

## Physicochemical Analysis of Drinking Water from Various Sources in Billiri Local Government, Gombe State

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### ABSTRACT

Water is an essential element of life and it has great effects on human health. This study is conducted on physicochemical analysis of drinking water in Billiri local government of Gombe State. Water samples from eight (8) different locations of the local government were collected and water parameters such as pH, electrical conductivity, Total Dissolved Solid, Salinity, Turbidity, Alkalinity, and Total hardness were analysed. The results revealed that the tap water of Billiri local government is considered good for domestic use. Heavy metals presence such as; Nickel (Ni), Lead (Pb), Copper (Cu), Arsenic (As) and Cadmium (Cd) had a bit higher recommended value whereas, Chromium (Cr) has the average mean of 0.022 mg/L lesser than the standard value of 0.05mg/L, Manganese (Mg) having 0.107 mg/L lesser to 0.1 mg/L and Zinc (Zn) 1.012 mg/L compare to 5.0 mg/L WHO value.

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### INTRODUCTION

Water is an essential part of life as it plays a significant role for all living organism (1,5). It is an elixir that supports life from the simplest organisms; microorganisms, plants, animals and to the most complex living system known as human body (2). Water can be obtained from various sources which are majorly categorised into two distinct phase; the surface water sources and groundwater sources (3). Surface water includes water that flows across the land in the form of streamlets, springs, streams and rivers or it collects to form ponds, lakes and seas. In contrast, groundwater is located in aquifers beneath the earth surface (4). By constituents the combination of molecules of hydrogen and oxygen atoms with a chemical formula of H<sub>2</sub>O is known to form water and is the most abundant compound (70%) on earth surface (5).

Water is known to be significance due to its unique physical and chemical properties (1). Portable water supports public health and ensures economic growth (4). Whether it is used for domestic purpose, food production, feeding of

animals or recreation. Improved water supply and sanitation, as well as better management of water resources, can boost countries' health status of its individuals, economic growth and contribute significantly to poverty reduction (6). Physicochemical parameters of water are used to monitor the quality of drinking water as regards the safety of human contact and for the health of ecosystems (7).

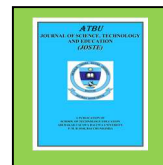
There is shortage of water in Billiri local government area of Gombe State and this is responsible for the quality of drinking water in the area. Poor quality drinking water lead to various health challenges. One of these challenges is that many areas are found with stained teeth that cannot be washed. The measurement of the quality can be done by water quality assessment. In this study, determination of water physicochemical parameter, presences of heavy metals and the quality of the drinking water of Billiri local government area of Gombe State was ascertain.

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## MATERIALS AND METHODS

### Collection of samples:

Eight (8) different water samples were collected aseptically from seven (7) different locations in Billiri local government area. The samples which are clearly labelled were transported to the laboratory for analysis.

### Study Area:

The study was conducted in Billiri local government area of Gombe State, Nigeria. Billiri local government was located in southern part of Gombe State with the coordinates of 9°51'55.62N and 11°13'34.46E. The seven (7) selected areas with the local government are; Lasale, Popandi, Baganje, Todi, Ladongor, Tal, Billiri town.

### Physicochemical analysis:

The parameters analysed comprises both physicochemical (such as pH, total dissolved solid, salinity, turbidity, total alkalinity, total hardness) and chemical properties which are related to the treatment of water (Na, Cl, Ca, K and Mg), ions (F, NO<sub>3</sub>, PO<sub>4</sub>, SO<sub>4</sub> and HCO<sub>3</sub>) as well as heavy metals (Ni, Cr, Pb, Cu, As, Zn, Cd, Mn and Fe) were determined using standard methods in triplicate as described by (8, 9) with modifications by (7, 10, 11).

### Data Analysis

Data were presented as mean values and standard error of mean (SEM).

## RESULTS AND DISCUSSION

### Results

**Table 1:** Physical Parameters of the Sample

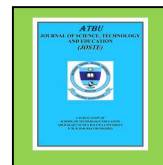
Samples	Physical properties						
	pH	E.C µS/cm	TDS mg/L	Salinity %	Turbidity NTU	T.H mg/L CaCO <sub>3</sub> eqv	Alkalinity mg/L
Lasale (A)	7.13	354.00	172.00	0.87	3.25	115.00	0.32
	7.18	356.00	173.00				
	7.15	357.00	174.00				
	Mean	7.15	355.67	173.00	0.87	3.25	115.00
SEM	0.03	1.23	2.15	0.00	0.00	0.00	0.00
Lasale (B)	7.28	289.00	143.00	0.69	3.54	84.00	0.56
	7.26	287.00	142.00				
	7.28	286.00	141.00				
	Mean	7.27	287.33	142.00	0.69	3.54	84.00
SEM	0.02	1.12	1.54	0.00	0.00	0.00	0.00
Popandi (C)	7.19	165.00	82.00	0.46	1.33	63.00	0.37
	7.18	167.00	84.00				
	7.18	164.00	83.00				
	Mean	7.18	165.33	83.00	0.46	1.33	63.00

