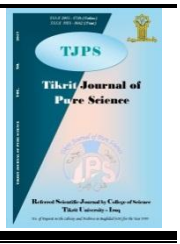
TJPS

TIKRIT JOURNAL OF PURE SCIENCE

Journal Homepage: http://main.tu-jo.com/ojs/index.php/TJPS/index



Studying the specific characteristics of the water of some wells in the city of Tikrit

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DOI: http://dx.doi.org/10.25130/tjps.23.2018.023

ARTICLE INFO.

Article history:
-Received: 22 / 10 / 2017
-Accepted: 19 / 12 / 2017
-Available online: / / 2018

Keywords: Tikrit City, Chemical and physical properties

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Abstract

The study of the water of five wells in the city of Tikrit was conducted for the period from December 2016 to March 2017 where its ages ranged from 6 to 27 years and the depths between 90 - 120 m and are all used to irrigate crops and for washing. Some physical and chemical properties were also studied, temperature which ranged between 22-23.6 C° and electrical conductivity which ranged between1742.5-3002.5 microsimens / cm and the total alkaline which ranged between 53-193 mg / L, as well as many other properties total hardness, calcium and magnesium hardness, pH, sodium and potassium ions. The results proved that the well waters were hard and ranged between 1055.7- 1257.48 mg / L.

1- Introduction

The study of underground water is of important consideration since it is used for purposes of development, irrigation, agriculture, and in many urban and industrial fields. Therefore, the estimation of underground water in an accurate and correct manner with the study of underground water properties has become of important consideration for its development, organization and protection to ensure its continued availability as a natural source of water [1,2].

The mineral content of the underground water varies according to the geological nature of the area through which the water passes through and stabilizes. In general, the majority of the underground water has a high salt content, so that the water is hard, and this water hardness decreases with the decrease of salts[3].

In addition, the salts transferred to the underground waters by washing and filtration processes and the tremendous development of agricultural and animal fields with the establishment of industrial and population complexes near the wells as well as the use of chemical fertilizers and waste water are considered a source for underground water pollution and deterioration of its quality, which poses a health hazard to consumers of water wells [4,5].

The quality of underground water varies according to geographical location, well depth, climatic and seasonal changes and solubility, through contact with rocks and waters, resulting in an increase in the concentration of water soluble substances [6].

and which increase continuously by being exposed to materials and elements in the ground layers [7]. Thus, improving underground water quality and making it conform to the standards of drinking water has become important with the increase of population and the increasing of different needs for freshwater by improving the physical and chemical properties of water [8].

In the study of the physical and chemical properties of underground water in the district of Sharqat, it was found that the water of some wells in the study area was very hard [9]. It was also noted that the water of some wells in the city of Samarra was very hard and the positive and negative ions were uneven due to different sources of nutrition [10]. The underground waters in the city of Tikrit and its suburbs were found to be pH-neutral and medium to slightly high electrical conductivity with high water hardness [11].

The research was aimed at studying some physical and chemical properties of ten wells in the city of Tikrit.

2- Materials and Methods

Five wells were studied in the city of Tikrit, in an open area that extended from Tikrit University in the north to Tikrit Teaching Hospital in the south and from the Tigris River in the east to Baghdad Road in the west.

Water samples were collected from wells for the period from December 2016 to March 2017, and once a month. The wells were numbered from 1-5 according to Table (1).

Some physical and chemical tests were carried out in situ and laboratory, which are:

1. Water temperature, electrical conductivity, soluble solids, total hardness according to the method APHA[12].

2 - pH, calcium and magnesium hardness, according to the method ASTM [13].

3 - The total alkaline according to the method by Welch [14].

