

7-7-2021

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### Recommended Citation

Ahmed, Hameed Rashid and Aziz, Hazhar Mohamed (2021) "Department of Basic and Applied Science, Federal Polytechnic Mubi, Adamawa state, Nigeria," *Al-Qadisiyah Journal of Pure Science*: Vol. 26: No. 3, Article 7.

DOI: 10.29350/qjps.2021.26.3.1435

Available at: <https://qjps.researchcommons.org/home/vol26/iss3/7>

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Al-Qadisiyah Journal of Pure Science

# Al-Qadisiyah Journal of Pure Science

ISSN(Printed): 1997-2490

ISSN(Online): 2411-3514

DOI: /10.29350/jops.

<http://qu.edu.iq/journalsc/index.php/JOPS>

## Investigation of Coliform bacteria and physicochemical Compositions of six drill well Drinking Water in Kifry City, Kurdistan-Iraq

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### Article History

Received on: 1/8/2021

Revised on: 22/8/2021

Accepted on: 22/8/2021

### Keywords:

Coliform, Drinking water, Physicochemical,

MaCconkey powder, Atomic absorption spectrometry, UV-VIS spectrophotometer.

DOI: <https://doi.org/10.29350/jops.2020.25.3.1435>

### ABSTRACT

Coliform bacteria are important Water quality indicators, related to human health. This study investigated , 30 samples of drinking water from five different sources of drilled well from Kifry city were collected March 2021 and investigated for the levels of their physiochemical characterization and coliform. Chemical tests were performed include tests of some soluble inorganic ions, such as chloride ( $\text{Cl}^-$ ) and calcium ( $\text{Ca}^{2+}$ ), potassium ( $\text{K}^+$ ) sodium ( $\text{Na}^+$ ), magnesium ( $\text{Mg}^{2+}$ ), the conductivity, pH, total dissolved solid (TDS), and turbidity. The results of chemical and physical test demonstrate the water of drilled wells in study area is possible for drinking according to Iraqi standard limits and international organization World Health Organization (WHO) for drinking water. Also collected sample for detection coliform bacteria in the laboratory direct five tubes put the solution each 5ml for one tube and 10 ml sample for each one, after that all the tube put the incubator at 37 °C. After for 24 hour the tubes that show turbidity change red to purple in color and show gas production (bubble in the Durham tube) are considered positive. but the (drilled well) water in Imam Mohamed area isn't suitable for drinking water, according to the (WHO) ranges for drinking water.

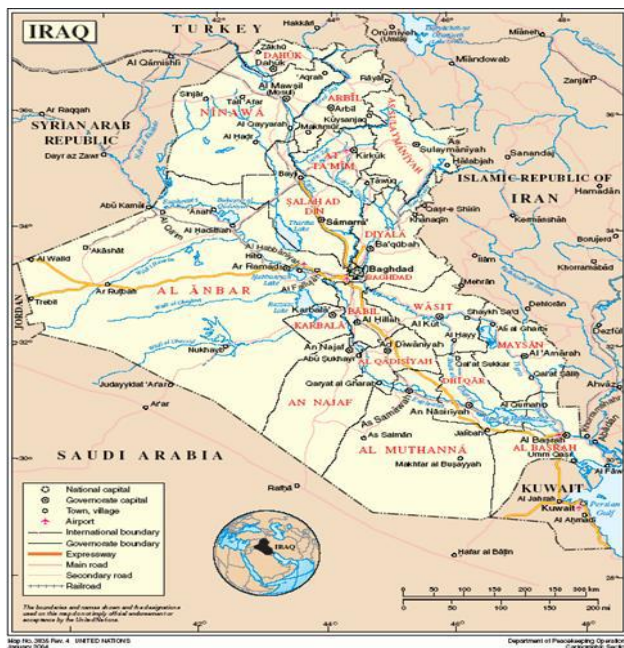
### Introduction

Drinking water is a fundamental requirement in the sustenance of human life, because it includes one of the fundamental human rights and critical for good life access equally for population. Some researches give evidence that most of water supplied for drinking is polluted [1]. Water quality was safe in terms of fecal coliform (FC) bacteria with increasing depth ground water sources [2, 3]. Like the majority of growing nations industrialization and urbanization have no longer protected with waste polluted materials of environment, as a consequence of this various issues increasing from environmental contamination [4, 5]. This is right for water sources wherein different hazardous industrial waste products , emission and effluents are being removal, making large quantity of hazardous with poisonous metals nearby digging water sources. Due to leakage of uncontrolled out flowing manufacturing products of industrial in the

