Available online at www.jobpcr.com

ISSN-2394:3076
CODEN(USA) : JBPCBK

Journal of Biological Pharmaceutical And Chemical Research, 2023, 10(2): 50-58

(*http://www.jobpcr.com/arhcive.php*)

Evaluation of Fluoride levels in some selected local government of Taraba State Nigeria

Omale Owoicho Precious[1]*, Adelagun A.O Ruth[1], Oko Odiba John[1],

[1]Department of chemical sciences, Federal University Wukari, Nigeria.

Corresponding author: omaleprecious7@gmail.com

ABSTRACT

Water fluoridation has been considered a global environmental challenge in the past decade since most humans rely on water for their daily needs. The purpose of this study was to determine the fluoride concentrations in water sources in some parts of Taraba State, Nigeria. An aggregate of twenty-one (21) water samples were retrieved from different sources in twelve (12) diverse points within the study area and assessed for its physico-chemical composition with emphasis on fluoride content following standard field and laboratory procedures. Fluorides samples shows general concentration ranges from 0.49-3.57 mg/L. Zing, Yakoko and Monkin samples from Zing LGA recorded 3.57 mg/L, 3.15 mg/L and 2.15 mg/L respectively for well samples and 2.05 mg/L, 2.2 mg/L and 1.79 mg/L respectively for Hand dung borehole, similarly, Gulum and Kona water samples from Jalingo LGA recorded 2.7, 2.15 respectively for well samples and 1.8 mg/L, 1.7 mg/L borehole also1.63 mg/L, 1.65 mg/L, 1.66 mg/L for borehole,1.55 mg/L, 1.74 mg/L, 1.90 mg/L for well respectively. It was observed About 10% of the water samples complied with the minimum (0.5 mg/L) and maximum (1.5 mg/L) threshold values for fluoride in drinking water (WHO, 2017). About 86% of samples were found to exceed the maximum permissible limits, while 4% of the samples had fluoride concentrations lower than the minimum acceptable limit (0.5 mg/L). The results of the study showed that high fluoride concentrations in the water samples were due to the geological and chemical composition of the underlying deep aquifers as well as to contributions from anthropogenic activities such as the use of fertilizer and pesticides in the area

Keywords: Water sources, Fluoride, Physicochemical, pollutants.

INTRODUCTION

Water is a finite and fragile natural resource, and the majority of it is held in the oceans as salt water (Barlow, 2003). As a result of effluents and pollutants, drinking water in poor nations, and Nigeria in particular, is prone to toxins (Dabi and Jidauna, 2010; Jidauna *et al.,* 2013). In many industrialised and emerging nations, common rural water sources including boreholes, wells, and streams are the most valued natural water sources because of their huge storage capacities and dependability during dry spells or droughts (Ali *et al*., 2016). Poor waste management systems are a problem in the majority of Nigerian communities, particularly in rural areas. The only sources of water for drinking and other uses in the majority of rural settlements in Nigeria are surface (ponds, streams, and rivers) and groundwater. It is difficult to build institutional structures that will guarantee that drinking water facilities or sources are safe from contamination, maintained, and managed in an effective, equitable, and sustainable way, making the provision of safe drinking water in rural regions a significant problem.

One of the biggest global environmental pollution concerns recently identified and acknowledged is fluoride poisoning of surface and underground water (Mahamud, 2012). An essential mineral called fluoride can be found in extremely small amounts in nature (Oladoja, 2016). According to Fawell *et al.,* (2006), Mamatha and Rao (2010), the majority of fluoride in groundwater is geogenic, meaning it comes from the breakdown of rocks that contain fluoride ions. Due to fluoride's profound impact on human physiology, its inclusion in drinking water sources is a contentious issue on a global scale (Oladoja *et al.,* 2016). A sufficient amount of fluoride (between 0.5 and 1.5 mg/L) can prevent dental caries, especially in young children under the age of 8 but a deficiency can lead to cardiovascular disease, osteoporosis, and dental caries (Fawell and Nieuwenhuijsen, 2003).

This study aimed at determining the fluoride concentration levels of selected water sources from three (3) local governments in Taraba State namely; Zing, Jalingo and Karim-Lamido, LGA.

