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Physicochemical Analysis of the Quality of Sachet Water Marketed in Delta State Polytechnic, Ozoro

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***Abstract*— *Physicochemical analysis 15 of 500ml sachet water samples sold in Delta State Polytechnic, Ozoro was evaluated. The pH and conductivity value were measured by pH meter and conductivity meter respectively. The concentration of Pb, Cu, Fe and Zn were determined using Atomic Absorption Spectrophotometer. Total dissolved solids was estimated by gravimetric method. The organoleptic test of samples was by physical observation. The result obtained indicates that the organoleptic, conductivity, dissolved solids and hardness, the concentration of the metals analyzed were below permissible limit by WHO and USEPA, with the exception of Zn level of sachet number (7) and (9) higher than the recommended by standard by WHO. In conclusion, the result obtained shows that the sachet water sold in Delta State polytechnic, Ozoro, meets with WHO (1999) and USEPA (1986) standard and suitable for drinking purpose.*

***Keywords*— *Physico- chemical, sachet water, Delta State polytechnic, organoleptics.*

I. INTRODUCTION

Water possesses power of life and it is a constant auxiliary to our daily life, social organizations, economic, ambition and function (Baroon et al. 2004) Water is one of the most important natural resources known on earth (Ojo et al. 2005). It has always been a subject of great interest to man since it is essential for man to survive. There is a dare need for water to fulfill basic human self – sufficiency demand. The human body composes of 65% of water (Uduman et al. 2014). Water is abundant in nature and it is an important part of the earth environment covering about 95% of the earth surface (Chandra et al, 2012). Water as one of the most important natural resources and is of vital importance to life (Herald, 2002). It has a crucial function in all spheres of life. However, a large number of the rural population in developing countries do not have access to portable drinking water. Water quality refer to the physical, chemical and biological characteristics of water (Diersing, 2009). And in its pure state, it should be colorless, odorless and tasteless, with it boiling point at 100^{o}C and freezing point at O^{o}C; and with a maximum density of 4^{0}C at 1.00 g/cm^{3} (Gregoria, et al. 2002). Water of good quality is important to human physiology and man's continued existence depends so much on its availability. Package water is any portable water processed and offered for sales in a sealed food grade bottle or other appropriate containers for human consumption, (FAO, 2002). Denloye, (2004) refers to sachet water as any commercially treated water, manufactured, package and distributed for sales in sealed food grade container and is intended for human consumption. The adequate supply of portable water is highly needed for drinking, personal hygiene and domestic purpose. This has consequently led to the close relationship between availability and economic development of a Nation. Despite Nigeria's endowment with abundance of surface and sub –surface water resources, most urban areas are still faced with the challenge of providing adequate portable water supply for its residents. However, to successfully manage water resources, the Nigeria Government in the past decade set up Federal and State Institutions as well as River Basin Development Authorities to solve her water problem. Although much has been achieved since independence but the quality and quantity of portable drinking water is still grossly inadequate. Despite all these efforts, portable water supply continues to remain a major problem in Nigeria. The inadequate supply of portable water in urban centers is a growing problem and as a result, communities resorted to buying of water from vendors of sachet water (Ayayi, 2008). There is dare need for adequate portable water to fulfill basic human self – sufficient demand. Safe drinking water is a basic need for human development, health and well being and it is an international accepted human right (WHO, 2001). The availability of good quality water is an indispensable feature of preventing diseases like diarrhea and related water borne diseases and to improve quality of life. The problem of providing portable drinking water is habitual in Nigeria because the Government could scarcely afford the cost of infrastructural facility and maintenance needed to provide adequate water for her citizen (Amoo, et al. 2005).The sachet water is supposed to be safe, hygienic, affordable and an instance source for consumption. To safe guide the health of people and to reduce to the barest minimum of urgly experiences of drinking or using low quality water, it is necessary that the quality of water should be monitored with the view of finding solution to health problems associate with use of low quality water, in producing sachet portable water, (Ukpong, 2004). The drinking water that is safe and aesthetically acceptable is a matter of high priority to National Agency of Food and Drugs Administration and Control (NAFDAC) and other regulatory Agencies like WHO, FEBA, and SON. Drinking portable sachet water that is fit for human consumption is expected to meet WHO standard and be free from chemical and physical substances and micro – organism in an amount that cannot be hazardous to health (Denloye, 2004). The production of sachet water started in Delta State as far back as 1999 and because it was readily available, it has become a fast selling substitute for regular consumption. The production of sachet water requires a source of regular water supply either directly from the water works or

