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Research Article

**DIFFERENT LEVELS OF CHLORIDE ION, SULPHATE ION,  
AND NITRATE IN TREATED WATER****Orogu J.O.\* and Ekibade, O.J.**Department of Science Laboratory Technology, Delta State Polytechnic Ozoro,  
Delta State, Nigeria**Abstract:**

According to the World Health Organization (WHO), drinking water should be free from any organism that might pose a health risk to the human population. Water authorities throughout the world are thus dedicated to ensure that the water that reaches the consumer is safe for consumption and free from any substances that may be harmful to health. The Different levels of chloride ion, sulphate ion, and nitrate in treated water was evaluated in the distribution of treated water. In all the samples analyzed, the residual chlorine of the treated water samples, the lowest value of 0.1mg/l was obtained from samples B and F, while the highest value of 0.9mg/l was obtained from sample A. The result of analysis of chloride ion in water shows that there was no significant difference ( $p < 0.05$ ) among samples B, and F. The lowest chloride ion value of 2.70mg/l was recorded for sample B and the highest value of 6.55mg/l for sample A. In the sulphate ion there was significant difference ( $p > 0.05$ ) among A, B, C, D, E and F with sample A having the highest sulphate ion level of 4.54mg/l while sample B have the lowest level of sulphate ion of 0.87mg/l. Furthermore, the result of analysis of Nitrate in water shows that there was no significant difference ( $p < 0.05$ ) among samples A, B and D, and E and F, However, an exception was noted for C. The lowest Nitrate value of 1.20mg/l was recorded for sample E and the highest value of 1.42mg/l for samples A and D. The parameters analyzed most generally conform to the WHO standards for drinking water.

**Key words:** *Different, Chloride, Ion, Sulphate, Nitrate, Treated, Water***Corresponding author:****Orogu Joshua Othuke,**

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**INTRODUCTION:**

The water treatment today through technological advancement such as disinfection and rapid filtration techniques tries to produce water that is safe and aesthetically acceptable to consumers. In Nigeria, the conventional water treatment plants are well designed to produce safe quality water supplies from most surface water sources on World Health Organizations (WHO) Guidelines (Iwugo, 1988). The primary objective of water treatment for public supply is to take water from the best available source and subject it to processing that will ensure that only potable water of good quality is distributed from the treatment source to the consumers' taps, while preserving its quality in the distribution system.

The principal operations employed in a municipal purification plant to produce potable water generally involve sedimentation, coagulation, filtration, and chlorination. The stages prior to disinfection are generally designed to remove suspended matter, microorganisms inclusive. The final disinfection process ensures that water is pathogen-free and also to confer a residual disinfectant on the water throughout the supply period. Disinfectants that have been used for water treatment include chlorine in the form of molecular or hypochlorite of sodium or calcium, ozone, chlorine dioxide, ultraviolet radiation and chloramines. After adequate water treatment, the maintenance of water portability throughout the distribution system and beyond until the faucet of the ultimate consumer presents a problem. As far back as 1984a, WHO reported that contamination of treated water in the distribution network could occur as a result of cross connections, back siphonage, leaks, low pressures, intermittent service and lack of sewerage systems.

Chlorination is the process of adding the element chlorine to water as a method of water purification to make it fit for human consumption as drinking water. Water which has been treated with chlorine is effective in preventing the spread of waterborne disease. The chlorination of public drinking supplies was originally met with resistance, as people were concerned about the health effects of the practice. The use of chlorine has greatly reduced the prevalence of waterborne disease as it is effective against almost all bacteria and viruses. Chlorination is often employed either as pre-treatment or final process in water softening plants. In simple chlorination, which consists of merely of the addition to water as a regular controlled doses (usually 0.1 – 0.2mg/l), a contact period of at least 30 minutes is needed since it is applied in small doses.

