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CORRELATION OF SOME PHYSICO-CHEMICAL PARAMETERS IN WATER SAMPLES FROM DIFFERENT WATER SUPPLIES IN ABA WITH WORLD HEALTH ORGANIZATION (WHO) STANDARD

Arvin Nwakulite[1], *Emmanuel Ifeanyi Obeagu[1,2], Lucy Onyinyechi Ezenofor[1], Richard Eze[1], C.C.N. Vincent[3], Adaobi Maryann Ibekwe[4], Nkiruka Millicent Amadi[5] and Onyinye Cecelia Arinze-Anyiam[6]

[1]Department of Medical Laboratory Science, Madonna University, Elele, Rivers State, Nigeria.
[2]Department of Medical Laboratory Science, Imo State University, Owerri, Nigeria.
[3]Department of Nursing Science, Imo State University, Owerri, Nigeria.
[4]Department of Nursing Science, Nnamdi Azikiwe University,Nnewi Campus, Nnewi, Anambra State, Nigeria.
[5]Department of Medical Laboratory Science, Enugu State University of Science and Technology, Enugu State, Nigeria.
[6]Haematology and Blood Transfusion Science Unit, Department of Medical Laboratory Science, Kwara State University, Malete, PMB 1530, Ilorin, Nigeria.

***Corresponding Author: Emmanuel Ifeanyi Obeagu**

Department of Medical Laboratory Science, Madonna University, Elele, Rivers State, Nigeria.

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ABSTRACT

This research was conducted to correlate some physicochemical parameters in water samples from different water supplies in Aba with WHO standard. 50 water samples were divided into 10 groups of 5 samples per group. The physicochemical parameters such as pH, turbidity and presence of heavy metals such as Lead (Pb) and Zinc (Zn) were determined to investigate their quality using standard methods and compared with the World Health Organization (WHO) standards. The data obtained was Analyzed using Statistical Package for Social Science 20 (SPSS 20) and values were considered significant at $p<0.05$ and insignificant at $p>0.05$.The result shows that pH of borehole, rain, pool and stream water with values 5.30±0.45, 7.54±0.55, 6.08±1.11, 5.64±0.50 respectively varied significantly ($p<0.05$) when compared to WHO standard (6.34±1.33). The turbidity of bottle, rain and satchet water with values 3.00±2.74, 1.00±2.24, 1.00±2.24 respectively did not vary significantly ($p>0.05$) when compared to WHO standard (3.00±1.58), while the river, pool and stream samples were significant ($p<0.05$). The Zn concentration of borehole, river, well, bottle, rain, satchet, pond, pool and stream water with values 0.02±0.00, 0.02±0.01, 0.38±0.20, 0.02±0.00, 0.02±0.00, 0.03±0.01, 0.02±0.01, 0.02±0.01 and 0.04±0.00 respectively vary significantly ($p<0.05$) with WHO (0.22±0.06), while tap water was not significant ($p>0.05$). Lead concentration of the tap water (0.15±0.25) varied significantly with WHO standard (0.01±0.00), while others were insignificant ($p>0.05$). This result shows that all water samples studied were contaminated and unfit for human consumption. This therefore calls for appropriate treatment measures before the consumption of these water samples by the populace to avoid long term accumulated health effect.

***KEYWORD**: physico-chemical parameters, water supplies, WHO standard.*

INTRODUCTION

Water is an inorganic, transparent, tasteless, odorless, and nearly colorless chemical substance, which is the main constituent of Earth's hydrosphere and the fluids of all known living organisms. It is vital for all known forms of life, even though it provides no calories or organic nutrients.

Water is an essential element for life. Fresh water comprises 3% of the total water on earth but only a small percentage (0.01%) of this fresh water is available for human consumption (Hinrichsen and Tacio, 2012). Safe drinking water is the basic need for safeguarding the health and well-being of humans all over the world (Ahmad *et al*., 2015). Being the most drinking fluid by living things and universal solvent, water is often a potential source of causing infections (Joyce *et al*., 2016). Nearly 75% of the world wide communicable diseases are water borne (Shengji *et al.*, 2014).