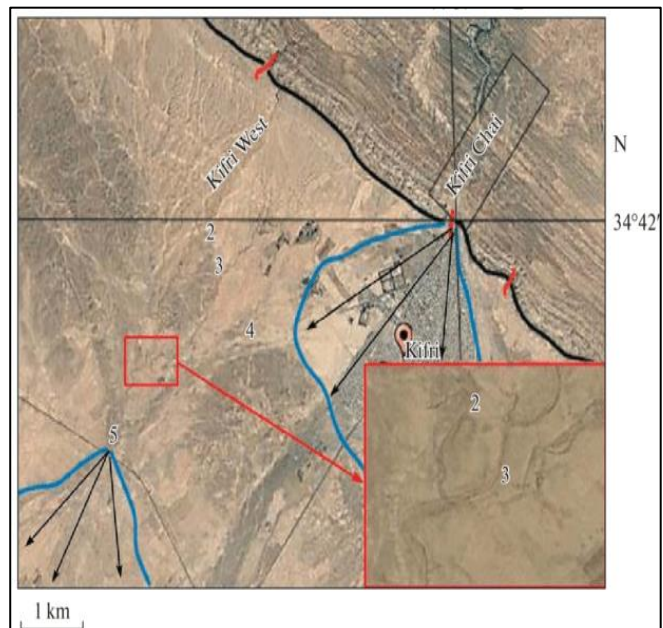
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sewage channels, nature worth of ground water quality is altered to harmful point therefore availability of healthy, clean and good quality drinking water is a problem in civilized region, make great concern [6]. Physiochemical parameters, sources of drinking water were analyzed to determine their safe and suitability for human consumption [7, 8]. Coliform bacteria are called microscopic organisms because that come from in the intestinal tract of warm blooded animals, soil and vegetation are found. The total coliform bacteria are commonly harmless; but their presence in drinking water illustrates the possibility of those disease generally causing by bacteria, viruses or parasites (pathogens) are also present in the water, the coliform microorganisms have used as an indicator for water quality and have traditionally resulting the public health protection concept[9,10]. Common actual microbiological techniques are mentioned, as are methods which have emerged from latest research developments. Approved traditional methods for detection coliform include microbiological fermentation such as the multiple-tube fermentation (MTF) technique and the membrane filter (MF) technique by using different particular media under suitable conditions for incubation [11]. The main objective of the present study was to determine Drinking Water in Kifry City contamination of coliform bacteria and the Investigation physicochemical Compositions, by people in Kifry City Information obtained from this assessment may help in the development of preventive and control strategies that will raise people's awareness and will safeguard the general public's



Map of Iraq showing Sulaimaniya governorate. kifri district



Map of Sulaimaniya showing location of kifri district

## Methods and Materials:

**Sampling:** Thirty water samples were collected at different time in ten hour/day from drilled well in kifri and stored in 100 mL labeled plastic bottles but for chlorinated samples of water the

bottles for counteract chlorine must contain sodium thiosulphate (0.1 ml of a 1.8% solution per 100 ml capacity). The collected sample March 2021

The MPN method used for Each five samples of them were collected among the different drinking water places (drilled wells).

Broth is prepared by dissolve 80 g of powder in 1 L of distilled water. As well as distributed in a series of five tubes fitted with Durham tube sterilize in the autoclave at 121°C for 15 minutes. Then sample in the laboratory direct five tube put the solution each 5ml for one tube and 10 ml sample for each one, after that all the tube put the incubator at 37 °C. After for 24 hour the tubes that show turbidity change red to purple in color and show gas production (bubble in the Durham tube) are considered positive.

During our investigation we used Biological-MacConkey Broth for the counting of coliforms bacteria by the MPN method, selecting positive tubes that show turbidity, a color change to red purple and gas production [9, 12].

Chemical- Reagents and solutions: analytical chemical grades were used to prepare all standard solutions. Standard solutions were freshly prepared to generate calibration curves.8 Thirty water samples were collected in ten hour/day at five different area in Kifry and stored in 100 mL labeled plastic bottles.