Drinking-water should ideally have no visible colour. Colour in drinking-water is usually due to the presence of coloured organic matter (primarily humic and fulvic acids) associated with the humus fraction of soil. Colour is also strongly influenced by the presence of iron and other metals, either as natural impurities or as corrosion products. It may also result from the contamination of the water source with industrial effluents and may be the first indication of a hazardous situation (WHO, 2008). The dissolved oxygen content of water is influenced by the source, raw water temperature, treatment and chemical or biological processes taking place in the distribution system. Depletion of dissolved oxygen in water supplies can encourage the microbial reduction of nitrate to nitrite and sulfate to sulfide. It can also cause an increase in the concentration of ferrous iron in solution, with subsequent discoloration at the tap when the water is aerated. No health-based guideline value is recommended (WHO, 2008). Hardness caused by calcium and magnesium is usually indicated by precipitation of soap scum and the need for excess use of soap to achieve cleaning. Public acceptability of the degree of hardness of water may vary considerably from one community to another, depending on local conditions. In particular, consumers are likely to notice changes in hardness. For effective disinfection with chlorine, the pH should preferably be less than 8; however, lower-pH water is likely to be corrosive. The pH of the water entering the distribution system must be controlled to minimize the corrosion of water mains and pipes in household water systems. Alkalinity and calcium management also contribute to the stability of water and control its aggressiveness to pipe and appliance. Failure to minimize corrosion can result in the contamination of drinking-water and in adverse effects on its taste and appearance (WHO, 2008). This present study therefore, focused on the determination of Chloride ion, Sulphate ion and Nitrate ion in treated and untreated water distributed in some parts of Ilorin.

**MATERIALS AND METHODS:****Study Area**

The study area is Ilorin, Kwara state capital, North central region of Nigeria.

**Sampling procedures**

All samples were collected in sterile sample bottles as follows;

Tap water

The tap was cleaned by wiping with a clean cloth to remove any dirt. It was then turned on at maximum flow and water was allowed to run for 1-2 minutes. The tap was turned off and sterilized for about one

minute with the flame from a cigarette lighter. The tap was then carefully turned on and water allowed to flow for 1-2 minutes at a medium flow rate.

The sample bottle was carefully opened and immediately held under the water jet and filled. This was done holding the protective cap of the bottle face down to prevent any entry of dust, which may contaminate the samples were immediately taken back to the laboratory for analysis

#### Sample Collection

6 sampling sites were analysed and designated as A, B, C, D, E, and F. Three samples were collected from each sampling site.

#### Free Residual Chlorine

The free chlorine residual was determined with the aid of the Lovibond comparator using its chlorine standard discs. The orthotolidine indicator was used and distilled water served as the control.

#### DETERMINATION OF CHLORIDE ION

The method of AOAC (2002) was used for the determination of chloride ion by titration of the water sample with silver nitrate. To 100ml of the water sample was added with potassium chromate (5%, 1ml) and titrated with 0.1M silver nitrate solution, the first appearance of buff colour, marks the end point of the titration.

#### Calculation:

$$\text{Chloride (mg/L)} = \frac{V_T \times M \times 100,000}{\text{ml. of sample}}$$

Where  $V_T$  = titre value

M = mole of  $\text{AgNO}_3$

#### DETERMINATION OF SULPHATE BY GRAVIMETRIC METHOD

50ml of the water sample was carefully measured into a beaker to which 2 drops of methyl red indicator was added which turn the solution into light yellow later add 2 drops of concentrated HCl was added later in excess which turn to pink and the solution was then boil to reduce to 1/3, hot barium chloride solution prepared was added to it with stirring until the formation of white precipitate is complete, two drops of barium chloride solution was added in excess and allow the precipitate to settle down which was then filtered by using a what man filter paper No 1 and the precipitate was then washed several time with distilled water until it was free of chloride ions.

The filter papers along with the precipitate were transferred carefully into crucible and ignite at  $100^\circ\text{C}$  in ovens, then cooled in desiccators and finally weighed. Sample 1, 2 and 3 turns faint yellow on heating but pink on addition of methyl orange and concentrated HCl and on heating turns to faint yellow but sample 4 remains pink and sample 5 also remain faint pink in colour.

#### Calculation:

233.4g of  $\text{BaSO}_4$  contains 96.06g of  $\text{SO}_4^{2-}$

Wg of  $\text{BaSO}_4$  contain Xg of  $\text{SO}_4^{2-}$

$$Xg = \frac{\text{Wg of } 96.06}{233.4} = y \text{ (g) of } \text{SO}_4^{2-} \text{ in 50ml.}$$

#### DETERMINATION OF NITRATE IN WATER SAMPLE

This was determined by colorimetric method (AOAC 2002). To a 10ml of the water sample, 10ml sulphuric acid (13N) was added in a conical flask.

The flask was then placed in a water bath at  $10^\circ\text{C}$  for about 3 minutes after which brucine reagent (0.5ml) was added. The tube was then place in a water bath for 25 minutes the colour changes to yellow. It is then allowed to cool and the absorbance of the sample was read using a spectrophotometer machine. The absorbance was read at 481nm

#### RESULT AND DISCUSSION:

##### RESULT

Table 1 reveals the residual chlorine of the treated water samples, the lowest value of 0.1mg/l was obtained from samples B and F, while the highest value of 0.9mg/l was obtained from sample A.