MATERIAL AND METHODS

Reagents

All materials and reagent used were of analytical standard.

Study Area

The study areas are within Taraba State, which is geographically located at 8°0'0"N 10°30'0"E. Taraba State shares borders with six neighbouring states in Nigeria, including Plateau, Benue, Bauchi, Adamawa, Gombe, and Nassarawa States. (Fig. 3.1). The area of Taraba State is 54,473 square kilometres. The states of Plateau, Nassarawa, and Benue border Taraba state to the west. Adamawa State and the Republic of Cameroon border Taraba state to the east. The State is mostly located in the centre of Nigeria and has an undulating topography with a few isolated mountainous features, including the beautiful and well-known Mambilla Plateau. The majority of the state is in the tropical zone, and its southern and northern halves both have grassland as vegetation.

Sample collection

In five chosen local government areas, namely Zing (Zing, Yakok, and Monkin), Jalingo (Kona, Gulum, and Maigwa), and Karim-Lamido (Karim, Mangai, and Mutumdaya), Taraba State, a total of twenty-one (21) samples were randomly collected from three different sampling points (three hand-dug well samples, three borehole water samples, and three samples from the surface Stream). Before soaking in diluted HCl (0.05M) for about 24 hours, sample containers were properly cleaned with detergents, rinsed with water, and then filled with distilled water. After that, they were dried by air in a dust-free setting. Containers were washed twice with pertinent samples at the collecting station, then filled with samples and securely corked.

Determination of Water Quality Parameters

Multi-parameter Water Quality Monitor was used to measure the physicochemical parameters which includes pH, Temperature TDS, Dissolved Oxygen (DO), Turbidity, Hardness, Alkalinity, Electrical conductivity (EC), Chloride, Nitrate, Phosphate, Magnesium, Calcium and sulphate. Prior to analysis the meter was calibrated to ensure accurate quality measurement.

Determination of Fluoride Ion Concentration

SPANDs Spectrophometric methods was used for the determination of fluoride concentrations of the collected water samples.

Table 1: showing all the keys for sampling points and water sources.

LGA	**Location**	**Water Source/Keys**		
		Borehole	**Well**	**Stream**
Zing	Zing	ZA1	ZA2	ZS
	Yakoko	ZB1	ZB2	
	Monkin	ZC1	ZC2	
Jalingo	Kona	JA1	JA2	JS
	Gulum	JB1	JB2	
	Magwai	JC1	JC2	
Karim-Lamido	Karim	KA1	KA2	KS
	Mangai	KB1	KB2	
	Mutum-daya	KC1	KC2	

RESULT AND DISCUSSION

Table 2 shows the mean concentration of fluoride in mg/L in water samples from the three (3) water sources and the sample area.

The results showed level of fluoride concentration from water sourced from borehole and well in Zing, Karim-Lamido and Jalingo were above WHO permissible limits while the fluoride concentration of stream from zing and Jalingo were within the WHO permissible limit while that of Karim-Lamido fall below the WHO permissible limits.

