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Assessment of Seasonal Changes of Some Physicochemical Parameters of Drinking Water in Dutsinma city Katsina state, Nigeria

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ABSTRACT

The research aimed at assessing seasonal changes of four sources of potable water i.e., treated tap-water, boreholes, hand-pumps and well-water, in Dutsinma city. It also aimed at investigating water quality in the area of study in terms of temperature,pH, colour, taste, odour and turbidity in the wet and dry seasons. The research adopted quantitative experimental method. Data were collected through field and laboratory works and were analyzed by using T-test as a statistical method in order to ascertain seasonal changes on the quality of water for consumption. Comparison was also made between the results obtained and the water quality standards set by the Nigerian Industrial Standards NIS (2007) and World Health Organization WHO (2006). The study revealed a number of results, most importantly: The quality of water varies with regard to different seasons. Some parameters recorded maximum levels in the dry season and others were at their maximum in the rainy season. The average values of pH (6.8) and Turbidity (7.5 NTU) were found slightly higher in the rainy season than in the dry season. That of temperature (28.5) was found slightly higher in the dry season than in the rainy season. Temperature and turbidity showed significantly seasonal variation while pH showed insignificant seasonal variation. The results also revealed that, most of the water quality parameters studied were found to be within the recommended standards. Consequently, most of the water sources were safe for human consumption in terms of the parameters studied.

Keywords: Analysis, Water, Seasonal Change, Dutsinma, Katsina State, Nigeria

I. INTRODUCTION

Water is one of the most important as well as one of the most abundant compounds on earth and is vital for the survival of any organism (Tortora et al., 2002) in (Onilude et al., 2013). Water is an essential natural resource for sustainability of life on earth (Chinedu et-al, 2011). Humans may survive for several weeks without food, but barely few days without water because constant supply of water is needed to replenish the fluids lost through normal physiological activities such as respiration, perspiration and urination (Murray et-al., 2003) in (Chinedu et al., 2011).Water is of fundamental importance to human life, animals and plants, it is of equal value with the air we breathe in maintaining the vital processes of life and it makes up about 60% of body weight in human body (Odikamnoro, Omowaye and Aneke 2014). Drinking water must be free from components which may adversely affect human health, such components include minerals, organic substances and disease causing organisms (Haydar, Arshad and Aziz 2009). Clean water is essential to human life; safe quality water supplied to communities is an important consideration in the protection of human health and well- being. Without water, life cannot be

sustained beyond few days and the lack of access to a safe water supplies leads to the spread of water borne diseases (Omer and Salam, 2012). According to Amira, Abdelmoneim and Elamin (2010), people can survive weeks or months without food but only about few days without water, although an absolute necessity for life can be a carrier of many diseases.

Natural water quality varies from place to place depending on climatic changes, types of soil, rocks and surfaces through which it moves. A variety of human activities such as agriculture, mining, urban and industrial development and recreation significantly alter the quality of natural water and change the water use potentially (Federal Ministry of Environment Nigeria FME, 1997). The key to sustainable water resources is therefore, to ensure that the quality of water resources is suitable for an intended use while at the same time maintaining the quality after use. When water from rain or snow moves on the land, and through the ground, the water may dissolve minerals in rocks and soils, percolate through organic materials such as roots and leaves and react with algae, bacteria and other microscopic organisms. Water may also carry plants, debris, silt and clay to rivers and streams making the water appear muddy or turbid. When water evaporates from lakes and streams, dissolved minerals are more concentrated in the water that remains. Each of these natural processes changes the quality and potentiality of the natural water (United States Environmental Protection Agency,USEPA, 2006).

II. MATERIALS AND METHODS

The research investigated potability as well as seasonal changes of some physicochemical properties of drinking water in Dutsinma city, Katsina, Nigeria. The selected physicochemical parameters were temperature, pH, odour, colour, taste and turbidity. These parameters were analyzed using standard laboratory techniques. The results obtained from laboratory analysis were compared with World Health Organisation WHO (2006) and Nigerian Industrial Standards NIS (2007) water quality standards to ascertain their suitable for drinking. Further analysis was carried out using t-test to find out the extent of seasonal variation.

