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# Estimation of Physicochemical Properties of Three Package Water within Enugu Metropolis, Enugu State

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## ABSTRACT

*Table water from table water factories within Enugu municipal were subjected to various physicochemical analyses. Table water from table water factory I pH of 6.50 and r conductivity of 1013 ($\Omega^{-1}$ Cm-1). Solid contents of the water such as: Total solids, suspended solid and total dissolved solids of the waste water were: 1022, 363.55 and 658.45 mg/ml, respectively. $BOD_5$ concentration and the temperature of the package water were observed at 0.52mg/ml and 37.67°C, respectively. Dissolved mineral Cl-, K, Ca, Mg were: 1203.42, 15.24, 39.76 and 23.71 mg/ml respectively; heavy metals of Fe, Cu were: 1.16 and 1.22 respectively while Pb, Hg, Cd and as were below detectable limit. TOC and TOM contents were 35.41 and 43.55 mg/ml respectively. Studies on the physicochemical properties of the table water from factory II-IV showed an increase in pH and water conductivity in table water from factory II while factory III table water showed a slight decrease in pH with accompanying increase in water conductivity. In all the table water, clinical health implicated heavy metals such as Pb, Hg, Cd, As were not detected within limit in all the sampled table water while iron and copper were relatively in abundant moderately. Dissolved mineral contents of calcium and magnesium were much in abundance in all the table water from Enugu metropolis while table water from factory Iv showed the highest in presence of Ca and Mg as evidently seen in the conductivity of the water. TOC and TOM contents were 35.41 and 43.55 mg/g respectively for table water from factory I while 37.48 and 46.10 mg/ml were gotten respectively for table water from factory II; 39.12 and 48.12 mg/ml for table water from factory III and 39.30 and 48.34 mg/ml were gotten for table water from factory IV respectively.*

**Keywords:** Table water, physicochemical, Enugu municipal

## INTRODUCTION

Portable Water is one which its physical, chemical and microbiological qualities adhere to specified standards (Onweluzo, and Akuagbazie, 2010). The Federal Ministry of Health stated that only about 30% of Nigerians have access to potable water while the United Nations

estimated that larger proportion of people all over the world have limited opportunity to table water (Oyeku *et al*., 2011; WHO, 2006).

Water is utmost necessity needed by all forms of life in ecosystem. It is found majorly beneath the biosphere (about 75%). Quality table water is rarely available to maneven though it's high presence in the ecosystem (Onweluzo and Akuagbazie, 2010). Packaged table water is very common in Nigeria; however, it is found in soldom as served water at food canteens and other food vendors in the country (Chen *et al*., 2013). Non- availability of good table water has resulted to an epidemiological hike in the number of health challenges as water is known to be a primary causative agent of many communicable diseases. Most third-world countries of today have reported 80% of all diseases and over 30% of deaths are related to drinking water (Olaoye and Onilude, 2009; Onweluzo and Akuagbazie, 2010). Interest by many entrepreneurs in going into the business of package table water production is very competitive recently due the attached market value (Dada, 2009). In many of the local areas in Nigeria and other African neighboring countries like Ghana, Niger, Benin, Togo etc this water is referred to as "pure water" (Oyeku *et al*., 2011). Packaged table water commonly sold is mainly sourced from drilled borehole, springs falls, taps etc. Packaged table water produced by growing industries is subjected to various degree of treatment which comprises: aeration, double or single filtration using porcelain molecular candle filter or membrane filters and in rare instances, biocidal agent is applied. Treatments to table water largely depend to the source where the water is gotten from.

However, physicochemical parameters are parameters that come to know the quality of water. These parameters comprise of physical properties like color, odor, taste, turbidity etc. and chemical properties that can be determine using chemical test e.g. chloride, alkalinity, dissolved carbon dioxide, water hardness etc.

