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Chemical Study to Evaluate the Drinking Water Quality in Ed – Dueim Locality-Sudan

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Abstract

People on globe are under tremendous threat due to undesired changes in the physical, chemical and biological characteristics of air, water and soil; due to many factors. The safety of drinking water is affected by chemical contaminants. Actually were cause serious health problems. Thus drinking water must be examined continually. The purpose of this study was to assess the physiochemical and quality of drinking water in Ed-Dueim Locality, from different sources, as to ascertain it is quality for human consumption. The samples were collected randomly, from twenty different locations, during the rainy season. Samples were represented surface (row and treated) and untreated underground water. Analyses were applied according to the standard methods. The analysis of these samples were done in stack laboratory. The results showed variation of physiochemical parameters in all samples as follows: turbidity 1.33 – 928 NTU, total suspended solids(TSS) 0.33 – 163 mg/l, electrical conductivity 163 - 1366 µs/cm , total dissolved solids (TDS) 98 - 816 mg/l, pH 7.57 – 8.6, alkalinity 90 - 621mg/l, total hardness 54 - 214 mg/l, Cl^{-1} 3 - 59 mg/l, F^{-1} 0.3 - 1.13 mg/l, SO_4^{-2} 2 – 37 mg/l, NO_3^{-1} 0.0003 – 15.7 mg/l, NO_2^{-1} 0.003 – 2.4 mg/l

المستخلص

الناس حول العالم تحت تهديدات هائلة غير مرغوب فيها, لتغيرات خصائص الهواء ,الماء و التربة ; بسبب العديد من العوامل. إن سلامة مياه الشرب تتأثر بالملوثات الكيميائية. في الواقع أنها تسبب مشكلات صحية خطيرة. عليه فإنَّ فحص مياه الشرب يجب ان يكون باستمرار. تهدف هذه الدراسة للتقييم الفيزوكيميائي لمياه الشرب في محلية الدويم, للتحقق من جودتها للاستخدام الادمي. جمعت العينات عشوائياً من عشرين موقعاً من مصادر مختلفة في فصل الخريف. مثلت العينات المياه السطحية (الخام والمعالجة) ومياه الابار غير المعالجة . طبق التحليل وفقاً للطرق القياسية . وتم تحليل هذه العينات بمعمل استاك. دلت النتائج على تباين في المعالم الفيزوكيميائية لجميع العينات كما في : العكارة 1.33 - 928 , مجموع المواد الصلبة 0.33- 163 ملجم / لتر , الموصلية الكهربية 163-1366 ميكرو سيمينز / سم, مجموع الاملاح الذايبة 98-816 ملجم / لتر, الأُس الهيدروجيني 7.57 – 8.6 , القاعدية 90- 621 ملجم / لتر , العُسر الكلي 54- 214 ملجم / لتر , Cl^{-1} 3 - 59 ملجم / لتر , F^{-1} 0.3-1.13 ملجم / لتر , SO_4^{-2} 2 – 37 ملجم / لتر , NO_3^{-1} 0.0003 - 15.7 ملجم / لتر , NO_2^{-1} 0.003 - 2.4 ملجم / لتر.

