Determination of Physicochemical Proprieties of MATATEEB Village's Drinking Water in North delta Locality- Kassala State- Eastern Sudan

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Abstract

The main objective of the present study is to investigate the physicochemical proprieties of MATATEEB Village's drinking water, in north delta Locality, Kassala State, Eastern Sudan, and to match the results with Sudanese and WHO standards for drinking water quality. Fresh water samples were taken from the main sources of Hopper surface water and underground water, during the period from January till Marc 2018. The analysis was done at Kassala drinking water Authority and General Health laboratories. Parameters measured includes: Color, Taste, Smell, Turbidity, Electrical Conductivity EC, Total Dissolve Solids (TDS), pH, Total Hardness, Carbonate, Bicarbonate, Ammonia, Ammonium, Nitrite and Nitrate. The physical analysis presents that this water is colorless of a good taste and smell, the mean average values were varied from 217.70 to 3.5) NTU for Turbidity, 206 to 418 µS/cm for EC, for pH is 7.9, for Total Hardness were 215.50 to 367.80 mg/L, and for TDS were 228.9 to 697.13 mg/L, for Hopper surface water and underground water respectively. The chemical analysis show that , the mean average values for (Carbonate, Bicarbonate, Ammonia, Ammonium, Nitrite and Nitrate) concentrations for Hopper surface water and underground water respectively in mg/L are : [(321.50 to 692.60), (0.86 to 0.43), (0.94 to 0.45), (1.74 to 0.02) , and (18.03 to 42.60)]. The analysis proved that, all measured parameters come of regular properties that are accepted by (WHO) and Sudanese standard guideline, except Turbidity of Hopper surface water , which was found out of acceptable limits of WHO. In spite of this the water is regarded as drinkable and almost it suitable for domestic and agricultural use, MATATEEB Village's drinking water show good properties.

Keywords: Drinking water; Turbidity; Physicochemical properties, underground water, Hopper.

INTRODUCTION:

Water is vital to man's existence and without it there would be no life on earth. It has numerous applications ranging from domestic applications such as drinking, cooking, washing and bathing to agricultural and industrial applications such as irrigation, power generation and industrial production. The earth holds approximately 1.4 × 10^9 cubic kilometers of water in the form of oceans, seas, rivers, lakes, ice, etc.; but only 3% of the total available water resources are in the form of fresh water found in rivers, lakes and groundwater. The fresh water that is needed for a clean water supply is limited, and demand far exceeds the available supply due to increasing population and industrialization (APHA et al., 2012). Safe drinking water is important in the control of many diseases such as diarrhea, typhoid. 80% of all diseases in the world are associated with surface water. Water of good chemical and physical quality is necessary from the point of view of its acceptability to consumer, protection health, and conservation of the water system. Offending chemical substances have made a water source unacceptable to the public even though its bacteriological quality was excellent.(Bashir, 2005).

The quality of drinking water is a powerful environmental determinant of health (WHO, 2010). The quality of water is affected by human activities and is declining due to the rise of urbanization, population growth, industrial production, climate change and other factors.

Increasing population, urbanization and industrialization has led to the decreased availability of water. Water pollution defined as the contamination of streams, lakes, seas, underground water or oceans by substances, which are harmful for living beings. The quality of used water is also being deteriorated as it is getting more and more polluted. This leads to some health hazards and harmful effects of water pollution. (Saad et al, 2018).People can survive days, weeks or months without food, but only about four days without water. Water, although an absolute necessity for life can be a carrier of many diseases. Water can be hard or soft, natural or modified, bottled or tap, carbonated or still, there are different types of water from different sources, soft and hard water. The hardness of water relates to the amount of calcium, magnesium and quality is a term used to express the suitability of water to sustain various uses or processes. Water quality can be defined by a range of variables which limit water use.(Ell-Amin , et al 2010). Water quality can be defined by a range of variables which limit water use. Although many uses have some common requirements for certain variables, each will have its own demands and influences on water quality. The composition of surface and underground waters is dependent on natural factors (geological, topographical, meteorological, hydrological and biological) in the drainage basin and varies with seasonal differences in runoff volumes, weather conditions and water levels.(Ell-Amin et al, 2016).

