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Analytical Study of Some Physicochemical Properties of Ground Water from El-Obeid (Bano Area) North Kordofan State, Sudan

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Abstract: The study area is situated in the North Kordofan State (NKS), the region is characterized by semi-arid and poor savannah climatic zone, where acute shortages of water are experienced. The study area is covered by the basement complex (Precambrian age) which is overlain by superficial deposits. A study carried out to analyze Physicochemical of Ground Water from Bano Area. Samples were taken from same places in Bano area. Analysis was done using standard methods, the Mean of parameters: The results shows that water pH of all sample showed no remarkable variation from the WHO and SSMO recommended value of all parameters, EC 982.33, (TDS) 368.33, Turbidity 0.32, Hardness 228.33, CO_3^- 4.33, HCO_3^-38.33, SO_4^{2-}9.75, F^-0.06, Cl^-0.18, NO_3^- 0.00, Na^+ 0.02, K^+ 0.00, Ca^{+2} 92.33, Mg^{+2} 51.00, Mn^{+2} 29.64, Fe^{+2} 0.05and Al^{+3} 37.49 mg/L. are within the permissible limit of WHO and S.S.M.O standards for drinking water.

Keywords: Ground water, physicochemical analysis, Cation, Anions spectrophotometer

INTRODUCTION

Only a small fraction (about 2.5%) of earth's water is fresh and suitable for human consumption. Approximately 13% of this fraction is ground water; an important source of drinking water for many people worldwide[1]. The ground water has been used for drinking for a long time and its purity has made it a well-known source of potable water all over the world[2].Groundwater can be defined as the water located in the pore space of soil and rocks. Sometimes it is useful to distinct between sub-

surface water, that is, closely associated with surface water and deep sub-surface water in aquifer (fossil water). Sub-surface ground water can be thought of in the same terms as sub-surface water inputs, outputs and storage. Ground water resources in arid and semi-arid regions with limited renewable potential have to be managed judiciously to ensure adequate supplies of dependable quantity and quality. It is a natural resource with economic, strategic and environmental value, which is under stress both due to changing climatic and anthropogenic factors[3]. Therefore the management strategic needs to be aimed at sustenance of these limited resources[4].

The present study is important for understanding the factors influencing the quality of drinking groundwater. 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 Ca^{2+}, Mg^{2+} and sometimes Fe^{2+} ions in the water. The more minerals present, the harder the water. Water 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[5]. Sudan is largest country in Africa and lies mostly in the arid region where water is a scarce commodity, it is considered to be rich in water resources[6].Water used in Sudan derives almost exclusively from surface water resources, as groundwater is used in only very limited areas.

The geological units act as containers for content in both quantity and quality. Two types of formations, which are inter-connected with each other, cover the study area. These formations include Basement Complex (NKS), Um Ruwaba formation and superficial deposits[7]. Therefore, the groundwater supply for the people depend either on hand dug (boreholes) or drilled wells with modern water pumps excavation and extracting groundwater mostly from deeper horizons[8]. Groundwater has proved to be a major resource in (NKS) in the development plans of water supply of Drinking water in the state relies on groundwater for more than 65% of the total consumption[9]. The general purposes of this work were to carry out a set of chemical analyses for drinking water of Bano area NKS South El-Obeid district, as well as the identification of pathogenic physicochemical in these groundwater samples.routier, Cameroun Afrique Centrale.

II. MATERIALS AND METHODS

Six Drinking water samples were collected in the plastic Bottles of 2.5 liter from selected wells in Bano area as source of groundwater is public supplied from open wells about five kilometers from El-Obeid town. Samples were kept in dry cleaned plastic containers and analyzed for determination of their physical and chemical properties. pH meter, Conductivity meter, Turbidity meter and spectrophotometer were used for calcium, magnesium, chloride, iron, nitrate, nitrite, (fluo\\1WDOIUHYqWAsxQqqq`WQ``2Zride). Analysis was carried out for various water quality parameters such as Temperature, pH, total dissolved solids (TDS), total alkalinity (TA), total hardness (TH), Total Dissolved Solids meter was used to measure the temperature of water and the total dissolved solids Concentration of chemicals was measured using standard method.

The results obtained were statistically analyzed using SPSS program. The analysis shows general suitability of the studied ground water sources for drinking. The results show that water quality of Bano area shows no remarkable variation from the WHO and SSMO recommended value of pH. The Drinking water of the area contains higher amounts of TDS than the desirable limits. No sample crossed the maximum permissible limit for TDS, alkalinity, hardness, calcium, magnesium, chloride, sulfate, nitrate, and fluoride. The concentration of chloride, sulfate, nitrate, and fluoride are well

within the desirable limit[10]. Electrical Conductivity (EC in dS/m) of water, as a measure of total dissolved solids, is one of the most important water quality parameters that affect the drinking water quality. A rapid determination of TDS can be made by measuring the EC of ground water samples, because TDS is associated and closely related with EC, where high values of TDS means high readings of EC and both of them have considerable tendency to increase with the direction. All samples show pH values less than (8), which is within the acceptable range **(Table. 1).** The highest value was 7.90 in sample (No.6), have the very short depth 45m, the lowest value was (7.00) in sample No. (1). the mean value was 7.30. The standard pH value according to WHO (1982)[11], Geneva and Sudanese Standardization Metrology Organization S.S.M.O) is ranging from (6.5 to 8.5). The highest pH values appeared in samples collected from well No. 6 and this may be due to the depth of these sources

