Scientific Research Publishing

Open Journal of Modern Hydrology, 2024, 14, 56-67
https://www.scirp.org/journal/ojmh
ISSN Online: 2163-0496
ISSN Print: 2163-0461

Some of the Chemical and Physical Characteristics of the Graff River in Kut City, Iraq

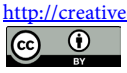
Salih Mahdi Ali[1*], Imad Kazem Ali[2]

[1]Ministry of Education, Wasit Education Directorate, Wasit Governorate, Iraq
[2]Department of Animal Production, College of Agriculture, Sumer University, Al-Rifai, Iraq
Email: *ffaall684@gmail.com

How to cite this paper: Ali, S.M. and Ali, I.K. (2024) Some of the Chemical and Physical Characteristics of the Graff River in Kut City, Iraq. *Open Journal of Modern Hydrology*, **14**, 56-67.
https://doi.org/10.4236/ojmh.2024.141004

Received: November 21, 2023
Accepted: January 28, 2024
Published: January 31, 2024

Copyright © 2024 by author(s) and Scientific Research Publishing Inc.
This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).
http://creativecommons.org/licenses/by/4.0/



Open Access

Abstract

Some of the chemical and physical water qualities of the Graff River in the city of Kut were studied, and for two sites of the river, One was at the Crimea site, the other in the Jihad district, and for the period from October/2018 to March/2019, Seven variables of river water have been analyzed: temperature PH, electrical conductivity, TDS, turbidity, alkaline, and chloride. The results showed that most of the chemical and physical water properties of the river were in normal proportions and did not rise, except for the turbidity, which was at a very high level, and that the pH values were close to the basal side. The results of the statistical analysis revealed positive significant relationships between the pH and (chloride and TDS). On the other hand, between electrical conductivity and both previous variables as well. And a negative significant connection between temperature and alkaline.

Keywords

Graff River, Kut City, Iraq, Chemical Characteristics, Physical Characteristics

1. Introduction

Iraq is distinguished by its abundance of fresh surface water, represented by the Tigris and Euphrates rivers and their tributaries and what they form in the course of the Shatt Al-Arab, in addition to the water of vast lakes and marshes. This water is exploited for human, agricultural, and industrial consumption and for generating electrical energy as well as for river transport [1]. Water is also a chemical compound with the formula H_2O, which is the most widespread compound on the surface of the Earth and the basic compound in every living cell,

without which life is not possible… It does not exist in nature in its pure chemical form but rather contains various impurities, the most important of which are dissolved salts [2]. The quality of water depends on its chemical, physical, and biological properties, which make its use for a purpose directly possible or not possible except after carrying out a specific treatment to modify one or more of those characteristics [3]. Chemical and physical characteristics are used as a criterion for estimating and evaluating water quality and thus determining its suitability for various uses [4]. In the beginning, humans judged water quality based only on its physical characteristics, such as taste, smell, and color. Over time, the chemical, biological, and natural sciences developed, as methods became available to measure water quality and determine its impact on human health and living organisms [5]. Water pollution is the occurrence of damage or corruption in the quality of water, which leads to a defect in its ecosystem in one way or another, which reduces water quality. Its ability to perform its natural role when used by humans, or it loses much of its economic value. Water pollution includes several types, including the depletion of large amounts of oxygen dissolved in the water, as well as an increase in the amount of dissolved salts and chemicals and the concentration of elements harmful to humans and microbes, which makes water use risky [6]. Water turbidity is also a measure of the number and size of suspended particles and an important indicator in the assessment of specialists in the design of treatment units, as it is related to the activity of microorganisms that are active and multiply in a way that is directly proportional to the concentration of plankton in the water. Turbidity values give an impression of the presence of impurities and heavy elements in the water [7].

