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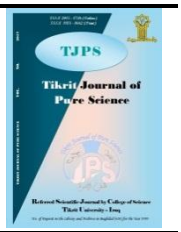

Study the physical and chemical properties of groundwater in the Al-Alam within the province of Salah al-Din

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Abstract

The current study was designed to investigate some of the physical and chemical properties of the five wells located in Al-Alam aera during the period from October2016 to March 2017. The results clarify monthly variation of above properties. Air and water temperature ranged (9-32) (19-24)C^0 respectively. Turbidity values were between (0.00-3.95) NTU, and electrical conductivity values were (2210-6350) µhs/cm. PH values ranged between (7.2-8.4). Chloride ions valeus were between (12-100) mg/L. The alkalinity values due to bicarbonate were varied between (60-351) mg/L. The total hardness, calcium and magnesium were varied between (1480-4600), (760-2000) and (160-2600) mg/L respectively. Nitrate values ranged between (0.200-3.51)µgN-NO3/L.

Introduction

Groundwater can be defined as the part of water trapped in the underground and porous reservoir, in addition to the penetration of rain water into the soil and lower ground layers.

Groundwater is one of the important water resources that humanse relied on for thousands years ago, especially in dry and semi-arid regions where millions of people lived on [1]. It is characterized by large amount of dissolved salts compared to river water .This can be due to the slow movement of ground water, which dissolves parts of the rocks , through which it passes and to the salts transformed to it. These salts are mainly calcium and magnesium. Mineral content of this water is characteristic that distinguishes it from other surface water .The salt constituents varies according to the geological nature of the area [2] Groundwater was used in rural areas for agricultural purposes, where there is no other water resources available. Groundwater has been increasingly contaminated with human activities [3]. The quality of groundwater is a result of interactions of many processes during the hydrological cycle. The quality of the groundwater varies according to the depth, different places and nature of geological formation[4]. Groundwater lack of suspended materials due to the infiltration process through which the water pass, therefore, deep well waters are colorless, pure and with stable compositions, compared with less deep well waters. The depth of well waters, and its isolated conditions makes their temperature almost constant or may change only few degrees. This is important in the field of industry and thermodynamics [5]. Recent demand of well water in Iraq has decreased, because of the low levels of the Tigris and Euphrates rivers and the rain drought in the past decates. Groundwater in Iraq has increasingly become important for drinking and irrigation [6]. The mian aim of the present study was to evaluate well water quality and suitability for various uses, through investigation of some physical and chemical properties .

Description of study area:

Five wells were selected in rural area of Al-Alam, area at Salah-Al-Deen Governorate. These wells were selected because of the shortage and lack of studies on the groundwater of the area. The study included monthly changes in selected wells which are located east of Tigris river figure(1) shows the situations of the different wells.

Well 1: This well is located in Al-Rebbadaa village apopulated area at a depth of 25 m. This well is closed and used for drinking and various daily uses**.**

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Well 2: Is located in the Khazamiyah village at a depth of 15m and it is of the open type and used for crops irrigation.
Well3: It is located in the village of samara at a depth of 40 m. The well is of closed type which is used for crops irrigation also.
Well 4: The well is at a depth of 65m and it is of closed type and used for irrigation.
Well5: Is located at a depth of 80m, and it is of a closed type and used for cattle drinking.

Figure 1

Materials and Methods

Sample Collection: Water samples were collected from different wells during the period from October 2016 to March 2017. Physiochemical measurements were performed immediately as follows :

1- Air and water temperature was measured in the field by placing a clean mercury thermometer
2- Turbidity: measured by using Turbidity meter
3- Electrical Conductivity and pH were measured by using (pH-EC meter, HI 9812, Hanna instrument).
4- Total Alkalinity: The method of correction with sulfuric acid (N 0.01) was followed by the presence of the orange instance
5 -Total hardness and Ca Hardness was measured with standard N2EDTA (N01,0) with Erichrom Blak-T and Murexide as dry powder respectively[7,8].
6 - Chloride Cl -: was measured by correction with standard silver nitrate solution (N 0.0141) with potassium dichromat [8,9] .
7. Nitrate measurements were followed by the methods described in APHA[8]

Result and Discussion

Temperature: affect a number of organic, inorganic and chemical constituents of water, as well as the taste .In addition, it acts geochemical and chemical reactions. The temperature has effects on the ability of water to hold oxygen and the resistance of living organisms against certain pollutants [10] .The results of air and water temperatures are shown in table (1). The maximum value temperature of air 32 °C in October at wells 2 and 3 and minimum value of 9 C° in December at the well 4 that the maximum value 23 ^{0}C in well during November and minimum value of water 19° C. Results of the statistical analysis using the analysis of variance showed, significant differences (P≤00.01) for tiem of sampling and significant differences (P≤00.01) between different wells. Therefore, the water can be classified as a warm water, became it exceeded 18 C°. The slight variation of temperature of the groundwater may be related to the distance from where the weather changes on the ground surface .

