

Determining some physical and chemical features on lower Zab river and wells water in the Zab township

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ABSTRACT

The current study was conducted on the water of the Zab river in the Zab township of the Hawija district / Kirkuk governorate / Iraq, through which some physical and chemical factors of the river's water and some wells were studied. The research began from August 2019 to January 2020, to study six sites on the Zab River and six wells in the Zab township the research included the measurement of physical factors (electrical conductivity and total soluble salts or electrical conductivity and TDS). And some chemical factors in river water and well water (Calcium, magnesium, sodium and potassium ions). And some of the heavy metals (cadmium, lead, copper, and cobalt).

The results of the current study showed that the values of electrical conductivity (312-518) microsemns / cm for river water and (741-8542) microsemns / cm for wells, while total dissolved salts ranged between (194-336) mg / L in river water and (253- 293.3 (mg / L for studied wells, calcium ions were recorded between (36-52) mg / L for the Zab River and (51.1-481.3) mg / L for wells. As for Magnesium Ions, it ranged between (15-24) mg / L for the Zab River and (26.6-480.5) mg / L for wells, Sodium ions recorded values ranging between (8-19) mg / L for the Zab river and (14.3-294.3) mg / L for well water, the values of potassium ions ranged between (1.4-3) mg / L for the Zab River and (9.5-155) mg / L of wells water, heavy metals (cadmium, lead, cobalt and copper) in both well water and the Zab River recorded very low values which were did not exceed 0.1 ppm.

The results of the statistical analysis of the Dunkin test also showed the presence of temporal and spatial differences in most of the studied physical and chemical factors at 0.05 level.

1. Introduction

Water is that vital resource for all forms of life, and it is one of the most abundant compounds in the universe, as the human body contains about 70% of its weight in water, and plants and animals contain (50-95%) of their weight as water, so it is the nerve of life as without it there is no life It is the medium in which all biological and chemical reactions take place within the bodies of living things, and water covers nearly two-thirds of the surface of the globe, and it has a special importance in human life in terms of benefits and uses, such as navigation, industry and agriculture, as well as recreational activities that depend on water, such as parks and gardens And swimming[1]. Water is a unique chemical compound

made of two hydrogen atoms and one oxygen atom, and it is the only substance that exists in three solid, liquid, and gaseous physical states at the normal temperatures and pressures of the globe, and it is these unique physical properties that give it its importance to life, interest in water resources, its characteristics, the nature of its exploitation, and its reflection on its behavior are topics that have been carefully studied by scholars and researchers since ancient times [2]. The study of the physical and chemical properties and the determination of the concentration of heavy metals is an important indicator to measure the quality of water and its suitability for various uses and to determine the

amount of pollution and the cases of food enrichment that negatively affect the quality of water and its suitability for various purposes in the stagnant and running freshwater systems [3]. Nevertheless, the development of societies, the progress of agriculture and industry, and the increase in population numbers have contributed to increasing environmental pollution in various forms and degrees.

The study area is located in the governorate of Kirkuk, in the northeast of Iraq, Zab is an Iraqi city that is administratively affiliated with the Hawija district. It is 35 km north of Baiji, the bottom of the tributary is located at. Northeast of Iraq and the bottom Zab passes through the provinces. Sulaymaniyah, Ta'mim, Erbil, and Salah al-Din, the river is about 400 km long and its common name is.

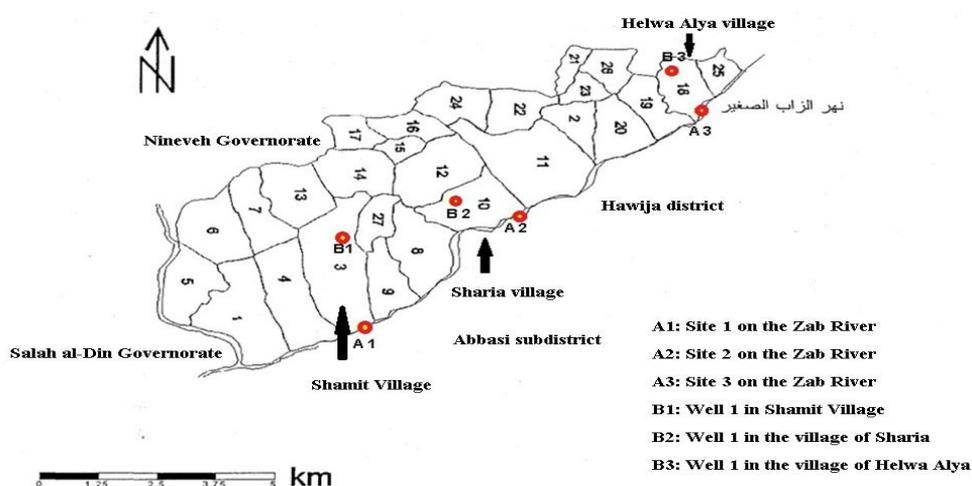
The small zab which is longer than the upper zab about 8 km[4].