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boreholes. This also requires plastic bottle or white selofin bags for the package. Several reservoirs are needed for temporary storage of water. The water is directly pumped into different surface reservoirs and retained for a number of hours, ranging from 20 to 24 hours. It is then treated with Alum as a coagulating chemical and allowed for sedimentation. The water is then passed through several filters and disinfectants added. The water then passes through micro-filter, UV sterilizer and into sealing machine. In Nigeria, the assessment of water quality has been closely monitored by National Environmental Standard Regulation and Enforcement Agency (NESREA) and National Agency for food and drugs Administration Commission (NAFDAC). In other to attain the provision of safe sachet drinking water for human consumption in Nigeria, NAFDAC recommended that portable water should not contain any pathogen and the physicochemical properties of the water should also not exceed the NAFDAC recommended limits (NAFDAC, 2001). Production outfit of such drinking water should also adhere strictly to the NAFDAC guide lines (NAFDAC, 2004). The quality of water is also monitored by other international bodies such as World Health Organization (WHO), Environment protection agency (EPA), European Community (APHA), American Republic Health Association (APHA) American Water Works Association (AWWA), and Federal Environmental Protection Agency (FEPA). Chemical in water supplies can cause very serious problem (WHO, 2007). The problem associated with chemical constituents of drinking water courses primarily from their ability to cause adverse health effects after prolonged period of explosive, of particular concentration are contaminants that have cumulative toxic properties, such as heavy metals and substances that are carcinogenic (DEWO, 1989). The abundance of toxic chemicals in drinking water may cause adverse effects on human health such as Cancer and Chronic illness (AL-Saleh and Al-Doush, 1998).The presence of toxic metals like Arsenic, Cadmium, mercury and lead could cause acute or chronic poisoning when present in drinking water. Besides, other contaminants in drinking water include physical, microbiological acid radio logical that are known to be hazardous to health (Amoo et al. 2005). Nearly 90% o diarrhea related cases and death have been attributed to unsafe or inadequate water supplies and sanitation conditions (WHO, 2006).Water that is meant for human consumption should be free of disease-causing germs and toxic chemicals that pose a threat to public human health (TWAS, 2005).

II. Materials And Methods

Location of the research: Ozoro town is the headquarter of Isoko North Local Government Area; one of the two administrative units in Isoko region of Delta State, Southern Nigeria. Ozoro is made up of five quarters: Uruto, Erovie, Etevie, Urude and Oruamudhu, There is no definite population censes figure but is one of the largest communities in Isoko Land, both in terms of size and population. It lies between longitude 6^{o}12'58" E and Latitude 5^{o}3'18" N (www.wikipedia.org).

Sample collection and analytical procedure: Fifteen different brands of 500ml of sachet water samples used in this study were purchased from the Delta State Polytechnic, Ozoro campus. The samples were labeled from 1-15. Duplicate samples were collected and analyzed per brand of sachet water within 6 hours of sample collection.

Phisico-chemical analysis: The appearance of water sample was by visual observation for colour and in hailed for odour. The taste was also determined physically. A conductivity meter (aquopro: Model AP-Z) was used to determine the conductivity of samples. The pH was determined using Jenway Model pH meter. The total dissolved solid (TDS) was estimated by Gravimetric method. TDS was measured using conductivity/TDS meter. Total hardness, calcium and magnesium of the sachet was determined by EDTA titrimetric method.