Water quality is the chemical, physical and bacteriological characterization of water, the primary basis for such characterization are parameters which relate to portability, safety for human consumption, human contact and for the health of ecosystems. Another general perception of water quality is that of a simple property that tells whether water is polluted or not. Water quality is a very complex subject, in part because water is a complex medium intrinsically tied to the ecology of the planet. Contaminants that may be found in untreated water include microorganisms such as bacteria, viruses, inorganic contaminants such as salts and metals, pesticides and herbicides, organic contaminants from industrial processes, petroleum use and radioactive contaminants (Abdel Magid , 2010). The presence of a safe and reliable source of water is thus as an essential prerequisite for the establishment of stable community. (Halder et al, 2015). As component of both organic and inorganic substances as well as in its function as solvent, reaction and transport medium, water is essential for all a biotic and biotic processes on Earth. Due to its ability of forming intermolecular hydrogen bonds, water possesses a range of particular physico-chemical properties which are of fundamental relevance for the matter and energy budgets of ecosystems (Gordalla et al, 2007). Water has the molecular formula H_2O but the hydrogen atoms are constantly exchanging due to protonation/deprotonating processes. Both acids and bases catalysis this process. Even when this proton exchange is at its slowest (at pH7), the average time that a water molecule (H_2O) exists between gaining or losing a proton is only about a millisecond. As this brief period is, however, much longer than the timescales encountered during investigations into water's hydrogen bonding or hydration properties, the water molecule is usually treated as a permanent structure.(Chaplin ,2001). Water used in Sudan derives almost exclusively from surface water resources, as groundwater is used in only very limited areas, and mainly from domestic water supply, Surface water is provided mainly by the Nile River. The main part of Nile is formed by the confluence of the Blue Nile (65%), the White Nile (23%) and the Atbara River (12%) (Ell-Amin et al, 2016). The water pollution resulting in a serious threat to the well-being of both the Earth and its population (Halder et al, 2015). Adequate supply of safe drinking water therefore is universally recognized as a basic human need and one of the most essential factors of civilization. Millions of people in developing countries do not have access to adequate and safe water supply. Increasing population and urbanization make it difficult for governments around the world to meet the increasing demand for portable drinking water. Majuru et al. (2011). A clean water supply is one of the key indicators for development in any country (Abam, 2001). The main objective of the present study is to investigate the physical and chemical proprieties of the drinking water samples of MATATEEB Village in north delta Locality, Kassala State, Eastern Sudan, to match the results with the Sudanese and international standards for drinking water quality.

MATERIAL AND METHODS:

Underground and Hopper surface water samples, were collected in a clean labeled Polyethylene bottles of one liter capacity, from MATATEEB Village in north delta locality, Kassala State, Eastern Sudan, during the period of January to March 2018, and send directly to the General health and Kassala Authority drinking water laboratories for analysis. For each samples of surface and underground water, pH was carried out at room temperature by portable pH meter , after calibrated., The Turbidity of water sample was directly determined by the portable Turbid meter (Code 2100), Conductivity and TDS were carried out at $25C^0$ by conductivity meter instrument after calibration with calibration. for Carbonate and Bicarbonate analysis : 25 ml of filtered sample water was putted in a conical flask, then 25 ml of distilled water was added to it, a few drops of Methyl Orange indicator was added to the mixture, then the mixture was titrated against Sulphuric acid, until the color of indicator was changed from yellow to orange. For Total hardness, 25 ml of filtered sample water was putted in a conical flask , then 25 ml of distilled water was added to it, a few drops Buffer solution and powder was added to the mixture, then the mixture was titrated against EDTA, until the violet color was changed to dark. For Ammonia and Ammonium values concentrations, two tablets indicator for Ammonia (1) and Ammonia (2) were added to 10 mil of each water's sample for ten minutes, then Photometer paliantest code 7500 instilment , at wave length of 4 nanometer was calibrated and used for determination of Ammonia and Ammonium concentrations. Finally, Nitrate and Nitrite concentrations were determined using Photometer paliantest code 7500 instrument , at wave length of 64 nanometer and 63 nanometer respectively. (APHA et al., 2012), and (ASTM, 2012) standard procedures with some modification. The data were statistically analyzed according to simple means comparison using computer software package.