Diseases emanating from utilization of polluted water include different communicable diseases such as respiratory disease, cancer, diarrheal disease, neurological disorder and cardiovascular disease (WHO, 2006). Peasant individual are highly susceptible to disease due improper sanitation, hygiene and water supply (Thebo *et al*., 2017). Unhygienic water has health implicated effect on women who are exposed to chemicals during pregnancy; it leads to still-birth and low weight new born due to fetal contamination (Currie *et al*, 2013).

## MATERIAL AND METHODS

### Materials

Research reagents, equipment used in the present study were graded analytically and are products of BDh, May and Baker, Sigma Aldrich. The equipments are calibrated at each use.

### Collection of the Experimental Samples

Water samples were collected from four (4) table water processing factories located within Enugu metropolis, Enugu state. The collected samples were freeze preserved in clean asceptic sample containers as described by Ezenwelu *et al.* (2022) and sent to the laboratory for further analysis. Control sample was collected at site of 48km on locus from Enugu state.

**Analysis of Water Physicochemical Properties**

Water sample from the table water factories were subjected to various physicochemical water analysis as described by ATSDR, (2010).

The following tests were carried out:

- pH Profiling Test
- Conductance Test
- Total solid (TS), Total suspended solid (TSS), Total dissolved solid (TDS)
- Dissolved oxygen content (DO)
- Biochemical oxygen dissolved count ($BOD_5$)
- Determination of Macro and Micro Contents of the water samples
- Total organic carbon contents
- Heavy Metals Identification such as Fe, Hg, As, Cd, Cu and Pb using the atomic absorption spectra (AAS).

## RESULT AND DISCUSSION

**Table 1. Physicochemical properties of table water from Enugu metropolis**

| **Physiochemical parameters** | **Control experiment** | **Table water I** |
|---|---|---|
| pH | 6.80 | 6.50 |
| Water Conductivity ($\Omega^{-1}cm^{-1}$) | 1182 | 1013 |
| Total dissolved solid (mg/ml) | 634.67 | 658.45 |
| Total suspended solid (mg/ml) | 377.66 | 363.55 |
| Total solid (mg/ml) | 1012.33 | 1022 |
| Chloride ion (Mg/ml) | 1123 | 1203.42 |
| Dissolved oxygen (Mg/ml) | 7.02 | 6.14 |
| Magnesium (Mg/ml) | 16.24 | 23.71 |
| Potassium (Mg/ml) | 9.02 | 15.24 |

| | | |
|---|---|---|
| Calcium (Mg/ml) | 32.33 | 39.76 |
| $B0D_5$ (mg/ml) | 0.88 | 0.52 |
| Iron (Mg/ml) | 1.25 | 1.16 |
| Cadmium (Mg/ml) | BDL | BDL |
| Mercury (Mg/ml) | BDL | BDL |
| Arsenic (Mg/ml) | BDL | BDL |
| Lead (Mg/ml) | BDL | BDL |
| Copper (Mg/ml) | 1.14 | 1.22 |
| Total Organic Carbon (TOC) (mg/ml) | 38.40 | 35.41 |
| Total Organic Matter (mg/ml) | 46.74 | 43.55 |

BDL= Below detectable limit. N=2

**Table 2. Physicochemical properties of table water from Enugu metropolis**

| **Physiochemical parameters** | **Control experiment** | **Table water I I** |
|---|---|---|
| pH | 6.80 | 6.70 |
| Water Conductivity ($\Omega^{-1}cm^{-1}$) | 1182 | 1124 |
| Total dissolved solid (mg/ml) | 634.67 | 665.30 |
| Total suspended solid (mg/ml) | 377.66 | 340.24 |
| Total solid (mg/ml) | 1012.33 | 1005.54 |
| Chloride ion (Mg/ml) | 1123 | 1221.05 |
| Dissolved oxygen (Mg/ml) | 7.02 | 6.87 |