Table I. Physical properties, pH and conductivity of the sachets water are presented in table.

Sample	Appearance	Taste	Odour	pH	Conductivity	Total Dissolve Solid (TDS)	Total Hardness
1	Colourless	Tasteless	Odourless	6.5	31.7	61.50± 0.31	78.4
2	Colourless	Tasteless	Odourless	6.6	32.2	64.70± 0.23	86.4
3	Colourless	Tasteless	Odourless	6.6	32.0	64.80± 0.30	87.4
4	Colourless	Tasteless	Odourless	6.5	32.2	70.60± 0.30	88.7
5	Colourless	Tasteless	Odourless	6.6	31.8	51.44± 0.43	88.7
6	Colourless	Tasteless	Odourless	6.5	32.1	64.54 ± 0.56	90.3
7	Colourless	Tasteless	Odourless	6.5	32.0	67.67± 0.35	92.4
8	Colourless	Tasteless	Odourless	6.6	31.5	70.66± 0.40	92.3
9	Colourless	Tasteless	Odourless	6.5	30.2	65.57± 0.21	92.3
10	Colourless	Tasteless	Odourless	6.6	29.8	61.71 ±043	93.4
11	Colourless	Tasteless	Odourless	6.6	29.9	63.45± 0.24	94.3
12	Colourless	Tasteless	Odourless	6.6	29.9	69.77± 0.32	95.4
13	Colourless	Tasteless	Odourless	6.5	30.9	66.34± 0.21	95.4
14	Colourless	Tasteless	Odourless	6.5	31.5	67.74± 0.33	98.5
15	Colourless	Tasteless	Odourless	6.5	31.5	70.60± 0.35	97.3
Who Standard	**Colourless**	**Tasteless**	**Odourless**	**6.5-9.5**	**900**	**100**	**100mg/l**

III. Results And Discussion

On the organoleptic assessment, (Table I) the sampled sachet waters were colourless, tasteless and odourless. This showed that the sachet water samples had good aesthetic value. The pH value (table I) obtained showed that eight (8) of the samples had pH of 6.5 while the remaining seven had 6.6 and are within the WHO, permissible limits (6.5 to 9.5). Low

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water pH can cause gastro –intestinal irritation in sensitive individuals. The conductivity was found to be between 29.8 to 32.2µs/cm. All the values were found to be below the maximum permissible limits of 900µs/cm set by the WHO standard. The TDS level (Table I) determined was found to be below the permissible limit set by WHO. Efac, De excel and POC had the highest TDS values (70.60+0.30, 70.66+0.40 and 70.60+0,35, respectively) but still falls within the permissible limit recommended by WHO (WHO, 1999).

Heavy Metals in Water

Heavy metals concentrations of the sachets water were illustrated in Table (II).

Metals concentrations in water were found in the following order: pb > Cu > Fe > Zn in the fifteen (15) sachets water from Ozoro. The sequences of metals concentration in the sachets water sample was as follow: pb > Cu > Fe > Zn (Table II).

TABLE II. Mean +STD of heavy metals concentration (mg/l) in sachet water from Ozoro metropolis.

Samples	Pb	Cu	Fe	Zn
1	0.04±0.0	0.03±0.00	0.03±0.00	0.03±0.00
2	0.03±0.00	0.03±0.00	0.03±0.00	0.03±0.00
3	0.07±0.00	0.05±0.00	0.02±0.00	0.02±0.00
4	0.03±0.00	0.04±0.00	0.03±0.00	0.03±0.00
5	0.03±0.00	0.03±0.00	0.02±0.00	0.02±0.01
6	0.03±0.00	0.03±0.00	0.02±0.00	0.03±0.00
7	0.06±0.00	0.04±0.00	0.07±0.00	0.07±0.00
8	0.06±0.01	0.03±0.00	0.03±0.00	0.04±0.00
9	0.04±0.01	0.09±0.00	0.063±0.00	0.08±0.00
10	0.03±0.01	0.02±0.00	0.03±0.00	0.03±0.00
11	0.03±0.00	0.03±0.01	0.03±0.00	0.02±0.00
12	0.02±0.00	0.01±0.01	0.02±0.00	0.02±0.00
13	0.05±0.00	0.04±0.01	0.04±0.00	0.05±0.00
14	0.03±0.00	0.064±0.01	0.02±0.00	0.03±0.00
15	0.04±0.00	0.03±0.01	0.02±0.00	0.03±0.00
PL	**0.01 WHO 1.0 USEPA**	**2.00 WHO**	**3.00 WHO 1.0 USEPA**	**3.00 WHO 0.05 USEPA**