Table -1: Descriptive Statistic of Physical Properties Concentration

	No. sample	**Range**	**Minimum**	**Maximum**	**Mean**	**Std. Dev**
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
pH	6	0.90	7.00	7.90	7.30	0.35
EC	6	504.00	541.00	1045.00	982.33	214.19
TDS	6	465.00	52.00	517.00	368.33	183.95
Turbidity	6	0.66	0.30	0.98	0.32	0.26
Hardness	6	265.00	165.00	400.00	228.33	88.47

The most good quality water samples were observed in all samples with TDS values, and EC values respectively. The mean TDS value was 368.33ppm and the mean EC value was 892.33µs/cm. The minimum measured EC value was 541.00µs/cm and the maximum value was 1045.00µs/cm in samples. The maximum measurement TDS value was 517.00 ppm in all samples and the minimum was 52.00 ppm in all samples. The use of such sources may be safe for human drinking according to WHO drinking water standards[12] which considered the highest TDS permissible level 500 mg/l and the maximum permissible level as 1500 mg/l and maximum EC values less than 1400 µs/cm with the exception of samples, the analyzed drinking water samples may be classified as safe for drinking from TDS and EC values as basic drinking water quality parameters. The study of groundwater chemistry can give important indication of the geological history of the enclosing rocks and direction of groundwater movement. A rapid determination of Total dissolved solid (TDS) can be made by measuring the electrical conductivity (EC) of a groundwater sample, because TDS is associated and closely related with EC, where high values of TDS means high readings of EC in the samples and both of them considerable tendency to increase with the flow direction. Turbidity values in some samples were significantly high but the mean value was in the permissible level (Table. 1).Total hardness values may be considered in the suitable range.

Table -2: Descriptive statistic of CO_3^-, HCO_3^-, SO_4^{2-}, F^-, Cl^- and NO_2^- concentration in (mg/L).

	No. of Samples	Range	Minimum	Maximum	Mean	Std. Dev
Anions	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
CO_3^-	6	10.00	1.00	11.00	4.33	1.41
HCO_3^-	6	24.00	24.00	48.00	38.33	9.06
SO_4^{2-}	6	0.140	0.45	0.59	9.75	22.66
F^-	6	0.80	0.32	1.12	0.60	0.29
Cl^-	6	0.77	0.03	0.80	0.18	0.03
NO_3^-	6	0.01	0.00	0.01	0.00	0.00

Sodium Na^+ and Potassium K^+ ions for all samples shows very low levels but agree with (SSMO and WHO) values (1993). There was association between the concentration of calcium and magnesium and hardness. Lina *et al.*[14], reported significant association between hardness and calcium and magnesium concentrations. The degree of hardness of drinking water is important for aesthetic acceptability by consumers and for economic and operational considerations. Iron is most abundant metal in Earth's crust, where it represents about 5%. Therefore, it can be released naturally, mainly among the igneous rocks as sulphide minerals and sedimentary rocks. In humans, increased body stores of iron have been shown to increase the risk of several estrogen-induced cancers[15]. The values are lower than those of both (SSMO and WHO) values which order of 0.3 mg/L. All concentrations in all samples were in the acceptable range. Manganese is essential for normal development and body function across the life span of all mammals[16.] Aluminum ion in drinking water may derived from natural origin sources and use of salts such as aluminum or poly-aluminum chloride as a coagulant is sewage treatment water to remove organic compounds, micro-organisms and particles[17]. Varying amounts of aluminum found naturally in ground and surface drinking water. The Mean of Al^{3+} ion concentration in all samples was found 37.49 mg/L, however, it is much higher than the values imperative water suitable for drinking. Several factors influence Al^{3+} ion mobility and subsequent transport within the environment. These include chemical speciation, hydrological flow paths, soil-water interactions and the composition of underlying geological materials. Acid environment caused by acid mine drainage or acid rain can cause an increase in the dissolved aluminum content of the surrounding water[18]. The higher of Al^{3+} ion inherits mineral-content in ground water may be due to the hosting sedimentary formation. Several studies were indicated that there is an association between aluminum exposure and dementia as Al^{3+} ion found in drinking water[19]. The behavior of aluminum in the environment depends upon its coordination chemistry and the characteristics of the local environment, especially pH. The major features of the biogeochemical cycle of aluminum include leaching of aluminum from geochemical formations and soil particulates to aqueous environments, adsorption onto soil or sediment particulates, and wet and dry deposition from the air to land and surface water. Aluminum occurs ubiquitously in natural waters as a result of the weathering of

aluminum-containing rocks and minerals. This mobilization of aluminum is often episodic in nature and is associated with pH (acidification) occurring during the spring snowmelt or associated with erosion from specific storms. The older rocks comprise the major hydrogeologic units of the deep groundwater system in the study area. The tectonics was important in establishing the distribution of the rocks that control the present flow patterns of groundwater. The study area is affected by tectonic that was caused faulting, folding, and fracturing[6].

CONCLUSION

The obtained results shows that the groundwater from Bano area as sources of drinking were found to have good quality, but the concentration of some metallic elements such as the aluminum metal indicated that all samples were higher in levels comparing with both SSMO and WHO standards.

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