| | | |
|---|---|---|
| Magnesium (Mg/ml) | 16.24 | 22.09 |
| Potassium (Mg/ml) | 9.02 | 13.39 |
| Calcium (Mg/ml) | 32.33 | 32.45 |
| $B0D_5$ (mg/ml) | 0.88 | 0.60 |
| Iron (Mg/ml) | 1.25 | 1.24 |
| Cadmium (Mg/ml) | BDL | BDL |
| Mercury (Mg/ml) | BDL | BDL |
| Arsenic (Mg/ml) | BDL | BDL |
| Lead (Mg/ml) | BDL | BDL |
| Copper (Mg/ml) | 1.14 | 1.08 |
| Total Organic Carbon (TOC) (mg/ml) | 38.40 | 37.48 |
| Total Organic Matter (mg/ml) | 46.74 | 46.10 |

BDL= Below detectable limit. N=2

**Table 3. Physicochemical properties of table water from Enugu metropolis**

| **Physiochemical parameters** | **Control experiment** | **Table water III** |
|---|---|---|
| pH | 6.80 | 6.40 |
| Water Conductivity ($\Omega^{-1}cm^{-1}$) | 1182 | 1141 |
| Total dissolved solid (mg/ml) | 634.67 | 796.42 |
| Total suspended solid (mg/ml) | 377.66 | 312.40 |
| Total solid (mg/ml) | 1012.33 | 1106.82 |

| | | |
|---|---|---|
| Chloride ion (Mg/ml) | 1123 | 1167.45 |
| Dissolved oxygen (Mg/ml) | 7.02 | 7.12 |
| Magnesium (Mg/ml) | 16.24 | 28.14 |
| Potassium (Mg/ml) | 9.02 | 14.52 |
| Calcium (Mg/ml) | 32.33 | 38.43 |
| $B0D_5$ (mg/ml) | 0.88 | 0.58 |
| Iron (Mg/ml) | 1.25 | 1.28 |
| Cadmium (Mg/ml) | BDL | BDL |
| Mercury (Mg/ml) | BDL | BDL |
| Arsenic (Mg/ml) | BDL | BDL |
| Lead (Mg/ml) | BDL | BDL |
| Copper (Mg/ml) | 1.14 | 1.13 |
| Total Organic Carbon (TOC) (mg/ml) | 38.40 | 39.12 |
| Total Organic Matter (mg/ml) | 46.74 | 48.12 |

BDL= Below detectable limit. N=2

**Table 4. Physicochemical properties of table water from Enugu metropolis**

| **Physiochemical parameters** | **Control experiment** | **Table water I V** |
|---|---|---|
| pH | 6.80 | 6.50 |
| Water Conductivity ($\Omega^{-1}cm^{-1}$) | 1182 | 1184 |
| Total dissolved solid (mg/ml) | 634.67 | 826.43 |

| | | |
|---|---|---|
| Total suspended solid (mg/ml) | 377.66 | 440.10 |
| Total solid (mg/ml) | 1012.33 | 11266.53 |
| Chloride ion (Mg/ml) | 1123 | 1176 |
| Dissolved oxygen (Mg/ml) | 7.02 | 7.27 |
| Magnesium (Mg/ml) | 16.24 | 28.22 |
| Potassium (Mg/ml) | 9.02 | 10.22 |
| Calcium (Mg/ml) | 32.33 | 40.28 |
| $B0D_5$ (mg/ml) | 0.88 | 0.67 |
| Iron (Mg/ml) | 1.25 | 1.33 |
| Cadmium (Mg/ml) | BDL | BDL |
| Mercury (Mg/ml) | BDL | BDL |
| Arsenic (Mg/ml) | BDL | BDL |
| Lead (Mg/ml) | BDL | BDL |
| Copper (Mg/ml) | 1.14 | 1.14 |
| Total Organic Carbon (TOC) (mg/ml) | 38.40 | 39.30 |
| Total Organic Matter (mg/ml) | 46.74 | 48.34 |