Geologically, the study area consisted of the sediments of the Cretaceous Period Of usually calcareous, limestone, igneous, metamorphic, and sedimentary rocks [5], The aim of current study was to identify some physical and chemical properties of the water of the Zab river and the wells in the Zab township

2. Materials and methods

2.1 Studying Area

Water samples were collected from the lower Zab River from three sites (three wells and three sites on the Zab River), once a month and for a period of six months started from August 8/2019 to January 1/2020 and the three sites are located in the Zab township



Map of sampling sites after coordinated by the researcher [6].

2.2 Sample collection sites

1. Zab River sites:

- Site 1: Samples were collected from the lower Zab River near the Great Shmet Bridge in the village (Shmet). The station is approximately 1.9 km from the village center and approximately 6.7 km from the center of the Zab township.

- Site 2: Water samples were collected from the lower Zab River near the village (Sharia). The station is approximately 1.3 km from the village center and approximately 21 km from the center of the Zab township.

- Site 3: Water samples were collected from the lower Zab River near the village (Helwa Olya). The station is approximately 2.6 km from the village center and approximately 40 km from the center of the Zab township.

2. Wells sites:

- Well 1: Water samples were collected from a well (Mahmoud Fahd Abdhameed) near the center of the village of Shamit, and the depth of the well is 45 m and a hole was automated in 2014 and is about 3.2 km from the Zab site and a distance of about 7.8 km from the center of the Zab township. It is used for home irrigation and planting trees

- Well 2: Water samples were collected from a well (Ibrahim Abdullah Alian) near the center of the village of Sharia and the depth of the well is 20 m and was dug mechanically in the year 2018 and away from the Zab station No. (2) with a distance of approximately 2.2 km and from the center of Zab township with a distance approximately 21 km and used for home use, watering trees and watering livestock.

- Well 3: Water samples were collected from (Abd Ali Salman) well near the center of the village of Helwa Olya and the depth of the well is 30 m and a hole was mechanically in 2010 and it is about 3.2 km from the Zab Station and a distance of about 3.2 km from the center of Zab township with a distance of approximately 39 km. It is used for home use, watering crops, trees and watering livestock.



A1: Site 1 on the Zab River



A2: Site 2 on the Zab River



A3: Site 3 on the Zab River



B1: Well 1 in Shmet Village



B2: Well 1 in the village of Sharia



B3: Well 1 in the of Helwa Olya village

2.3 Physical and Chemical tests

A number of physical and chemical tests were carried out on the samples, according to Standard methods for the examination of water and waste water [7]. The electrical conductivity was measured by using the electrical conductivity in units (microsimens / cm) . While the total dissolved salts were measured using T.D.S. meter, in mg / L unit and calcium and magnesium ions were corrected against the standard Na₂EDTA solution (0.02 N) and expressed in mg / l unit. The Flam Emission photometric method, described in APHA [6] was used to measure sodium and potassium ions and was expressed in mg / L unit.

Concentrations of heavy metals (cadmium, lead, cobalt and copper) in water using a flame absorption device Thermo Atomic Absorption Spectrometer AA-200 manufactured by the American Perkin Elmer Company.

Statistical analysis was done by using SPSS 20.0 Special Program for statistical system (using ANOVA) test analysis of Variance, which is used to know the presence of significant differences or their absence in the studied variables (physical and chemical properties) according to the variables at the level of significance $P \leq 0.05$.

3. Results and discussion

3.1 Electrical conductivity:

Electrical conductivity is a numerical expression of positive and negative ions found in water and depends on the concentration, equivalence and solubility of ions in water the water temperature during measurement and increases the electrical conductivity of water by (2%) when its temperature increases by one degree Celsius [7].

