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Effect of Storage Conditions on Physicochemical Parameters of Borehole Water

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ABSTRACT: *The aim of this paper is to investigate the effect of storage conditions (time, containers and locations) on physicochemical parameters of borehole water in Awka, Anambra state, Nigeria. Borehole water sample were collected from Okpuno in Awka and was analysed for thirty-one days. The water were stored in clay pots, white plastics, blue plastics, plain metal and black metal, inside and outside laboratory (indoor and outdoor). The total suspended solids had a concentration range (before storage) of 110-20mg/l (during storage), total dissolved solids(before storage) 90-20mg/l (during storage), total solids (before storage) 180-40mg/l (during storage), total alkalinity (before storage) 13-65mg/l (during storage), chlorine (before storage) 23.99-66.47mg/l (during storage), turbidity (before storage) 6.55-0ntu (during storage), temperature (before storage) 26-31^{0}C (during storage), electrical conductivity (before storage) 192-287 (during storage), pH (before storage) 5.9-7.6 (during storage), total hardness (before storage) 0.40-0.95mg/l (during storage), phosphate (before storage) 6.3-22.97mg/l (during storage), sulphate (before storage) 3.58-5.97mg/l (during storage) colour (before storage) 10-25 tcu (during storage). The results indicated that all the physicochemical parameters analysed are within WHO standard except colour for plain and black metals that deteriorated after ten days of storage. Statistically, storage time affected all parameters except total solids, chloride and total hardness. On locations, total dissolved solids, total solids, total alkalinity, turbidity, total hardness and phosphate were not affected, while storage containers affected all parameters(indoor and outdoor)except chloride and turbidity. This study has shown that borehole water should be stored in white plastic containers(indoor and outdoor) as time improves water quality during storage.*

KEYWORDS: *Borehole water, Storage containers, Physicochemical parameters, Water quality*

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I. INTRODUCTION

Water is essential for all dimension of life. Therefore, its quality is of paramount importance to human physiology and man's continued survival depends very much on its availability(Andrew et al.,2017). Edet et al.,(2012), opined that good quality water is one that is free from diseases causing microorganisms and chemical substances harmful to human health. The common sources of water are borehole, rain, river, well and stream(Emerole et al.,2015) . In most areas in Nigeria, water is a scarce commodity. Due to its scarcity, there is tendency to store for future use whenever it is found(Osuji et al.,2015). However, during storage the quality parameters of water never remain constant as there are numerous reactions taking place in the stored water due to change in the environment, time, location and as well as the impacts from the material of construction used as storage containers or vessels(Ogbozige,2015.,Akubuenyi et al.,2013.,Maggy et al.,2003.,Agbede et al.,1995). Most houses in Nigeria pump ground water into overhead storage tanks made from steel or plastic usually installed outside. The storage location of the water tank or container exposes them to solar radiation which generates heat when covered(Ogbozige,2015). Similarly, some containers like plastic, metal and clay pot containers are stored inside or outside depending on the usage. The water may be contaminated at the point of collections storage or

serving at homes(Ravichandran et al.,2016;Nala et al.,2003;Tambekar et al.,2006;Rufener et al.,2010). The water stored for hours or even days may increase the possibility of faecal contamination of otherwise good quality water inside the household(Valerie et al.,2010;Subbaraman et al., 2013). Hence, it is important from a public health point of view to maintain the quality of drinking water during storage.
The aim of the present study is to investigate the effects of storage conditions on physiochemical parameters of borehole water in Awka, Anambra state, Nigeria.

II. MATERIALS AND METHODS

2.1 Description of study area

Awka (Igbo: Oka) is the study area and state capital of Anambra State, Nigeria. The state lies between the co-ordinates of 6◦35' E to 7◦30'E and 5◦40'N to 6◦48N, with an estimated population of 301,657 thousand people according to the 2006 National population census of Nigeria. It has an approximate area of 199.1km (123.7m), by road, directed north of Port-Harcourt in the centre of the densely populated Igbo heartland in South East Nigeria. Awka is located between two major cities in Northern Igboland, Onitsha and Enugu. It has an average humidity of 80%, Mean Daily Temperature of 27°C and Mean Annual Rainfall of 200cm.

2.2 Method of sampling and Collection of water samples

Borehole water sample was collected in Okpuno, Awka in Anambra state. The borehole water analysis was carried out in Civil Engineering Laboratoray at Nnamdi Azikiwe Universitiy, Awka. Prior to storage, all the containers were rinsed with distilled water and later with the water sample to be stored. The borehole water was stored in clay pots, white plastics, blue plastics, plain metals and black metals containers inside and outside the laboratory(indoor and outdoor). The water sample was stored for thirty one days. Analyses were carried out using the water stored in these containers at intervals of three days.

2.3 Physicochemical parameters

The fresh borehole water as well as stored samples were analyzed for physico-chemical properties. Temperature and Electrical conductivity of the water samples were measured using HM digital EC meter aqua pro water tester. pH was done by electronic pH meter(JENWAY,2015). Turbidity was determined using Hanna turbidity meter. Total suspended solids, total dissolved solids, total solids, total alkalinity, total hardness, sulphate, phosphate, chloride and colour were carried out as described by Standard Analytical Procedures for Analysis(1999) .

2.4 Statistical Analysis All the data collected were analyzed statistically using analysis of variance (Two-factor without replication) Microsoft excel spread sheet 2007 version.