BDL= Below detectable limit. N=2

**Discussion**

Enugu metropolis is a commercial hub within the south east region of Nigeria, the city is being disturbed with lots of pollution from commercial and domestic activities. Several on-going activities lead to introduction of contaminants to water; these contaminants are mostly inorganic ions which are introduced into the water from the source through which water flows and to a varying extent anthropogenic pollution by chemicals agents. Some of these contaminants are found

in some of the packaged water produced in Enugu because during the purification process the water is not thoroughly purified before being packaged by some of the industries. Consumption of these untreated water could lead to diseases which may include diarrhea, typhoid, cholera etc. The above enlisted waterborne diseases have been the major problem associated with the people of Enugu.

In the present study, table water from table water factories within Enugu municipal were subjected to various physicochemical analyses. Table water from table water factory I within Enugu municipal showed a lower pH of 6.50 and relatively more conductivity of 1013 ($\Omega^{-1}$ Cm-1) when compared with the reference. The relative lower pH and higher conductivity of the water compared to the control experiment can be attributed to the nature of the water source ie the drilled soil olefeirs which may contain higher acidic and higher ionizable compounds contents as stated in the proceedings of the ASTDR (2009).

Solid contents of the water such as: Total solids, suspended solid and total dissolved solids of the waste water were: 1022, 363.55 and 658.45 mg/ml, respectively. $BOD_5$ estimation and the temperature of the table water were recorded at 0.52mg/ml and 37.67°C, respectively. Proceedings of ASTDR (2009) and Valerro (2010), stated that every water body both flowing and underground water are associated by the presence of solid particles, these solids may be undissolved (suspended) along the costal axis of the water line or dissolved in the olefiers of the water bed. The proceedings went further to state that these solid particles composite of the water mostly is as a result of rock weathering, human activities such as querrying, volcanic eruption in the water bed and water bodies eutrophications. BOD which the quotient of biochemical oxygen demand by living biota in a water body showed the marked biochemical activity of aquatic fauna and flora within the ecosystem. As stated by Valerro (2010) increased demand of oxygen by living organisms in an aquatic ecosystem is an indication of microbial bloom from an in-fluxed biodegradable waste matter in the said ecological niche. There was a noticeable decrease in the BOD count of the table water from factory I within Enugu municipal modeled under five (5) days. This decrease in demand of oxygen can be attributed to the absence of biodegradable organic matter present in the waste water.

Dissolved mineral Cl-, K, Ca, Mg were: 1203.42, 15.24, 39.76 and 23.71 mg/ml respectively; heavy metals of Fe, Cu were: 1.16 and 1.22 respectively while Pb, Hg, Cd and As were below detectable limit. TOC and TOM contents were 35.41 and 43.55 mg/ml respectively.

Studies on the physicochemical properties of the table water from factory II-IV showed an increase in pH and water conductivity in table water from factory II while factory III table water showed a slight decrease in pH with accompanying increase in water conductivity. Table water from factory IV showed the highest water conductivity among the four sampled tabled water within Enugu metropolis. In all the table water, clinical health implicated heavy metals such as Pb, Hg, Cd, As were below detectable limit in all the sampled table water while iron and copper were relatively in abundant moderately. Dissolved mineral contents of calcium and magnesium were much in abundance in all the table water from Enugu metropolis while table water from factory Iv showed the highest in presence of Ca and Mg as evidently seen in the conductivity of the water.

TOC and TOM contents were 35.41 and 43.55 mg/g respectively for table water from factory I while 37.48 and 46.10 mg/ml were gotten respectively for table water from factory II; 39.12 and 48.12 mg/ml for table water from factory III and 39.30 and 48.34 mg/ml were gotten for table water from factory IV respectively. There was a correlation in the organic and oxidizable carbon contents of the table water samples from the factories within Enugu metropolis to the respective control sample. Mbachu *et al*. (2016) stated that total organic carbon and organic matter content of a

medium reveal the carbon catenation oxidizable in the sampled area and organic matter show the degradable composite of the oxidizable carbon. The two enlisted components revealed the presence of carbon in an ecosystem. They reported a TOC and TOM of 38.71 and 43.95 mg/g. correspondingly on the TOC and TOM contents of water polluted with effluents showed an elevated empirical of the physicochemical parameters.