The results of the current study showed in Table 1 that the rates of the values of electrical conductivity in the water of the Zab river and wells water ranged between (383.3 - 430.6) microsemens / cm for the Zab river and between (741-8542) microsemens / cm for wells. Electrical is directly proportional to the rates of soluble salts in water site 1 on the Zab River recorded the highest value of electrical conductivity compared to other sites and this may be due to its being the furthest of the three sites from the source, therefore, it contains the largest amount of accumulated pollutants and salts, while the great variation in the electrical conductivity values may be

in the studied wells for the difference in the geological formations of the region and the depths of the groundwater [8].

The results of the Zab River came close to the results reached by [9] and [10] on the lower Zab River,

while the well-water results came close to the results reached by [11] and [12].

The decrease in the water conductivity values of the Zab River is due to a decrease temperatures and high levels of water are caused by rain that dilutes salts in the river's water and hence low values for electrical conductivity [13].

Table 1: Electrical conductivity in the studied sites

Months	The waters of the Lower Zab River				Wells Water			
	1	2	3	Average Months	1	2	3	Average Months
August 2029	518	494	416	476 a	3530	8990	694	4405 a
September 2019	433	383	312	376 b	3480	8480	708	4223 c
October 2019	447	452	458	452.3 a	3588	8699	701	4329 b
November 2019	406	385	351	380.7 b	3580	9010	752	4447 a
December 2019	384	396	373	384.3 b	3150	8003	800	3984 d
January 2020	396	388	390	391.3 b	3210	8104	796	4037 d
Average stations	430.6 a	416.3 a	383.3 b		3423 b	8542 a	741 c	

The results of the analysis showed the Dunkin statistician for electrical conductivity, there are spatial moral differences (between sites) with temporal significant differences (between months) for river water, well water, and at moral level $P \leq 0.05$

The river waters matched the Iraqi determinants of the river and water protection system from pollution (1967). The standard specifications for drinking water. Iraqi in the Central Organization for Standardization and Quality Control (1996) and global [14] and amounting to 1600 microsemens / cm, while it did not match in wells except for well 3.

3.2 Total dissolved salts:

It is defined as all solids dissolved in water, whether ionized or non-ionized and does not include suspended or colloidal materials [15].

The results of the current study showed in table 2. that the average values ranged between (253-294.3) mg / L for the Zab River and (431-5056) mg / L for the wells studied. The results of the Zab River in the

current study showed that they are close to the results reached by [9] on the Zab River,

While the results of the wells are relatively close to the results obtained by [12]. The increase in the values of dissolved salts is due to the direct impact of the disposal of residential gatherings, industrial plants, car garages, and what is thrown from household waste to sewage networks [16] Due to the lack of plants and factories sewerage networks and total dissolved salts recorded low values the waters of the Lower Zab River. The reason for the high values of total dissolved solids in the wells may be due to rainfall, which It works to dissolve and wash away existing salts. In the soils and lands surrounding the wells. As for the decrease in the total soluble material values in well 3, it may be due to the quality of the reservoir rocks for this water, or it may be because the well is close to the Zab river, and there may be other reasons to reduce total dissolved salts.

Table 2: Total dissolved salts in the studied sites

Months	The waters of the Lower Zab River				Wells Water			
	1	2	3	Average Months	1	2	3	Average Months
August 2029	314	328	278	306.7 a	1870	5288	332	2497 ab
September 2019	264	310	208	260.7 b	1874	5269	460	2534 a
October 2019	328	336	282	315.3 a	1900	5100	364	2455 b
November 2019	294	220	194	236 c	1940	5100	420	2487 b
December 2019	280	266	268	271.3 b	2100	4800	510	2470 b
January 2020	286	288	288	287.3 b	1978	4780	500	2419 c
Average stations	294.3 a	291.3 a	253 b		1944 b	5056 a	431 c	

Results shown statistical analysis according to Dunkin's choice of total dissolved salts. Temporal morale with presence. Significant spatial differences between sites for Zab and well water at the $P \leq 0.05$ level.

It was found that the water values of the lower Zab River are lower than the well water, and that the water values of the lower Zab River and the water of Well 3 are suitable for drinking by humans. Conformity to standard specifications for Iraqi drinking water (Central Organization for Standardization and Quality Control, 1996) and the world [14], which ranges between (1000-450) mg / L with the non-validity of wells 1 and 2.

3.3 Calcium and Magnesium Ions:

calcium. Magnesium is one of the most ions causes hardness in natural waters[17].