Among the studies in this field, [3] showed that the specifications of the water of the Kufa Shatt are somewhat consistent with the standards for using water for domestic purposes, except turbidity and sulfates, which showed an increase beyond the permissible limits. The results of the study [8] also showed that the raw water of the Euphrates River has good physical and chemical quality properties, but bacterial contamination was very high. As for [9], their results indicated that the pH rates of the Kufa River water tended toward alkalinity, while the salinity concentration and total hardness increased. The results of a study [10] showed that the pH values of water are within the weakly basic side. The main goal of this study is to conduct some tests on the physical and chemical characteristics of the water of the Al-Graff River in the cities of Kut for the period from October 2018 until March 2019, to study these characteristics and their influence on environmental reality, as well as to the relationship between these characteristics and the degree of their connection.

2. Materials and Methods

2.1. Description of Study Stations

At the site of the Kut Dam, the Graff and Dualia Rivers branch off from the right bank, and the Graff River continues on its course. Within the city of Kut, it

passes through Al-Moweaqua district and Al-Hay district within Wasit Governorate, then enters the lands of the governorate, Dhi Qar. Two sites were chosen to study the chemical and physical characteristics of the river's water. The first is after its exit from the Kut Dam in the Karmia area, and the second is at the end of the Al-Jamahiriya neighborhood, which is 3 km away from the first site. Figure 1 shows the study sites on the Al-Graff River.

2.2. Sampling Procedure

Two sites were chosen from the Graff River to study water samples, one of them in the Al-Karmia area and the second at the end of the Al-Jamahiriya neighborhood, once a month for the period from October 2018 to March 2019. Water samples were collected using clean, sterile plastic containers with a capacity of (500 ml) and taking into account the conditions for storing samples, most of the measurements were conducted in the laboratory of the Wasit Water Directorate.

2.3. Physical and Chemical Properties Test

1) **pH**: Acidity of the river water was measured using a multipurpose environmental measuring device of the Martini Instrument type, model MI 180, after calibrating it with the following state.

2) **Temperature**: The temperature was measured using a simple mercury thermometer, produced by Brannan (U.K.) and buffer solutions (pH 10, pH 7, pH 4).

3) **Electrical Conductivity**: The measurement of electricity was made using the device called Session 5 produced by HACH (Germany).

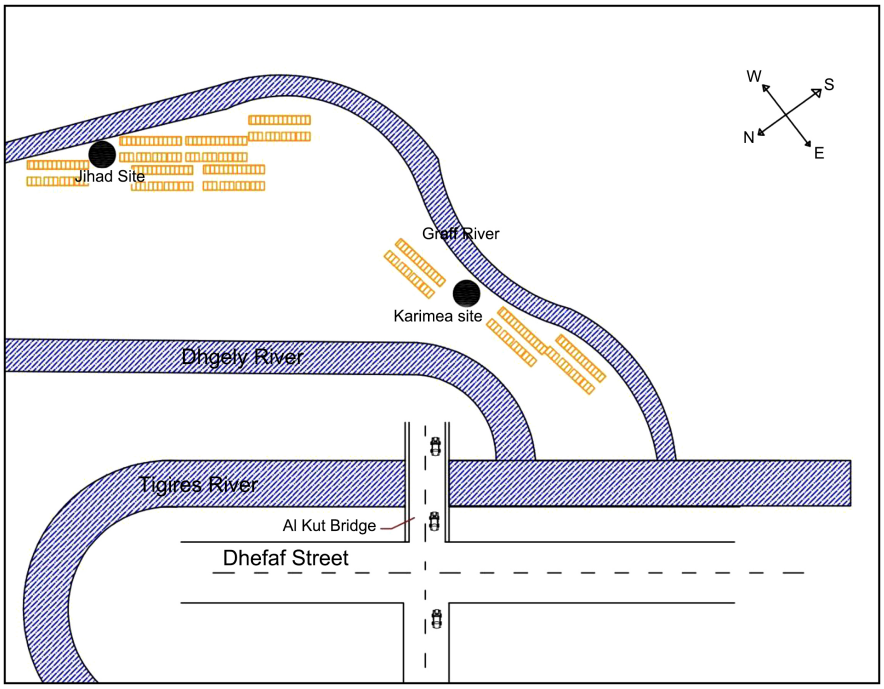


Figure 1. A map of the Graff River showing the study sites.