Each sample of them was collected from separately sources (drilled well).9 for calibration curve of our experiment were prepared standard solutions. Before starting measurements, all instruments were calibrated according to their manufacture procedures. PH-meter (WTW inoLab pH-720)10 was used for measuring pH .

Conductivity meter (WTW inoLab cond-720) used for measurement the total dissolved solid (TDS) and electrical conductivity (EC). And chloride (Cl-) were measured titrimetric ally. Atomic absorption spectrophotometer (AAS 6300) was used to determine the concentration of calcium (Ca<sup>2+</sup>), magnesium (Mg<sup>2+</sup>).11-12 A flame photometer (PFP7 Industrial Flame Photometer) was used to measure sodium (Na) and potassium (K+) concentrations. The turbidity was measured by a turbidity meter [13, 14].

## Results and Discussion

### A. Physicochemical tests

- B. The physicochemical features among the different drinking water places in kifri were investigated with the aim of classification according to Iraqi standard values for water drinking samples. Our results obtained have been presented in Tables below. Physicochemical test results of drilled well water are shown in Table 1.

Table 1: Physiochemical test results of drilled well water (locality Raparin)

Sample No. / Parameters	W1	W2	W3	W4	W5	W6	Mean	Iraqi standard limits	WHO
pH	7.2	7.2	7.3	7.4	7.2	7.3	7.26	6.5-8.5 at 25 °C	
EC	456	505	555	550	552	550	523	1500 $\mu$ S/cm	
TDS	210	223	244	231	259	232	233	1000 ppm	
Turbidity	2.94	0.47	2.0	0.28	3.25	2.25	1.78	5 NTU	
Ca <sup>2+</sup>	85	89	93	98	88	87	90	150ppm (CaCO <sub>3</sub> )	
Cl <sup>-</sup>	37.5	21	28.5	12	9.8	21	21.76	350 ppm	
Na <sup>+</sup>	45	66	69	73	32	65	57	200 ppm	
K <sup>+</sup>	1.56	1.78	1.35	1.88	1.67	1.55	1.64	12 ppm	
Mg <sup>2+</sup>	25	18	23	12	44	22	24.4	100 ppm (CaCO <sub>3</sub> )	

Table 1 shows that, the lowest pH value was 7.2 and the highest value was 7.4, which are in accordance with the standard limits. Electrical conductivities were in the range 456-555 $\mu$ S/cm. The results of TDS were ranged between 210 to 259 ppm.

The values of turbidity of tap water can be seen (table 1), which arranged in 2.0 to 3.25 NTU. The calcium concentrations results in the examined water samples had determined in variety 85-98 ppm. Although the lowest level of chloride was 12 mg/L (W4), the highest value was 37.5 mg/L (W1). The ranges of sodium and potassium in the sample were 32-73 ppm, 1.35-1.88 ppm respectively. Finally, magnesium concentrations were determined in the variety 12-44 ppm

Table 2: Physiochemical test results of drilled well water (locality Shahidan)

Sample No. / Parameters	W1	W2	W3	W4	W5	W6	Mean	Iraqi standard limits	WHO
pH	7.4	7.2	7.2	7.6	7.3	7.2	73	6.5-8.5	
EC	459	560	502	525	575	525	524	1500 $\mu\text{S}/\text{cm}$	
TDS	215	228	260	235	255	235	238	1000 ppm	
Turbidity	3.94	0.59	3.5	1.23	3.4	3.5	2.53	5 NTU	
Ca <sup>2+</sup>	93	88	85	94	93	88	90	150 ppm(CaCO <sub>3</sub> )	
Cl <sup>-</sup>	37.8	25	30.5	18	10.8	25	24.43	350 ppm	
Na <sup>+</sup>	55	75	65	78	42	65	63	200 ppm	
K <sup>+</sup>	1.35	1.65	1.46	1.35	1.25	1.65	1.41	12 ppm	
Mg <sup>2+</sup>	35	15	33	18	55	33	31.2	100 ppm (CaCO <sub>3</sub> )	

**Table 2** shows that, the lowest pH value was 7.2 and the highest value was 7.6, which are in accordance with the standard limits. EC were in the range 459-575  $\mu\text{S}/\text{cm}$ , TDS were ranged between 215 to 260 ppm.