Sampling Programme

A purposive sampling technique was adopted and samples were drawn purposefully from the four water sources (treated tap, hand pumps, boreholes and open well water). During reconnaissance survey, eight sampling points were selected; two sampling points for the treated tap water, two for hands pumps, two for boreholes and two others for open wells. The sampling points selected were water treatment plant and Bayan area for the treated tap, Unguwar Kudu and Low-cost Housing Estate for hand pumps, Sokoto Rima and Isah Kaita College of Education for Boreholes and police station well and new market well for the open concrete wells. Eight water samples were drawn from eight sampling points selected, two samples from treated tap water, two samples from hand pumps, two samples from boreholes and two samples from open wells. Sampling collection was carried out thrice in the rainy season and thrice in the dry season respectively. Sample's collection for the dry season was carried out in the month of January, February and April 2016. For the rainy season, the samples were collected in the month of July, August and September 2016. Water samples were collected using sterilized 2-liter plastic containers, thoroughly washed and acidified with nitric acid and clearly marked and labeled after the sampling points, time and date. The containers were further rinsed with the sample water at the sites of the sample collection before the samples were collected to avoid contamination. This is in accordance with Balarabe,Oladimeji and Abubakar (1998), Nirmala et al, (2012), Abed, Hussain and Pradhan (2011), Agbaire, Akporido and Akporhonor (2014), Nwaichi, Monamu and Njoku (2013) and Makwe and Chup

(2013). All samples were collected between 8:00am to 10:00am and kept in coolers filled with ice blocks before they were finally conveyed to the laboratory where they were analysed for all the selected parameters.

Laboratory Analysis

Physicochemical Parameters selected were analyzed in the laboratory, they were (temperature, pH, odour, colour, taste and turbidity. These parameters were tested using standard laboratory techniques. Temperature and pH were measured on the field immediately after sample collection. The analysis of the water samples was carried out at Katsina State Water Board Laboratory (Ajiwa Water Treatment Plant Central Laboratory). Six series of results were obtained from laboratory analysis, three results for rainy season and three results for dry season. For each of the two seasons, the average of the three results were taken to serve as the main results for the research, one result for the rainy season and one for dry season.

Statistical Techniques/Methods

For the purpose of this research, t-test was used to analyze the results obtained from laboratory so as to determine whether there is significant difference in the quality of potable water in the study area between the two seasons. Bar graphs were also used to show comparison of water quality between the seasons.

Results and Discussion

After laboratory processes, six sets of laboratory results were obtained, three results for the rainy season and three results for dry season. The average of the results for both the seasons were taken and presented in tables 1 and 2 below as the main results for the research.

Table 1. Results of Physicochemical Analysis of Water Samples collected in Dry Season (Dec, 2015 – April, 2016)

	Sampling Points							
Parametres	1. Water Treatment Plant	2. Bayan Area Treated Tap	3. I.K.C.O.E Dutsinma Borehole	4. Sokoto Rima Borehole	5 .Lowcoast Hand Pump	6. Unguwar Kudu Hand Pump	7. Police Station Mosque Open Well	8. Zubairu Primary School Open Well
Temp. (^{0}C)	28	25	27	28	31	30	29	29
Ph	5.51	5.44	7.5	8.08	7.7	7.42	8.16	8.13
Odour	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
Colour (Hazen)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Taste	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless
Turbidity (NTU)	3.98	3.88	2.0	2.7	3.0	3.5	5.25	9.2

Source : Field and Laboratory Analysis (Dec 2015 – May, 2016)

Table 2. Results of Physicochemical Analysis of Water Samples collected in Rainy Season (June – Sept, 2016)