III. RESULTS AND DISCUSSION.

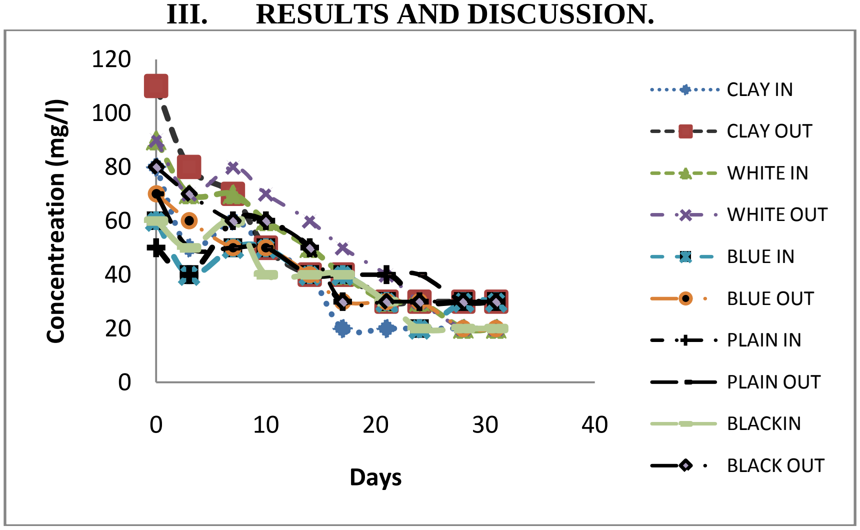

Figure 1: Borehole water stored indoor and outdoor total suspended solids concentrations

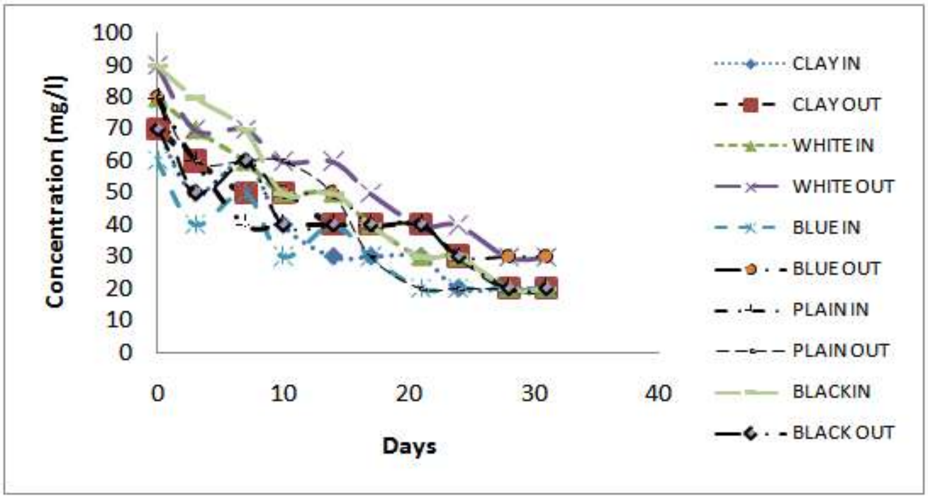

Figure 2: Borehole water stored indoor and outdoor total dissolved solids concentrations

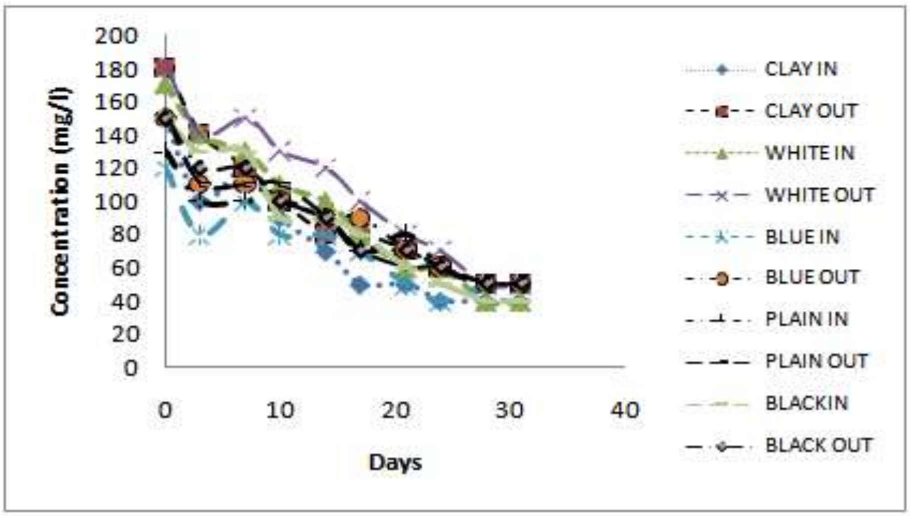

Figure 3: Borehole water stored indoor and outdoor total solids concentrations

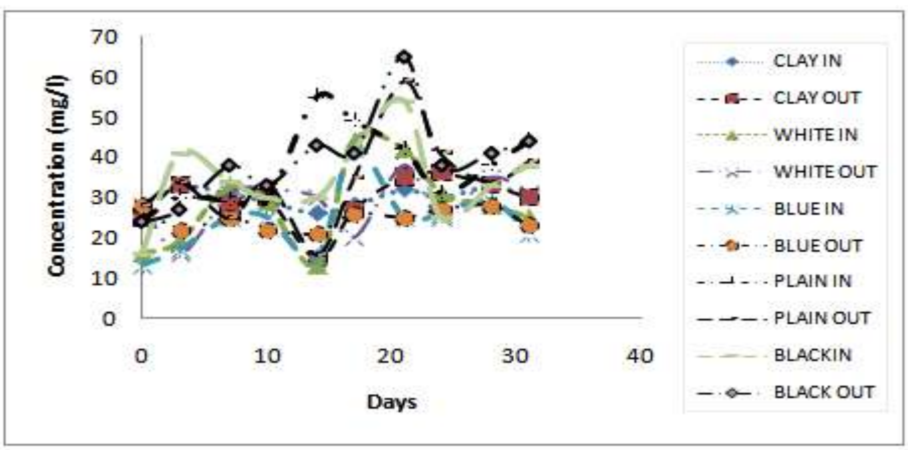

Figure 4: Borehole water stored indoor and outdoor total alkalinity concentrations