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SEM	0.01	1.05	1.37	0.00	0.00	0.00	0.00
Bangaje (D)	7.05	236.00	117.00	0.58	2.25	75.00	0.18
	7.01	235.00	116.00				
	7.03	234.00	115.00				
Mean	7.02	235.00	116.00	0.58	2.25	75.00	0.18
SEM	0.02	1.42	2.73	0.00	0.00	0.00	0.00
Tal (E)	7.11	154.00	72.00	0.25	1.39	54.00	0.19
	7.13	156.00	73.00				
	7.14	158.00	74.00				
Mean	7.13	156.00	73.00	0.25	1.39	54.00	0.19
SEM	0.02	1.20	1.17	0.00	0.00	0.00	0.00
Billiri town (F)	6.96	593.00	242.00	1.34	6.73	186.00	0.15
	6.95	596.00	243.00				
	6.94	597.00	244.00				
Mean	6.95	595.00	243.00	1.34	6.73	186.00	0.15
SEM	0.02	2.11	2.08	0.00	0.00	0.00	0.00
Todi (G)	7.23	328.00	163.00	0.83	1.45	105.00	0.52
	7.21	325.00	162.00				
	7.25	329.00	164.00				
Mean	7.23	327.33	163.00	0.83	1.45	105.00	0.52
SEM	0.02	1.43	1.37	0.00	0.00	0.00	0.00
Ladgr (G)	6.15	469.00	232.00	1.02	4.53	137.00	0.08
	6.14	468.00	234.00				
	6.15	467.00	233.00				
Mean	6.15	468.00	233.00	1.02	4.53	137.00	0.08
SEM	0.01	1.25	1.23	0.00	0.00	0.00	0.00

**Table 2:** Anion Presences in the Water

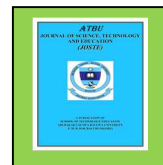
Sample/Parameters	Fe	NO <sub>3</sub>	PO <sub>4</sub>	SO <sub>4</sub>	Cl	HCO <sub>3</sub>
Lasale (A)	1.78	60.21	0.85	12.62	40.79	182.00
Lasale (B)	1.44	78.32	0.90	6.42	28.10	192.0
Popandi (C)	1.10	72.20	1.24	11.58	32.68	120.60
Baganje (D)	1.12	41.34	1.11	9.20	36.46	250.00
Tal (E)	1.40	50.36	1.79	24.41	36.62	170.00
Billiri town (F)	3.62	146.60	2.21	36.50	70.12	58.00
Todi (G)	1.36	59.21	1.12	6.28	51.44	207.60
Ladongor (H)	2.18	80.48	1.25	50.16	43.26	36.00

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**Table 3:** Water Treatment Chemicals Presences in the Sample

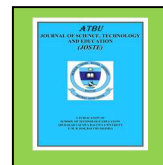
Samples	Concentrations mg/L			
	Na	K	Ca	Mg
Lasale (A)	2.53	5.61	34.39	28.42
	2.47	5.38	34.52	28.16
	2.35	5.42	34.75	28.32
Mean	7.15	5.47	34.55	28.30
SEM	0.02	0.34	1.43	0.52
Lasale (B)	1.28	3.47	26.72	17.38
	1.26	3.15	26.61	17.23
	1.19	3.64	26.58	17.59
Mean	1.24	3.42	26.64	17.40
SEM	0.01	0.07	1.12	0.29
Popandi (C)	0.79	2.73	14.68	9.56
	0.75	2.56	14.37	9.28
	0.76	2.41	14.25	9.34
Mean	0.77	2.57	14.43	9.39
SEM	0.01	0.05	0.52	0.13
Bangaje (D)	1.15	1.38	23.54	12.23
	1.09	1.24	23.65	12.79
	1.11	1.52	23.39	12.54
Mean	1.12	1.38	23.53	12.52
SEM	0.02	0.03	1.23	0.25
Tal (E)	0.63	1.87	9.45	7.67
	0.61	1.59	9.23	7.59
	0.67	1.52	9.64	7.35
Mean	0.64	1.66	9.44	7.54
SEM	0.01	0.03	0.58	0.31
Billiri town (F)	14.25	23.59	62.43	43.18
	14.73	23.32	62.63	43.76
	14.46	23.75	62.05	43.24
Mean	14.48	23.56	62.37	43.39
SEM	0.16	1.11	1.34	1.28
Todi (G)	2.38	5.39	21.28	25.53
	2.32	5.45	21.79	25.34