World Health Organization (WHO) declares that in developing countries, 80% of all human diseases are water borne (Abera *et al*., 2011).Water plays a significant role in maintaining the human health and welfare. Clean drinking water is now recognized as a fundamental right of human beings. Around 780 million people do not have access to clean and safe 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. Therefore, water quality control is a top-priority policy agenda in many parts of the world. In the today world, the water use in household supplies is commonly defined as domestic water. This water is processed to be safely consumed as drinking water and other purposes. Water quality and suitability for use are determined by its taste, odor, colour, and concentration of organic and inorganic matters. Contaminants in the water can affect the water quality and consequently the human health. The potential sources of water contamination are geological, industrial and agricultural activities, and water treatment plants. These contaminants are further categorized as microorganisms, inorganics, organics, radionuclides, and disinfectants.

Water could be obtained from ground water and surface sources. The ground water sources include boreholes and hand dug wells while surface water sources include rivers, streams and lakes. The quality of water depends on its physical, chemical and biological characteristic. Water quality and sustainability for use is determined by its taste, odour, colour and concentration of organic and inorganic matters. Water for human consumption is referred to as potable or drinking water and should be of safe quality, which entails that it does not present any significant health risk over life time consumption.

Lead(Pb) contamination is as a result of the piping used for the water distribution system and also the surrounding soil which may have a higher amount of Pb, which may be leached into the water. The common symptom of contamination of lead is lead poisoning which displays as anemia because lead interferes with the formation of hemoglobin. It prevents iron uptake. Higher levels of lead may produce permanent brain damage and kidney dysfunction. Over time, lead will substitute. Acute exposure to lead is known to cause proximal renal tubular damage. Long-term lead exposure may also give rise to kidney damage. Acute exposure of lead can cause loss of appetite, fatigue, sleeplessness, hallucinations, vertigo, renal dysfunction, hypertension and arthritis, while chronic exposure can result in birth defects, mental retardation, autism, psychosis, allergies, paralysis, weight loss, dyslexia, hyperactivity, muscular weakness, kidney damage, brain damage, coma and may even cause death(Engwa *et al*.,2018).

Zn has been shown to exert adverse reproductive biochemical, physiological and behavioral effect on a variety of aquatic organisms as concentrations exceed 20 mg/kg. Toxicity is, however, influenced by many factors such as the temperature, hardness and pH of the water (WHO, 2011).

The study was done to correlate some physicochemical parameters in water samples from different water supply in Aba with WHO standard.

MATERIALS AND METHODS

STUDY AREA

The study was done in Aba, a city in Abia State, Nigeria.

STUDY POPULATION

The study consists of 50 samples. This samples comprises of rain water, borehole water, tap water, pond water, well water, stream water, pool water, bottled water, satchet water.

EXPERIMENTAL DESIGN

The samples were divided into nine (9) groups:

a) Group 1: water gotten from rain (rain water)
b) Group 2: water gotten from borehole (borehole water)
c) Group 3: water gotten from well (well water)
d) Group 4: water gotten from pool (pool water)
e) Group 5: water gotten from pond (pond water)
f) Group 6: water gotten from stream (stream water)
g) Group 7: Tap water
h) Group 8: Satchet water
i) Group 9: Bottled water
j) Group 10: River water

MATERIALS

pH indicator, Refrigerator, Atomic Absorption Spectrophotometer (AAS), Plain container(100mls), Cigarette lighter, gloves, Detergent, HCl, thermometer, colorimeter, Concentrated Nitric acid, Standard thermometer (Uniscope), Photoelectric colorimeter, Cotton wool.

SAMPLE COLLECTION

100mls of different water samples such as borehole water, tap water, rain water, well water, stream water, bottled water, pond water and satchet water were collected from residential and commercial areas. The samples were numbered against their locations and sources (Table 1). Before collection, the mouth and the outer parts of the borehole taps were sterilized with the flame of a cigarette lighter, and allowed to cool by running the water for about 1 minute. Each sample for analysis was collected using a clean 100mls plastic container with a screw cap which was thoroughly washed with detergent, soaked with acid and rinsed with distilled water. At the point of collection, the container was rinse three times with the water sample. All the samples were stored in laboratory, freshly refrigerated at 4°C in a refrigerator prior to analysis to avoid microbial action affecting their concentration. All the chemicals used were of the analytical grade.

Table 1: Sampling Area Descriptions.