4. Sodium and potassium ion concentrations APHA[15].

Table (1): Places and specifications of wells under study

Well	Symbol	Locations	Depth/Meter	Method of drilling	Distance from the Tigris River/Meter	Diameter of water lifting tube(inch)	Diameter of well coating (inch)	Age of well by year	The distance between wells according to sequence	Use
1	W1	Al-Fursan sector-in front of university	100	Mechanical	3011	3	8	13	5109	Irrigation of crops such as wheat, barcley, vegetables, and olives used for household purposes
2	W2	Inside the Al-Qadisiya games city	90	Mechanical	668	3	8	6	1466	To water gardens , wash the corridors and sustain the fish lake
3	W3	Inside the enclosure of the wells department behind the industrial sector	96	Mechanical	1655	3	8	12	2982	Watering gardens and some vegetables
4	W4	Al-Zuhoor sector- Second Al-Zuhoor park	120	Mechanical	2361	4	8	27	2917	Watering gardens and washing buildings
5	W5	Inside enclosure of college of medicine-Tikrit university	120	Mechanical	952	4	8	10		Watering gardens, washing buildings and watering vegetables

Results and Discussion

1- Physical Properties

1-1 Water Temperature

The water temperature of the study wells are shown in Table (1).

Table (2): Monthly changes of water temperature during the study period (C°)

Date	Well 1	Well 2	Well 3	Well 4	Well 5	Average
20/12/2016	19	18	18	19	19	18,6 c
20/1/2017	21	21.5	22	23	23	22,1 b
20/2/2017	23	23	24	20	20	22.8 b
20/3/2017	24	26.5	25	26	26	25.5 a
Average	21.7 a	22.25 a	22.25 a	22 a	23 a	

Between 21.7 and 23 ° C at wells 1 and 5, respectively, therefore, in the current study, these waters were classified in the average as warm waters due to a temperature exceeding 18 ° C and the lowest temperature recorded as 18 ° C in wells 2 and 3 respectively in December 2016 while the highest temperature recorded was 26.5 at the well 2 in March 2017. The temperature of underground water depends on the depth of the layer carrying it, its geographic latitude and the source of this water [16].

The results are similar to those reached by [17][4][18]. in the study of the quality of wells in Kirkuk governorate. The results of the statistical analysis according to the test of variance analysis of water temperature showed that there were significant temporal differences and no significant spatial differences between the study wells at a significant

level ($p \leq 0.05$), as shown in Table (2). The reason for the discrepancy in the current study may be due to the region's climate variability during the months of the year and the difference in the sampling time [19].

1-2 E.C. Electrical Conductivity

The results of the study in Table (3) indicate that the average values of the electrical conductivity ranged from 2425-3002.5 microsimens / cm in wells 1 and 2 respectively. The lowest value was 2390 microsimens / cm in February 2017 in well 2 and the highest value was 3080 microsimens / cm in the month of February 2016 in the well 1. These results were similar to those by [20]. in her study of underground water quality assessment in the Musayyib project area and its validity for irrigation ranging from 3210-1555 µm/ cm in wells 5 and 1, respectively.

This difference in the values of electrical conductivity in the studied wells may be due to the difference in the geological formations between the regions. The characteristics of the natural water depends on the type of rocks and the soil that are in contact with it, the time period of the contact process and the distance between the wells [21]. The processes of washing with rainwater also washes away salts from neighboring lands [22]. The results of the statistical analysis according to the Duncan mean test showed significant spatial differences with no significant temporal differences at a significant level ($p \leq 0.05$) between the study wells as shown in the table below.

Table (3) :Electrical conductivity of water wells during the study period (microsimens / cm)

Date	Well 1	Well 2	Well 3	Well 4	Well 5	Average
20/12/2016	3020	2470	2550	2770	2510	2664a
20/1/2017	2940	2410	2550	2790	2520	2642 a
20/2/2017	3080	2390	2490	2680	2450	2618 a
20/3/2017	2970	2430	2440	2670	2450	2592 a
Average	3002,5 a	2425 d	2507,5 c	2727,5 b	2482,5 d	