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Samples	Concentrations mg/L			
	Na	K	Ca	Mg
	2.37	5.23	21.46	25.83
Mean	2.36	5.36	21.51	25.57
SEM	0.01	0.04	0.52	0.87
Ladongor (H)	23.14	18.73	43.56	36.42
	23.56	18.64	43.21	36.53
	23.82	18.29	43.37	36.69
Mean	23.51	18.55	43.38	36.55
SEM	0.01	1.32	1.09	0.42

**Table 4:** Heavy metals presences in the sample

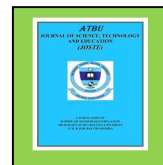
Samples	Concentration of Elements (mg/L)								
	Ni	Cr	Pb	Mn	Cu	As	Zn	Cd	Fe
Lasale (A)	0.0172	0.0066	N.D	0.0531	0.0328	N.D	1.3328	0.0051	0.0325
	0.0175	0.0062	0.0000	0.0532	0.0325	0.0000	1.3342	0.0050	0.0332
Mean	0.0174	0.0064	0.0000	0.0532	0.0326	0.0000	1.3335	0.0051	0.0329
SEM	0.0001	0.0001	0.0000	0.0000	0.0001	0.0000	0.0005	0.0000	0.0002
Lasale (B)	0.0728	0.0029	N.D	0.0159	0.0065	0.0024	3.5909	0.0086	0.0153
	0.0726	0.0022	0.0000	0.0157	0.0063	0.0025	3.5912	0.0087	0.0150
Mean	0.0727	0.0026	0.0000	0.0158	0.0064	0.0025	3.5911	0.0087	0.0152
SEM	0.0001	0.0002	0.0000	0.0001	0.0001	0.0000	0.0001	0.0000	0.0001
Popandi (C)	0.0344	0.0165	N.D	0.0219	0.0013	N.D	0.2147	0.0092	0.0855
	0.0345	0.0164	0.0000	0.0215	0.0017	0.0000	0.2145	0.0093	0.0857
Mean	0.0345	0.0165	0.0000	0.0217	0.0015	0.0000	0.2146	0.0093	0.0856
SEM	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001
Bangaje (D)	0.1801	0.0103	N.D	0.0823	0.0126	0.0196	0.7283	0.0116	0.0564
	0.1806	0.0102	0.0000	0.0824	0.0124	0.0192	0.7256	0.0112	0.0558
Mean	0.1804	0.0103	0.0000	0.0824	0.0125	0.0194	0.7270	0.0114	0.0561
SEM	0.0002	0.0000	0.0000	0.0000	0.0001	0.0001	0.0010	0.0001	0.0002
Tal (E)	0.0213	0.0040	N.D	0.0227	0.0025	N.D	0.1023	0.0016	0.0635
	0.0214	0.0041	0.0000	0.0226	0.0023	0.0000	0.1028	0.0014	0.0628
Mean	0.0214	0.0041	0.0000	0.0227	0.0024	0.0000	0.1026	0.0015	0.0632

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SEM	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0002	0.0001	0.0002
Billiri town (F)	0.0177	0.1238	0.0890	0.6038	0.2135	0.4252	3.2317	0.0731	0.1409
	0.0170	0.1243	0.0892	0.6032	0.2128	0.4245	3.2312	0.0732	0.1402
Mean	0.0174	0.1241	0.0891	0.6035	0.2132	0.4247	0.0315	0.0732	0.1406
SEM	0.0002	0.0003	0.0001	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001
Todi (G)	0.0818	0.0628	N.D	0.0723	0.0571	0.0059	0.0941	0.0256	0.0156
	0.0817	0.0625	0.0000	0.0728	0.0565	0.0058	0.0940	0.0252	0.0154
Mean	0.0818	0.0627	0.0000	0.0726	0.0568	0.0059	0.0941	0.0254	0.0155
SEM	0.0000	0.0001	0.0000	0.0002	0.0001	0.0000	0.0000	0.0001	0.0001
Ladongor (H)	0.1521	0.0610	0.0813	0.0432	0.0725	0.2026	2.1572	0.3164	0.1870
	0.1523	0.0614	0.0815	0.0434	0.0721	0.2021	2.1575	0.3169	0.1875
Mean	0.0522	0.0617	0.0814	0.0433	0.0723	0.2024	2.0074	0.367	0.1873
SEM	0.0001	0.0000	0.0001	0.0001	0.0001	0.0002	0.0001	0.0000	0.0002