1. Introduction

A major part of innovations in scientific and technological development has been directed towards generation or elevation of human comforts, thereby increasing the standard of living in the society. This led to increase in industrialization. Supply of safe water and minimizing water-borne diseases through improved water technology consider to be an important impro- vements in our standard of living that can be attributed to the application of science and technology. Consequent to these improvements, disturbing side effects such as environmental pollution, deforestation, urbanization, loss of arable land, evolution of new organisms resistant to control, etc., have emerged. These effects are considered as potential threats to environment and to humans. Today the cry of "Environmental Pollution" is heard from all corners of the world. Pollution has now become a distinct threat to the very existence of mankind on this earth. It is now a major challenge of our times. Rapid urbanization, industrial- lization and population growth have been the major causes of stress on the environment leading to problems like human health problems, eutrophication and fish death, coral reef destruction, biodiversity loss, ozone layer depletion and climatic changes [(1)]. In spite of environmental pollution problems witch water is considerable one of them, also water is a scarce resource (ninety seven per cent of water on the Earth is saltwater, while only 3% is freshwater. With regard to the freshwater, 79% is stored in polar ice caps and mountain glaciers, 20% is stored in aquifers or soil moisture, and 1% is surface water) that requires utmost protection. It is estimated that 40 % of the world population will live in water scarce regions by the year 2025[(2)] . Water plays a significant role in maintaining the human health and welfare. Clean drinking water is now recognized as a fundamental right of human beings [(3)]. Around 780 million people do not have access to clean and safe water and around 2.5 billion people do not have proper sanitation. As a result, around 6–8 million people die each year due to water related diseases and disasters. Therefore, water quality control is a top-priority policy agenda in many parts of the world. In the today world, the water use in household supplies is commonly defined as domestic water. This water is processed to be safely consumed as drinking water and other purposes. Contaminants in the water can affect the water quality and consequently the human health. The potential sources of water contamination are geological conditions, industrial and agricultural activities, and water treatment plants. These contaminants are further catego- rized as microorganisms, in organics, organics, radionuclide's, fertilizers and disinfectants. A number of scientific procedures and tools have been developed to assess the water contaminants. These procedures include the analysis of different parameters such as pH, turbidity, conductivity, total suspended solids (TSS), total dissolved solids (TDS), total organic carbon and heavy metals. These parameters can affect the drinking water quality, if their values are in higher concentrations than the safe limits set by the World Health Organization (WHO) and other regulatory bodies. Therefore, the investigation of the drinking water quality by researchers and governmental departments has been performed regularly throughout the world [(3)]. Commonly, water quality is defined by its physical, chemical, biological and aesthetic (appearance and smell) characteristics. The suitability of groundwater resources is determined by both the quality of the water and by the available yield. The chemical quality of water depends primarily of the chemical characteristics of TDS. Fluorine is a common element that frequently occurred in water. High fluoride concentrations can be found in many parts of the world, particularly in parts of India, China, East African, Central Africa and South America. Virtually all foodstuffs contain at least trace fluorine. Fluoride is found in almost all natural waters at some concentration. Seawater contains about 1 mg/l while rivers and lakes, generally, exhibit concentrations of less than 0.5 mg/l. In groundwater's, however, low or high concentrations of fluoride can occur, depending on the nature of the rocks and the occurrence of fluoride-bearing minerals. Therefore, fluoride is expected in groundwater from calcium-poor aquifers and in areas where fluoride-bearing minerals are common. In many aspects, appropriate concentration of fluoride in drinking water, positively, affects human health. Optimal fluoride concentration in drinking water helps to prevent dental caries, acts as bactericidal and contributes to mineralize teeth and bone formation. On the other hand, excessive exposure to fluoride in drinking water, or in combination with exposure to fluoride from other sources, can give rise to a number of adverse effects. Beside fluoride water contains a wide variety of substances that can adversely affect humans' health when found in excess of the recommended levels. On the other hand, it is possible that the deficiency of certain elements will pose serious health problems. For example, the high intake of nitrate in drinking water and dietary sources is responsible for -anemia (Blue baby syndrome) in infants. Furthermore, caring- agenesis is another potential risk of nitrate contamination. Total dissolved solids are also implicated in the literature as a major factor in causing adverse human health effects. For example, hypertension has been linked to excessive sodium intake whereas high concentration of chloride may impart a salty taste to the water. Fluoride and nitrate can be removed from drinking water by ion exchange. Calcium and vitamin C intake is a safeguard against the risk of fluoride exposure. Distillation, reverse osmosis and deionization are also used in removing excessive elements from drinking water (4). The contamination of water resources with faucal material, industrial sewage, domestic, agricultural waste still remains a serious problem in the developing countries and became a public health concern. The major problem of drinking water in Sudan and other developing countries is not just a lack of water availability, but in fact, that the people are not concerned with the water quality (5). Many years ago Sudan's peoples did not pay much attention to water pollution problems, but today the population is aware of the importance of good water quality and its relation to health. The main resources of drinking water in Ed-Dueim Locality (the city and villages adjacent) are the White Nile River and wells. The water of the White Nile River is very turbid; considerable in the rainy season, therefore, it is expected to be contaminated with chemicals as well as microorganism, and accordingly; it may cause health problems such as toxicity and some disease, although water was treated and distributed through different pipelines to the consumers. On the other hand, the construction of some wells are not precise and without regularity and consonantal methods. That happens, because the Government of Ed-Dueim

Locality doesn't have a sufficient financing. So, the constriction of these wells was implemented by popular efforts.