1-3 Total Dissolved Salts TDS

The results of the current study in Table (4) show that soluble salt concentrations ranged from 1621.82 to 2037.92 mg/L in wells 2 and 1, respectively, and the lowest value was 1492.99 mg/L in March in well 2 and the highest value was 2149.27 mg/L in December in well 1. The results were higher than the results by [4] where the soluble salt concentration values ranged between 707.8-1205.5 mg/L, respectively. This was also lower than the results by [23]. recording 5416 mg / l respectively. The results of the statistical analysis using the Duncan test showed significant spatial and temporal differences at a significant level ($P \leq 0.05$). The increase in dissolved solids may be due to the increase of some ions such as sulfur ions as shown in Table 17. This is what [24]. observed as that it is all dissolved solids in ionized and non-ionized solution and dissolved gases.

Table (4): Monthly changes of dissolved solids in well waters during the study period (mg/ L)

Date	Well 1	Well 2	Well 3	Well 4	Well 5	Average
20/12/2016	2149.27	1757.84	1814.78	1971.35	1786.31	1859.91 a
20/1/2017	2007.66	1641.11	1736.44	1864.38	1670.13	1783.94 b
20/2/2017	2055.96	1595.37	1645.27	1907.30	1599.36	1762.09 b
20/3/2017	1938.81	1492.99	1561.6	1672.91	1535.07	1640.27 c
Average	2037.92 a	1621.82 c	1654.87 c	1853.98 b	1647.71 c	

2- Chemical Properties

2-1 pH

The results of the current study in Table (5) show that pH values ranged between 7.31-7.55 in wells 4 and 5, respectively. Its lowest value was 7.10 in December 2016 in well 5, and the highest value of 7.69 recorded in February 2017 in the well 4. The results were lower than those reached by [25]. recording 7.98. The results of the statistical analysis using the analysis of variance showed no significant temporal differences, with significant spatial differences at ($p \leq 0.05$) between the wells under study. The water of the current study wells has a low base, possibly because of the water's distance from the direct atmospheric changes caused by the decomposition of carbon dioxide in the water[26].

Table (5): Monthly changes of pH in wells during the study period

Date	Well 1	Well 2	Well 3	Well 4	Well 5	Average
20/12/2016	7,27	7,26	7,32	7,33	7,10	7,25 a
20/1/2017	7,45	7,54	7,53	7,58	7,39	7,49 a
20/2/2017	7,50	7,39	7,54	7,69	7,45	7,51 a
20/3/2017	7,36	7,43	7,39	7,60	7,31	7,41 a
Average	7,39 a	7, 40 a	7,44 a	7,55 a	7,31 a	

2-2 Total Hardness

The results of the present study in Table (6) showed that the total hardness rates ranged between 1078.3-1242.21mg/L in the water of wells 3 and 4, respectively. The lowest concentration of total hardness was 846 mg/ L in January 2017 in wells 2, 4 and 5 and the highest value was 1,636.2 mg /L in February 2017 in well 5. The results of the current study were lower than the results of the study by [25]. as the total hardness averages ranged between (1420-1990) mg/ L, and higher than those by [27]. where the total hardness values ranged from 150 to 382 mg /L. The results of Duncan's statistical analysis showed no significant spatial differences with significant temporal differences at a significant level (P≤0.05). It is most likely that the values of hardness in well water at this level are likely to appear in the geological formations in the areas where these wells are abundant with calcium limestone and calcium sulphate, which are important sources of water scarcity [26].

Table (6): Monthly changes of Total Hardness of well waters during the study period(mg/L)

Date	Well 1	Well 2	Well 3	Well 4	Well 5	Average
20/12/2016	1137.6	1252.8	1209.9	1512	1267.2	1275.9 b
19/1/2017	907.2	864	950.4	864	864	889.9 d
21/2/2017	1393.2	1344.6	1263.6	1441.8	1636.2	1415.8 a
20/3/2017	994,08	889.44	889.44	1151.04	994.08	983.6 c
Average	1108.02 a	1087.81a	1078.3 a	1242.21 a	1190.37a	