RESULTS and DISCUSSION:

RESULTS:

The analysis results of Physical and Chemical properties of surface and ground water samples of MATTATEB Village are shown in the following tables:

Table-1: Show water analysis results of MATTATEB Village's (Underground Water) During the Period from January to March 2018:

DISCUSSION:

At the present study , tables 1, 2 are represent the analysis of underground and Hopper surface water samples of MATATEEB Village in north delta Locality, Kassala State, Eastern Sudan, during the period from January till Marc 2018, and table represent the Comparison between the water analysis results of MATATEEM Village (Ground and surface Water), with Sudanese and World Health Organization Standards , Based on the above results we found that : this water samples are colorless of a good taste and smell, and accepted according to WHO guidelines. The electrical conductivity range were varied from 302.00, 480, to 473 µS/cm with mean 418,for underground water , and for Hopper surface water, the electrical conductivity range were varied from151, 132, to 129 µS/cm with mean206, the EC mean values were in the range of the WHO (5000 - 1000)for sea and surface water respectively. PH is one of the importance on determining the corrosively of water because generally the lower the pH, the higher the level of corrosion (WHO, 1996). Cautious attention to pH is necessary at all stages of water treatment before distribution to ensure satisfactory clarification and disinfection to minimize the corrosion of water. Exposure to

Table-1:Show water analysis results of MATTATEB Village's (Underground Water) During the Period from January to March 2018:

PRAMETERS		Analysis results in Month				Main average values
Parameter	**Symbols**	**January**	**February**	**March**	**Units**	
Turbidity	-	7.01	0.56	3.17	NTU	3.58
Acidity	Ph	8.00	7.40	8.30	mg/L	7.90
Electrical conductivity	EC	302.00	480	473	(µS/cm)	418
Total Dissolve Solids	TDS	503.0	800.0	788.4	mg/L	697.13
Total Hardness	CaCO3	287.00	522.00	294.40	mg/L	367.80
Carbonate	CO_3^{-2}	345.00	748.00	609.60	mg/L	567.53
Bio carbonate	HCO_3^{-1}	421.00	913.00	743.70	mg/L	692.60
Ammonia	NH_3	-	0.048	0.78	mg/L	0.43
Ammonium	NH4+	-	0.052	0.845	mg/L	0.45
Nitrate ion	NO_3-	-	5.20	80.00	mg/L	42.60
Nitrite ion	NO_2-	-	0.01	0.03	mg/L	0.02

Table-2: Show water analysis results of MATTATEB Village's (Hopper surface water) During the Period from January to March 2018:

PRAMETERS		Analysis results in Month				Main average values
Parameter	Symbols	January	February	March	Units	
Turbidity	-	173	416	224	NTU	217.70
Acidity	pH	7.90	7.40	8.40	mg/L	7.90
Electrical conductivity	EC	151	132	129	(µS/cm)	206
Total Dissolve Solids	TDS	251.40	220.80	215.20	mg/L	228.9
Total Hardness	$CaCO_3$	138	143	365.60	mg/L	215.50
Carbonate	CO_3^{-2}	250.00	351.00	759.20	mg/L	453.40
Bio carbonate	HCO_3^{-1}	305.00	428.20	231. 50	mg/L	321.50
Ammonia	NH_3	-	1.008	0.72	mg/L	0.86
Ammonium	NH_4^+	-	1.092	0.78	mg/L	0.94
Nitrate ion	NO_3-	-	36	0.05	mg/L	18.03
Nitrite ion	NO_2-	-	0.92	2.560	mg/L	1.74

Table 3: Comparison between water analysis results of MATATEEM VILAGE (Surface and Ground Water) during the period from January to March 2018, with Sudanese and World Health Organization Standards (WHO's drinking water standards 1993, 2008, 2011) guideline.

PRAMETERS	Symbols	Sudanese Std. mg/L	WHOstd. mg/L	Analysis results main Average	
				Underground Water	Surface Water
Turbidity	-	5	5	3.58	217.70
Acidity	pH	6.5 -8.5	6.5 -8.5	7.90	7.90
Electrical conductivity	EC	5000	1000	418	206
Total Hardness	$CaCO_3$	500	500	367.80	215.50
Total Dissolve Solids	TDS	1000	1000	697.13	395.80
Carbonate	CO3-2	-	-	567.53	453.40
Bio carbonate	HCO3-1	-	-	692.60	321.50
Ammonia	NH3	0.2	1.5	0.43	0.86
Ammonium	NH4+	0.2	1.5	0.45	0.94
Nitrate ion	NO3-	50	50	42.60	18.03
Nitrite ion	NO2-	2	2	0.02	1.74