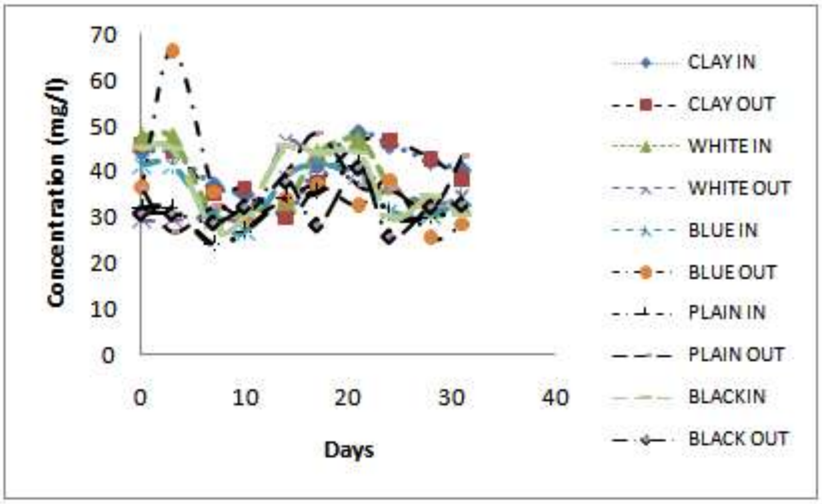

Figure 5: Borehole water stored indoor and outdoor chloride concentrations

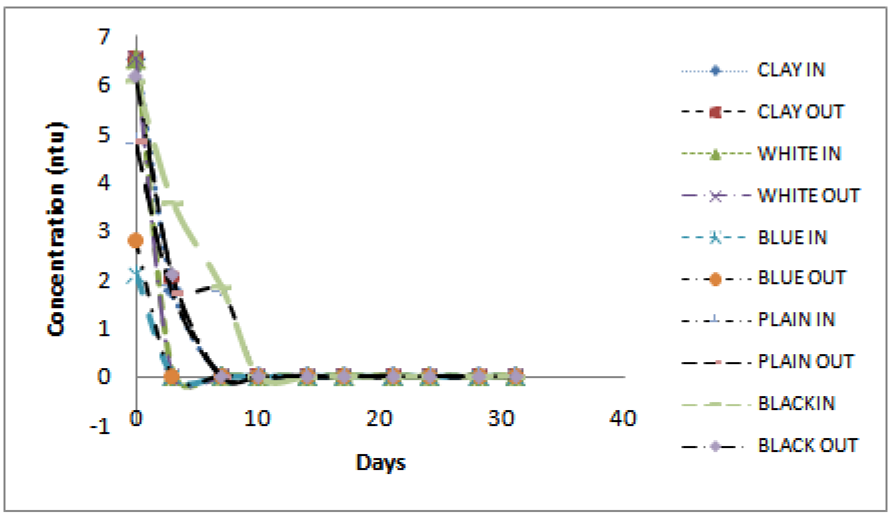

Figure 6: Borehole water stored indoor and outdoor turbidity concentrations

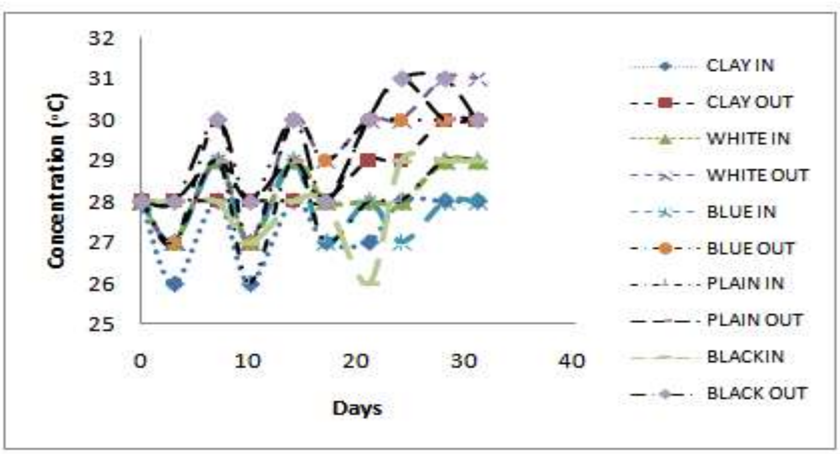

Figure 7: Borehole water stored indoor and outdoor temperature concentrations