2. Chemical Characteristics:

2.1. Normally, water pH ranges from 6 to 9. It is noticed that water with low pH is tend to be toxic and with high degree of pH it is turned into bitter taste (6). Although pH usually has no direct impact on consumers, it is one of the most important operational water quality parameters optimum. According to WHO standards pH of water should be 6.5 to 8.5(6).

2. 2 Alkalinity: It can be defined as the capacity to neutralize acid. Moderate concentration of alkalinity is desirable in most water supplies to stable the corrosive effects of acidity. However, excessive quantities may cause a number of problems. The WHO standards tell the alkalinity only in terms of total dissolved solids (TDS) of 500 mg/l(4).

2.3 Fluoride (F^{-1}): Fluoride accounts for about 0.3 g/kg of the Earth's crust and exists in the form of fluorides in a number of minerals (7). The most important source of fluoride in drinking water is naturally occurring. Inorganic fluoride-containing minerals are used widely in industry for a wide range of purposes, Elevated fluoride intakes can also have more serious effects on skeletal tissues. It has been concluded that there is a clear excess risk of adverse skeletal effects for a total intake of 14mg/day and suggestive evidence of an increased risk of effects on the skeleton at total fluoride intakes above about 6mg/day (8). The 1958 and 1963 WHOreferred to fluoride, stating that concentrations in drinking-water in excess of 1.0–1.5 mg of fluorine per liter may give rise to dental fluorosis in some children, and much higher concentrations may eventually result in skeletal damage in both children and adults.

2.4 Chloride (Cl^{-1}) Chloride in drinking-water originates from natural sources, The main source of human exposure to chloride is the addition of salt to food, and the intake from this source is usually greatly in excess of that from drinking-water. However, chloride concentrations in excess of about 250 mg/litre can give rise to detectable taste in water The 1958 WHO suggested that concentrations of chloride greater than 600 mg/litre would markedly impair the portability of the water. No health-based guideline value for chloride in drinking-water was proposed in the 1993 Guidelines, although it was confirmed that chloride concentrations in excess of about 250 mg/litre can give rise to detectable taste in water (9).

2. 5 Nitrate And Nitrite (NO_3^{-1}, NO_2^{-1}): Nitrate and nitrite are naturally occurring ions that are part of the nitrogen cycle. Nitrate is used mainly in inorganic fertilizers, and sodium nitrite is used as a food preservative, especially in cured meats. The formation of nitrite is as a consequence of microbial activity and may be intermittent. Nitrification in distribution systems can increase nitrite levels, usually by 0.2–1.5 mg/litre(6).

2.6 Sulfate (SO_4^{-2}): Sulfates occur naturally in numerous minerals and are used commercially, principally in the chemical industry. The average daily intake of sulfate from drinking-water, air and food is approximately'500mg, The 1958 WHO suggested that concentrations of sulfate greater than 400 mg/litre would markedly impair the portability of the water. The presence of sulfate in drinking-water may also cause noticeable taste at concentrations above 250 mg/litre and may contribute to the corrosion of distribution systems(4).

3. Materials and Methods

3.1 Introduction: Both surface and underground water are utilized as sources for drinking water in the study area. The White Nile (raw and treated water), Wadis and khours running annually during the rainy season, agricultural channels are the sources of surface water, while deep boreholes are used to abstract underground water. Samples were selected taking into account the human activities carried out within the area.

3.2 Collection of samples: The field work was carried out during the period of July-September 2015 (rainy seasons in the study area). The samples were collected approximately from all the types of drinking water sources within Ed-Dueim Locality area. In this work, forty samples were collected for examining the physiochemical characteristics.