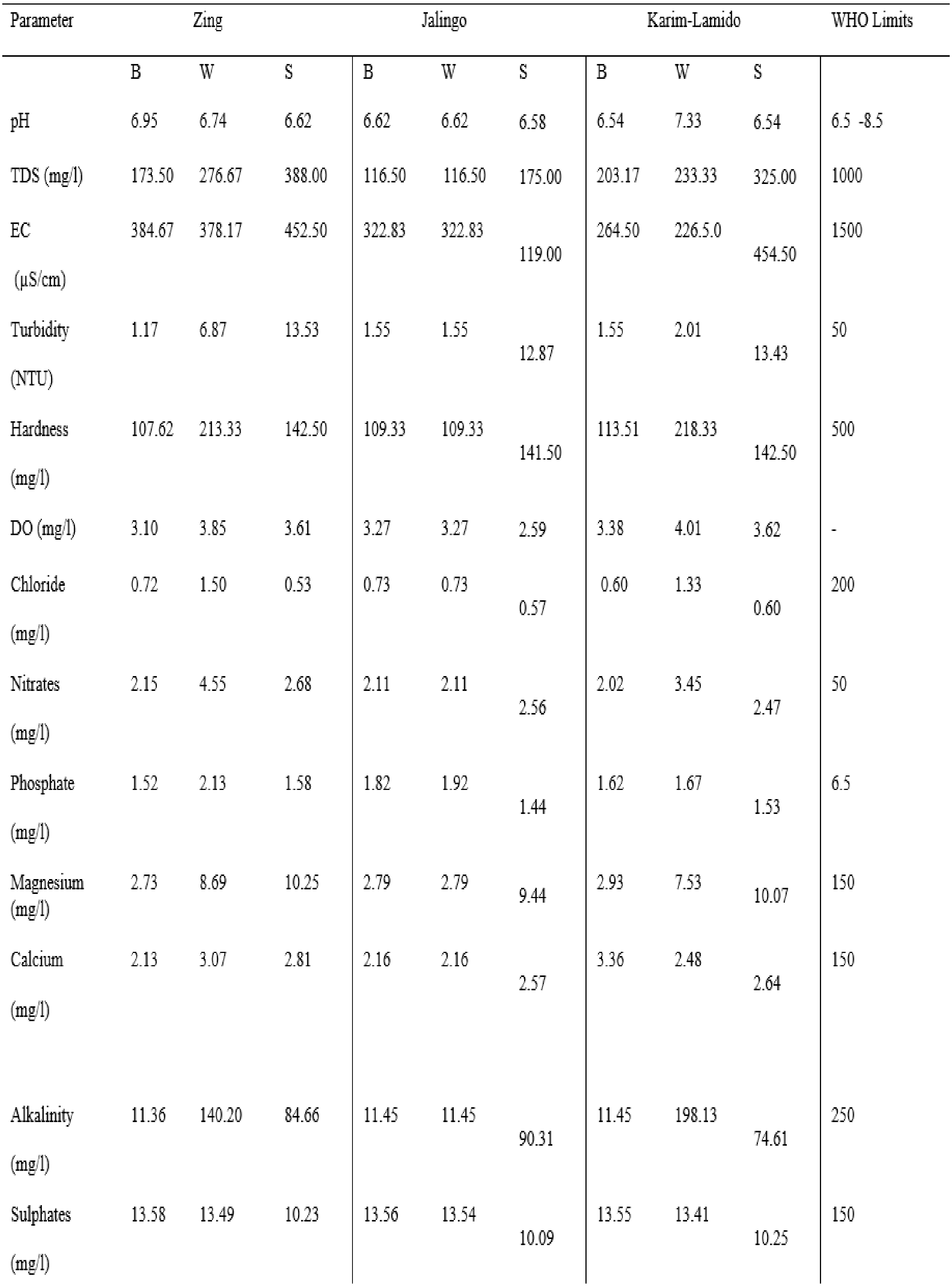
LGA	**Location**	**Concentration (mg/L)**
Zing	ZA1	2.08
	ZB1	2.30
	ZC1	1.80
	ZA2	3.56
	ZB2	3.15
	ZC2	2.16
	ZS	0.72
Jalingo	JA1	1.81
	JB1	1.78
	JC1	1.73
	JA2	1.83
	JB2	1.78
	JC2	1.73
	JS	0.68
Karim-lamido	KA1	1.63
	KB1	1.65
	KC1	1.66
	KA2	1.88
	KB2	1.74
	KC2	1.90
	KS	0.49

The range of fluoride concentrations is 0.49 to 3.57 mg/L. According to the WHO's 2017 report, just 10% of the water samples met the fluoride threshold levels for drinking water, which are 0.5 mg/L and 1.5 mg/L, respectively. While 4% of the samples had fluoride concentrations below the permitted minimum (0.5 mg/L), 86% of the samples were found to surpass the maximum permissible limits. Values for both borehole (2.30 mg/L), well (3.56 mg/L) and stream (0.39 mg/L) water reported in Zing, Jalingo and Karim-lamido LGA were generally similar to those reported by iwar *et al.*, (2021). Several factors, including the chemical makeup of the traversing groundwater, its contact or residence time with fluorine-bearing materials found in the geological formations, and a variety of anthropogenic activities, can be linked to high fluoride levels in water samples from Zing, Jalingo, and Karimlamido. . From the study conducted a significant variation of fluoride concentration was observed in different locations. It was observed that the fluoride concentration in Zing, Jalingo and Karim-Lamido were higher than the WHO permissible limit, this results is in accordance with a research conducted by Munta *et al.*, (2020).