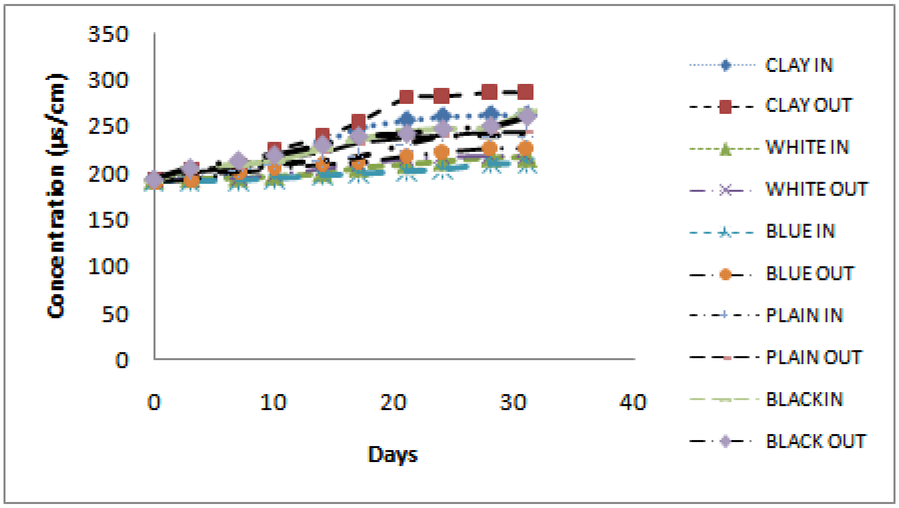

Figure 8: Borehole water stored indoor and outdoor electrical conductivity concentrations

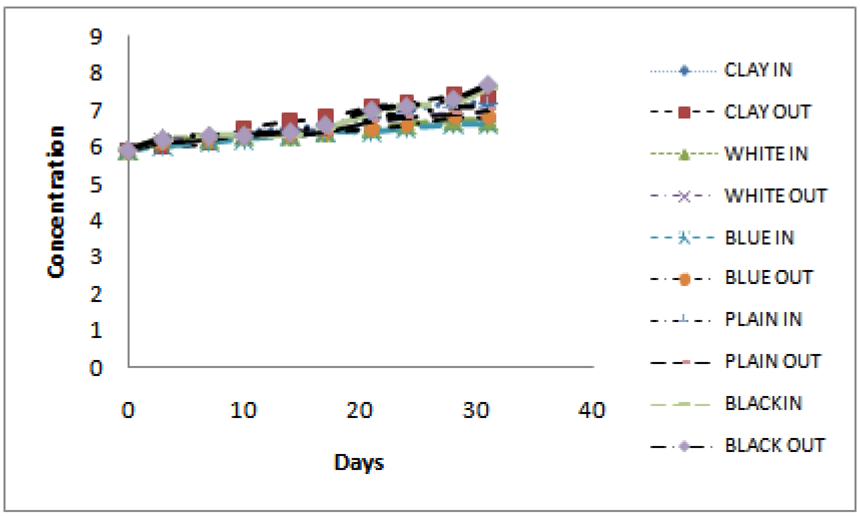

Figure 9: Borehole water stored indoor and outdoor pH concentrations

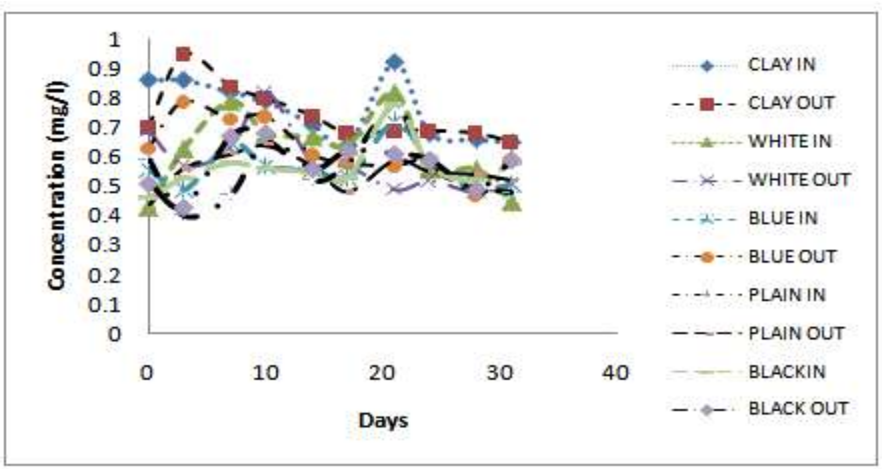

Figure 10: Borehole water stored indoor and outdoor total hardness concentrations