3.3 pH: At a given temperature the intensity of the acidic or basic character of solution is indicated by pH or hydrogen activity. It's the intensity factor of acidity (10). For measuring the pH value, the electrode was first rinsed by the buffer solution before adjusting for pH 5.0 and 9.0 each separately, and then rinsed with distilled water and with the water sample for measuring each sample. The electrode bulb was immersed well in the water sample (50 ml water sample in a 100 ml clean beaker) and pH was measured by direct reading using pH meter at room temperature (11). The results were reported**.**

3.4 Alkalinity: Alkalinity of a water is its acid-neutralizing capacity. It is the sum of all the titratable bases. The measured value may vary significantly with the end-point pH used. Alkalinity is a measure of an aggregate property of water and can be interpreted in terms of specific substances only when the chemical compos-sit ion of the sample is known. Alkalinity was determined by titration of the sample with standard solution of a strong acid (10).

3.5 Procedures: 100 ml of water sample was mixed with two to three drops of phenolphthalein indicator in the porcelain basin (if no color was produced the alkalinity to phenolphthalein was zero). If the sample turned pink or red, the alkalinity was determined by titration with standard acid until the pink color disappeared. In all case the determination was continued by using the sample to which phenolphthalein had been added.

1. A few drops of methyl orange indicator were added, and if the sample was orange without the addition of acid, the total alkalinity was zero and if the sample turned yellow titration with standard acid was done till the first perceptible color change towards orange took place.
2. The determination by means of mixed indicator was done in the same way as with methyl orange. The following colour responses were yielded by the mixed indicator. Above pH 5.2; greenish blue, pH 5.0; light blue with lavender grey, pH 4.8; light pink – grey with a bluish cast, pH 4.6; light pink. (11)

3.6 Procedures: Preparation of standards curve: The fluoride standards in the range of 0 to 1.4 mg F^- /l were prepared by diluting appropriate quantities of standard fluoride solution to 50 ml with distilled water. Five ml of the spadnos solution were pipetted and the10.00 ml of the mixed acid zirconyl were pipetted and mixed well.

1. Preparation of the blank: 10 ml of spadnos solution were added to 100 ml water, and acidified with a solution prepared by diluting 7 ml of concentrated hydrochloric acid to 10 ml with deionizedwater.
2. The spectrophotometer was set to zero absorbance with reference solution and the absorbance reading (570 nm) of the standards was obtained. Curve of the relationship between mg fluoride and absorbance was plotted
3. Sample pretreatment: Residual chlorine was removed by adding 5 ml of silver sulphate solution.
4. Colour development: A fifty ml sample was used, the temperature was adjusted as in the standards curve. Five ml of spadnos mixed reagent were added. The absor- bance at 570 nm was reported**.(10)**

3.7 Chloride: Chloride was determined in a neutral or slightly alkaline solution by titration with standard silver nitrate solution using potassium chromate as an indicator. Silver chloride was quantitatively precipitated before red sliver chromate were formed.

3.8 Procedure:

1. Sample of 100 ml was measured into porcelain dish and pH was adjusted to about 8.
2. One ml of potassium chromate indicator solution was added and stirred.
3. The sample was titrated with sliver nitrate solution with constant stirring until slight reddish coloration persists.
4. Steps 1 to 3 were repeated on a 100 ml distilled water blank to allow for the presence of chloride in any of the reagents and for the solubility of sliver chromate.(10)

3.9 Nitrate And Nitrite:

4. Procedures:

1. Preparation of standards: 2.5, 5.0, 10.0 and 15.0 mg/L standards solution were prepared by Addition of 2.5, 5.0, 10.0 and 15.0 mL of stock 50 mg/L nitrate solution respectively to a 100-mL graduated cylinder. purified water were added and diluted to a volume of 50 mL, transferred to a 250-mL Erlenmeyer flask.
2. Preparation of reduction column: The reduction column is a U-shaped, 35 cm length, 2 mm I.D. glass tube. The reduction columns was filled with purified water to prevent entrapment of air bubbles during the filling operations. The copper-cadmium granules were transferred to the reduction column, and a glass wool plug was placed in each end.
3. Reduction of cadmium column: Cadmium column was rinsed with 25mL of diluted ammonia buffer solution, the flow rate is controlled at 3-5mL/minute. Samples were poured into column and collected at a rate of 7-10 mL/minute. All collected effluents are reduced again by running through the Cadmium column, the secondary effluent was collected in the 100 mL volumetric flask.