The results of the water of the Zab River and the wells water in the current study showed in Tables 3,4. that the rate of calcium ions ranged between (38.3-42.3) mg / L for the Zab River and (51.1-481.3) mg / L for wells, while the magnesium ions ranged between (21.5- 22.5) mg / L for the Zab River and (26.6-480.5) mg / L for wells, respectively. Observe

through the results that a common condition for results is an increase in values calcium At the expense magnesium in all study sites, this is due to the tendency of magnesium to settle in large quantities [18].

Calcium ions recorded lower results compared to the study of [19] and that of [10] on the river Zab while the results of well water were close to the study of [20] and [11]. The magnesium values recorded the results of a similar approach to the results of the study [9] and the study of [19] on the Zab River, while the results of magnesium in the well water were similar Results with [21] .

A significant difference was observed between the values of calcium and magnesium ions in the three wells where the values of well 2 were high, which may be due to the formation (the-Feteha) which consists of successive periodic sediments responsible for the presence and increase of salts in groundwater, lower values in well 3 may return to installation (Al-Injana) which consists of successive sand rocks with clay rocks, Its sediments represent a riverine water environment in his lake, so its water is fresh [22].

Table 3: Calcium Ions in the studied site

Months	The waters of the Lower Zab River				Wells Water			
	1	2	3	Average Months	1	2	3	Average Months
August 2029	40	38	52	43.33 a	140	510	36	228.7 c
September 2019	50	40	40	43.33 a	406	520	40	322 a
October 2019	44	37	50	43.67 a	395	500	37	310.7 a
November 2019	40	36	36	37.33 b	390	470	59	306.3
December 2019	36	40	38	38 b	382	480	65	309 a
January 2020	38	39	38	38.33 b	370	408	70	282.7 b
Average stations	41.3 a	38.3 a	42.3 a		390.6 b	481.3 a	51.1 c	

Table 4: Magnesium Ions in the studied site

Months	The waters of the Lower Zab River				Wells Water			
	1	2	3	Average Months	1	2	3	Average Months
August 2029	24	22	19	21.67 a	250	502	23	258.3 a
September 2019	15	23	20	19.33 a	245	523	20	262.7 a
October 2019	20	23	24	22.33 a	256	529	22	269 a
November 2019	23	24	22	23 a	244	447	17	236 b
December 2019	24	21	23	22.67 a	234	424	36	231.3 b
January 2020	23	22	22	22.33 a	253	458	42	251 a
Average stations	21.5 a	22.5 a	21.6 a		247 b	480.5 a	26.6 c	

The results of the statistical analysis of calcium ions showed that there are temporal significant differences with no moral spatial differences for river water with moral and spatial significant differences for wells at a significant level $P \leq 0.05$.

The results of the statistical analysis and Dunkin test for magnesium ions also showed no moral or spatial moral differences for river water, with moral and spatial spatial differences for well water, at a significant level $P \leq 0.0$.

It was found that the calcium and magnesium ions in the groundwater are much higher than the water of the Zab river, especially Well 2, and the rates of calcium and magnesium values in the water of the Zab River met the Iraqi and international standards while the rates of hardness values in the groundwater did not meet the standard specifications except for well 3 which matched the standard determinants of magnesium Just.

3.4 Sodium and Potassium Ions:

There is sodium ionically in water, all water contains sodium because its salts dissolve. In water, potassium ions are found in fresh water in much smaller quantities because potassium ion is more stable than sodium ion because of its high resistance to chemical weathering agents and its easy absorption from mud minerals [21].

The results of the current study showed in Tables 5,6 that the average values of the concentrations of sodium and potassium ranged between (10-11.5) and (1.9-2.3) mg / L, respectively, for river water. -155) mg / L.

The month of August recorded a slight increase in the sodium values on the Zab River, which may be due to waste household and agricultural impacts flowing into the river with the water used in the houses [23].

The current study also showed that the values of potassium ions fewer sodium ion values were reported at all sites and that because potassium silica minerals are more resistant for chemical weathering of sodium-containing minerals [24], This corresponds to previous studies such as the study of [10] and the study of [9] on the Zab River and the study of [25] on the Euphrates.

The results of the sodium came as an approach the results of [9] reached on the lower Zab river, while the results of sodium in the wells came as an approach [26] . While the results of potassium in the waters of the Zab River came close to the study of [10] and [9] on the Zab River. The results of potassium in well water are relatively close to the study [26] and [27] .