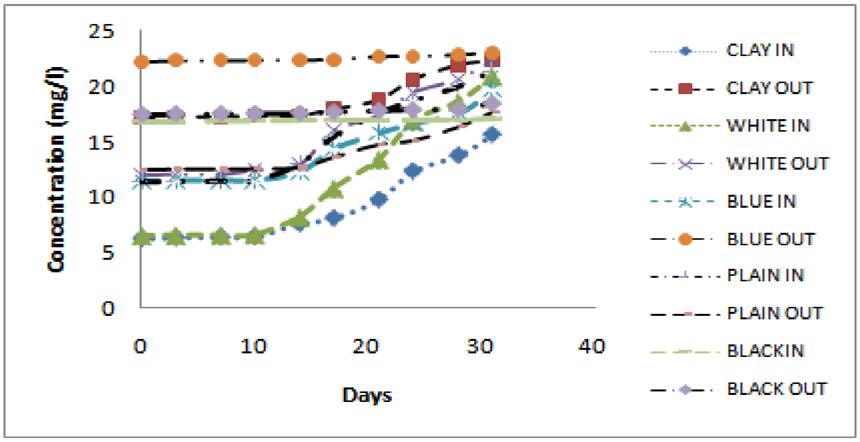

Figure11: Borehole water stored indoor and outdoor phosphate concentrations

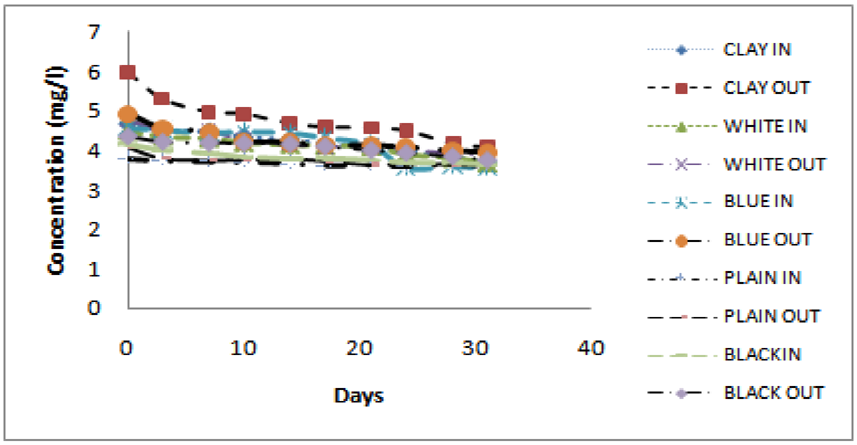

Figure12: Borehole water stored indoor and outdoor sulphate concentrations

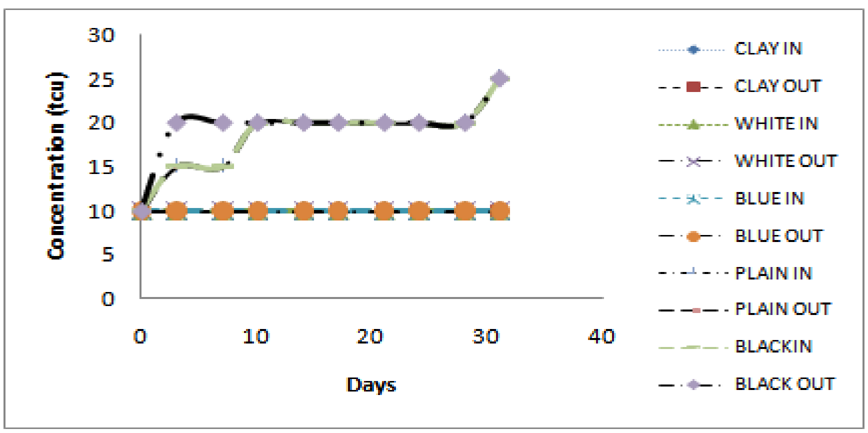

Figure 13: Borehole water stored indoor and outdoor colour concentrations

KEY: CLAY IN=Clay pot stored indoor, CLAY OUT= Clay pot stored outdoor,
WHITE IN= White plastic stored indoor, WHITE OUT= White plastic stored outdoor,
BLUE IN= Blue plastic stored indoor, BLUE OUT= Blue plastic stored outdoor,
PLAIN IN= Plain metal stored indoor, PLAIN OUT= Plain metal stored outdoor,
BLACK IN= Black metal stored indoor, BLACK OUT= Black metal stored outdoor.

The borehole water stored in clay pot, white plastic, blue plastic, plain metal and black metal containers (indoor and outdoor) had total suspended solids concentration range of 20mg/l to 110mg/l as shown in Figure 1. The reduction observed in total suspended solids concentration each day of this study due to the fact that, upon storage, big suspended or flocculated particles as well as other impurities settled down at the bottom of the storage container thus reducing the total suspended solids. This result is in agreement with what was reported by other researchers in similar study(Ehiowemwenguan et al.,2014;Mgbemena et al.,2014;Ogbozige,2015). In the same vein, the borehole water stored in all containers (indoor and outdoor) had total dissolved solids concentration range of 20mg/l to 90mg/l as shown in Figure 2. This falls within WHO permissible limit of 600mg/l. Similarly, the borehole water stored in all containers (indoor and outdoor) had total solids concentration range of 40mg/l to 180mg/l as shown in Figure 3. The concentration reduced each day of this study due to the fact that big suspended or flocculated particles and other impurities settled down at the bottom of the containers upon storage as observed in total suspended solids and total dissolved solids. This result is in agreement with what was reported in similar work by Ogbozige,(2015). However, the borehole water stored in all containers (indoor and outdoor) had total alkalinity concentration range of 13mg/l to 65mg/l as shown in Figure 4. Chloride had a concentration range of 23.99mg/l to 66.47mg/l(indoor and outdoor) for the borehole water stored in all containers and falls within WHO permissible limit of 300mg/l as shown in Figures 5. On the other hand, the borehole water stored in all containers(indoor and outdoor) had turbidity concentration of 6.55NTU the first day of this study but reduced 0NTU in subsequent days and falls within WHO standard of 5NTU as shown in figure 6. Additionally, the temperature of the borehole water stored in all containers (indoor and outdoor) had a concentration range of 26^{o}C to 31 ^{o}C as shown in Figure 7. This result is agreement with the result in similar study by(Mgbemena et al.,2014). The temperature reading was taken between 10am to 12noon each day of the study. Electrical conductivity had a concentration range of 192µs/cm to 287µs/cm(indoor and outdoor),but falls within WHO permissible limit of 1000µs/cm as shown in figure 8. pH had concentration range of 5.9 to 7.6 (indoor and outdoor) for the borehole water stored in all containers. The pH values were slightly acidic for seven days of this study but increases gradually and falls within WHO standard of 6.5 to 8.5. The slight increase in pH values might be due to some election fluctuation upon storage(Ravichandran et al.,2016) as Seen in Figure 9. Total hardness had a concentration range of 0.40mg/l to 0.95mg/l (indoor and outdoor) and falls within WHO permissible limit of 300mg/l as shown in Figure 10. Nevertheless, phosphate had concentration range of 6.32mg/l to 22.97mg/l(indoor and outdoor) as shown in figure 11, while Sulphate had concentration range of 3.58mg/l to 5.97mg/l(indoor and outdoor) as shown in Figure 12. This falls within WHO permissible limit of 1000mg/l. Furthermore, colour had concentration range of 10TCU to 25TCU(indoor and outdoor).The borehole water stored in plain and black metals containers increased in colour after ten days of storage due to corrosion as seen in Figure 13.