4) **Total Dissolved Solids**: Total dissolved salts were measured with the same device above used to measure electrical conductivity.

5) **Turbidity**: Turbidity was measured using a Micro 100 Turbidity meter produced by Scientific, Inc. (USA).

6) **Alkaline** as $CaCO_3$: This is done using the phenolphthalein guide and scouring with sodium hydroxide solution in the presence of sulfuric acid (0.02N) and through the following equation: Alka (as $CaCO_3$) = V*N*50,000/ml of sample V = ml of titration for sample N = Normality of H_2SO_4.

7) **Chloride**: (50 ml) of sample water is taken, two drops of potassium chromate reagent are added to it, and it is pulverized with silver nitrate (0.0141 N) until it changes from yellow to a hazy brown color. According to the following equation: Cl (mg/L) = A*N*35.45*1000/ml of sample N = Normality of $AgNO_3$.

A = ml titration for sample.

2.4. Statistical Analysis

The results were analyzed using the statistical program Gretl 2012, which is one of the modern statistical programs [11] to analyze the relationship between the physical and chemical characteristics of the water of the Graff River, by extracting the correlation value (P-value) and indicating the type of relationship, negative or positive. Also, the most important statistical parameters were extracted (minimum value, maximum value).

3. Results and Discussion

3.1. Physical and Chemical Properties

3.1.1. Temperature

Table 1 indicates the results of measurements of the physical and chemical properties of the water of the Graff River at two locations of the river, the first after the branch of the Tigris River on the Karmia neighborhood side and the second at a distance of 3 km from the first location on the Jihad neighborhood side for the period from October 2018 to March 2019, and that Temperatures ranged between (34.3 - 12.1) degrees Celsius. The highest temperatures were recorded in October for the Karmia site and their lowest in January for the same site. This is due to the nature of the climate in our country, Iraq. There was no clear difference between the two locations and the results are almost similar between them. The effect of temperature affects other properties of water, especially color and taste [12]. **Figure 2** shows the temperature values for the two sites of Al-Karmia and Hay Al-Jihad.

3.1.2. pH Values

pH values ranged between (7.1 - 7.7), and the highest pH value for the river water was (7.7) in the month of December for both sites (Al-Karmia and Hay Al-Jihad), and its lowest value was (7.1) in the month of January at the Al-Karmia site From observing the pH values during the study period and for

Table 1. Results of measurements of the physical and chemical properties of the Graff River water during the study period during the study period.

Oct.	Nov.	Dec.	Jan.	Feb.	March.	Station	Properties—Unit
34.3	21.4	17.5	12.1	19.7	18.3	Karimea	Temperature C^0
33.4	21.4	19.8	16.9	19.8	18.3	Al-Jihad	
7.4	7.3	7.7	7.1	7.5	7.3	Karimea	PH
7.4	7.3	7.7	7.1	7.5	7.5	Al-Jihad	
50.3	48.4	79	40.4	15.9	19.8	Karimea	Turbidity T.N.U
61.6	58.4	75.9.	46.5	38.3	35.2	Al-Jihad	
928	1064	1282	1106	1088	1091	Karimea	Electrical Conductivity μm/cm
927	1065	1275	1094	1092	947	Al-Jihad	
586	692	1002	786	788	676	Karimea	Total Dissolved Solids (TDS) mg/L
588	688	884	769	790	590	Al-Jihad	
156	160	174	178	160	180	Karimea	Alkaline mg/L
158	160	173	178	160	164	Al-Jihad	
82.4	88	118	88	95.4	82.4	Karimea	Chloride mg/L
72	84	120	86.4	91.3	74.7	Al-Jihad	