4. The first 25 ml were discarded , the rest of the sample were collected (approximately 70 ml) in the original sample flask.
5. 2.0 mL of color reagent were added to 50.0 mL of sample. Allowed 10 minutes for color development. Within 2 hours the absorbance at 220 nm against a reagent blank were measured.
6. The reduction of standards were carried out, exactly as described for the samples. At least one nitrite standard should be compared to a reduced nitrate standard at the same concentration to verify the efficiency of the reduction column.
7. The sample absorbance was measured at 275 nm (organic matter). If Abs 275 nm x 2 > 10% Abs 220 nm, the sample contains too much organic matter and an alternative method should be used.(11)

1. Six 50 ml standard glass flask were taken (four for stand- ard, one for the blank and one for the sample).
2. 10 ml, 20 ml, 30 ml and 40 ml of the standard sulphate solution were added in first, second, third and fourth stan- dard flask respectively.
3. For the blank, distilled water were added alone.
4. To the sixth standard flask, 20 ml of the sample were added.
5. For the all (except the blank) 5 ml of conditioning reagent were added and mixed. While stirring, 0.15 g of barium chloride were added with the help of magnetic stirrer for about an hour. The volume were completed to 100 ml for the all.
6. The absorbance against a distilled water (blank) was measured at 420 nm using spectrophotometer. Absorbance for the blank sample was taken to correct for sample color and turbidity.
7. The standard solutions of different strengths were processed in similar way and the absorbance for each solution were recorded .
8. Standard sulfate calibration curve was plotted on a graph paper from these absorbance values putting strengths (mg/L) on X-axis and absorbance - 420 nm on Y-axis.
9. The standard sulfate calibration curve was used to found out sulfate concentration in the unknown sample in mg/L.(10)

5. Results and discussion;

5.1 pH pH is classified as one of the most important water quality parameters. It refers to the measure of hydrogen ions concentra- tion in water. In general, water with a pH of 7 is considered neutral, while lower of it referred acidic and a pH greater than 7 known as basic. Normally, water pH ranges from 6.5 to 8.5 according to the WHO and SSMO. It is noticed that water with low pH is tend to be toxic and with high degree of pH is turned into bitter taste(36).

As shown in table (1) the averaged values for the twenty sites (SW and UW samples) were ranged from 7.57 to 8.60. The highest mean value for SW (8.30) was reported in site 6, while the lowest one (7.57) was reported in site 5. The highest mean value for UW (8.60) was reported in site 9, while the lowest one (7.73) was reported in site 1. Hence, in the study areas, the pH values were not exceeded the standard limit, however they were falling in basic or alkaline range. Although, from the final data on the table (1) it can be concluded that, all water samples were within the allowable limits for pH which is 6.5 to 8.5 in drinking water, except for sampling site 9 (UW) which was above pH 8.5. Study values indicated the alkalinity nature (basic effluents; hydroxide, carbonate and bicarbonate) throughout the study period. It's being discharged into the most sources in the study area. The high values may be due to attributed sewage discharged by surrounding city and agricultural fields. The results were agreeing with the findings of El-Hassan[39],who found that the pH of the three Niles (White, Blue and main Nile) ranged from 7.1 to 8.1. Also the results were agreeing with Abdellah *et. al.*[12], whom found that, the pH of the samples in Khartoum City for SW ranged from 7.8 to 8.5 and for UW were ranged from 7 to 8.

5.2 Alkalinity(Alk): Alkalinity is the sum total of components in the water that tend to elevate the pH to the alkaline side of neutrality. The main sources for alkalinity are rocks contain carbonate, bicarbonate and hydroxide compounds [9].

The results revealed that, the twenty sites (for SW and UW samples) showed different values of alkalinity(Alk) as shown in table (1), which were ranged from 90 to 621.33 mg/L. The highest mean value for SW (133.67 mg/L) was reported in site 6, while the lowest one (90 mg/L) was reported in site 4. The highest mean value for UW (621.33 mg/L) was reported in site 9, while the lowest one (92.67) was reported in site 10. All the samples (SW and UW) had values lower than the WHO and SSMO permissible value of 500 – 1000 mg/L, except that of the UW sample in site 9, recorded very high value, which may be due to geological nature; deposits of underground minerals.