xPL: Permissible limits according to WHO (1999) and USEPA (1986). Data's shown are statistically different at $P < 0.05$ level. The difference in the concentration of the four metals content of the water sample shows significance. The mean± STD values of the measured metals (Pb, Cu, Fe, and Zn) were recorded for the sachet water. The Cu (figure 6) and Fe (figure 7) levels were lower than the permissible limits (Table 2) as recommended by WHO, (1999) and USEPA (1986). The Zn (figure 8) levels for sachet water falls within the permissible limit for WHO, (1999) while are higher than the recommended by USEPA (1986). The Pb (figure 5) level is lower than the permissible limit recommended by USEPA, but higher than the permissible limit recommended by WHO, (1999) (Khallaf et al, 1998). This may be attributed to the huge effort to pre-treatment the water and make it good for consumption. On the other hand Pb values that is higher than the permissible limit recommended by WHO could be linked to the pre treatment protocol by USEPA adopted by this sachet water depot, but is still within the required recommendation for consumption according to USEPA (1986).

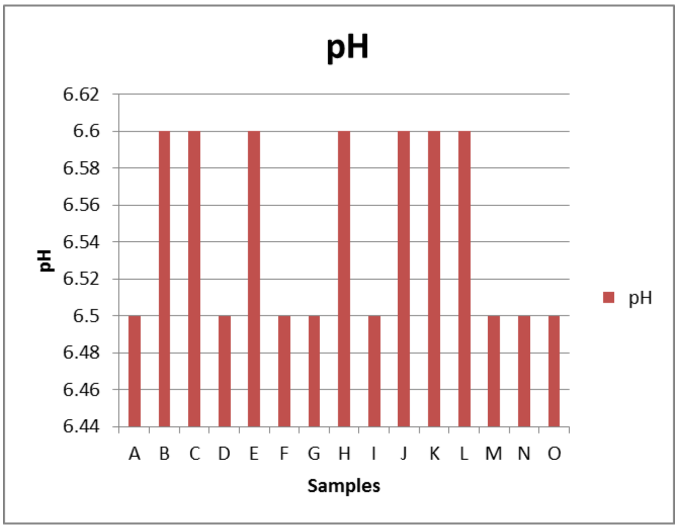

Fig. 1. Distribution pH in sachet water sample.

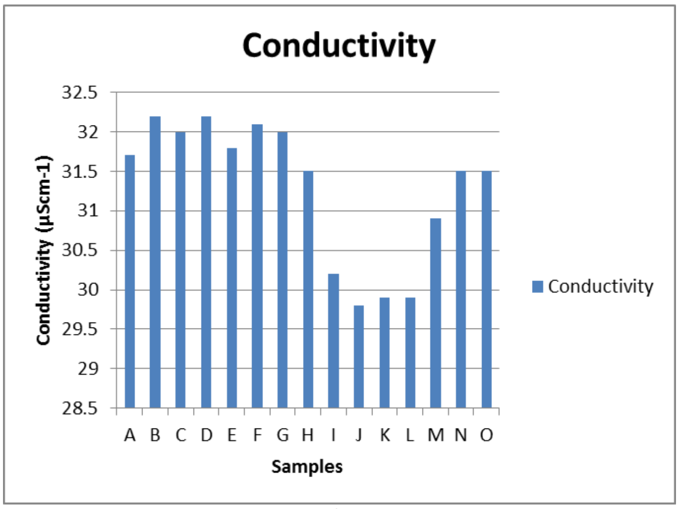

Fig. 2. Frequency distribution pattern for conductivity in sachet water sample.