Fluoride concentration levels recorded from boreholes and hand dug wells in Zing, Jalingo, and Karim-lammido are significantly higher than those obtained by Malum *et al.,* (2019) for boreholes and handdug wells in Kaltungo, Gombe state, Nigeria. Fluoride concentrations in water above 1.5 mg/L have been linked to dental fluorosis in humans (particularly children), while excessive concentrations have been linked to skeletal fluorosis in children and adults (WHO, 2004). This could explain the mottling and colouring of teeth in the study area (Zing, Jalingo, and Karim-lamido). Fluoride concentrations are sometimes described as a two-edged sword because low concentrations can promote tooth cavities (Yousef *et al.,* 2018). According to recent research, it is believed that high fluoride consumption can cause cancer in humans (WHO, 2004). Thus, fluoride removal from drinking water supplies is highly essential in the provision of potable drinking water.

Mean Concentration Values of water quality parameter with WHO standard

A presentation summary of Water Quality Parameter, samples from all the three (3) sources of water (Borehole, Well and Stream).



Parameter	Zing			Jalingo			Karim-Lamido			WHO Limits
	B	W	S	B	W	S	B	W	S	
pH	6.95	6.74	6.62	6.62	6.62	6.58	6.54	7.33	6.54	6.5 -8.5
TDS (mg/l)	173.50	276.67	388.00	116.50	116.50	175.00	203.17	233.33	325.00	1000
EC (µS/cm)	384.67	378.17	452.50	322.83	322.83	119.00	264.50	226.5.0	454.50	1500
Turbidity (NTU)	1.17	6.87	13.53	1.55	1.55	12.87	1.55	2.01	13.43	50
Hardness (mg/l)	107.62	213.33	142.50	109.33	109.33	141.50	113.51	218.33	142.50	500
DO (mg/l)	3.10	3.85	3.61	3.27	3.27	2.59	3.38	4.01	3.62	-
Chloride (mg/l)	0.72	1.50	0.53	0.73	0.73	0.57	0.60	1.33	0.60	200
Nitrates (mg/l)	2.15	4.55	2.68	2.11	2.11	2.56	2.02	3.45	2.47	50
Phosphate (mg/l)	1.52	2.13	1.58	1.82	1.92	1.44	1.62	1.67	1.53	6.5
Magnesium (mg/l)	2.73	8.69	10.25	2.79	2.79	9.44	2.93	7.53	10.07	150
Calcium (mg/l)	2.13	3.07	2.81	2.16	2.16	2.57	3.36	2.48	2.64	150
Alkalinity (mg/l)	11.36	140.20	84.66	11.45	11.45	90.31	11.45	198.13	74.61	250
Sulphates (mg/l)	13.58	13.49	10.23	13.56	13.54	10.09	13.55	13.41	10.25	150

Keys: S = Stream, W = Well, B = Borehole

The overall pH value of the samples ranged from 6.54 to 7.33. The lowest value was observed for water from a hand dug well located in KA2 similarly as reported by Oko *et al*., (2014) while the highest value was observed for water obtained in KB2. The water samples exhibited great variability over the study area in terms of its pH values and were adjudged as slightly acidic to slightly alkaline in composition. However, for drinking purposes, alkaline water is recommended as it helps in the regulation of the physiological and metabolic functions in humans (WHO, 2017).

In the present study, water from well and stream sources had higher amount of dissolved solids (397.50 and 388.0 mg/L), all in Zing LGA, correlating with their high turbidity and electrical conductivities. Overall Mean TDS value of 232.57 mg/L obtained for water samples in the study area were however lower than the WHO and NDWQS limits of 1000 and 500 mg/L.

