A Study of the Drinking Water Physical and Chemical Factors at Al-Qadisiyah Drinking Water Station - Salah Al-Din Province

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Abstract

The current study was conducted on drinking water to identify some of the physical and chemical properties of the drinking water station in the city of Tikrit - Al-Qadisiyah district, with four distributed sites since November 2018 to January 2019 for a period of three months by measuring the temperature of air, water, pH, D.O., BOD, E.C., salinity, hardness, chloride salts, nitrites and phosphates.

The results of the current study showed that the temperature of air and water ranged respectively between (15.5 - 17.3) and (15 - 18.2) C°, while the value of E.C. ranged (52.60 - 61.05) µS/cm. As for the pH, the values ranged between (7.31 - 7.39) whereas the D.O. values ranged (2.06 - 2.5) mg/L, while the values of the B.O.D. ranged from (0.98 - 0.50) mg/L and it was noticed that this water had a low level of hardness, as the T.H. values ranged between (9.5 - 12.6) mg/L and Ca hardness ranged between (6.66 - 9.66) mg/L, while the Mg hardness recorded values ranging between (13 - 30) mg/L, while the salinity values ranged (1.51 - 1.55) g/L, while the Cl values ranged from (0.041 - 0.13). This study recorded low concentrations of phosphate values, as the values ranged between (0.04 - 0.27) µg/L of atom phosphate, while the values of nitrite ranged between (0.01 - 0.7) µg/L of nitrogen atom - nitrite.

Keywords: *Drinking water, filtration, dissolved oxygen, biochemical oxygen demand. Total hardness.*

Introduction

Water covers about 71 percent of the Earth's surface area, and is considered one of the most important natural resources ever [(1)]. Water is the essential element in the life-enhancing system, as it moves in an endless cycle of evaporation and condensation. This cycle is known as the water cycle, as it affects the environment of living organisms such as plants, animals, and microorganisms to a great degree. Thus, it generates seasonal and daily changes that calm the atmosphere and maintain its moderation [(2)]. Water also represents one of the strategic dimensions in making life in all its forms and guarantees its continuity and permanence, as Lavon[(3)] mentioned that any change in the physical and chemical properties causes a change in its status, directly or indirectly, so that it becomes less fit for natural uses, whether for drinking or for domestic or agricultural or Industrial consumption. Also, due to development, expansion and population growth Iraq needs water [(4)]. Water is an essential component of our environment and has a fundamental role in all vital processes that occur within the body of living organisms [(5)]. The sources of water in most societies are surface water such as streams, rivers and lakes, so the water balance may be at risk as this water itself is used for drinking, hygiene and watering, so drinking water will become in danger unless it is treated healthfully and its supplies is controlled with great care [(3)].

Materials and Methods

1- Physical Factors:

1-1 Temperature

The water and air temperatures were measured at sites using a mercury thermometer with a range of (50 - 10) C° with a 0.1 C° steps.

1-2- E.C.

The E.C. of the samples were measured using a WTW Multi-line device after calibrating it at a rate of two readings, in terms of µS/cm.

2- Chemical Agents:

2-1 pH

The pH was measured via a WTW Multi-line P4 immediately after calibration of the device in the laboratory using standard solutions with various pH values, and by taking the average of two pH readings.

2-2 DO

The method was followed as described in [6] to determine D.O. levels, where a 250 ml bottles were filled by immersing them in water and the sample was fixed by adding (1 ml) of $MnSO_4.4H_2O$, then (1 ml) of alkaline potassium iodide (KOH + KI) and shaking the bottles well and leaving them for 10 minutes. Then by adding (1 ml) of absolute H_2SO_4, and a (100 ml) of the mix was taken and titrated with $Na_2S_2O_3$ (0.025 N). The results were expressed in mg/L.

2-3 BOD

Depending on the method of the American Health Association [7], and through gathering drinking water samples and treating them according to the method used to determine the concentrations of dissolved oxygen for a period of five days at 25 C° and results were expressed in mg/L.

2-4 Total Hardness

It was measured using the method approved by the American Society for Testing and Methods [8], where (50 ml) of water sample was taken and (2 ml) of Buffer Solution were added to regulate the pH, then (2-3) drops of Erichrom Blak T indicator were added till the color of the water sample became purple and then titrated with a standard solution of Ethylene Diamine Disodium Salt Tetra Acetic Acid (Na_2EDTA) (0.05 N). Then, the calculations were performed and the results were expressed in (mg/L) of $CaCO_3$.

2-5 Ca Hardness

According to water tests in ASTM [8], Calcium hardness was measured by adding 2 ml of buffer NaOH (1 N) to (50 ml) of drinking water sample, then 2-3 drops of Calcium indicator were added and titrated with EDTA (N 0.01) then calculations were performed and results were stated in (mg/L) of $CaCO_3$.

2-6 Mg hardness

The magnesium concentration was calculated by subtracting the amount of calcium hardness from the total hardness, and the result was expressed in (mg/L) $MgCO_3$ [9].

