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PHYSIOCHEMICAL ANALYSIS OF TAP WATER OBTAINED AT MADA WATER WORKS, GUDI-AKWANGA, NASARAWA STATE.

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ABSTRACT: The analysis of treated tap water sample obtained at Mada Water Works is aimed at determining the physiochemical components of the municipal water which is distributed to some parts of Nasarawa State amongst which are Akwanga, Gudi, Keffi and Karu. The Physiochemical parameters includes; pH, Total Dissolved Solids (*TDS*), Turbidity, Percentage Dissolved Oxygen *(%DO2)*, Biochemical Oxygen Demand (*BOD*), Conductivity, Alkalinity, Hardness, Sulphate (SO_4^{2-}), Nitrate (NO_3^-), Phosphate (PO_4^{2-}) and Chloride (Cl^-). The result of the analysis indicate that the physical parameters agree with the standard set by World Health Organisation (WHO) for drinking and domestic water with few exceptions. This is an indication that the water sample was produced under poor sanitary conditions or that the water was "improperly handled". Therefore the present study has led to the conclusion that the water treatment plant (Mada Water Works) should effectively treat the water which is channelled for distribution so as to eliminate or highly reduce the presence of some contaminants that may have negative impact to health.

Keywords: Analysis, contaminants, Gudi-Akwanga, Mada Water Works, physiochemical, quality, tap water

INTRODUCTION

Water is one of the most unique and universal solvent essential for health. It is needed for the well-being of plants and animals, including humans. Due to its importance in sustaining life, an adequate and safe water supply must be available to all and thus can result in tangible benefits to health when improved access is achieved. The availability of good quality water is an indispensable feature for preventing diseases and improving quality of life [6]. Water can be obtained from a number of sources, among which are streams, lakes, rivers, ponds, rain, springs and wells. Unfortunately, clean, pure and safe water only exists briefly in nature and is immediately polluted by prevailing environmental factors and human activities [2]. Water from most sources is therefore unfit for immediate consumption without some sort of treatment. Natural water contains some types of impurities whose nature and amount vary with source of water. The original source of any drinking water is rich in aquatic microbes, some of which could be dangerous if they enter the human body. Accordingly, the treatment of water for drinking involves stages where microbes are removed or destroyed before the water gets into homes. After purification the water is subjected to tests by bacteriologists to ensure the safety for human consumption. Metals and other dissolved materials for example, are introduced into aquatic system through several ways which include, weathering of rocks and leaching of soils, dissolution of aerosol particles from the atmosphere and from several human activities, including mining processing and the use of metal based materials [5]. Metals after entering the water many be taken up by fauna and flora and eventually, accumulated in marine organisms that are consumed by human being [15]. Conformation with the set standards for drinking water by both the international, national and local agencies is of paramount importance because of the capacity of water to spread myriad of pathogens and contaminant have are harmful to health especially when consumed in excess amount [17]. Thus, adequate measures should be put in place to eliminate or drastically reduce the presence of substances which might have negative implication to health. This study set out to ascertain the physicochemical quality of the sampled drinking water and also serve as a pollution study within the environment [20].

MATERIALS AND METHODS

Sampling

The tap water was obtained from the treated water tank of Gudi Mada Water Works. The water sample after been collected was taken to Sheda Science and Technology Complex (CHESCO) for analysis.

Sample Analysis

The methods used for the determination of the Physiochemical parameters (Total Dissolved Solids, Turbidity, Percentage Dissolved Oxygen, Biochemical Oxygen Demand, pH, Electrical Conductivity, Alkalinity,

Hardness, Sulphate, Nitrate, Phosphate and Chloride) was described by A.O.A.C. (2005) and Standard Analytical Procedures for Water Analysis, 1999.

RESULTS AND DISCUSSIONS

Table 1: Result of Physiochemical Analysis

Physiochemical Parameters	WHO Standard	Result
pH	6.5-8.5	7.69
TDS (mg/l)	500	42.30
Turbidity (NTU)	6.5-8.5	14.88
$\%DO_2$	80-110	196.1
BOD (mg/l)	2.0-5.0	17.68
EC (μScm^{-1})	500.0	69.8
Alkalinity (mg/l)	25-500	2.13
Hardness (mg/l)	500	306
Sulphate (mg/l)	250.0	12.51
Nitrate (mg/l)	10.0	-
Phosphate (mg/l)	0-5	0.91
Chloride (mg/l)	250.0	103