From borehole water sources, lowest electrical conductivity (199.00 µS/cm) was recorded for sample obtained at JS, while highest value (426.5 µS/cm) was recorded for sample obtained at ZB1. On the other hand, electrical conductivities of stream water ranged from 119 to 454.50 µS/cm, with the least value observed in water from JS and highest value in water from KS. The observed mean (298.99 µS/cm) for the total water samples was lower than the permissible level (1500 µS/cm) recommended by WHO and NSDWQ for drinking water quality (NSDWQ, 2007; WHO, 2020).

Chlorides in borehole water ranged from 0.55 mg/L in KA2 to 1.33 mg/L in KB2. In well sources, values ranged from 0.59 mg/L in JC2 to 78.68 mg/L in IA2, while in stream sources, they ranged from 0.535 to 18.35 mg/L with lowest and highest values observed at Zing LGA. Overall assessment of the chloride content among all water samples revealed a mean value of 19.12 mg/L. Zing, Jalingo and karim-lamido had lower values compared to what was reported by Iwar *et al.,* (2021) for water samples in Makurdi, although the values from the overall assessment were far below the minimum permissible recommended by WHO, (2020) and NSDWQ, (2007).

Nitrate concentrations in the water samples from borehole, well and stream sources in the study area ranged from 1.58 to 5.89 mg/L, with an overall mean value of 2.49 mg/L. Highest value was observed in well water at ZC2. It was observed that despite the high use of agro-chemicals and fertilizers by farmers in the study area, there was no violation. All samples fell with acceptable limits of 50 mg/L established in standards (NSDWQ, 2007; WHO, 2020).

Turbidity values from borehole sources ranged from 0.885 to 1.745 NTU with least and highest values observed in in ZS and KS, while those from well and stream sources ranged from 1.47 NTU in JB2 to 7.86 NTU in ZC2 and 10.68 NTU to 13.53 NTU in respectively. The overall turbidity value of the water samples ranged from 0.885 to 13.53 NTU, with a mean value of 6.90 NTU. Furthermore total water samples were lower than 50 NTU acceptable limit (NSDWQ, 2007; WHO, 2020).

Phosphate values in borehole water ranges from 1.44-2.13 mg/l with no sample showing violation. All values were lower than the acceptable limit of 6.5 mk/L (NSDWQ, 2007; WHO, 2020).

Hardness Values for borehole water (107.67 mg/ L to 113.51 mg/L), well water (109.33 to 218.33 mg/L) and stream water (141.5 to 142.5 mg/L). High concentrations of carbonates in the study area may have implications for pipes, water heating appliances, soap and detergent efficiency, fabric colour, and human skin; however, they may be beneficial as they may contribute to the intake of essential minerals like calcium and magnesium, despite increasing the boiling point of water. The overall hardness mean of the samples indicate that they fall within the safe recommended limits (500 mg/L) for drinking water (NSDWQ, 2007; WHO, 2020).

In the current study, all samples were far below the WHO (2020) acceptable limits of 150 mg/L for Calcium in drinking water, with values ranging from 2.16-3.36, and mean value of 2.17 mg/L. Hence, the water is free from health hazards and if excess calcium, it can cause depression of the function of muscles and nervous tissues. There was no significant variation from the water samples in all the locations and sources obtained.

Generally, water samples from boreholes in the present study displayed lower magnesium values (2.75 to 2.90 mg/L) than their counterparts from wells (2.79 to 8.60 mg/L) and streams (9.44 to 10.24 mg/L) These values were far below the permissible value for the magnesium established for drinking water and therefore pose no threat (NSDWQ, 2007; WHO, 2020). Far lower values were reported by Musa *et al.,* (2019) in their study within North central, Nigeria.

CONCLUSION

With over 90% of the samples having pH values that are in the acidic range, the physico-chemical properties of the samples showed significant variation among the sources and locations. Fluoride concentrations were found to be high in Zing, Karim-Lamido, and Jalingo; this may be the cause of the area's residents' brown and coloured teeth.