Table1: Statistical variation of storage time and location for physicochemical parameters of stored borehole water

Parameters	Source of variance	Type of storage container	F_Cal	F Critical	P_value
Total Suspended Solids (Mg/l)	Time	Clay pot	20.485	3.178	0.000
	Location		15.059	5.117	0.003
	Time	White plastic	85.160	3.178	0.000
	Location		9.000	5.117	0.014
	Time	Blue Plastic	7.741	3.178	0.002
	Location		0.101	5.117	0.757
	Time	Plain Metal	4.416	3.178	0.018
	Location		0.375	5.117	0.555
	Time	Black Metal	11.516	3.178	0.000
	Location		8.191	5.117	0.018
Total Dissolved Solids (Mg/l)	Time	Clay pot	21.977	3.178	0.000
	Location		5.000	5.117	0.052
	Time	White plastic	161.000	3.178	0.000
	Location		81.000	5.117	0.000
	Time	Blue Plastic	37.571	3.178	0.000
	Location		72.428	5.117	0.000
	Time	Plain Metal	9.000	3.178	0.000
	Location		0.060	5.117	0.811
	Time	Black Metal	11.975	3.178	0.000
	Location		3.644	5.117	0.088
Total Solids (Mg/l)	Time	Clay pot	42.617	3.178	0.000
	Location		21.441	5.117	0.001

	Time	White plastic	160.000	3.178	0.000
	Location		40.090	5.117	0.000
	Time	Blue Plastic	27.307	3.178	0.000
	Location		22.153	5.117	0.001
	Time	Plain Metal	30.782	3.178	0.000
	Location		0.801	5.117	0.393
	Time	Black Metal	63.736	3.178	0.000
	Location		0.473	5.117	0.508
Total Alkalinity (Mg/l)	Time	Clay pot	3.271	3.178	0.046
	Location		0.320	5.117	0.585
	Time	White plastic	1.312	3.178	0.345
	Location		0.027	5.117	0.871
	Time	Blue Plastic	1.462	3.178	0.290
	Location		0.132	5.117	0.723
	Time	Plain Metal	0.917	3.178	0.550
	Location		0.282	5.117	0.607
	Time	Black Metal	6.168	3.178	0.006
	Location		4.002	5.117	0.076
Chloride (Mg/l)	Time	Clay pot	36.858	3.178	0.000
	Location		1.101	5.117	0.321
	Time	White plastic	1.013	3.178	0.492
	Location		1.065	5.117	0.328
	Time	Blue Plastic	2.253	3.178	0.120
	Location		0.057	5.117	0.815
	Time	Plain Metal	2.636	3.178	0.082
	Location		5.846	5.117	0.038
	Time	Black Metal	2.199	3.178	0.127
	Location		5.985	5.117	0.036
Turbidity (Ntu)	Time	Clay pot	2401.026	3.178	0.000
	Location		1.000	5.117	0.343
	Time	White plastic	6.040	3.178	0.000
	Location		0.000	5.117	0.421
	Time	Blue Plastic	48.600	3.178	0.000
	Location		1.000	5.117	0.343
	Time	Plain Metal	31.379	3.178	0.000
	Location		1.178	5.117	0.305
	Time	Black Metal	32.486	3.178	0.000
	Location		2.014	5.117	0.189
Temperature (°C)	Time	Clay pot	2.368	3.178	0.107
	Location		17.052	5.117	0.002
	Time	White plastic	5.300	3.178	0.041
	Location		11.250	5.117	0.000
	Time	Blue Plastic	3.059	3.178	0.055
	Location		15.059	5.117	0.003
	Time	Plain Metal	3.696	3.178	0.032
	Location		12.235	5.117	0.006
	Time	Black Metal	2.111	3.178	0.140
	Location		12.250	5.117	0.006
Electrical Conductivity (µs/cm)	Time	Clay pot	53.192	3.178	0.000
	Location		20.429	5.117	0.001
	Time	White plastic	90.425	3.178	0.000
	Location		6.178	5.117	0.003
	Time	Blue Plastic	10.243	3.178	0.000
	Location		35.314	5.117	0.000
	Time	Plain Metal	71.943	3.178	0.000
	Location		23.691	5.117	0.000
	Time	Black Metal	174.609	3.178	0.000
	Location		4.487	5.117	0.063
pH	Time	Clay pot	53.522	3.178	0.000
	Location		7.363	5.117	0.023
	Time	White plastic	44.710	3.178	0.000