Table 1. Magnitudes of pH and ALKparameters of U.W and SW samples collected from Ed-Dueim Locality

Site.No	pH		Alk(mg/L)	
	U. W	S.W	U. W	S.W
1	7.73 ±0.2082	7.77 ±0.0577	106.33 ±4.04	114.67 ±4.73
2	8.10 ±0.100	7.67 ±0.1528	136.20 ±4.58	90.67 ±9.29
3	8.07 ±0.1155	7.77 ±0.1528	126.67 ±3.51	94.00 ±6.56
4	7.92 ±0.0473	7.97 ±0.1155	116.00 ±4.58	90.00 ±9.17
5	7.77 ±0.0473	7.57 ±0.3055	239.33 ± 8.02	93.00 ± 7.55
6	7.80 ±0.1002	8.30 ±0.1732	99.33 ±7.02	133.67 ±6.03
7	8.15 ±0.0458	7.87 ±0.1528	387.00±11.53	92.67 ±7.02
8	8.50 ±0.1000	8.00 ±0.2646	342.67 ±6. 66	133.33 ±5. 86
9	8.60 ±0.2000	7.87 ±0.2517	621.33 ±9. 07	126.00 ±7. 94
10	7.84 ±0.2517	7.80 ±0.1000	92.67 ±8.33	112.33 ±6.51
SSMO	6.5 – 8.5		500- 1000	
WHO	6.5 – 8.5		1000	

5.3 Chloride: Chloride is mainly obtained from the dissolution of salts of hydrochloric acid which were added through industrial waste, sewage, sea water etc. SW bodies often have low concentration of chlorides as compared to UW. It has key importance for metabolism activity in human body and other main physiological processes. High chloride concentration damage metallic pipes and structure as well as harms growing plants. According to WHO and SSMO standards, concentration of chloride should not exceed 250 mg/l. The existence of chloride in water in excessive amounts is not desirable. High concentration above the permissible limit, imparts water taste and may harm metallic pipes[9].

There were significant differences in values of chloride among all the sites (for SW and UW samples) as indicated in table (2). It ranged from 3.33 to 59.67 mg/L. The highest mean value for SW (12.67mg/L) was reported in site 1, while the lowest one (3.33 mg/L) was reported in site 8. The highest mean value for UW (59.67 mg/L) was reported in site 9, while the lowest one (5 mg/L) was reported in site 2. All the readings fall below the threshold value of the WHO and SSMO standards (250 mg/L). Hence, these ranges were acceptable and concentration of chloride is not harmful. Although there were high values found in site 1(which may be due to the pollution; crowded area with high activity) for the SW and site 5,7, 8 and 9 for the UW (which may be due to geological nature), the water quality of chloride levels doesn't exceed the quality standards.

Table 2. Magnitudes of chloride andfluoride parameters of U.W and SW samples collected from Ed-Dueim Locality.

Site .No	Cl^-(mg/L)		F^-(mg/L)	
	U. W	S.W	U. W	S.W
1	14.33 ±2.082	12.67 ±4.509	0.5333 ±0.1528	0.6333 ±0.1528
2	5.00 ±2.646	7.33 ±2.517	0.8000 ±0.1000	0.4000 ±0.1000
3	7.00 ±2.00	9.00 ±2.616	0.8000 ±0.1000	0.3667 ±0.1155
4	12.67 ±2.517	9.00 ±2.00	0.6667 ±0.1528	0.5000 ±0.1000
5	36.00 ± 5.568	8.00 ± 2.000	0.4333 ±0.1528	0.5333 ±1.0577
6	7.00 ±2.00	5.33 ± 1.528	0.4000±0.1000	0.3000 ±0.1000
7	50.00 ±3.606	7.00 ±2.00	1.1333 ±0.2082	0.6000 ±0.1000
8	33.33 ±5. 508	3.33 ±1.528	0.4000 ±0.1000	0.6000 ±0.1000
9	59.67 ±7.506	10.33 ±2. 517	0.7667 ±0.1528	0.4667 ±0.1528
10	18.00 ±3.000	9.00 ±2.00	0.6667 ±0.1528	0.6000 ±0.1000
SSMO	250		1.5	
WHO	250		1.5	

To some extent, the results were disagreeing withAbdellah*et al.*[12], whom found that the level of chloride of the samples in Khartoum City for SW were ranged from 0.4 to 1.04 mg/L and for UW were ranged from 0.8 to 2.8 mg/L. But, there were no difference when comparing the values withMamoun*et al.*[16] whom worked on the same area .El-Tingari [41], reported that, the chloride levels ranged between 0.5 to 39 mg/l in the upper aquifer, whereas in the lower aquifer the range was between 0.2 to 4.8 mail in Khartoum City.