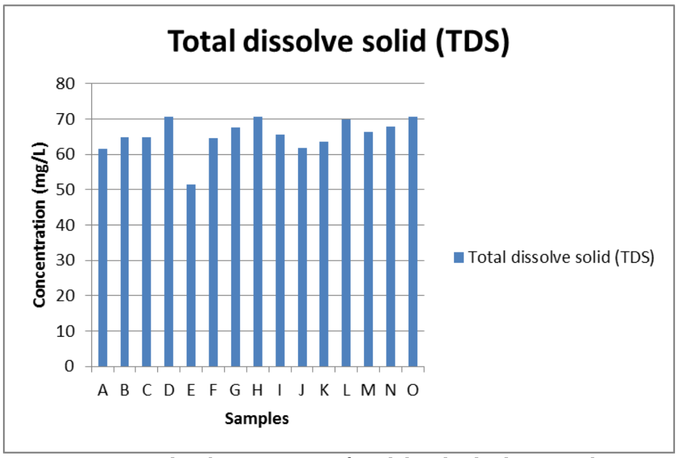

Fig. 3. Frequency distribution pattern of total dissolved solute in sachet water sample.

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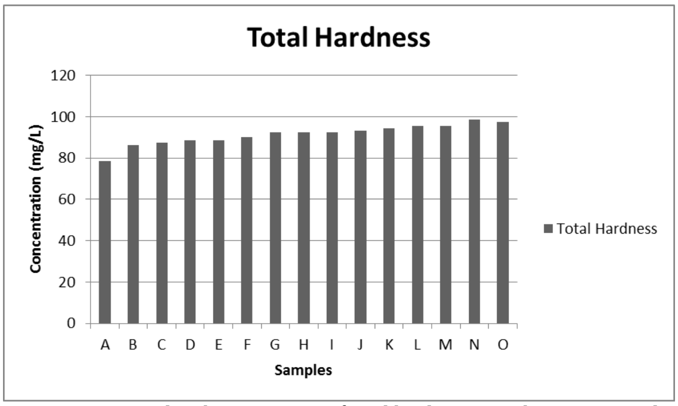

Fig. 4. Frequency distribution pattern of total hardness in sachet water sample.

The pH values obtained were between 6.5 and 6.6. The pH values shows that eight of the samples had pH of 6. 5 while the remaining seven had pH of 6.6. All the pH values were within the WHO permissive limit (6.5-9.5) .The conductivity values ranged 29.8 to 32.2µscm. All the values were below the maximum permissible limits of 1000µs/cm set by WHO standard. The TDS level determined were below the permissible limits by WHO (100mg/l). However, the samples 4, 8 and 15 had the highest TDS values (70.60+0.30 70.66+ 0.40 and the 70.60 + 0.35, respectively). The total hardness ranged from 34.02+3.7 mg/l to 69.35+4.4mg/L which was below the maximum allowable limit of 150 mg/L. The sampled sachet water organileptic assessment were all colorless, tasteless and odorless. The mean concentration value of pb, Cu, Fe and Zn estimated were below the WHO permissible limits of 0.01mg/ L(pb). 2.0 mg/L (Cu), 3.0 mg/L (Fe) and 3.0mg/L (Zn).

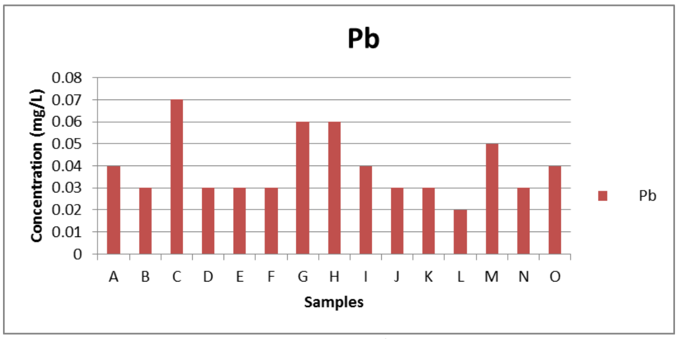

Fig. 5. Frequency distribution pattern of lead in sachet water sample.