	Location		10.565	5.117	0.000
	Time	Blue Plastic	52.428	3.178	0.000
	Location		14.877	5.117	0.003
	Time	Plain Metal	82.750	3.178	0.000
	Location		5.062	5.117	0.051
	Time	Black Metal	441.96	3.178	0.000
	Location		9.000	5.117	0.014
Total Hardness (Mg/l)	Time	Clay pot	3.014	3.178	0.057
	Location		0.298	5.117	0.598
	Time	White plastic	1.085	3.178	0.452
	Location		0.521	5.117	0.488
	Time	Blue Plastic	1.089	3.178	0.450
	Location		2.862	5.117	0.124
	Time	Plain Metal	1.222	3.178	0.384
	Location		0.012	5.117	0.914
	Time	Black Metal	2.271	3.178	0.118
	Location		0.100	5.117	0.758
Sulphate (Mg/l)	Time	Clay pot	8.534	3.178	0.001
	Location		37.400	5.117	0.000
	Time	White plastic	26.415	3.178	0.000
	Location		13.337	5.117	0.005
	Time	Blue Plastic	5.377	3.178	0.009
	Location		1.369	5.117	0.271
	Time	Plain Metal	5.318	3.178	0.010
	Location		11.030	5.117	0.008
	Time	Black Metal	19.192	3.178	0.000
	Location		116.329	5.117	0.000
Phosphate (Mg/l)	Time	Clay pot	14.364	3.178	0.000
	Location		431.370	5.117	0.000
	Time	White plastic	34.870	3.178	0.000
	Location		69.136	5.117	0.000
	Time	Blue Plastic	1.368	3.178	0.323
	Location		87.411	5.117	0.000
	Time	Plain Metal	6.920	3.178	0.004
	Location		2.855	5.117	0.125
	Time	Black Metal	2.902	3.178	0.064
	Location		117.002	5.117	0.000
Colour (Tcu)	Time	Clay pot	6553	3.178	0.000
	Location		6553	5.117	0.000
	Time	White plastic	6553	3.178	0.000
	Location		6553	5.117	0.000
	Time	Blue Plastic	6553	3.178	0.000
	Location		6553	5.117	0.000
	Time	Plain Metal	6553	3.178	0.000
	Location		6553	5.117	0.000
	Time	Black Metal	12.750	3.178	0.000
	Location		2.250	5.117	0.167

The total suspended solids concentration for borehole water stored in clay pot, white plastic and black metal containers were significantly ($p<0.05$) affected by storage time and location, while, the total suspended solids concentration for borehole water stored in blue plastic and plain metal storage containers were significantly ($p<0.05$) affected by storage time but were not significantly ($p>0.05$) affected by storage locations as shown in table 1. Similarly, the total dissolved solids concentration for borehole water stored in clay pot, plain and black metal containers were significantly ($p<0.05$) affected by storage time but were not significantly ($p>0.05$) affected by storage location, while, the total dissolved solids concentration for borehole water stored in white and blue plastic containers were significantly($p<0.05$) affected by storage time and location. In the same vein, the total solids concentration for the borehole water stored in clay pot, white and blue plastic were significantly ($p<0.05$) affected by storage time and location, the total solids concentration for the borehole water stored in plain and black metal containers were significantly ($p<0.05$) affected by storage time but were not significantly($p>0.05$) affected by storage location as shown in table 1. On the other hand, the total alkalinity concentration for the borehole water stored in clay pot and black metal containers were significantly ($p<0.05$) affected by storage time but were not significantly ($p>0.05$) affected by storage location, while the total alkalinity concentration for the borehole water stored in white plastic, blue plastic and plain metal containers were not significantly ($P>0.05$) affected by storage time and location as shown in table 1. Nevertheless, Chloride concentration for borehole water stored in clay pot was significantly ($p<0.05$) affected by storage time but was not significantly ($P>0.05$) affected by storage location, white and blue plastic storage containers were not significantly ($P>0.05$) affected by storage time and location. Plain and black metal containers were not significantly ($P>0.05$) affected by storage time but were significantly ($p<0.05$) affected by storage location as shown in table 1. The turbidity concentration for the borehole water stored clay pot, white plastic blue plastic, plain and black metal storage containers were significantly ($p<0.05$) affected by storage time but were not significantly ($P>0.05$) affected by storage location shown in table 1. In another vein, the temperature of the borehole water stored in clay pot, blue plastic and black metal were not significantly ($p>0.05$) affected by storage time but were significantly ($p<0.05$) affected by storage location, while the temperature of the borehole water stored in white plastic and plain metal were significantly ($P<0.05$) affected by storage time and location as shown in table 1. The electrical conductivity of the borehole water stored in clay pot, white plastic, blue plastic and plain metal storage container were significantly ($P<0.05$) affected by storage time and location, while the electrical conductivity of the borehole water stored in black metal container was significantly ($P<0.05$) affected by storage time but was not significantly ($P>0.05$) affected by storage location. The pH of the borehole water stored in clay pot, white plastic, blue plastic and black metal containers were significantly($p<0.05$) affected by storage time and location, the pH concentration for the borehole water stored in plain metal container was significantly($P<0.05$)affected by storage time but was not significantly ($p>0.05$) affected by storage location as shown in table 1. The total hardness concentration for the borehole water stored in all the storage containers were not significantly ($P>0.05$) affected by storage time and location. Sulphate concentration for the borehole water stored in clay pot, white plastic, plain metal and black metal containers were significantly ($p<0.05$) affected by storage time and location, while the sulphate concentration for borehole water stored in blue plastic container was significantly($P<0.05$) affected by storage time but was not significantly($P>0.05$) affected by storage location as shown in table 1. Additionally, phosphate concentration for the borehole water stored in clay pot and white plastic containers were significantly ($P<0.05$) affected storage time and location, while the phosphate concentration for the borehole water stored in blue plastic and black metal containers were not significantly($P>0.05$) affected by storage time but were significantly ($p<0.05$) affected by storage location. Phosphate concentration for the borehole water stored in plain metal was significantly($P<0.05$) affected by storage time but was not significantly($P>0.05$) affected by storage location as shown in table 1. Furthermore, colour concentration for the borehole water stored in clay pot, white plastic, blue plastic and plain metal containers were significantly($P<0.05$) affected by storage time and location, colour concentration for the borehole water stored in black metal container was significant($p<0.05$) but were not significantly ($P>0.05$) affected for storage location as shown in table 4.20