## CONCLUSION

Water naturally contains contaminants, especially inorganic contaminants which may arise from the source through which water flows and to a varying extent anthropogenic pollution by chemicals. Therefore, this experiment stands in to fill in the gap of providing with experimental data the compromised situations of the so-called packaged table waters distributed by pure water industries in Nigeria using the test sample area of Enugu metropolis.

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**Author's Contributions**

Nwanjoku, Chioma Helen: Conceived and designed the experiments, she also participated in performing the experiment and data processing and analysis.

Nwanjoku, Obinna K: Revised the manuscript and performed the experiment.

Ozumba Uchenna.: Processed the data and wrote the manuscript.

**Ethics**

Authors declared no ethical issues that may arise after the publication of this manuscript.

**Appreciation**

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**Conflicts of Interest**

The authors declare no conflicts of interest regarding the publication of this paper.

## REFERENCE

[1] Agency for Toxic Substance Development and Disease Registry (ATSDR) (**2009**). Documentary on toxicological profile of total petroleum hydrocarbon contaminations. Agency for toxic substance and disease registry, division of toxicology and toxicology information branch, Atlanta Georgia.

[2] Agency of Toxic Substances and Disease Registry (ATSDR) (**2010**). Public Health Statements: Used mineral based crankcase oil. ATSDR. Atlanta Georgia.

[3] Chen, Z., Ngo, H. and Guo, W. (**2013**). A critical review on the end uses of recycled water. Critical Review on Environal Science and Technology, 43:1446–1516.

[4] Dada, C. (**2009**). Towards a successful package water regulation in Nigeria. *Scientific Research and Assay,* 4(9):921-928.

[5] Ezenwelu, C., Aribodor, O., Ezeonyejiaku, C., Okafor, S. and Oparaji, E. (**2022**). Assessment of physicochemical properties and microbial loading index of soil samples from mgbuka market, Anambra state. *Journal of Environmental Pollution and Management,* 12:134-176.

[6] Ezeonu, M., Okafor, J. and Ogbonna, J. (**2013**). Laboratory Exercises in Microbiology.1st Edn. Ephrata Publishing and Printing Company, Nsukka. Pp 100-117.

[7] Mbachu, A. E., Chukwurah, E. I., and Mbachu, N. A. (**2016**). Isolation and characterization of hydrocarbon degrading fungiform used (spent) engine oil polluted soil and their use for polycyclic aromatic hydrocarbons (PAHs) degradation. *Universal Journal of Microbiologial Researches*4 (1):31-37.

[8] Onweluzo, J. and Akuagbazie, C. (**2010**). Assessment of the quality of bottled sachet water sold in Nsukka town. *Agro-science Journal of Tropical Agriculture, Food and Environmental Science*, 9(2): 104-1010.

[9] Oyeku, O., Oduyoye, O., Karimu, F., Akindoju, A., Ibikunle, A. and Elemo, G. **(2020).** Environmental uncertainty and entrepreneurial success. *International Journal of Small Business and Enterprenuernal Research*, 8(4):2053-583

[10] Thebo, A., Drechsel, P. Lambin, E., Nelson, and K. (2017). A global, spatially-explicit assessment of irrigated croplands influenced by urban wastewater flows. *Environmental Research Letters*, 12:074008.

[11] Valerro D. **(2010).** Environmental biotechnology: A Biosystems approach. 4th edition. Pp. 1245-1453.

[12] World Health Organization (**2006**). Guidelines for the Safe Use of Wastewater, Excreta and Greywater. Volume 1 World Health Organization; Geneva, Switzerland.