	Sampling Points							
Parametres	1. Water Treatment Plant	2. Bayan Area Treated Tap	3. I.K.C.O.E Dutsinma Borehole	4. Sokoto Rima Borehole	5. Lowcost Hand Pump	6. Unguwar Kudu Hand Pump	7. Police Station Mosque Open Well	8. Zubairu Primary School Open Well
Temp. (^{0}C)	25	24.3	26.3	26	26	28.3	28	28.7
pH	6.2	6.15	6.8	6.85	6.6	6.9	7.5	7.49
Odour	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
Colour (Hazen)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Taste	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless
Turbidity (NTU)	7.23	9.94	6.78	6.41	6.06	7.23	7.99	8.06

Source: Field and Laboratory Analysis (June – Sept, 2016)

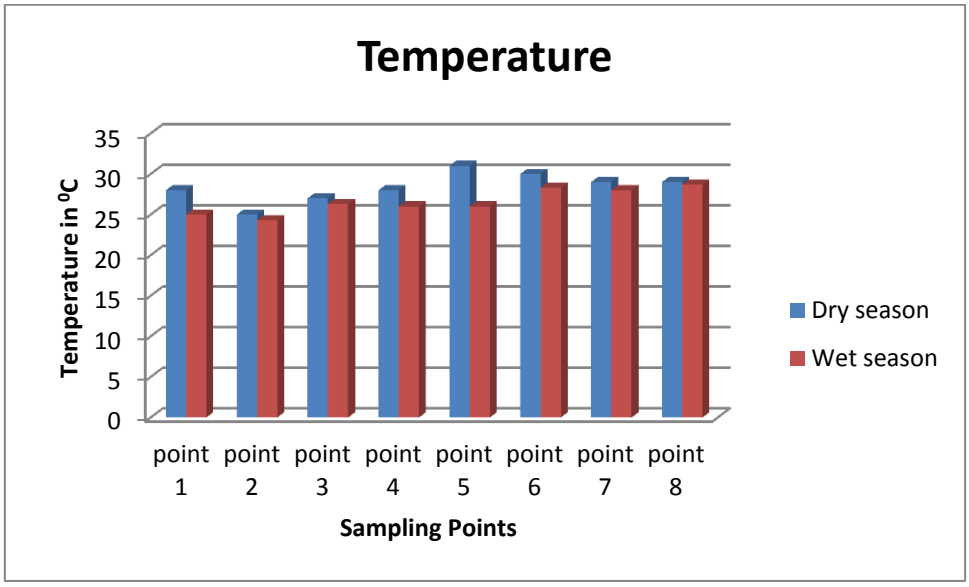
Table 3. Result of t-test showing seasonal variation in water quality

	Pair	Mean	STD. Error	STD. Deviat	N	d.f	T	p≤0.05	Rmk
Temp. (^{0}C)	Wet season	26.58	0.57	1.60	8	7	-3.263	0.014	SIG
	Dry season	28.38	0.65	1.85					
pH	Wet season	6.81	0.18	0.51	8	7	-1.651	0.143	NS
	Dry season	7.24	0.40	1.13					
Colour	Wet season	5.00	0.00	0.00	8	7			
	Dry season	5.00	0.00	0.00					
Turbidity	Wet season	7.46	0.43	1.22	8	7	4.453	0.003	SIG

STD Error= Standard Error, STD Deviat=Standard Deviation, df =Degree of Freedom, SIG=Significant, NS= Not Significant. Decision: If P-Value is less than significant level (0.05), then there is significant difference between the two seasons