Table2: Statistical variation of storage time and container type for physicochemical parameters of stored borehole water (indoor)

Paramaters	Source of variation	F_Cal	F Critical	P-Value
Total Suspended Solids (Mg/l)	Time	19.163	2.152	0.000
	Containers	2.655	2.633	0.048
Total Dissolved Solids (Mg/l)	Time	38.512	2.152	0.000
	Containers	8.185	2.633	0.000
Total Solids (Mg/l)	Time	43.213	2.152	0.000
	Containers	5.319	2.633	0.001
Total Alkalinity (Mg/l)	Time	3.590	2.152	0.002
	Containers	5.332	2.633	0.001
Chloride (Mg/l)	Time	8.825	2.152	0.000
	Containers	7.615	2.633	0.000
Turbidity (Ntu)	Time	21.844	2.152	0.000
	Containers	1.906	2.633	0.130
Temperature (°C)	Time	9.283	2.152	0.000
	Containers	3.080	2.633	0.002

Electrical Conductivity (µs/cm)	Time Containers	15.294 21.636	2.152 2.633	0.000 0.000
pH	Time Containers	32.405 9.248	2.152 2.633	0.000 0.000
Total Hardness(Mg/l)	Time Containers	5.843 14.397	2.152 2.633	0.000 0.000
Sulphate(Mg/l)	Time Containers	11.584 24.654	2.152 2.633	0.000 0.000
Phosphate(Mg/l)	Time Containers	12.418 22.433	2.152 2.633	0.000 0.000
Colour(Tcu)	Time Containers	2.666 42.639	2.152 2.633	0.017 0.000

Table3: Statistical variation of storage time and container type for physicochemical parameters of stored borehole water (outdoor)

Paramaters	Source of variation	F_Cal	F Critical	P-Value
Total Suspended Solids (Mg/l)	Time Containers	26.310 3.837	2.152 2.633	0.000 0.010
Total Dissolved Solids (Mg/l)	Time Containers	49.178 9.321	2.152 2.633	0.000 0.000
Total Solids (Mg/l)	Time Containers	89.323 9.744	2.152 2.633	0.000 0.000
Total Alkalinity (Mg/l)	Time Containers	3.401 7.123	2.152 2.633	0.004 0.000
Chloride (Mg/l)	Time Containers	0.721 1.623	2.152 2.633	0.685 0.189
Turbidity(Ntu)	Time Containers	40.197 1.479	2.152 2.633	0.000 0.228
Temperature (˚C)	Time Containers	18.593 2.672	2.152 2.633	0.000 0.047
Electrical Conductivity (µs/cm)	Time Containers	17.009 21.628	2.152 2.633	0.000 0.000
pH	Time Containers	36.755 8.273	2.152 2.633	0.000 0.000
Total Hardness(Mg/l)	Time Containers	3.888 11.677	2.152 2.633	0.001 0.000
Sulphate(Mg/l)	Time Containers	12.658 43.085	2.152 2.633	0.000 0.000
Phosphate(Mg/l)	Time Containers	5.699 42.135	2.152 2.633	0.000 0.000
Colour (Tcu)	Time Containers	2.358 50.826	2.152 2.633	0.032 0.000

Storage time and containers had a significant($p<0.05$) effects on total suspended solids, total dissolved solids, total solids, total alkalinity, chloride, turbidity, temperature, electrical conductivity, pH, total hardness, sulphate, phosphate and colour concentrations(indoor) as shown in table 2. However, storage time and containers had a significant($p<0.05$) effects on total suspended solids, total dissolved solids, total solids, total alkalinity, temperature, electrical conductivity, pH, total hardness, sulphate, phosphate and colour concentrations, while storage time and containers had no significant($p>0.05$) effect chloride concentrations for borehole water stored outdoor as shown in table 3. Storage time had a significant($p<0.05$) effect on turbidity concentration but had no significantly($p<0.05$) effect on borehole water stored outdoor as shown in table 3.

IV. CONCLUSION

The present study focused on the effects of storage conditions on physicochemical parameters of borehole water in Awka, Anambra state, Nigeria. Storing of borehole water was found desirable as it improve the water quality upon storage with respect to time. All physiochemical parameters were significantly affected by storage containers(indoor and outdoor), except chloride and turbidity(outdoor). Storage location had a significant effect on total dissolved solids, total alkalinity, chloride, turbidity and total hardness for borehole water stored in clay pot. Storage location had a significant effect on turbidity and total hardness for borehole water stored in white plastic containers. Storage location had a significant effect on total dissolved solids, total alkalinity, chloride, turbidity, total hardness and sulphate for borehole water stored in blue plastic. Storage location had a significant effect on total suspended solids, total dissolved solids, total solids, turbidity, total hardness and phosphate for borehole water stored in plain metal. Storage location had a significant effect on total dissolved solids, total solids, total alkalinity, electrical conductivity, turbidity, total hardness and colour for borehole water stored in black metal. Consequently it is being recommended that borehole water should be stored in white plastic container(indoor and outdoor).

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