The values of turbidity of tap water can be seen (table 2), which arranged in 0.59 to 3.94 NTU. The calcium concentrations results in the investigated water samples were determined in the variety 85-94 ppm. Although the lowest level of chloride was 10.8 mg/L (W5), the highest level was 37.8 mg/L (W1). The ranges of sodium, potassium, and magnesium concentrations in the sample were 42-78 ppm, 1.25-1.65 ppm, 15-55 ppm respectively.

Table 3: physiochemical test results of drilled well water (locality Imam muhamed)

Sample No. / Parameters	W1	W2	W3	W4	W5	W6	Mean	Iraqi standard limits	WHO
pH	7.2	7.2	7.5	7.4	7.3	7.2	73	6.5-8.5 at 25 °C	
EC	520	510	522	670	580	570	560	1500 $\mu\text{S}/\text{cm}$ at 25 °C	
TDS	215	250	270	245	220	250	240	1000 ppm	
Turbidity	2.95	2.55	1.5	1.15	2.5	1.15	2.13	5 N. TU	
Ca <sup>2+</sup>	85	75	82	80	95	80	83	150 ppm(CaCO <sub>3</sub> )	
Cl <sup>-</sup>	40.5	30	40.5	25	12.8	25	29.76	350 ppm	
Na <sup>+</sup>	45	65	40	70	83	65	60	200 ppm	
K <sup>+</sup>	1.2	1.55	1.43	1.31	1.22	1.55	1.34	12 ppm	
Mg <sup>2+</sup>	32	18	40	22	35	32	29.4	100ppm (CaCO <sub>3</sub> )	

Table 3 shows that, the lowest pH value was 7.2 and the highest value were 7.5, which are in accordance with the standard limits. Electrical conductivities ( $\mu\text{S}/\text{cm}$  at 25°C) were in the range 510-670 $\mu\text{S}/\text{cm}$ . The results of total dissolved salts (TDS) were ranged between 215 to 270 ppm. The values of turbidity of tap water can be seen (table 3), which arranged in 1.15 to 2.95 NTU. The calcium concentrations results in the examined water samples had determined in variety

75-95 ppm. Although the lowest level of chloride was 12.8 mg/L (W5), the highest value was 40.5 mg/L (W1). The ranges of sodium, potassium, and magnesium in the sample were 40-83 ppm, 1.2-1.55 ppm, 18-40 ppm respectively.

Table 4: physicochemical test results of drilled well water (locality Hwari nwe)

Sample No. Parameters	S1	S2	S3	S4	S5	S6	Mean	Iraqi standard limits
pH	6.8	7.2	7.4	7.3	7.3	7.2	7.2	6.5-8.5 at 25 °C
EC	575	525	540	680	550	540	576	1500 $\mu$ S/cm at 25 °C
TDS	220	240	255	260	240	255	243	1000 ppm
Turbidity	1.55	1.55	2.5	2.55	0.5	1.5	1.73	5 N. TU
Ca <sup>2+</sup>	95	65	74	85	88	80	81	150 ppm] (CaCO <sub>3</sub> )
Cl <sup>-</sup>	35.5	45	43.5	35	20.5	45.5	35.9	350 ppm
Na <sup>+</sup>	45	65	55	65	95	65	69	200 ppm
K <sup>+</sup>	1.4	1.65	1.75	1.44	1.33	1.4	7.56	12 ppm
Mg <sup>2+</sup>	22	25	30	25	45	25	29.4	100 ppm (CaCO <sub>3</sub> )

Table 4 shows that, the lowest pH value was 6.8 and the highest value was 7.4, which are in accordance with the standard limits. Electrical conductivities ( $\mu$ S/cm at 25 °C) were in the range 525-680 $\mu$ S/cm. The results of total dissolved salts TDS were ranged between 220 to 260 ppm. The values of turbidity of tap water can be seen (table 4), which arranged in 0.5 to 2.55 NTU. The calcium concentrations results in the investigated water samples were determined in the variety 65-95 ppm. Although the lowest level of chloride was 20.5 mg/L (W5), the highest level was 45 mg/L (W2). The ranges of sodium, potassium, and magnesium concentrations in the sample were 45-95 ppm, 1.33-1.75 ppm, 22-45 ppm respectively.