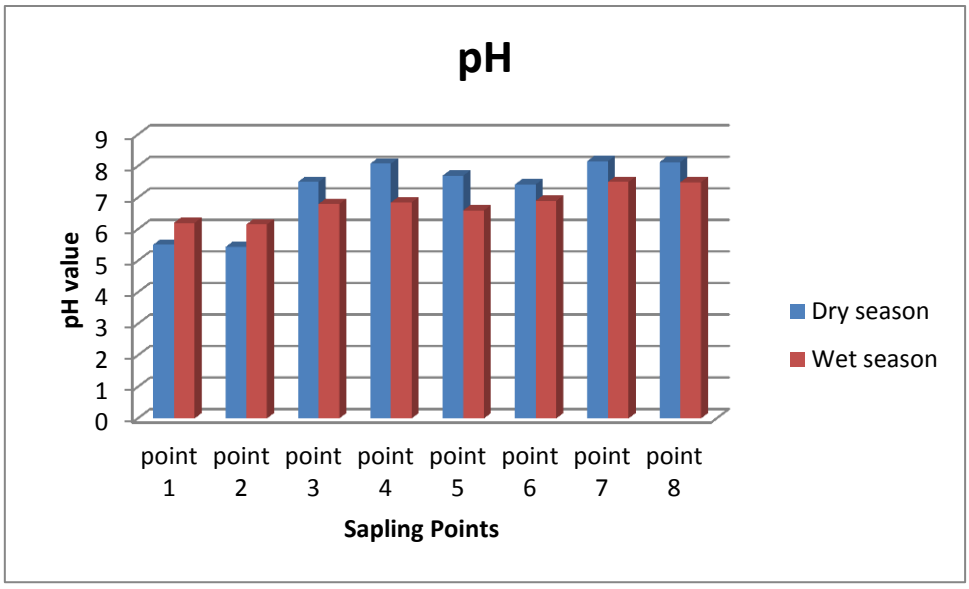
III. DISCUSSION

-Temperature: The temperature of water samples analyzed ranged between (25^{0}c to 31^{0}c) in the dry season. Sampling point 1 recorded higher value of temperature (31^{0}c). This was followed by sampling point 6 with (30^{0}c), point 7 and 8 with (29^{0}c), points I and 5 with (28^{0}c), point 3 with (27^{0}c) and point 2 with the lowest value of (25^{0}c). in the rainy season, the temperature readings ranged between (24.3^{0}c to 28.7^{0}c). Sampling point 8 was found to have the highest value (28.7^{0}c), point 6 (28.3^{0}c), point 7 (27^{0}c), point 3 (26.3^{0}c), point 4 and 5 (26^{0}c), point 1 (25^{0}c) and point 2 with lowest temperature of (24.3^{0}c). The values of temperature were found to be higher in the rainy season across all the sampling points. This conformed to the findings of Lawal et-al (2004) and Makwe and Chup (2013). The t- test conducted revealed significant seasonal variation on water temperature. Similar result was observed by Lianthuamluaia et-al (2013).



Bar charts showing seasonal variation on temperature

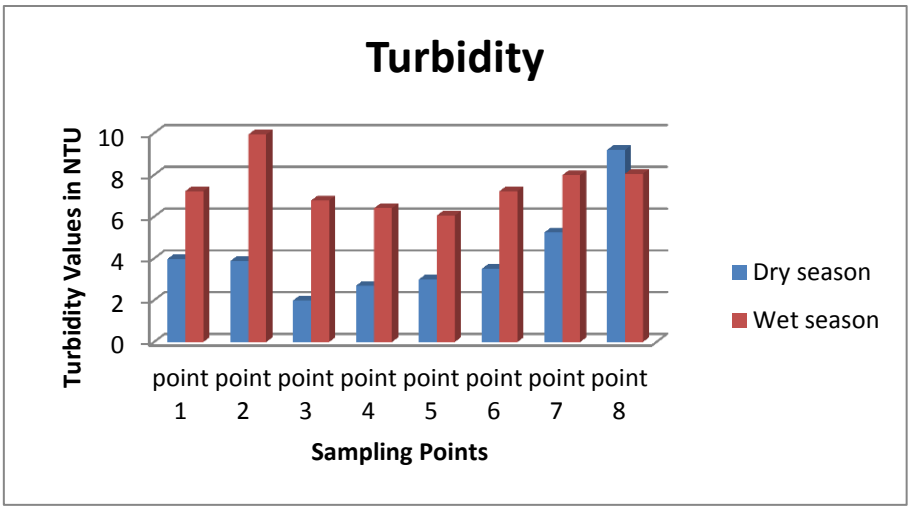
-pH: pH of water is the degree of acidity or alkalinity of water. It measures the concentration of hydrogen ion. The values of pH obtained in this study ranged between (5.44 to 8.16) in the dry season. Higher pH values were recorded from sampling points 7, 8, and 4 (8.16, 8.13 and 8.08), moderate pH values were obtained from points 5, 3 and 6 (7.7, 7.5 and 7.42). Lower pH values in the dry season (5.51 and 5.44) were found from points 1 and 2 respectively. During rainy season, pH values ranged between (6.15 to 7.5) with sampling points 7 and 8 having the highest values (7.5 and 7.49). Next to them was point 6 (6.9), point 4 (6.85), point 3 (6.80), point 5 (6.6), point 1 (6.2) and point 2 with the lowest value (6.15). pH values were slightly in rainy season than in the dry season. This result agreed with that of Lalparmawii and Mishra (2012) and Makwe and Chup (2013). It however contradicted the findings of Patale et-al (2012) and Efe et-al (2005). The seasonal variation in pH according to t-test was insignificant. All the pH values recorded in both dry and rainy season did not exceed the recommended water quality standards set by WHO (2006), NIS (2007) and FME (1997).