ACKNOWLEDGMENT

The research team wish to acknowledge the support and contribution of Mr. Bando Christopher David and Mr. David Ephraim Haruna towards ensuring the success of this research**.**

REFERENCE

[1] Ali, S., Thakur, S. K., Sarker, A., and Shekhar, S. (**2016**). Worldwide Contamination of Water by Fluoride. *Environmental Chemistry Letters*. Https://Doi.Org/10.1007/ S10311-016-0563-5.

[2] Barlow, P. M. (**2003**). Ground Water in Freshwater-Saltwater Environments of the Atlantic Coast (Vol. 1262). Washington, DC: US Department of the Interior, US Geological Survey.

[3] Dabi, D. D., & Jidauna, G. G. (**2010**). Climate Change and Local Perception in Selected Settlement in the Sudano-Sahelian Region of Nigeria. *Journal of Environmental Sciences and Resources Management*, *2*, 1-12.

[4] Fawell, J. And Nieuwenhuijsen, M. J. (**2003**). Contaminants in Drinking Water: Environmental Pollution and Health. *British Medical Bulletin* 68.1: 199-208.

[5] Fawell, J., Bailey, K., Chilton, J., Dahi, E. And Magara, Y. (**2006**). Fluoride in Drinking-Water. IWA Publishing.

[6] Gwaha, A. M. (**2017**). Dental Fuorosis In A Rural Nigerian Community: Is The Water To Blame? (P. 64). Thesis, Department of Natural and Environmental Sciences, American University of Nigeria.

[7] Iwar, R. T., Utsev, J. T. And Hassan, M. (**2021**). Assessment of Heavy Metal and Physico-Chemical Pollution Loadings of River Benue Water at Makurdi Using Water Quality Index (WQI) and Multivariate Statistics. *Applied Water Science*, 11(7), 124.

[8] Jidauna, G. G., Dabi, D. D., Saidu, J. B., Abaje, B., & Ndabula, C. (**2013**). Assessment of Well

Water Quality in Selected Location in Jos, Plateau State, Nigeria. *International Journal of Marine, Atmospheric & Earth Sciences*, *1*(1), 38-46.

[9] Mahamud, H. S. (**2012**). Pilot Column Studies on Adsorption of Fuoride onto Coated High Aluminium Bauxite Ore (HABO) and Charcoal. Msc. Thesis, Department Of Civil Engineering, Kwame Nkrumah University of Science and Technology. *Ghana*, 100pp

[10] Malum, J. F., Onoja, S. B. And Udochukwu, M. O. (2019). Prevalence of Fluoride Contamination In Ground Watersources In Kaltungo, Gombe State, Nigeria. *International Journal of Trend in Research and Development*, 6 (1), 2394, 2403.

[11] Mamatha, P. And Rao, S.M. (**2010**). Geochemistry of Fluoride Rich Groundwater in Kolar and Tumkur Districts of Karnataka. *Environ Earth Sci* 61: 131-142.

[12] Oko, O. J., Aremu, M. O., Odoh, R., Yebpella, G. And Shenge, G. (**2014**). Assessment Of Water Quality Index Of Borehole And Well Water In Wukari Town, Taraba State, Nigeria.

[13] Oladoja, N. A., Helmreich, B. And Bello, H. A. (**2016**). Towards The Development of a Reactive Filter from Green Resource for Groundwater Deflouridation. *Chemical Engineering Journal* 301: 166-177.

[14] WHO. (**2017**). One Health. *World Health Organization*, *736*.

[15] WHO. (**2006**). the World Health Report: Changing History. Switzerland.

[16] WHO. (**2012**). Guidelines For Drinking Water Quality, 4th Edition Incorporating The First Addendum. Switzerland.

[17] WHO. (**2014**). Guidelines for Drinking Water Quality, 1(3), Switzerland.

[18] WHO/UNICEF, (**2015**). WHO/UNICEF Joint Monitoring Program for Water Supply and Sanitation (JMP). *UN Water.*

[19] Yousefi, M., Ghoochani, M. And Mahvi, A. H. (**2018**). Health Risk Assessment to Fluoride in Drinking Water of Rural Residents Living In the Poldasht City, Northwest Of Iran. *Ecotoxicology and Environmental Safety*, 148, 426-430