2-3 Calcium Hardness

The results of the current study in Table (7) showed that the values of calcium hardness ranged between 468.9-569.26 mg/ L in wells 1 and 4 respectively, and the lowest concentration of calcium hardness was 424.8 mg/ L in February in well 1 and the highest concentration 628.26 Mg/ L in March in well 4. The results of the present study were lower than those by [25]. Study where the values of calcium hardness ranged between (1089-1542) mg/ L, while they were close to the results of the study by [17]. for well water as the values of the hardness of calcium ranged between (390-699) mg/L. The results of the statistical analysis using the Duncan test showed that there were significant temporal and spatial differences of calcium concentration at a significant level (p≤0.05). Calcium ions are mainly due to the geological nature of the areas in which the water passes. Calcium accounts for 30.23% of sedimentary rocks[28].

Table (7): Monthly changes of Calcium Hardness in well waters during the study period (mg/L)

Date	Well 1	Well 2	Well 3	Well 4	Well 5	Average
20/12/2016	439.2	489.6	468	540	504	488.16 c
20/1/2017	468	547.2	460.4	561.6	525.6	512.56 b
20/2/2017	424.8	511.2	475.2	547.2	504	492.48 c
20/3/2017	543.78	572.4	562.86	628.26	620.1	585.48 a
Average	468.9 c	530.1 b	491.6 c	569.26 a	538.42 b	

2-4 Magnesium Hardness

The results of the current study in Table (8) showed that the concentration averages of magnesium hardness ranged between 414.55 - 505.29 mg / L in wells 2 and 4, respectively. The lowest value of magnesium concentration was 184.46 mg/ L in January in well 4 and the highest 972 mg/ L in December in well 4. The results of the present study were higher than the results by[25]. where the concentration averages of magnesium hardness ranged between 331-571 mg/ L. The results of the statistical analysis using the Duncan test showed that there were significant temporal differences with no significant spatial differences as shown in Table (8). Magnesium ions are mainly due to the geological nature of areas where sedimentary rocks pass through water [28].

Table (8): Monthly changes of magnesium hardness in well waters during the study period (mg / L).

Date	Well 1	Well 2	Well 3	Well 4	Well 5	Average
20/12/2016	698.4	763.2	738.6	972	763.2	787.08 a
20/1/2017	267.91	193.24	298.56	184.46	206.42	230.11 c
20/2/2017	590.72	508.37	480.92	545.82	690.64	563.29 b
20/3/2017	274.68	193.39	199.21	318.89	238.12	242.85 c
Average	457.92 a	414.55 a	429.32 a	505.29 a	472.09 a	

2-5 Total Alkilinity

The total alkaline values may be due to the nature of the geological formation of the study area. This variance varies by source of carbonate CO3 and bicarbonates HCO3 in well waters. Their sources in underground water are calcareous rocks that touch groundwater, rainwater that consists of carbon dioxide as well as underground water itself [23].

The total alkaline value averages during the current study period ranged from 53-193 mg/ L in wells 1

and 5, respectively. The lowest value of total alkalinity recorded was 48 mg/ l in December in well 1 and the highest was 206 mg / l in March in well 5. Table (9) shows that the results of the current study of the total alkilinity are close to the results by [25]. The rates ranged between (53.6-124.2) mg / L. And lower than the results by [17]. The total alkilinity values ranged from 208-540 mg / L.

The results of the statistical analysis according to the the Duncan mean test clarified that there were no significant temporal differences with significant spatial differences at a significant level ($p \leq 0.05$). noted that the total base values may be due to the nature of the geological formations of the study area[23].

Table (9): Monthly changes of the total alkilinity of well water during the study period (mg / L).