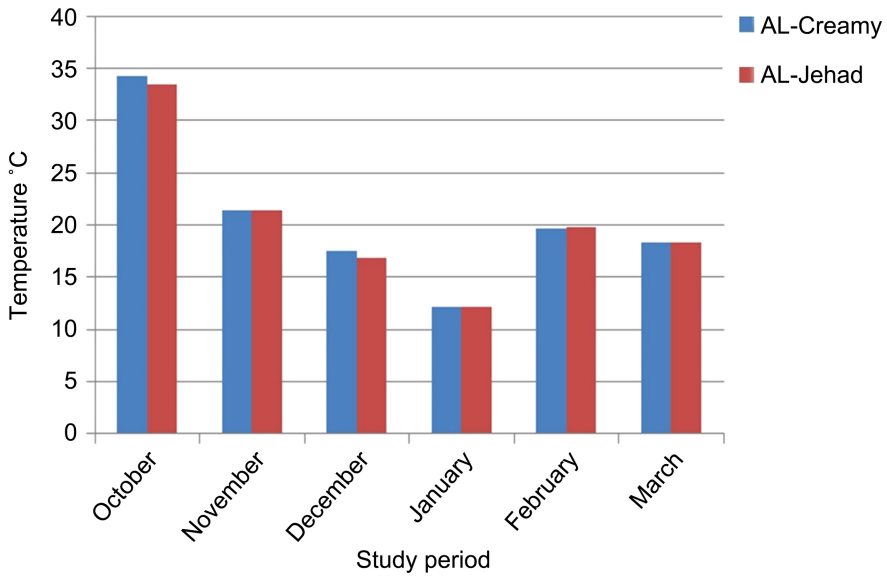


Figure 2. Temperature values of the Graff River water during the study period.

both sites, they were close during the months (October - November - December - February) and were close to the basal side, as there were very heavy rains in these months, and this is consistent with what was found [10]. It was shown that

the abundance of rainfall led to an increase in the basicity of the water as a result of the dissolution of calcium and magnesium bicarbonate compounds and bicarbonate in addition to hydroxides and ammonium. Irrigation water tends to be lightly alkaline, and this may be due to the possibility of the predominance of bicarbonate ions and total alkalinity, which is a distinctive characteristic of Iraqi water [13] (**Figure 3**).

3.1.3. Electrical Conductivity

When observing **Figure 4**, which shows the electrical conductivity values of the Graff River water, as well as **Table 1** regarding the chemical and physical characteristics of the river water, they were within the range (927 - 1282) micromoles/cm, with their highest values being in the month of December (1282, 1275)

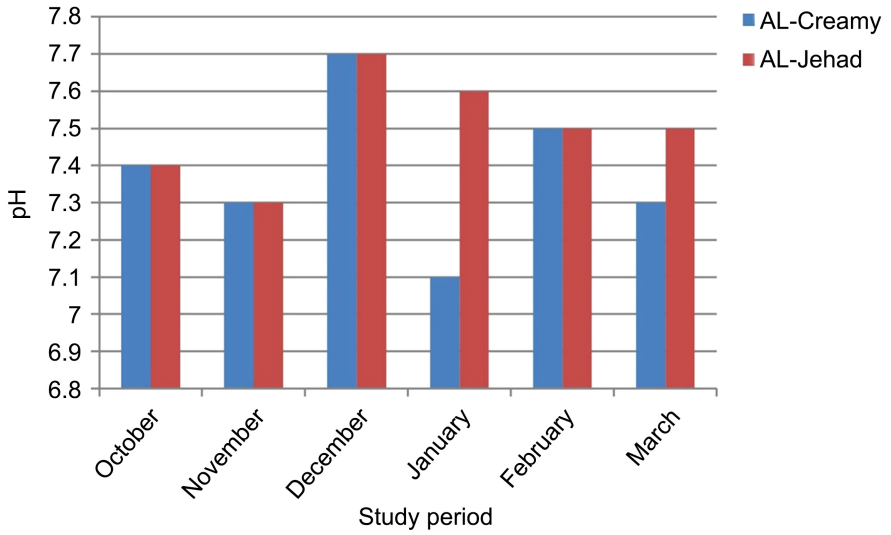


Figure 3. pH values of the Graff River water during the study period.