Table 5. Sodium Ions in the studied sites.

Months	The waters of the Lower Zab River				Wells Water			
	1	2	3	Average Months	1	2	3	Average Months
August 2029	19	9	12	12	340	249	11	200 b
September 2019	10	9	10	10	346	252	12	203.3 b
October 2019	12	10	11	11	320	250	10	193.3 b
November 2019	10	10	9	9	310	360	15	228.3 a
December 2019	8	9	9	9	240	246	20	168.7 c
January 2020	10	9	9	9	210	252	18	160 c
Average stations	11.5 a	9.3 a	10 a	10 a	294.3 a	268.1 b	14.3 c	

Table 6: Potassium Ions in the studied sites.

Months	The waters of the Lower Zab River				Wells Water			
	1	2	3	Average Months	1	2	3	Average Months
August 2029	3	2.6	2	2.533 a	146	218	3.3	122.4 a
September 2019	2.2	2	2	2.067 a	165	192	2.8	119.9 a
October 2019	2.8	3	2.5	2.767 a	148	180	3	110.3 a
November 2019	2	3	2	2.333 a	130	106	15	83.67 b
December 2019	1.7	2	1.6	1.767 a	100	110	15	75 b
January 2020	1.5	1.4	1.4	1.433 a	110	124	18	84 b
Average stations	2.2 a	2.3 a	1.9 a		133.1 b	155 a	9.5 c	

Statistical analysis of sodium ions showed that there were temporal significant differences with no differences spatial significance of the river Zab, with temporal or spatial differences in well water at significant level $P \leq 0.05$.

Results of statistical analysis showed using potassium ions the Dunkin test showed that there were no spatial and spatial morale differences for the water of the Zab river with there are temporal and temporal differences for well water at the level of significance $P \leq 0.05$

It was observed that the sodium and potassium ions in the groundwater are much higher than the water of the Zab river, and the rates of the sodium and potassium values in the water of the Zab River met the Iraqi and international standards, while the rates of the sodium and potassium values in the groundwater did not meet the standard specifications except for well 3 that matched the standard setting.

3.5 Heavy metals

That Multiple use of water in industry and agriculture led to contains different concentrations of metals heavy the pH plays a clear role in increasing the readiness and dispersion of organisms in the water [28].

The result of current study showed that the values of each of the studied metals (cadmium, lead, cobalt, copper) in both well water and the Zab river during the study period were very low and did not exceed 0.1 ppm (Table 6). This may be due to the lack of factories, sewage and sources contaminated with heavy metals on the course of the Zab River and in the region, which leads to a lack of heavy metals in the river and groundwater in the Zab side so the water is considered safe to drink because it is free from heavy toxic metals and harmful to health.

Table 6: Heavy metals in the studied sites.

sample		Cd ppm	Pb ppm	Co ppm	Cu Ppm
August	well	1	< 0.1	< 0.1	< 0.1
		2	< 0.1	< 0.1	< 0.1
		3	< 0.1	< 0.1	< 0.1
	river	1	< 0.1	< 0.1	< 0.1
		2	< 0.1	< 0.1	< 0.1
		3	< 0.1	< 0.1	< 0.1
September	well	1	< 0.1	< 0.1	< 0.1
		2	< 0.1	< 0.1	< 0.1
		3	< 0.1	< 0.1	< 0.1
	river	1	< 0.1	< 0.1	< 0.1
		2	< 0.1	< 0.1	< 0.1
		3	< 0.1	< 0.1	< 0.1
October	well	1	< 0.1	< 0.1	< 0.1
		2	< 0.1	< 0.1	< 0.1
		3	< 0.1	< 0.1	< 0.1
	river	1	< 0.1	< 0.1	< 0.1
		2	< 0.1	< 0.1	< 0.1
		3	< 0.1	< 0.1	< 0.1
sample		Cd ppm	Pb ppm	Co ppm	Cu Ppm
November	well	1	< 0.1	< 0.1	< 0.1
		2	< 0.1	< 0.1	< 0.1
		3	< 0.1	< 0.1	< 0.1
	river	1	< 0.1	< 0.1	< 0.1
		2	< 0.1	< 0.1	< 0.1
		3	< 0.1	< 0.1	< 0.1
December	well	1	< 0.1	< 0.1	< 0.1
		2	< 0.1	< 0.1	< 0.1
		3	< 0.1	< 0.1	< 0.1
	river	1	< 0.1	< 0.1	< 0.1
		2	< 0.1	< 0.1	< 0.1
		3	< 0.1	< 0.1	< 0.1
January	well	1	< 0.1	< 0.1	< 0.1
		2	< 0.1	< 0.1	< 0.1
		3	< 0.1	< 0.1	< 0.1
	river	1	< 0.1	< 0.1	< 0.1
		2	< 0.1	< 0.1	< 0.1
		3	< 0.1	< 0.1	< 0.1

