymes, nerve conduction, and muscle contraction, bone and tooth formation, and protein metabolism. Magnesium is necessary to prevent the calcification of soft tissue. It confers a protective effect on the arterial lining, and protects it from stress caused by changes in blood pressure. A Deficiency in magnesium may result to the health problem which includes: confusion, insomnia, irritability, nervousness, poor digestion, rapid heartbeat, seizures, diabetes, cardiac arrhythmia, cardiovascular disease, hypertension, asthma, chronic fatigue, chronic pain syndrome, depression, irritable bowel syndrome, premature labor, pre-eclampsia, and diabetes. In order to reduce these effects as stated above, WHO and SON recommends the concentration of magnesium in water should be 50mg/l and 20mg/l. Sample collected from the five sources in within Dutsinma town indicate low magnesium concentration except for well source 1.8mg/l (figure 2.7) which appears to be the highest, but still falls below the standard (WHO & SON). Therefore water from these sources should be used for drinking since the magnesium content is within the standards, however water from water vendors, borehole, and tap has the highest concentration of magnesium while dam and wells has low concentration which should either be used for agricultural uses or for industrial uses.

The Results of Calcium Concentrations from Water Sources.

The concentration of calcium in water sample from the different sources are presented in figure 2.8. Calcium is very important to human body; calcium helps to conduct nerve impulses, muscle contraction, blood clotting, bone and tooth formation, and heart action. Calcium is the most abundant mineral in the body.

It is also the fifth most common substance in the body after carbon, hydrogen, oxygen, and nitrogen. Calcium is essential for the formation of strong bones and teeth and for the maintenance of healthy gums. It increases the rate of bone growth and prevents against bone loss associated with osteoporosis. Calcium is important in the maintenance of a regular heartbeat and transmission of nerve impulses. Calcium helps lower cholesterol levels and helps prevent against cardiovascular disease and certain forms of cancer including colorectal cancer. Calcium is an important of normal blood clotting processes that aid in the early stages of wound healing. In addition, calcium also wards off the accumulation of an excess of acid or alkali in the blood (Shymala, Shanthi, & Lalitha, 2008; Orman, 2011). Because of the role, function and importance of calcium to human body WHO and SON recommend that water should have 75mg/l concentration of calcium.

However a deficiency in calcium is associated with aching joints, eczema, brittle nails, elevated blood cholesterol, hypertension, heart palpitations, insomnia, muscle cramps, nervousness, rickets, tooth decay, rheumatoid arthritis, cognitive impairment, depression and, in severe cases, convulsions and delusions. From samples collected in Dutsinma town borehole water has the highest amount of calcium among the others sources of sample collected which is 9.17mg/l which is less than what is recommended by WHO and SON, while sample from dam has the

lowest concentration of calcium with 0.04mg/l which is also below what is recommended by WHO and SON (Table 2).

The Results of Copper Concentration from Water Sources

The concentrations of copper in water sources in Dutsinma town is present in table 2. Copper is needed in the body because, copper aid in the growth and formation of bone, formation of myelin sheaths in the nervous systems, helps in the incorporation of iron in hemoglobin, assists in the absorption of iron from the gastrointestinal tract (GIT) and in the transfer of iron from tissues to the plasma in the body.

Increased levels of copper are seen in acute infections and in chronic conditions such as cirrhosis, rheumatoid arthritis and in post-operative stages. Increased level is also found in malnutrition. Clinical disorders associated with Cu deficiencies include anaemia, bone disorders, neonatal ataxia, depigmentation and abnormal growth of hair, fur or wool, impaired growth and reproductive performance, heart failure and gastrointestinal disturbances (WHO, 1976). Thus, excess dietary Cu causes an accumulation of Cu in the liver with a decrease in blood haemoglobin concentration and packed cell volume. Liver function is adversely affected in copper poisoning. Deficiency disease or symptom include anaemia (hypochromic, microcytic)

However, World Health Organization and Standard Organization of Nigeria recommend that the standard for copper concentration in water should be 1mg/l. From the sample collected copper concentration in the water sources falls within the limit by WHO and SON, well water in Dutsinma town has the highest concentration of copper ions with 0.45mg/l which is below the what is been recommended by WHO and SON (Figure 9), tap water in Dutsinma town has the lowest concentration of 0.27mg/l among the sources of water collected in Dutsinma town.

The Results of Lead Ions Concentrations from Water Sources

Lead concentrations in water sample collected and analyzed are present in figure 2.10. Lead ion is a ubiquitous environmental and industrial pollutant that has been detected in every facet of environmental and biological systems.

Lead can be found in water pipes, insecticides, lining of equipment where corrosion resistance and pliability are required, in petroleum refining, in construction, gun bullets, x-ray and atomic radiation. Reproductive dysfunction by lead has distinct morphological and biochemical features such as disorganized epithelia, decreased sperm quality and altered sperm morphology and low androgen levels. WHO and SON recommends that the concentration of lead in water should be 0.5mg/l and 0.1mg/l. However, from Sample collected wells, tap has the highest concentration of lead ions sample collected with 0.13mg/l which is higher than what is recommended by SON (Figure 2.10), thus base on SON standard, water from wells and tap should not be used for domestic purpose since they are above the standard for lead concentrations in water, while water from water vendors, borehole and dam has low concentration which is below the limit by WHO and SON. Water that is of high quality is expected to have the concentration of lead in trace form (Odoh & Jidauna, 2013).

Conclusion

The study focuses on chemical water quality assessment of selected water sources in Dutsin-Ma town. The results reveals that most water sources used for domestic purposes are below the recommended standard values by WHO and SON. However, possible causes of contamination and pollution of water sources within Dutsin-Ma urban area can be attributed to urbanization, poor waste management system, farming close to water sources (dam), uncovered wells, and dumping of refuse on drainage channels (e.g. gutters and river). Though, the findings from the study show that most of the concentration of the elements are within tolerable limits of WHO and SON, water from wells and taps shows high lead ions concentration which is higher than what is recommended by WHO and SON. Further, studies on this is strongly suggested considering the rapid and astronomical urban/ population growth that the town is witnessing in a bid to avert a future risk for the water management.

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