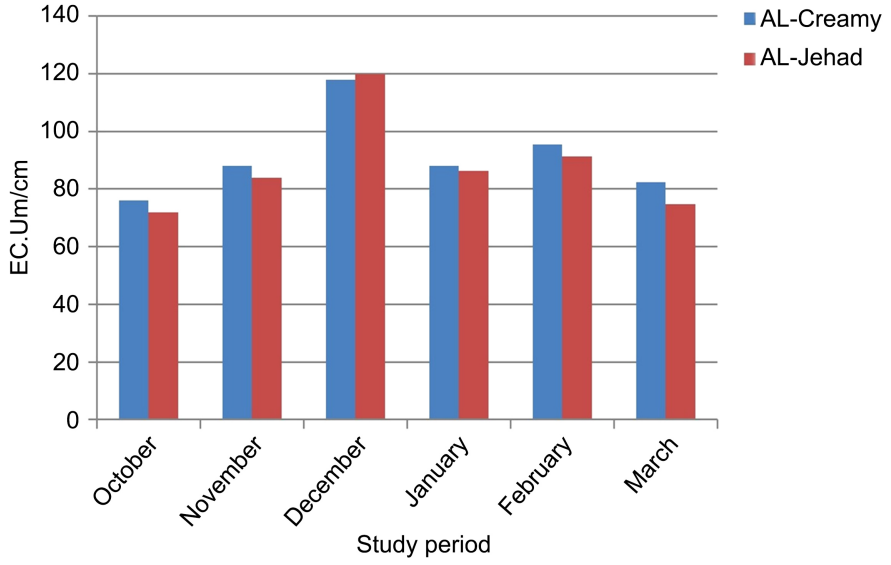


Figure 4. Electrical conductivity values of Al-Graff water during the study period.

micromole/cm for the Al-Karmia and Hay Al-Jihad sites, respectively, and the lowest values are (928, 927) micromoz/cm for the same two sites, respectively, and that was in the month of October 2018 These values in the water of the Al-Graff River are not high, and this is due to the high levels of the river during that period until they reached dangerous levels that threaten residential areas in Wasit Governorate. These rates of electrical conductivity in river water are much lower than the permissible limits in drinking water. The Iraqi standard specified that the value (2000 micromos/cm) is the maximum permissible limit for water conductivity [14]. These rates are consistent with study [13], which showed that water levels have a significant impact on conductivity values.

3.1.4. Total Dissolved Solids (TDS)

Figure 5 shows the values of total dissolved solids during the study period, and the results of the tests in Table 1 showed that the values were limited to (1002 - 586 mg/L), and its highest value was in December (1002 mg/L, 884) for the Karmia and Hay Al-Jihad sites, respectively, and its lowest values were in the month of October (mg/L 586, 588) for the two sites, respectively The results of laboratory tests of the river water and for both sites showed that the values of total dissolved solids (TDS) were very similar at the two sites for the river water, except in December, it was slightly high at the Karmia site, and this may be due to the effect of household waste and waste that is thrown into the river. Domestic and industrial wastes have an effect in increasing the value of total dissolved solids in river water [15]. The TDS of water expresses all dissolved salts, and inorganic substances are a source of dissolved substances, the most important of which are (sodium, chloride, calcium, magnesium, and bicarbonate). These salts have an effect on the appearance of the taste. Unpalatable, which appears after a concentration of 600 mg/L [8]. The majority of the concentration of total dissolved substances in the water of the Graff River for all months of the study and