Table 5: physiochemical test results of drilled well water (locality Anfalakn)

Sample No. / Parameters	W1	W2	W3	W4	W5	W6	Mean	Iraqi standard limits	WHO
pH	7.8	7.3	7.2	7.3	7.3	7.2	7.3	6.5-8.5 at 25 °C	
EC	555	545	550	650	550	545	570	1500 $\mu\text{S}/\text{cm}$ at 25 °C	
TDS	225	245	265	270	255	270	252	1000 ppm	
Turbidity	2.55	1.25	1.5	1.55	1.55	1.25	1.68	5 NTU	
Ca <sup>2+</sup>	85	75	65	80	85	75	78	150 ppm (CaCO <sub>3</sub> )	
Cl <sup>-</sup>	45.5	35.5	42.5	37.5	25.5	35.5	37.3	350 ppm	
Na <sup>+</sup>	55	59	65	75	85	65	67.8	200 ppm	
K <sup>+</sup>	1.5	1.25	1.45	1.55	1.35	1.25	1.42	12 ppm	
Mg <sup>2+</sup>	35	15	40	25	25	25	28	100 ppm (CaCO <sub>3</sub> )	

Table 5 shows that, the lowest pH value was 7.2 and the highest value was 7.8, which are in accordance with the standard limits. Electrical conductivities ( $\mu\text{S}/\text{cm}$  at 25 °C) were in the range 545-650 $\mu\text{S}/\text{cm}$ . The results of total dissolved salts (TDS) were ranged between 225 to 270 ppm. The values of turbidity of tap water can be seen (table 5), which arranged in 1.25 to 2.55 NTU. The calcium concentrations results in the examined water samples were concluded in variety 65-85 ppm. Although the lowest level of chloride was 25.5 mg/L (W2), the highest value was 45.5 mg/L (W1). The ranges of sodium and potassium in the sample were 55-85 ppm, 1.25-1.55 ppm respectively. Finally, magnesium concentrations were determined in the variety 15-35 ppm.

#### B Coliform test

The main microbiological (coliform) properties of five different sources of well drinking water in Kifri city were investigated with the aim of classification of the different water sources according to Iraq and WHO standard drinking water for drinking water quality. The test results obtained are presented in tables below.



Table 6: Investigated microbiological coliform test results for of drilled wells water of kifri at five different areas Raparin, Shahidan, Imam muhamed, Hawri nwe, and Anflakan

Sample No.	Coliform Result					Iraqi standard limits	WHO
	Raparin	Shahidan	Imam muhamed	Hawri nwe	Anflakan		
S1	0.0(-ve)	0.0(-ve)	>16(+ve)	0.0(-ve)	0.0(-ve)	< 1	
S2	0.0(-ve)	0.0(-ve)	0.0(-ve)	0.0(-ve)	0.0(-ve)	< 1	
S3	0.0(-ve)	0.0(-ve)	>16(+ve)	0.0(-ve)	0.0(-ve)	< 1	
S4	0.0(-ve)	0.0(-ve)	>16(+ve)	0.0(-ve)	0.0(-ve)	< 1	
S5	0.0(-ve)	0.0(-ve)	0.0(-ve)	0.0(-ve)	0.0(-ve)	< 1	

Table 6 shows that, drilled well water sample among five different areas Raparin, Shahidan, Imam muhamed, Hawri nwe, and Anflakan areas, after investigated microbiological (coliform) form in the laboratory indicator all area are equal to zero, according to Iraqi standard limits the results in the water samples are negative. While the results of ( Imam Mohamed) area for microbiological (coliform) in the laboratory three out of five samples are positive, because the values are greater than 16, therefore this water is not suitable for drinking.

### Conclusion:

In conclusion, the physicochemical properties of the different drinking water samples in Kifri city have been investigated and the test results were in accordance with the Iraqi Government and WHO. However, there are few results which were not in agreement with the Iraqi standard limits. Finally, according to the results, the quality of drinking water sources in Kifri city can be classified from low to high quality depend upon WHO, drilled well water. Nevertheless, to classify these sources further resourcefully the biological and some other physicochemical properties have to be examined which cannot be done in this study.

The result of microbiological (coliform) test of the different drinking water samples in kifri city is accordance with the World Health Organization (W.H.O) standards, but the results in a few drilled wells water in Imam Mohamed area are not safe for drinking.

Drinking water sources in most drilled wells in Imam Mohamed have high risk on population health

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