2-7 Cl

Chloride was measured according to the method used by [9] by adding (3) drops of k_2CrO_4 to (50 ml) of water sample and mixing them well, then was titrated with silver nitrate solution $AgNO_3$ (0.025 N). Calculations were performed and results were stated in mg/L.

2-8 NO_2

The method that was published by Strickland and Parsons [10] was relied on. The nitrite concentrations of samples were determined using a (Shimadzu-Spectrophotometer UV- 120-01) device at a wavelength of (543 nm). The results were reported in atom/L of nitrogen-nitrite.

2-9 Reactive Dissolved Phosphate measurement

The method described by the American Health Association [7] was followed by adding (8 ml) of the combined reagent, which was prepared from sulfuric acid, potassium ammonium tartrate, ammonium molybdate and ascorbic acid, to (50 ml) of the filtered water sample with good mixing, and left for 30 minutes. The complex was reduced giving a blue solution whose intensity is direct proportional to the phosphate concentration. Chromatic absorption of the complex formed was read by the spectrophotometer at a wavelength of (860 nm), and the results were expressed in (mg/L).

Results and Discussion

The results of the recent study in Table No.1 revealed that the averages of air temperature ranged (15-18.2) C° at site 1 and 2, respectively, as the highest temperature was 24.5 C° in November at site 1 and the lowest temperature was 10.5 C° in January at site

2. In this study, the difference in temperature may be attributed to the dissimilarity of the weather temperature of the period for sampling due to the continental climate that characterizes Iraq, which is hot in summer and cold in winter , or may be due to the difference in air temperature at sites 1,2,3,4 at the same period of the month as a result of the variance in time of sampling, considering the far distances among sites, as it takes few hours for sampling.

Table (1). Weekly and local changes of the ambient air temperature of the water site during the study period shown in C°.

Date	Sampling Sites			
	1	2	3	4
11/11/2019	21	22	23	21
26/11/2019	24.5	15	18	14
9/12/2019	13	14	12	18
23/12/2019	15	10.5	11.5	15.5
8/1/2020	16	13	13.5	15
20/1/2020	20	19	16.5	20
Average	18.25	15.5	15.7	17.2

D.O.

In table No. 2 of the results of this study presented that the rates of DO concentrations ranged (0.06-2.5) mg/L at sites 2 and 3, respectively. The highest value of dissolved oxygen was (3.5) mg/L in December at site 3. As the results of the current study indicated that the DO concentration was low, and this may be due to the high temperature and the shortage of oxygen solubility in summer.

Table (2). Weekly and local changes of DO during the study period shown in mg/L.

Data	Sampling Sites							
	1		2		3		4	
	DO	BOD	DO	BOD	DO	BOD	DO	BOD
11/11/2019	2.1	1.1	2.6	1.1	2	1.7	2	0
26/11/2019	1.6	0.1	1.3	0.1	1.2	0	1.3	0.1
9/12/2019	2.5	2	2.5	0	3	0.8	3.1	1.1
23/12/2019	2.7	0.9	2.5	1	3.5	2.1	3.2	1.7
8/1/2020	2.1	0.6	1.5	0.3	1.5	0.2	2	0.8
20/1/2020	2.5	1.2	2	0.5	1.9	0.4	2	0.5
Average	2.25	0.983	2.06	0.5	2.51	0.226	2.26	0.7

BOD

In this study, the table No. 3 showed the values of BOD ranged (0.08-0.50) mg/L at sites 1 and 2, respectively, as the highest value was (2.1) mg/L at site 3 in December. while the lowest value was (0) mg/L at site 4 in November, also at site 2 in December.

The reason for the low values of the BOD is that the sites are far from the sources of pollution. Also, the results of this study revealed that the values of the BOD were identical to the Iraqi standard specifications of 1996 for drinking water, which is less than 3 mg/L.

Total hardness

The results of this study revealed that the TH values ranged (9.5-12.6) mg/L, where the highest value was (18) mg/L in January at sites 1 and 2, respectively, however the lowest value of total hardness was (5) mg/L in January at site 4 as in table 3. The reason for the decrease in total hardness may be attributed to the presence of chloride and calcium salts at low levels. These results were within the Iraqi drinking water standard limits and global, which range (250-500) mg/L (Central Organization for Measurement and Quality Control 1996).

Table (3). Weekly and local changes of water TH during the study period shown in mg/L.

Data	Sampling Sites			
	1	**2**	**3**	**4**
11/11/2019	8	7	15	13
26/11/2019	12	10	10	10
9/12/2019	10	7	9	12
23/12/2019	12	12	15	12
8/1/2020	10	15	14	5
20/1/2020	18	18	13	5
Average	11.66	11.5	12.66	9.5

Ca and Mg hardness

The current study results displayed that the calcium hardness values ranged (6.66-9.66) mg/L at sites 1 and 3, respectively, where the highest value of calcium hardness was 15 mg/L at site 4 in January, while the lowest value was 4 mg/L at Site 1 in November as in table 4. The reason for the difference in calcium hardness values may be due to the nature of the geological structure.