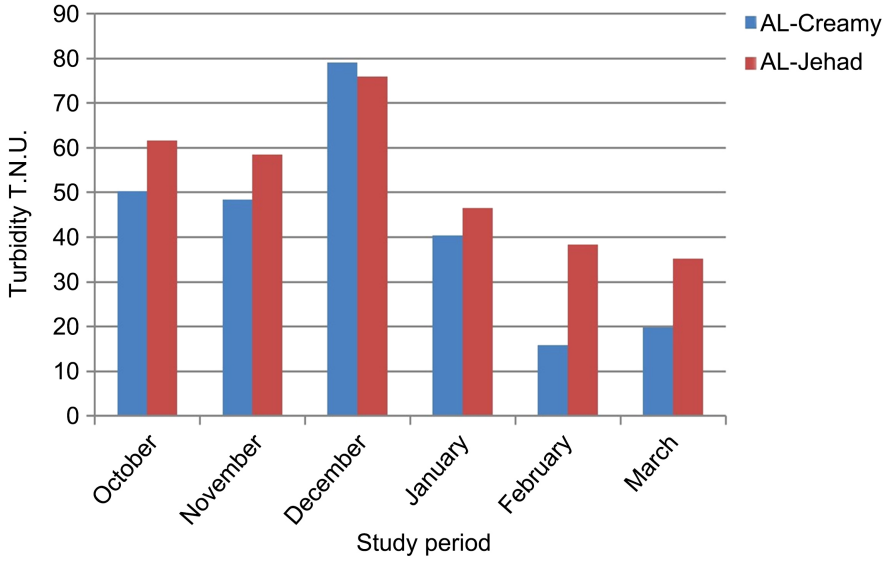


Figure 5. Total dissolved salt values for all stations during the study period.

both sites were within the recommended limits according to the Iraqi standardization and quality control system for the year 2009, which specified that the value (1000 mg/L) is the maximum permissible limit for drinking water [14].

3.1.5. Turbidity

Turbidity values ranged between (79 - 15.9 T.N.U.) during the study period, and its highest values were in December 2018, with a value of (79, 75.9 T.N.U.) for the two sites of Al-Karmia and Hay Al-Jihad, respectively, and its lowest value was (15.9, 19.8 T.N.U.) for the months of February and March 2019 respectively, at the Karmia site, as shown in **Figure 6**. We note that the turbidity values for most of the months of the study were high in the Jihad neighborhood site, which was 3 km away from the Karmia site. This may be due to the fact that the Jihad neighborhood area has a high population density and thus an increase in organic materials resulting from heavy household waste and industrial waste, which in organic materials resulting from heavy household waste and industrial waste, which in turn it increases the value of turbidity compared to the Carimea site, and this is consistent with [3], as it was shown that the reason for the high level of turbidity is due to the fact that the samples represent raw water, that is, the natural characteristics of the river that are affected by the spread of sinkholes, rainfall, and mud drifts for riverbeds and other sewage conditions.

3.1.6. Alkaline

The basal values were very close for most of the months of the study and for both sites, and ranged between (156 - 180 mg/L), with the highest value reaching (180 mg/L) at the Karmia site for the month of March, and a value of (178 mg/L) for the site Al-Jihad neighborhood, in the month of January. The lowest value was (156, 158 mg/L) for the Karmia and Al-Jihad neighborhood sites, respectively,