Sample identity	Location
Tap A	Industrial layout
Tap B	Aba breweries
Tap C	Ehi road
Tap D	Aba town hall
Tap E	Cameron road
River A	Waterside, ogbohill
River B	Waterside, ogbohill
River C	"
River D	"
River E	"
Stream A	Okpulumobom
Stream B	Okpulumobom
Stream C	"
Stream D	"
Stream E	"
Borehole A	Market road
Borehole B	Azikiwe road
Borehole C	Omuma road
Borehole D	Cemetery road
Borehole E	Jubilee road
Pond A	Terminus, Aba
Pond B	City Global, Aba
Pond C	La ville, Okigwe road
Pond D	Benidone, Ph road
Pond E	Cruiz, Asa road
Rain A	
Rain B	
Rain C	
Rain D	
Rain E	
Well A	12A Iheorji
Well B	33 Ogbonna street
Well C	21A iheorji
Well D	43B iheorji
Pool A	Terminus hotel,Azikiwe road
Pool B	City Global hotel,Okigwe road
Pool C	La paix,Brass
Pool D	Enitona, Immaculate road
Pool E	Presidential ,Ariaria
Satchet A	Trixis satchet water
Satchet B	GoodLife satchet water
Satchet C	Bejoy water
Satchet D	Fauzee water
Satchet E	Anthonio water
Bottle A	Humbel bottle water
Bottle B	Eva bottle water
Bottle C	Sparawassa water
Bottle D	Aquadanna
Bottle E	Nestle

METHODS OF ANALYSIS

Water samples that will be collected from different water supplies are to be analyzed using the following methods to determine the pH, turbidity and presence of Pb and Zn. All reagents were commercially purchased and the manufacturers Standard operating procedures strictly followed.

DETERMINATION OF pH

METHOD: Indicator method, using pH indicator.

DETERMINATION OF TURBIDITY

METHOD: Colorimetric method using Photoelectric colorimeter.

DETERMINATION OF LEAD AND ZINC

METHOD: metal analysis was conducted using Varian AA240 Atomic Absorption Spectrophotometer according to the method of APHA 1995 (American Public Health Association)

STATISTICAL ANALYSIS

The data was analyzed using ANOVA and were expressed as mean ± Standard deviation (mean ± SD). Statistical significance was obtained at $p<0.05$ and $p>0.05$ considered as non significant. The results obtained was Analyzed using Statistical Package for Social Science (SPSS) version 20 for windows 7.

RESULT

TABLE 2: SHOWING THE MEAN ± STANDARD DEVIATION VALUES FOR pH, TURBIDITY, ZINC AND LEAD OF DIFFERENT WATER SAMPLES.

	pH	TURBIDITY (NTU)	ZINC (Mg/dl)	LEAD (Mg/dl)
TAP	7.14±0.22	2.00±2.74	0.13±0.26	0.15±0.25*
BOREHOLE	5.30±0.45*	2.00±2.73	0.02±0.00*	0.06±0.11
RIVER	5.70±0.45	12.00±2.74*	0.02±0.01*	0.11±0.11
WELL	5.84±0.79	6.00±4.18	0.38±0.20*	0.02±0.01
BOTTLE	7.00±0.79	3.00±2.74	0.02±0.00*	0.01±0.02
RAIN	7.54±0.55*	1.00±2.24	0.02±0.00*	0.03±0.06
SATCHET	6.62±0.69	1.00±2.23	0.03±0.01*	0.11±0.12
POOL	6.08±1.11*	6.00±4.18*	0.02±0.01*	0.00±0.00
POND	6.04±0.62	7.00±2.74	0.02±0.01*	0.05±0.05
STREAM	5.64±0.50*	11.00±2.24*	0.04±0.00*	0.12±0.11
WHO	6.34±1.33	3.00±1.58	0.22±0.06	0.01±0.00
P value	0.00	0.00	0.00	0.278

Values are represented as Mean ± SD of triplicate evaluation. Values with superscript (*) are statistically significant at $p<0.05$.

The results presented in table 1 shows that borehole, river, well, pool, pond and stream water has mean ± standard deviation values below the WHO standard for pH, while tap, bottle and rain water has value higher than that of WHO. The turbidity of tap, borehole, rain and satchet water are below the WHO mean±S.D value for turbidity while river, well, pool and river water are higher than the WHO value. The Zn concentration of well water is higher than the WHO value for Zn while others are lower. Bottle water has mean±S.D below that of WHO.