5.4 Fluoride: The most significant source of fluoride in drinking water is naturally occurring.Amongfactors which control the concern- traction of fluoride are the climate of the area and the presence of accessory minerals in the rock minerals assemblage through which the ground water is circulating [13]. As per IS: 10500-2012 Desirable limit for fluoride is1 and 1.5 mg/l in permissible limit. According to WHO and SSMO standards, concentration of fluoride should not exceed 1.5 mg/L.

Study results revealed that, the twenty sites (for SW and UW samples) showed a convergent different values of fluoride as indicated in table (2). They were ranged from 0.30 to 1.133 mg/L. The highest mean value for SW (0.633 mg/L) was reported in site 1, while the lowest one (0.300 mg/L) was reported in site 6. The highest mean value for UW (1.133 mg/L) was reported in site 7, while the lowest one (0.400 mg/L) was reported in site 6. All the readings fall below the threshold value of the WHO and SSMO standards (1.5 mg/L). Hence, these ranges were acceptable and the concentration of fluoride is not harmful. Although there were high values found in site 1(which may be due to the pollution; crowded area with high activity) and site 7, 8 and 10 (which may be due to the climate of the area and the presence of accessory minerals in the rock minerals assemblage through which the ground water is circulating) for the SW, as well as sites2,3,7 and 9 for the UW (which may be due to geological nature), the water quality of fluoride levels doesn't exceed the quality standards(WHO and SSMO).Concentrations in drinking water above the permissible limit (1.5 mg/L) causes dental fluorosis. Continuous intake of 3 mg/L to 6mg/L fluoride content water for a long period may lead to skeletal fluorosis, if these concentrations exceeded, crippling skeletal fluorosis occur[14]. Based on this reality the water sample in site 7 for UW may not be suitable for drinking and livestock watering purposes.

The difference of fluoride levels of UW in the neighboring boreholes is probably a result of the high electro negativity, which characterizes the fluoride ion. The high electro-negativity makes fluoride ion couple strongly with metals and under normal conditions is rarely replaced by other ions. Therefore, the high electro negativity of fluoride constricts migration of fluoride through internal movement of UW to the neighboring boreholes[15].

5.5 Sulphate: Sulfate mainly derived from the dissolution of salts of sulfuric acid and abundantly found in almost all water bodies. High concentration of sulfate may be due to oxidation of pyrite and mine drainage etc. Sulfate concentration in natural water ranges from a few to a several hundred mg per liter but no major negative impact of sulfate on human health is reported [12]. The WHO has established 400 mg/l as the highest desirable limit of sulfate in drinking water, while the SSMO has established guidelines value to be 250 mg/L. The results revealed that, the twenty sites (for SW and UW samples) showed different values of sulfate as indicated in table (3), which were ranged from 2.67 to 37.67 mg/L. The highest mean value for SW (30.33 mg/L) was reported in site 8, while the lowest one (4.33 mg/L) was reported in site 2. The highest mean value for UW (37.76 mg/L) was reported in site 7, while the lowest one (2.67) was reported in site 3.Most of the SW and UWsamples had sulfate values lower than the permissible standards. To some extent, the results were agreeing with Abdellah*et al.*[12], whom found that the level of the sulphate in Khartoum City for SW samples were ranged from 0 to 41 mg/L and for UWsamples were ranged from to 0.2 to 9 mg/L . There were no distinctly difference when comparing the values of sulphate withMamoun*et al.*(16)whom worked on the same area. Study results almost in agreement withMamoun*et al*.

Table 3 . Magnitudes of sulphate parameter of U.W and SW samples collected from Ed-Dueim Locality.