Date	Well 1	Well 2	Well 3	Well 4	Well 5	Average
20/12/2016	48	70	56	172	186	106.4 a
20/1/2017	52	76	62	156	192	107.6 a
20/2/2017	60	79	64	163	188	110.8 a
20/3/2017	52	96	110	180	206	128.8 a
Average	53 d	70.25 c	73 c	167.75 b	193 a	

2-6 Sodium Ions

The appearance of sodium compounds in underground water was due to the presence of rock salt, limestone salt, clay salt and dolomite in the formations of underground water [29]. The sodium rates in the wells under study as shown in Table Between 67-216.85 mg/L in wells 5 and 1 respectively, and recorded the lowest values of 56.7 in March in well 5 and the highest value of 245.1 mg/ L for the month of January in Well 2. The results of this study were lower than that by [30]. The sodium concentrations were 618.4 mg / Liter respectively.

The results of the statistical analysis under the Duncan mean test showed significant spatial differences and the absence of significant temporal differences at a significant level ($p \leq 0.05$) between the wells under study. The appearance of sodium compounds in groundwater is due to the presence of rock salt, limestone, dolomite, and dolomite in the formations of aquifers [29].

Table (10): Monthly changes of sodium ions in well waters during the study period (mg / L).

Date	Well 1	Well 2	Well 3	Well 4	Well 5	Average
20/12/2016	245.1	77.9	127.3	100.7	77.9	125.78 a
20/1/2017	201.6	77.4	135	79.2	64.8	111.6 b
20/2/2017	205.4	73.5	117.6	93.9	68.6	111.8 b
20/3/2017	195.3	67.5	94.5	80.1	56.7	98.82 c
Average	216.85 a	74.075 d	118.6 b	90.7 c	67 d	

2-7 Potassium Ions

The results of the present study showed in Table (11) that the average potassium ions were 2.4-4.1 mg / L in wells 2,3 and 5. The lowest recorded value of potassium ions was 2.1 mg/L in well 2 during December and well 4 during March and the highest was 4.5 mg/ L in well 5 during January. The results of the present study were lower than those by [27]. The lowest value of potassium ions was 0.001 mg / L and the highest value was 1.214 mg / L, where it was lower than the study by [31]. with the lowest value of potassium 8.81 mg / l, while the highest value was 12.34 mg / L.

The results of the statistical analysis according to the Duncan mean test were the absence of significant temporal differences with significant spatial differences at a significant level ($p \leq 0.05$). The appearance of potassium in these concentrations is due to the geological nature of the region [29].

Table (11): Monthly changes of potassium ions in well water during the study period (mg / L).

Date	Well 1	Well 2	Well 3	Well 4	Well 5	Average
20/12/2016	3.4	2.1	2.3	2.2	4.1	2.8 a
20/1/2017	3.6	2.7	2.7	3.6	4.5	3.4 a
20/2/2017	3.6	2.5	2.4	2.3	4	2.9 a
20/3/2017	3.3	2.6	2.3	2.1	3.8	2.8 a
Average	3.4 c	2.4 b	2.4 b	2.5 b	4.1 a	

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دراسة الخصائص النوعية لمياه بعض الآبار في مدينة تكريت

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الملخص

تم دراسة مياه خمسة آبار في مدينة تكريت للفترة من كانون الاول 2016 الى آذار 2017 تراوحت اعمارها 6 سنة الى 27 سنة وأعماقها بين90–120م وجميعها تستخدم لري المزروعات والغسل ودرست بعض الصفات الفيزيائية والكيميائية لها مثل الحرارة وتراوحت بين 22–23.6 م° والتوصيلية الكهربائية تراوح بين 1742.5–3002.5 مايكروسمنس/ سم والقاعدية الكلية بين 53–193 ملغم / لتر فضلاً عن العديد من الصفات الأخرى كالعسرة الكلية وعسرة الكالسيوم والمغنسيوم والأس الهيدروجيني وأيوني الصوديوم والبوتاسيوم واظهرت النتائج إن مياه الآبار كانت عسرة وتراوحت عسرتها بين 1055.7– 1257.48 ملغم / لتر.

الكلمات المفتاحية: مدينة تكريت ، الصفات الفيزيائية والكيميائية ، عسرة .