Table 3: Showing Comparison of pH, turbidity, zinc and lead level between groups.

	pH	**turbidity**	**Zn**	**Pb**
WHO vs tap	.097	.583	.162	.043*
WHO vs borehole	.033*	.583	.004*	.454
WHO vs river	.182	.000*	.003*	.124
WHO vs well	.295	.104	.017*	.901
WHO vs bottle	.169	1.000	.003*	.983
WHO vs rain	.015*	.275	.003*	.790
WHO vs satchet	.556	.275	.004*	.142
WHO vs pool	.024*	.032*	.003*	.532
WHO vs pond	.528	.104	.003*	.957
WHO vs stream	.045*	.000*	.006*	.088

NOTE: * shows that the mean difference is significant at the 0.05 level.

The result shows that for the lead concentration of tap water varies significantly when compared to WHO standard. The pH and Zn concentration of borehole water varies significantly. The turbidity and Zn concentration of river water varies significantly with WHO standard. Only Zn concentration of well, pond and bottle water varies significantly. The pH and Zn concentration of rain water varies significantly with WHO standard. The Zn concentration of satchet water varies significantly as compared to others sources. The pH, turbidity and Zn concentration of pool and stream water varies significantly with WHO standard.

DISCUSSION

Water is an essential part of human nutrition and the quality of water is very important. Poor quality water

poses a great danger to health and thus water should be assessed before drinking.

pH is classified as one of the most important water quality parameters and the measurement of pH relates to the acidity or alkalinity of a solvent, substance or solution. A sample is considered to be acidic if the pH is below 7.0 and alkaline (basic) if the pH is higher than 7.0. Acidic water can lead to corrosion of metal pipes and plumping system, while alkaline in water disinfects. The normal drinking water pH range mentioned in WHO guidelines is between 6.5 and 9.2. The result shows that there is significant difference ($P<0.05$) in the pH of borehole, rain, pool and stream water when compared to WHO standard. The pH values of all the drinking water samples were found to be in the range between 5.0 and 8.0 which was earlier reported by Baig *et al*., 2005.

Turbidity is the cloudiness of water caused by a variety of particles. Turbidity in water is caused by the presence of suspended particles of clay or silt and colloidal organic materials (Adegoke *et al.*, 2012). According to WHO (2006) guidelines, maximum acceptable value for turbidity is 5 Nephelometric turbidity unit (NTU). The lowest turbidity unit is 0 NTU while the highest is 15 NTU. River water, pool water, stream water, well water have turbidity beyond the permissible limit. River, pool and stream water vary significantly ($p<0.05$) from WHO standard (5NTU) while other samples (tap, borehole, bottle, rain, satchet water) did not vary significantly ($p>0.05$) when compared to WHO standard.

The presence of heavy metals in drinking water higher than a certain concentration can cause detrimental impacts on human health (brain damage, acute psychosis, reduced consciousness). According to WHO (2006), the acceptable concentration for Zinc in drinking water is 3mg/dl. Metal mining and metal corrosion is the common source of Zn, which can be channeled into water through the process of leaching. All the water samples studied with the exception of tap water varied significantly ($p<0.05$) with WHO standard (3mg/dl).

Lead (Pb) in water at an increased level can cause detrimental effect on health, most especially lead poisoning and anaemia. The slight higher concentration of Pb in some of the samples may be due to the piping used for the water distribution system and also the surrounding soil which may have a higher amount of Pb, which may be leached into the water. The permissible limit according to WHO is 0.06mg/dl. Only tap water varies significantly ($p<0.05$) with WHO standard.

CONCLUSION

The values of water quality parameters such as pH and turbidity of few samples collected from different residential and commercial areas of Aba, Abia State were found to be within the recommended limits of WHO, while others are way above the normal range for WHO standard. The concentration of Zn and Pb were also measured and was found that the Zn contamination of water was low, with the exception of the tap and well water samples, while the Pb contamination was very high in the tap water sample. Geological strata of the area, surrounding pollution sources, corrosion, poor construction and maintenance of drinking water sources were found to be the key factors responsible for water quality deterioration. Therefore, portable water consumed for drinking and domestic purposes in the residential areas of Aba is not recommended for use without first undergoing proper treatment process.

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