The results of the Zab river water converged well water with the study of [29], as it recorded intangible values for the copper and cadmium metals in all study stations except for the first station, as it recorded a concentration of cadmium (0.008) mg / L at the beginning of November in the water of the Tigris River.

Heavy item values matched for water Zab River and Well Water in the Current Study International Determinants of Drinking Water WHO for the year

1999 as well as the Iraqi Specifications for the year 1996.

3.6 Conclusions

The results showed the validity of the Zab River water and Well 3 for drinking, domestic use and irrigation of human crops due to its conformity with the standard specifications for drinking and international water, and the inadequacy of wells 1 and 2.

Table 7: Iraqi and international standards approved for drinking water

WHO, (2011)	CANADA (2008)	EPA-USA (2002)	WHO, (1999)	IRS, (2001)	IRS, (1996)	References
						Determinants
		1600	1600	1250		(Electrical conductivity micros / cm)
600	500	1000	1000	1000	1000	Total soluble salts (mg / l)
300-100	25	50	50	200	50	Calcium (mg / l)
200-300	50	125	125	50	50	Magnesium (mg / l)
200	200	200	200	200	200	Sodium (mg / l)
5			12	10	5	Potassium (mg / l)

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تقييم بعض الخصائص الفيزيائية والكيميائية لمياه نهر الزاب الأسفل وبعض الآبار

الارتوائية في ناحية الزاب

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الملخص

أجريت الدراسة الحالية على مياه نهر الزاب في ناحية الزاب التابعة لقضاء الحويجة / محافظة كركوك/ العراق، إذ تم من خلالها دراسة بعض العوامل الفيزيائية والكيميائية لمياه النهر. بدأ البحث من شهر اب 2019 ولغاية شهر كانون الثاني 2020، لدراسة ستة مواقع على نهر الزاب وستة آبار في ناحية الزاب، إذ شملت قياس العوامل الفيزيائية (التوصيلية الكهربائية، الأملاح الذائبة الكلية TDS). وبعض العوامل الكيميائية في مياه النهر ومياه الآبار (أيونات الكالسيوم والمغنيسيوم، أيونات صوديوم والبوتاسيوم). وبعض العناصر الثقيلة (كاديوم، رصاص، نحاس، كوبلت) في مياه الزاب ومياه الآبار المدروسة.

أظهرت نتائج الدراسة الحالية أن قيم التوصيلية الكهربائية (312-518) مايكروسمنس/ سم لمياه النهر و (741-8542) مايكروسمنس/سم للآبار، بينما تراوحت الأملاح الذائبة الكلية بين (194-336) ملغم/لتر في مياه النهر و(253-293.3) ملغم/لتر في مياه الآبار المدروسة، وسجلت أيونات الكالسيوم ما بين (36-52) ملغم/لتر لنهر الزاب و(51.1-481.3) ملغم/لتر للآبار اما أيونات المغنيسيوم فتراوحت بين (15-24) ملغم/لتر لنهر الزاب و(26.6-480.5) ملغم/لتر للآبار، وسجلت أيونات الصوديوم قيم تراوحت بين (8-19) ملغم/لتر لنهر الزاب و(14.3-294.3) ملغم/لتر لمياه الآبار، وتراوحت قيم أيونات البوتاسيوم بين (1.4-3) ملغم/لتر لنهر الزاب و(9.5-155) ملغم/لتر لمياه الآبار، سجلت العناصر الثقيلة (الكاديوم، الرصاص، الكوبلت، النحاس) في كل من مياه الآبار ونهر الزاب قيم منخفضة جدا و لم تتجاوز 0.1 ppm. وأظهرت أيضاً نتائج التحليل الإحصائي لاختبار دنكن وجود فروق معنوية زمانية ومكانية في معظم العوامل الفيزيائية والكيميائية المدروسة وعند مستوى معنوي 0.05.