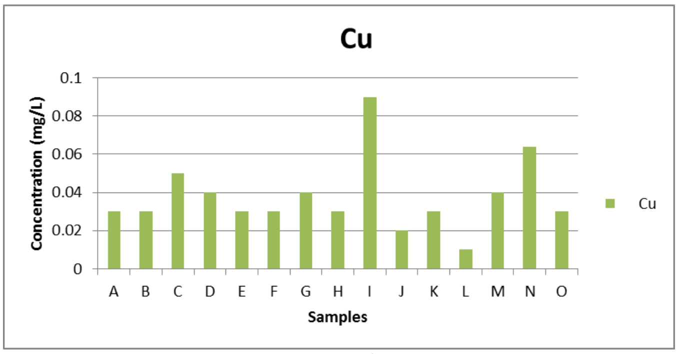

Fig. 6. Frequency Distribution pattern of copper in sachet water samples.

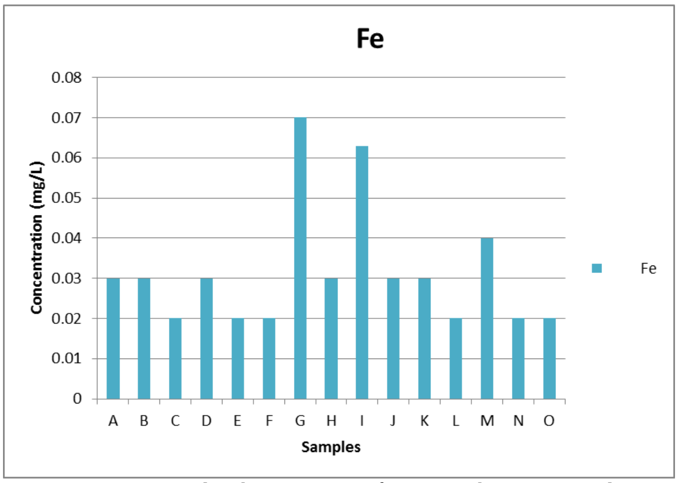

Fig. 7. Frequency distribution pattern of iron in sachet water samples.

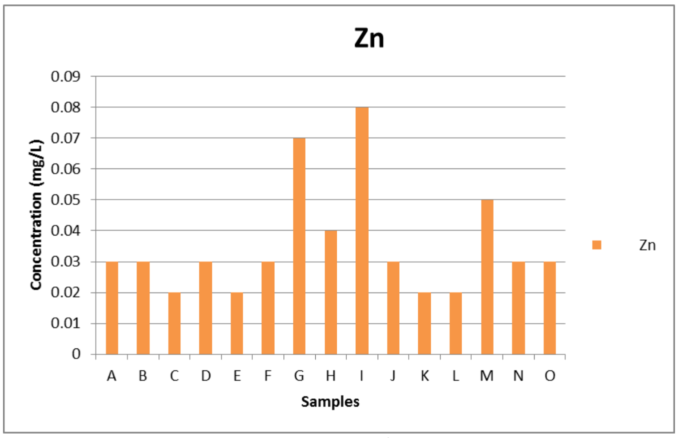

Fig. 8. Frequency Distribution pattern of zinc in sachet water sample.

IV. CONCLUSION

The physic – chemistry properties investigated in this study were with the NAFDAC and WHO permissible limit and show that sachet water sold in Delta State Polytechnic, Ozoro Campus are of good qualities. Nevertheless, it is also very important that the regulatory authorities should and must continue with their regular inspection activities of sachet water supplies to the campus. In order to safe guide the health of consumers, there should be expiring date labeled on the sachet portable water.

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