Bar chart showing seasonal variation on pH

Odour, Colour and Taste :- All the water samples analyzed in both the rainy and dry season were found to be odourless, colourless and tasteless. This made all the water sources safe for human consumption regarding these three physical parameters. The result of these three parameters showed no seasonal variation.

Turbidity (NTU):- Turbidity values varied between (2.0 to 9.2 NTU) in the dry season. A higher turbidity value of (9.2 NTU) was detected from point 8. This was followed by point 7 (5.25 NTU), point 1 (3.98 NTU), point 2 (3.88 NTU), point 6 (3.5 NTU), point 5 (3.0 NTU), point 4 (2.7, NTU) and point 3 with the lowest value of (2.0 NTU). In the rainy season, the values of turbidity ranged between (6.06 to 9.94 NTU). The values were obtained in this order point 2 (9.94 NTU), point 8 (8.06 NTU), point 7 (7.99 NTU), points 1 and 6 (7.23 NTU), point 3 (6.06 NTU), point 4 (6.41 NTU) and point 5 (6.06 NTU). Contrary to the findings of Efe et-al (2005), turbidity values in this research were found higher in the rainy season than in the dry season across all the sampling points except point 8 with higher value in the dry season, this occurs due to run-off in the rainy. However the result was in conformity with that of Makwe and Chup (2013) and Ibtisam and Abdul (2012). Student's t-test revealed significant seasonal variation in water quality between the two seasons. Comparison of the turbidity values with the water quality standard showed that, turbidity values for the dry season were within the allowable limit of (5.0 NTU) except for sampling point 8 that had values above the standard (9.2 NTU) because the well is not covered during the research work. However, in the rainy season, the values of all the sampling points were found above the recommended threshold of (5.0 NTU) set by WHO (2006), NIS (2007) and FME (1997).



Bar charts showing seasonal variation on turbidity

Result's Summary:

The selected water parameters were analysed using standard laboratory techniques. The results revealed that,

- ✓ . The temperature of water was found slightly higher in the dry season than in the rainy season with significant seasonal variation.
- ✓ . pH values were higher in the rainy season with insignificant seasonal variation. The values of pH across all the sampling points and Seasons were found within recommended levels of NIS (2007) and WHO (2006).
- ✓ . All the water samples were colourless, Tasteless and odorless.
- ✓ . The level of turbidity was found higher in the rainy season with significant seasonal variation. Turbidity values obtained in the dry season conformed to the NIS (2007) and WHO (2006) water quality standards. Turbidity results in the rainy season were found above the recommended standard.

IV. CONCLUSION

Some parameters recorded maximum levels in the dry season and others were at their maximum in rainy season. The average values of P^H (6.8) and Turbidity (7.5 NTU) were found slightly higher in the rainy season than in the dry season. That of temperature (28.5) was found slightly higher in the dry season than in the rainy season. Based on the analysis of the result, it may conclude that, the quality of water varies with the season. Temperature and turbidity showed significant seasonal variation and pH showed insignificant seasonal variation.

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