The current results also showed that the values of magnesium hardness ranged (13-30) mg/L at the sites 1 and 4, respectively, as the highest value of magnesium hardness was in November and December at the sites 1 and 4, respectively, while the lowest value was 0 In January at site 4 as in table 5. The reason the shortage of magnesium ion, may be due to the lack of water salinity which lowers the concentration of magnesium ion [11].

Table (4). Weekly and local changes of Ca and Mg hardness during the study period shown in mg/L.

Data	Sampling Sites							
	1		2		3		4	
	Ca	Mg	Ca	Mg	Ca	Mg	Ca	Mg
11/11/2019	6	2	6	1	10	3	12	1
26/11/2019	4	8	5	5	7	3	8	2
9/12/2019	5	5	6	1	8	1	10	2
23/12/2019	5	7	10	2	11	4	4	8
8/1/2020	8	2	10	5	10	4	15	0
20/1/2020	12	6	10	8	12	1	5	0
Average	6.66	30	7.833	22	9.666	16	9.333	13

Salinity

The results of this study indicated that salinity values ranged (1.51-1.55) g/L at sites 2,3, and 4, respectively. Where the highest value was (1.23) g/L in December at site 4, and the lowest value was (0.03) g/L in November at site 3, as shown in Table 5. The salinity values recorded in the current study were low, and we found that there was a relationship of direct proportion between EC and salinity and the concentrations of chloride and calcium ion, so this water is considered safe to drink. (Central Organization for Measurement and Quality Control 1996).

Table (5). Weekly and local changes of salinity during the study period shown in mg/L.

Data	Sampling Sites							
	1		2		3		4	
	Sal.	pH	Sal.	pH	Sal.	pH	Sal.	pH
11/11/2019	0.04	7.83	0,03	7.11	0.04	7.42	0,04	7.27
26/11/2019	1.21	7.12	1.21	7.30	1.20	7.20	1.19	7.26
9/12/2019	1.19	7.02	1.18	7.48	1.18	7.35	1.17	7.46
23/12/2019	1.22	7.18	1.21	7.39	1.21	7.32	1.23	7.20
8/1/2020	1.20	7.25	1.21	7.45	1.20	7.33	1.22	7.38
20/1/2020	1.18	7.48	1.20	7.60	1.19	7.69	1.22	7.80
Average	1.006	7.31	1.006	7.36	1.003	7.38	1.01	7.39

PH

The current study results revealed that pH values ranged (7.31-7.39) at sites 1 and 4 respectively, as the highest value was (7.8) in January at site 4 and the lowest value was (7.11) in November at site 2, as shown in Table 5. It was noticed through the results recorded in this study that the extent of the variation in the pH values is narrow and the reason may be due to the regulatory capacity of the water containing bicarbonate and carbonate compounds as well as other compounds resulting from the drinking water process that enter the water body as the Iraqi drinking water is rich in these compounds that neutralize water acidity [12].

Cl

The results of the current study showed values for chloride, whose rates ranged (0.041-0.13) mg/L at site 2 and 3 respectively, as the highest value of chloride reached 0.51 mg/L in January at site 2 and the lowest values were recorded at sites 1, 2, and 3 In November.

The results showed the variation in the chloride values during the months of study, and the reason may be due to the climatic differences between summer and winter seasons. The results also showed that the chloride values were associated with the EC values, as EC values were directly proportional to the concentration of elements, including chloride [13].

Table (6). Weekly and local changes of Cl in water during the study period shown in mg/L.

Data	Sampling Sites							
	1		2		3		4	
	Cl	PO4	Cl	PO4	Cl	PO4	Cl	PO4
11/11/2019	0.01	0.97	0.01	0.20	0.01	0.01	0.11	0.01
26/11/2019	0.11	0.18	0.07	0.12	0.05	0.01	0.04	0.27
9/12/2019	0.01	0.29	0.04	0.07	0.06	0.10	0.07	0.13
23/12/2019	0.06	0.01	0.07	0.01	0.03	0.14	0.07	0.27
8/1/2020	0.04	0.01	0.51	0.27	0.03	0.01	0.05	0.30
20/1/2020	0.06	0.19	0.08	0.61	0.07	0.01	0.06	0.31
Average	0.048	0.275	0.13	0.213	0.041	0.046	0.066	0.215

PO_4

The results of this study showed that phosphate values ranged around (0.17) mg/L at site 1 and 4 respectively, as the highest value reached (0.31) mg/L in the water of site 4 in January, and the lowest value was (0.01) mg/L in the water of the sites 1 and 2 in November and December, and that most of the samples did not exceed the maximum limit in the local standard specifications for drinking water, which is (0.4) mg/L as in Table 6. [14].

Ethical Considerations: All Research participants haven't been subjected to any kind of harm in any way.

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Conflict of Interest: The author declare no conflict of interest regarding this research.

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