The result from table 2, the analysis of chloride ion in water shows that there was no significant difference ( $p < 0.05$ ) among samples B, and F. The lowest chloride ion value of 2.70mg/l was recorded for sample B and the highest value of 6.55mg/l for sample A. Table 2 also revealed that in the sulphate ion there was significant difference ( $p > 0.05$ ) among A, B, C, D, E and F with sample A having the highest sulphate ion level of 4.54mg/l while sample B have the lowest level of sulphate ion of 0.87mg/l.. Furthermore, Table 2 shows the result of analysis of Nitrate in water, that there was no significant difference ( $p < 0.05$ ) among samples A, B and D, and E and F, However, an exception was noted for C. The lowest Nitrate value of 1.20mg/l was recorded for sample E and the highest value of 1.42mg/l for samples A and D. revealed that the result of analysis.

**Table 1: Residual chlorine of treated water samples**

| Samples | Residual Chlorine (Mg/L) |
|---------|--------------------------|
| A       | 0.9±0.02 <sup>c</sup>    |
| B       | 0.1±0.05 <sup>a</sup>    |
| C       | 0.6±0.05 <sup>a</sup>    |
| D       | 1.1±0.02 <sup>c</sup>    |
| E       | 0.5±0.08 <sup>b</sup>    |
| F       | 0.1±0.08 <sup>b</sup>    |

Values are Mean ± Standard Error of Mean (SEM). Means in the same column not sharing a common subscript are significantly different at P<0.05 while means sharing the same letters are not significantly different.

**Table 2: Different levels of chloride ion, sulphate ion and nitrate in the water samples**

| Samples | Chloride ion (Mg/L)    | Sulphate ion (Mg/L)     | Nitrate (Mg/L)         |
|---------|------------------------|-------------------------|------------------------|
| A       | 6.55±1.00 <sup>h</sup> | 4.54±1.00 <sup>f</sup>  | 1.42±0.04 <sup>c</sup> |
| B       | 2.70±0.01 <sup>a</sup> | 0.87±0.01 <sup>a</sup>  | 1.40±0.04 <sup>c</sup> |
| C       | 4.81±1.00 <sup>g</sup> | 2.62±1.00 <sup>d</sup>  | 1.34±0.01 <sup>d</sup> |
| D       | 4.40±1.00 <sup>f</sup> | 3.93±1.00 <sup>c</sup>  | 1.42±0.04 <sup>c</sup> |
| E       | 3.30±1.00 <sup>d</sup> | 0.91±0.01 <sup>ab</sup> | 1.20±0.0 <sup>c</sup>  |
| F       | 2.73±0.01 <sup>a</sup> | 0.96±0.09 <sup>b</sup>  | 1.21±0.08 <sup>c</sup> |

Values are Mean ± Standard Error of Mean (SEM). Means in the same column not sharing a common subscript are significantly different at P<0.05 while means sharing the same letters are not significantly different.

### DISCUSSION:

The chloride levels in the water ranged from 2.70mg/l to 6.55mg/l. WHO (1993) specifications permits up to a maximum level of 250mg/l of chloride in drinking water. At higher levels, water could become salty in taste and could enhance corrosion rates of iron, steel and other plumbing materials. Presently, conventional water treatment processes do not remove chlorides and if the chloride content of water has to be reduced, some form of desalination has to be applied (Twort *et al.*, 2000b).

Nitrate was another inorganic constituent that was monitored in the water samples. Nitrate levels ranged from 1.20mg/l to 1.42mg/l. However, all values recorded fall within acceptable limits of 50mg/l specified by WHO (1993) standards. Contamination of drinking of drinking water supply could occur at leaking points in the distribution network where nitrites from nitrogenous fertilizer can gain access to drinking water supplies. Similarly, when nitrite is detected in potable water in considerable amounts, it is indication of sewage/bacterial contamination and inadequate

disinfection. Nitrates can be removed through anion exchange.

Sulphate concentrations were within the WHO permissible limits of 200mg/L. The sulphate levels ranged from 0.87mg/l to 4.54mg/l. Sulphate have no health implication on human but at high concentration, sulphate could cause gastro intestinal irritation (WHO, 1971). Sulphate concentration is a function of the volume of river water especially during rainy season.

### CONCLUSION:

Water delivered to consumers should contain no pathogenic organisms and should not contain concentration of chemicals which may be physically harmful to health.

### RECOMMENDATIONS

Therefore, it is recommended that guideline values for drinking water should be strictly adhered to by institutions, individuals, and treatment plants. Examination of drinking water should be both frequent and regular and the results should comply with the suggestions given in the drinking water guidelines.

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