Site .No	(mg/l)SO_4^{-2}	
	U. W	S.W
1	13.33 ±1.528	9.00±2.000
2	4.33 ±1.528	4.33 ±1.528
3	2.67 ±1.155	6.33 ±2.082
4	6.33 ±2.517	6.67 ±1.528
5	8.00 ±3.000	5.67 ±2.082
6	5.00 ±2.000	10.33 ±2.517
7	37.67 ±3.512	17.33 ±3.512
8	8.33 ±3.512	30.33 ±4.509
9	23.00 ±3.000	8.00 ±2.000
10	10.33 ±2.517	12.00 ±3.000
SSMO	250	
WHO	400	

5.6 Nitrate And Nitrite: Nitrate is present in raw water and mainly it is a form of nitrogen compounds (of its oxidizing state) (30). In SW,nitrate is produced from chemicals and runoff from fertilized use, faces of animals, decline vegetables, leaching from septic tanks, sewage and erosion of natural deposits and industrial discharge(4).

Study results revealed that, the SW samples showed cover- gent values of nitrate as indicated in table (4), which were ranged from0.003 to 2.673 mg/L. The highest mean value (2.673 mg/L) was reported in site 8, while the lowest one (0.003 mg/L) was reported in site 2.The results, also revealed that, the UW samples shown different values of nitrate as indicated in the same table, which were ranged from 0.003 to 15.767 mg/L. The highest mean value (15.767 mg/L) was reported in site 5, while the lowest one (0.003 mg/L) was reported in site 6. On the other hand, there were convergent values of nitrite among all the sites (for SW and UW samples) as indicated in table (4). It were ranged from 0.003 to 2.453 mg/L. The highest mean value for SW (2.073 mg/L) was reported in site 8, while the lowest one (0.006 mg/L) was reported in sites 2 and 7. The highest mean value for UW (2.453 mg/L) was reported in site 5, while the lowest one (0.003) was reported in sites2 and 10.

Table 4. Magnitudes of nitrate and nitrite parameters of U.W and SW samples collected from Ed-Dueim Locality.

Site .No	NO_3^-(mg/L)		NO_2^-(mg/L)	
	U. W	S.W	U. W	S.W
1	3.167 ±0.723	0.0167±0.0115	0.0167±0.0115	0.0133±0.0058
2	0.007 ±0.006	0.0033 ±0.0508	0.0033 ±0.0508	0.0067 ±0.0058
3	0.017 ±0.006	0.0133 ±0.0058	0.0767 ±0.1069	0.0133 ±0.0058
4	5.393 ±0.595	0.0067 ±0.0058	0.2967 ±0.0907	0.010 ±0.0100
5	15.767 ±2.201	0.0133 ±0.0058	2.4533 ±0.2940	0.0100 ±0.0100
6	0.003 ±0.006	0.0250 ±0.0458	0.0033 ±0.0058	0.2167 ±0.0252
7	2.963 ±0.237	0.0100 ±0.0100	0.1033 ±0.0153	0.0067 ±0.0058
8	2.957 ±0.302	2.6733 ±0.3465	0.1967 ±0.0709	2.0733 ±0.2307
9	0.010 ±0.010	0.0067 ±0.0058	0.0300 ±0.0100	0.0100 ±0.0100
10	0.007 ±0.006	0.0133 ±0.0058	0.0033 ±0.0058	0.0100 ±0.0100
SSMO	45-50		2-10	
WHO	45-50		2-10	

Although, all the SW and UW samples showed values of nitrate and nitrite lower than the WHO and SSMO permissible value, site 5 for UW sample recorded very high value of nitrate. High presence of nitrite as shown from the table (site 5 and 8 for UW and SW respectively) may be due to organic wastes, agricultural fertilizers, intensive livestock, surface runoff, and atmospheric deposition.

The results were agreeing with the findings of El-Hassan(16), who found that the level of nitrate for SW samples of the three Niles (White, Blue and main Nile) were ranged from 0.1 to 0.7 mg/L and the level of nitrite were ranged from 0.001 to 0.031 mg/L (appendix 4). Also the results were agreeing withAbdellah*et al.*(14), whom found that, the level of nitrate for SW of the samples in Khartoum City for SW were ranged from 0 to 5.9 mg/L and for UW were ranged from 0 to 0.66 (appendix 2).According to Murdoch , high nitrate content (>1 mg/L) is not conducive for aquatic life. Nonetheless, in unpolluted waters the level of nitrate-nitrogen is usually less than 0.1 mg/L (17).

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