Table (1) Air and water temperature in the different wells during the different sampling times

Wells	Well1		Well2		Well3		Well4		Well5	
Month	W	A	W	A	W	A	W	A	W	A
OCT	19	31	21	32	20	32	19	32	21	30
NOV	22	12	21	10	22	10	21	12.5	23	12
DEC	22	11	20	10	22.5	10	21	9	21	10
JAN	22.5	16	21	17	21	15	21.5	15	20	16
FEB	22	14	20.5	13	22	13	20	11	20.5	12
MAR	24	17	23	17	22.5	18	21.5	19	20	18

The turbidity: The highest turbidity value was in October in well 2 (3.95) NTU and the lowest value was (0.00) NTU in wells 3 November , well 4 and 5 during January and February, Statistical analysis showed significant temporal and spatial differences (P≤00.01) .The results obtained in this work were less than the study of Mahdi [1], In his study, turbidity values ranged (1-70) NTU. This decrease is related to that, the underground water is relatively stagnant. These values are shown in table(2).

Table (2) Monthly and local changes of the turbidity (NTU) for studied wells

Wells / Month	Well1	Well2	Well3	Well4	Well5
OCT	1.49	3.27	2.99	1.17	2.13
NOV	1.43	2.94	0.00	0.25	3.90
DEC	1.22	1.52	0.8	0.45	1.17
JAN	0.22	1.33	0.11	0.00	0.00
FEB	0.4	2.10	1.52	0.00	0.3
MAR	1.56	2.2	0.77	0.3	0.1

Electrical conductivity EC: is defined the ability of one cm^3 of water to conduct electrical current, at 25

°C. This factor is measured by (µhs/cm) or (Mhs/cm). Conductivity depends on the soluble salts concentration and water temperature [11]. The conductivity values in the different wells ranged from 2210 µhs/cm in October to 6350 µhs/cm in December .The results of the present work were close to the results of Al-obaidy which was (1920-7675) µhs/cm in north of Salahaddin Province[12] .The statistical analysis showed significant differences (P≤00.05) among the differences wells. These values are shown in table (3)

Table (3) Monthly and local changes of the EC for studied wells

Wells / Month	Well1	Well2	Well3	Well4	Well5
OCT	3830	2980	2210	4790	2700
NOV	3068	3710	6350	2881	2863
DEC	3044	3866	5340	3230	2640
JAN	4000	3484	5120	3150	2542
FEB	3550	3676	5687	3446	2600
MAR	4000	3495	5987	3090	2630

pH: The pH of the aquatic systems is a good indicator for the water quality and the pollution extend. Values of pH of the present work are shown in table (4). The maximum pH valuhe was found in well 1 during October and was 8.4 and the minimum value was 7.2 in well 3 during March. Analysis of variance showed significant differences in different times and the different wells (P≤00.05).The results of the present study were slightly differ than the study of Ghaeeb [13] on the Physical, Chemical and bacteriological characteristics of Some Wells in Tikrit City, which was (7.49- 7.83).

Table (4) Monthly and local changes of the pH for studied wells

Wells / Month	Well1	Well2	Well3	Well4	Well5
OCT	8.4	7.8	8	7.9	7.3
NOV	8.18	8	7.75	7.96	8.07
DEC	8	7.7	7.5	7.71	7.9
JAN	7.8	7.8	7.51	7.5	7.6
FEB	7.7	7.4	7.43	7.4	7.27
MAR	7.51	7.46	7.3	7.6	7.6

Chloride: Differences were observed in the values of chloride table (5). The minimum and maximum ranges of the chloride value were (12-100)mg/L. Analysis of variance showed significant temporal differences (P≤00.01) While there were no spatial differences at the different wells during the study period .

Table (5) Monthly and local changes of the Cl (mg/l) for studied wells.