### DISCUSSION OF FINDINGS

pH is a prominent physical property of water though; it has no direct impact on humans. pH determines the degrees of acidity or alkalinity of a substance (12). The pH value of 6.5 to 8.5 was recorded for this study with the average mean pH of 7.01. This shows that the water is in its good quality form in regards to its pH. Both organic and inorganic compounds present in water influence the pH value of the water. An alteration in water pH is attributed to change in other physicochemical parameters (11). The maximum allowed value of electrical conductivity of drinking water is up to 1000  $\mu\text{S}/\text{cm}$ . The WHO recommended electrical conductivity of drinking water is 900  $\mu\text{S}/\text{cm}$ . Electrical conductivity (EC) of the water sample recorded in this study was within the range of 154.00  $\mu\text{S}/\text{cm}$  to 597.00  $\mu\text{S}/\text{cm}$ . The average mean EC of 327.71  $\mu\text{S}/\text{cm}$  was observed. Therefore, based on EC, the water is safe for consumption. Salinity refers to concentration of dissolved salt in water. Freshwater salinity is usually <1%. The lowest and highest salinity value of 0.25% and 1.02% was recorded with the average mean of 0.76%. Alkalinity of water is the ability of the water to neutralize acids and control corrosion. In this study, alkalinity of the water sample as recorded was 0.25% and 1.02%

respectively as lowest and highest value with an average mean alkalinity value of 0.30 mg/L.

The total dissolved solid of less than about 600mg/L of water is generally considered as wholesome (13). The TDS of range 72.00 mg/L to 244.00 mg/L with an average mean of 153.25 mg/L was recorded which is within the acceptable range. Higher or lower TDS value of water has no any health significance.

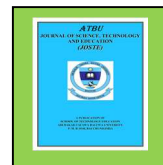
Hardness of water is associated with Calcium and Magnesium precipitations. Total hardness (TH) of Calcium ion threshold based on recommendation is 100-300 mg/L (13). Consumer tolerates water hardness in excess of 500 mg/L. In this study; the average TH recorded was 102.38mg/L. To evaluate the quality of the water, anions and other water treatment chemical parameters were observed and compared with the standard desirable limits approved by World health organization (13). Based on the presence of anion present in the water, positive ions such as; Iron (Fe), Nitrate ( $\text{NO}_3$ ), Phosphate ( $\text{PO}_4$ ), Sulfate ( $\text{SO}_4$ ), Chlorine (Cl) and Bicarbonate ( $\text{HCO}_3$ ) records the average mean of 1.75, 73.59, 1.31, 19.65, 42.43 and 12.16 respectively. Water treatment chemicals such as Sodium (Na), Potassium (K), Calcium (Ca) and Magnesium (Mg) also had the average mean of 6.41, 7.45,

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29.48 and 22.58 respectively. From the point of view, the sample water is safe for drinking.

From the laboratory analysis result, heavy metals detected in the water sample were mostly higher than the recommended value of the World Health Organization (13). It was found that Chromium (Cr) has the average mean of 0.022 mg/L lesser than the standard value of 0.05mg/L, Manganese (Mg) having 0.107 mg/L lesser to 0.1 mg/L and Zinc (Zn) 1.012 mg/L compare to 5.0 mg/L recommended value. Other metals such as Nickel (Ni), Lead (Pb), Copper (Cu), Arsenic (As) and Cadmium (Cd) recorded a value higher than the expected figure.

### CONCLUSION

The study on physicochemical parameters of tap drinking water conducted in Billiri local government area of Gombe State showed that, the water parameters observed ascertained the water to be portable for domestic use based on the World Health Organization recommendations. Though, in some sampling sites, the values were found to be slightly higher than the standard values but still within permissible limits. Therefore, the study found that the maximum parameters were not at a level of pollution which may not cause harmful effect to the consumers.

### RECOMMENDATION

Further research work can be carried out on physicochemical parameters of drinking water in Billiri comparing the various sources of water of the inhabitants.

### FUNDING/ACKNOWLEDGEMENT

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edition incorporating the first and second  
addenda