Extreme (pH > 11) results in irritation in eyes, skin and mucous membrane and also cause hair fibers to swell in human. Similarly, low pH also results in same effects with the severity of which increases with decreasing pH (WHO Working Group, 1986). The mean pH of the present study of water samples was found to 7.9which are in the range of the WHO guide lines (6.5-8.5), Turbidity is one of the foremost parameter for the acceptability of drinking water quality. WHO guidelines for turbidity are < 5 NTU. All natural waters are turbid but generally surface than ground water. Raw water turbidity has been reported to < 1 to 1000 NTU (Department of National Health and Welfare Canada, 1991). The consumption of high turbid water would be a health risk due to microorganism as the probable part in it. Further turbidity can also protect the pathogens from the effects of disinfectants, facilitate their growth and increase the chlorine demand (WHO, 1996). The observed values of turbidity at the present study were varied from 7.01 ,0.56 to 3.17 NTU with mean 3.58 for the underground water samples, and for Hopper surface water were varied from 173, 416 to 224 NTU with mean 217.70. On the grounds of turbidity the underground water samples were found within the WHO limits, but the turbidity of the surface water was not. Total dissolve solids TDS from natural source have been found to vary from 30 to 6000mg/L (WHO/UNEP, GEMS, 1989). The WHO TDS standard for drinking water is <1000 ppm. The observed TDS in the present study were varied from 503.0, 800.0 to 788.4 mg/ L with mean 697.13 for underground water sample, and for surface water were varied from 251.40, 220.80 to 215.20 mg/ L with mean 228.9, therefore the TDS of the present study were followed the Sudanese standard and WHO standard guidelines. On the basis of level of hardness samples were classified into four categories are: 0 -60 ppm = soft; 61 – 120 ppm = Moderate Hard; 121-180ppm = Hard and >180ppm = Very Hard. Public acceptability of the degree of hardness may vary considerably from one community to another. Hardness value above 500 mg/L is generally unacceptable, although this level is tolerable in some communities, total hardness observed for streams and rivers throughout the world range between 1-1000 ppm as $CaCO_3$. Hardness reflects the composite measure of polyvalent action whereas calcium and magnesium are the primary constituent of hardness (Asadullah et al, 2013). The values of total hardness for the present studies samples were varied from 287.00, 522.00 to 294.40 mg/L with mean 367.80, for underground water , and for surface water vary from 251.40, 220.80 to 715.20 mg/L with mean 395.80, which were in agreement with WHO guideline WHO standard value for hardness (500 mg/L). The values of Carbonate concentrations for the underground and surface water samples at the present study, were varied from 345.00, 748.00to 609.60 mg/l with mean 567.53, and 250.00, 351.00, to 759.20 mg/L with mean453.40 respectively. The values of Bio Carbonate concentrations for the underground and surface water samples at the present study were varied from 421.00, 913.00, to 421.00 mg/L with mean 692.60, and 305.00, 428.20, to 231. 50 mg/L with mean 321.50respectively.The values of Ammonia concentrations for the underground and surface water samples at the present study were varied from 0.048 to 0.78 mg/L with mean 0.43, and 1.008 to 0.72mg/L with mean 0.86, which were with agreement with the WHO guideline standard value for Ammonia (1.5 mg/L). The values of Ammonium concentrations for the underground and surface water samples at the present study were varied from 0.05 to 0.845 mg/L with mean 0.45, and 1.092 to 0.78 mg/L with mean 0.94 respectively, which are with agreement with the WHO guideline standard value for Ammonia (1.5mg/L). The values of Nitrate ion ($NO3^-$) concentrations for the underground and Hopper surface water samples at the present study, were varied from 5.20to 80.00 mg/L with mean 42.60 , and 36 to 0.05 mg/L with mean 18.03 respectively, which are with agreement with the WHO guideline standard value for Nitrate ion (50mg/L). The values of Nitrite ion ($NO2^-$) concentrations for the underground and surface water samples at the present study, were varied from 0.01 to 0.03 mg/L with mean 0.02, and 0.92 to 2.560 mg/L with mean 1.74 respectively, which are with agreement with the WHO guideline standard value for Nitrate ion (2 mg/L).

CONCLUSSION:

The goal of the present study was to determine the Physicochemical properties of the underground and Hopper surface drinking water in MATATEEB village area, the analysis indicated that, all measured parameters are closely matched with Sudanese and WHO standards guideline for drinking water, except the turbidity of the surface water, which is very high and out of range of WHO and Sudanese standards guideline for drinking water. Hence, these water sources almost are safe and suitable for domestic use, but surface water source should be strictly monitored to avoid the water pollution and pollutant. Finally it is highly recommended that bacteriological examination should be carried out for this water sources system to control the hygienic quality of the water supply and to avoid water's diseases.

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