Wells / Month	Well1	Well2	Well3	Well4	Well5
OCT	30	12	13	22	19
NOV	40	20	24	28	19
DEC	37	23	27	24	21
JAN	35	25	28	25	24
FEB	38	26	36	26	31
MAR	33	31	100	27	21

Alkalinity: The alkalinity ranges of the samples during the study period are shown in table (6). Most carbonate and bicarbonate ion of groundwater are derived from carbon dioxide in the soil [14].The alkalinity values were 60mg/L to 35mg/L. The reason for this could be related to the high rate of organic matter degradation by bacteria and the increase in carbon dioxide (CO2), and this will lead to the formation of bicarbonate[13] .Results were statistical significant (P≤00.05) spatially and non - significant temporal.

Table (6) Monthly and local changes of the Alkalinity (mg/L) for studied wells.

Wells / Month	Well1	Well2	Well3	Well4	Well5
OCT	120	230	210	150	120
NOV	260	210	200	60	150
DEC	185	193	205	132	145
JAN	255	243	350	143	100
FEB	232	250	321	143	110
MAR	240	243	351	160	130

Total Hardness: indicate towards the concentration of calcium and magnesium, which are able to precipitate when it is heated and affect negatively the solubility of soap in the water [15]. The values of total hardness are shown in table(7).The total hardness during the study period ranged 1480mg/L in January in well 5 to4600 mg/L in well 3 during March. The high value in the March may be due to rainfall which cause washing away salts from neighboring soils. Statistical analysis showed significant spatial differences (P≤00.05), and with significant temporal differences (p≤00.01) .The water in the study wells considered as very hard water according to table (13).

Table (7) Monthly and local changes of the total hardness (mg / L) for studied wells.

Wells / Month	Well1	Well2	Well3	Well4	Well5
OCT	2400	1600	2082	1840	2000
NOV	1600	2400	2800	2000	1680
DEC	1650	2355	2950	2000	1678
JAN	1750	2000	2640	2080	1480
+FEB	1850	2400	3565	2132	1650
MAR	2400	2300	4600	2800	2600

Calicum and Magnesium hardness: Calcium and magnesium ions enter the groundwater through infiltration from minerals like Calcite, Gypsum and Dolomite [14]. The maximum value of calcium hardness was 2000mg/L and the minimum value was 760mg/L during October among the different wells . Analysis of variance showed significant spatial difference (P≤00.01).

Table (8) Monthly and local changes Ca hardness (mg/ L) for studied wells.

Wells / Month	Well1	Well2	Well3	Well4	Well5
OCT	2000	1340	800	880	760
NOV	1200	2200	1600	1400	1520
DEC	1460	1950	1600	1440	1250
JAN	1400	1800	1400	1620	1200
FEB	1350	1800	1720	1400	1300
MAR	1600	1700	2000	1600	1400

The present results showed that, the ranges calcium hardness during the study period was (720-1900)mg/L. These results were similar to the study of Safawi and others (2008) in their study on well water of the Shrikhan-Kubba region in Nineweh province, where they record a range of (720 -1900) mg/l[16] . Table (9) shows these values. Table (10) shows the values of the magnesium hardness, which were (160-2600) mg/L. Statistical analysis showed significant spatial and temporal differences (p≤00.01).

Table (9) Monthly and local changes of the Mg hardness (mg / L) for studied wells.

Wells / Month	Well1	Well2	Well3	Well4	Well5
OCT	400	260	1282	960	1240
NOV	400	200	1200	600	160
DEC	190	405	1350	560	428
JAN	350	200	1240	460	478
FEB	500	600	1845	732	350
MAR	800	1500	2600	1200	1200

Nitrate: influence greatly plant growth and may have a hazard effect on drinking water of their value exceeded 10ppm[14]. Table 12), shows the minimum and maximum values of nitrate, which were (0.200-3.59)ppm. Nitrate concentration depends on many physical and chemical factors in water system, In addition to the discharge from the surrounding agricultural area and the nature of microbiology.

Table (10) Monthly and local changes of No3 for studied wells

Wells / Month	Well1	Well2	Well3	Well4	Well5
OCT	1.750	0.372	5.88	2.1 62	0.512
NOV	0.895	0.125	1.126	1.126	1.478
DEC	0.641	0.356	1.320	1.780	1.545
JAN	0.843	0.932	1.798	2.123	1.872
FEB	0.200	0.835	0.835	2.042	1.730
MAR	0.534	1.126	3.591	3.557	2.716

Results of the statistical analysis using the analysis of variance showed significant differences (P≤00.01) spatial with no significant temporal differences .