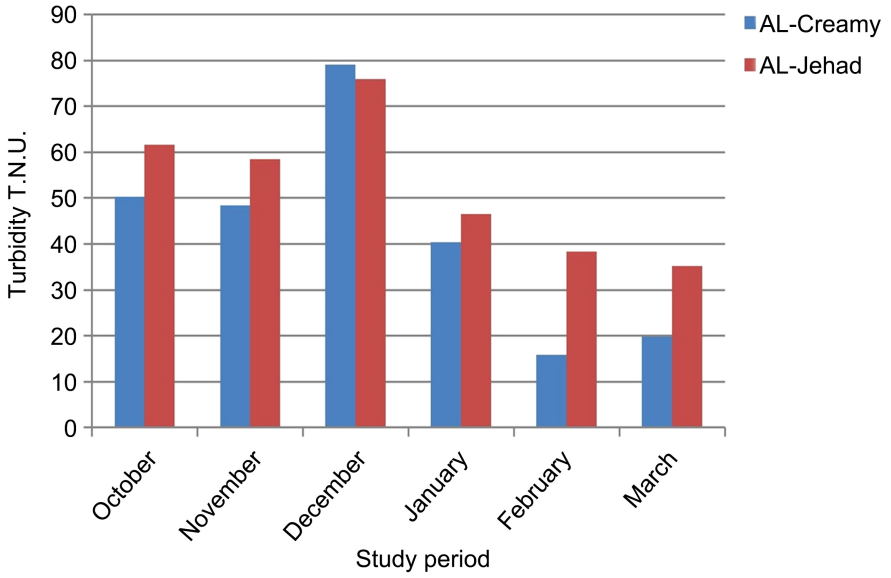


Figure 6. Values of turbidity concentrations of the water of the Graff River during the study period.

in the month of October, as shown in Figure 7. The alkalinity values of the Graff River water were low and less than the Iraqi standard for drinking water (200 mg/L). Alkalinity is affected by temperature, increased decomposition of organic materials, increased carbon dioxide concentration, high water levels, and magnesium concentration [16].

3.1.7. Chloride

The results of the study showed that the chloride level in the two study sites was limited to (72 - 120 mg/L), with its highest value in December being (120 and 118 mg/L) for the Al-Karmia and Hay Al-Jihad sites, respectively. Its lowest value was in the month of October (76 and 72 mg/L) and for the same two locations in a row as well. These percentages in the water of the Graff River are considered normal and not high, as Figure 8 showed that the maximum concentration of chloride is acceptable in the water according to The World Health Organization (WHO) and the Iraqi standard is (250 mg/L), and the chloride levels in the water of the Graff River did not reach these limits. Chlorides are among the widespread salts in nature. They are found in several forms, including chloride (sodium, potassium, and calcium), making up approximately 0.05% of the lithosphere. They enter surface waters from several sources, including the dissolution of organic and inorganic salts in the water, drain water, irrigation of agricultural lands, industrial and oil activities, and sewage [17].

3.2. Correlation between Chemical and Physical Properties of River Water

The results of the statistical analysis showed Gretl Table 2 about the correlation of the physical and chemical properties of river water with each other. The results indicated the existence of a negative relationship at a significant level (0.05)

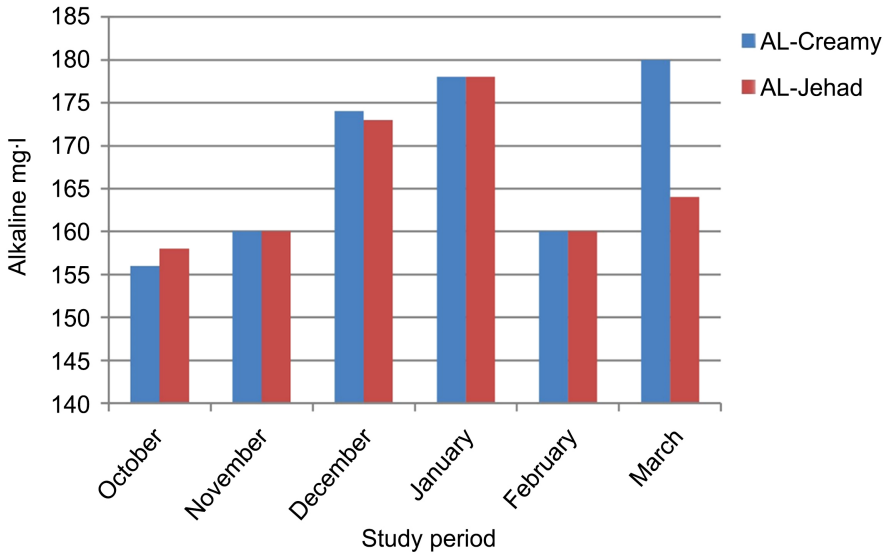


Figure 7. Values of basal concentrations of water in the Graff River during the study period.