DISCUSSION

The **pH** of the treated tap water sample is 7.69. This resultant value is found to be within the acceptable limit of 6.5-8.5 [23]. Deviation of pH from the neutral 7.0 is as a result of CO_2/bicarbonate/carbonate equilibrium. pH values lower than the minimum limit can be considered acidic for human consumption and can cause health problems such as acidosis while pH value higher than the maximum limit can be considered as too alkaline and thus may lead to alkalosis [10]. The **Total Dissolved Solids** (TDS) of the water sample was discovered to be 42.30mg/l and was found to be within the recommended standard of 500mg/l of drinking water [25]. TDS refers to the total amount of all inorganic and organic substances – including minerals, salts, metals, ions– that are dispersed within a volume of water and it's not considered primarily as pollutant but its consumption can have aesthetic problems such as a bitter or salty taste. High TDS levels typically indicate hard water may indicate elevated levels of ions that do pose a health concern, such as aluminium, arsenic, copper, lead, nitrate and others. **Alkalinity** of the water samples obtained showed a value of 2.13mg/l. This value is within the WHO permissible limit (25mg/l to 500mg/l) for drinking water. The alkalinity of water is caused mainly due to OH, CO_3, HCO_3 ions. Alkalinity of water is its quantitative capacity to react with a strong acid to a designated pH. Highly alkaline waters are usually unpalatable and can result to alkalosis due to excessive consumption of alkaline in water or any other source while low alkalinity waters tend to dissolve minerals and metals [4]. Analysing the **Hardness** of the tap water sample collected showed a value of 306.0 mg/l. This resultant value is within the recommended standard of (500 mg/l) for drinking and domestic water. There are no health effects or drinking water standards for hardness but hard water can cause numerous aesthetic problems, especially when water is heated. Because hardness reduces corrosion of household plumbing, a level of 90 to 100 mg/L is often considered optimum to reduce corrosion while also preventing unwanted aesthetic effects. Total hardness is usually reported in one of six categories as shown follow: soft water has a hardness concentration of 0 to 50 mg/L; moderately soft water has a hardness concentration of 50 to 100 mg/L; moderately hard water has a hardness concentration of 100 to 200 mg/L; hard water has a hardness concentration of 200 to 400 mg/L; very hard water has a hardness of 400 to 600 mg/l and a hardness greater than 600 mg/l is considered to be extremely hard. **Turbidity** in water is caused by suspended and colloidal matter such as clay, silts, finely divided organic and inorganic matter, plankton and other microscopic organisms. Presence of these solid particles in water indicates contamination and may be as a result of poor filtration method [13]. The turbidity value of the water is 14.88 NTU which is above the recommended limit for drinking water. This very high turbidity level is an indication of high presence of impurities in the sample which can interfere with disinfection and provide a medium for microbial growth thus may result to gastrointestinal disease [1]. **Percentage Dissolved Oxygen** ($\%DO_2$) of the water sample is 196.1%. This value is beyond the WHO acceptable standard and thus can have adverse effect to health over time of consumption [11]. Growth of aerobic and facultative anaerobic bacteria will be enhanced by the presence of dissolved oxygen in the water samples. WHO reported that there is tendency for the level of dissolved oxygen to fall with time indicating possible microbial respiration of organic materials amongst other reasons [24]. **Biochemical Oxygen Demand** is the amount of molecular oxygen required for biological oxidation of organic matter and it is an indication of a pollution of the water which may be attributed to peculation of hydrocarbon (crude oil) and other solid organic wastes [14]. The analytical data value reflects the intensity of organic pollution in the water samples. Biochemical Oxygen Demand analysis in the water sample yielded a value of 17.68 mg/L. This is highly above the WHO permissible range (2.0 to 5.0 mg/l) of BOD for drinking water and thus the water sample require significant treatment so as to eliminate or greatly reduce the impact of high BOD to health. **Electrical Conductivity:** conductivity of the analyzed water sample yielded a value of 69.8µS/cm. This value is within the desirable level of 500µS/cm [18]. Specific conductance yields a measure of water's capacity to convey an electric

current. This property related to the total concentration of the ionized substances in water and the temperature at which the measurement is made the nature of the various dissolved substances, their actual and relative concentrations, and the ionic strength of the water sample vitally affects the specific conductance. There is no **Nitrate** content in the water sample collected. This is an indication that there is an improve nitrate elimination from the water sample. Nitrates represent the final product of the biochemical oxidation of ammonia. Monitoring of nitrates in drinking water supply is very important because of health effects on humans and animals. The **Chloride** content of the water sample is 103 mg/l. This value is within the WHO standards (250mg/l). Chloride is needed for good health and may be important for kidney health, the nervous system and nutrition. There is no known health effects associated with chloride. However, the sodium often associated with chloride can be a concern to people suffering from heart disease or kidney disease [18]. **Phosphate** content of the water sample is 0.91 mg/l. The water sample is within the WHO permissible range for phosphate. Phosphate itself does not have adverse health effects [9]. However, high phosphate may interfere with coagulation in water treatment plants. As a result, organic particles that harbour microorganisms may not be completely removed. Concentration of **Sulphate** in the collected water sample shows the value of 12.51 mg/l. The sample is within the WHO permissible limit of 250 mg/l [26]. Sulphate is a substance that occurs naturally in drinking water. Health concerns regarding sulphate in drinking water have been raised because of reports that diarrhoea may be associated with the ingestion of water containing high level of sulphate [22]. Of particular concerns are groups within the general population that may be at greater risk from the laxative effects of sulphate concentrations to drinking water with high sulphate concentrations.

CONCLUSION

Permissible levels are subject to review from time to time as more information about the toxicity of such substances in drinking water become available. To ensure there is adequate protection of public health, it is essential to maintain infrastructure, improve water treatment procedure, developing and maintain relationships among the groups that advocate for safe drinking water [19]. It is also necessary for municipal water treatment plants to be regularly monitored and inspected [27]. This will help to enforce the existing regulations and if need be, promulgate new ones to ensure that the health of the populace is guaranteed.

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