Conclusions

1-It was found that the water of all wells were warm during the study period, The values of the turbidity within the permissible limits of drinking water for all wells during the study period

2.The concentration of chloride within the permissible limits and all wells that it does not cause any danger when used for domestic use.

3.The general guidelines for classification of hardness water explain that most water in wells is very hard.

4. All sites of wells forNO3 was within permissible limits as per WHO for aquatic life.

Table (11)Duncan test of multiple averages by wells - studied sites

Wells	TCA	T^0CW	EC	TU	pH	AK	TH	Ca^{+2}	Mg^{+2}	Cl^-	N03
Well1	16.83a	21.75a	358b	1.05b	7.93a	215.3b	1942c	1502ab	440b	35.50a	0.810bc
Well2	16.58a	20.917a	3535b	2.227a	7.693a	228.1b	2326b	1798a	528b	22.83a	0.629c
Well3	16.33a	21.667a	5116a	1.032b	7.582a	272.7a	3106a	1520ab	1586a	35.9a	2.425a
Well4	16.08a	20.667a	3431b	0.362b	7.678a	131.3c	2142bc	1390b	752b	25.33a	2.132a
Well5	16.33a	20.917a	2662b	1.623b	7.623a	125.8c	1848c	1238b	643b	22.50a	1.642b

Table (12) Duncan test of multiple averages by months of study

MONTHS	TCA	T^oCW	EC	TU	pH	AK	TH	Ca	Mg	Cl	NO3
OCT	31a	20b	3302a	2.21a	7.88ab	166a	1984c	1156b	828b	16.63c	2.135a
NOV	11.3ef	21.8ab	3774a	1.704ab	7.99a	176a	2096bc	1584a	512c	26.20b	0.950a
DEC	10.1f	21.3ab	3624a	1.032bc	7.76bc	172a	2127bc	1540a	587c	26.40b	1.128a
JAN	15.8c	21ab	3659a	0.332c	7.64c	218a	1990c	1484a	546c	27.40b	1.514a
FEB	12.6de	21ab	3792a	0.864c	7.44d	211a	2319b	1514a	805b	31.40b	1.134a
MAR	17.8b	22a	3840a	0.986c	7.49d	224a	3120a	1660a	1460a	42.40a	2.305a

Table(13) classification of water according to total hardness[17,18].

Todd 2007		**Boyd 2000**	
Degree of water hardness	***Term***	***Quality of water***	***Degree of water hardness***
0 < TH ≤ 60	Soft	Soft	50 ≥ TH
60 < TH ≤ 120	Moderately hard	Moderately hard	50 < TH ≤ 150
120 < TH ≤ 180	Hard	Hard	150 < TH ≤ 300
180 < TH	Very hard	Vary hard	300 < TH

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دراسة الخصائص الفيزيائية والكيميائية لبعض الابار في ناحية العلم ضمن محافظة صلاح الدين

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الملخص

اجريت الدراسة الحالية لمعرفة بعض الخصائص الفيزيائية والكيميائية، لمياه خمسة ابار واقعة في ناحية العلم، وللفترة من تشرين الاول 2016الى اذار2017. اظهرت نتائج الداراسة تباينات شهرية في بعض الخصائص الفيزيائية والكيميائية. اذ تراوحت قيم درجتي حرارة الهواء والماء على التوالي (9−32)(19−23)م، وتراوحت قيم الكدرة بين (0.00−3.95)NTU، وقيم التوصيلية الكهربائية بين(2210−6350) µhs/cm. ان قيم PH في المياه الجوفية للمنطقة المدروسة هي متعادلة الى قاعدية خفيفة تراوحت بين (7.2−8.4)، كانت قيم ايونات الكلوريد في مياه الابار بين (12−100) ملغم/لتر. اوضحت نتائج الدراسة بان قيم القاعدية تعود الى البيكاربونات اذ تراوحت بين (60−351)ملغم/لتر. وقيم كل من العسرة الكلية وعسرة الكالسيوم وعسرة المغنسيوم مابين (1480−4600)(760−2000)(160−2600) ملغم/لتر على التوالي، تراوحت قيم النترات بين (0.200−3.51) مايكروغرام نتروجين−نترات/لتر.

الكلمات المفتاحية: مياه جوفية ، ابار، الخصائص الفيزاوية والكيميائية للمياه الجوفية.