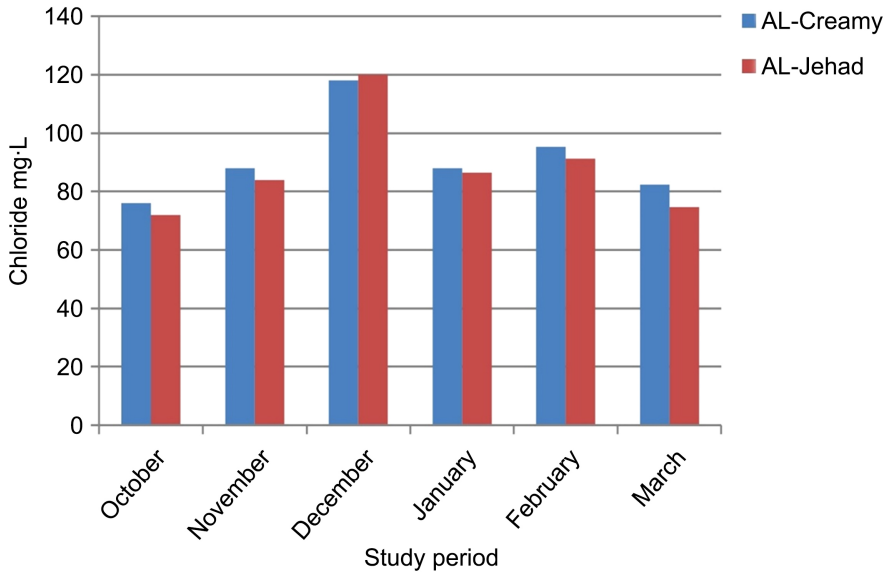


Figure 8. Chloride concentration of the water of the Graff River during the study period.

Table 2. Results of Gretl statistical analysis to extract the P-value of the correlation.

	Tem	Ph	Turb.	EC.	TDS	Alka.	Cl
Temp.		0.3905	0.6491	−0.1093	−0.1500	−0.0546*	−0.2613
pH			0.2781	0.2189	0.0861*	−0.5067	0.0303**
Turb.				0.3517	0.2200	−0.9945	0.1335
EC.					0.0006***	0.1135	0.0022***
TDS						0.3324	4.4605***
Alka.							0.4138
Cl							

between temperature and basal values, where the correlation value was p-value = 0.0546, and this It agrees with [16], which showed that the decrease in basic values is due to the consumption of CO_2 gas by phytoplankton, and carbons also precipitate when the temperature rises.

The results revealed a positive relationship between pH and the amount of total dissolved salts (TDS) at a level of significance (0.05), and the correlation p-value was = 0.0861. Also, a positive relationship between pH and chloride values, but at a high level of significance (0.01) when the correlation value reached p-value = 0.0303, and this is consist with [19]. There was a positive relationship between the electrical conductivity of water with both (total dissolved salts TDS and chloride Cl) at both levels of significance (0.05, 0.01) when the correlation values for the conductivity with both (total dissolved salts TDS and chloride) were (0.0006, 0.0022) on Respectively, this is consistent with what was found by [18] that there is a highly significant relationship between both conductivity and

total dissolved salts on the one hand, and between conductivity and total hardness values and chloride on the other hand. There were other relationships among the properties, but they were not significant.

4. Conclusion

Most of the physical and chemical characteristics of the Graff River water were within normal rates. The turbidity level in the river water was high and the water had a PH close to the alkaline side. Household waste and waste have an effect on some water characteristics. The heavy amount of rainfall has a major impact on the characteristics of the river's water There is an overlap between the physical and chemical characteristics of water, where some relationships were positive and others were negative and at a significant level.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Al-Saadi, H.A., Al-Daham, N.Q. and Jalil, L.A. (1986) Aquatic Ecology. Ministry of Higher Education and Scientific Research, University of Basra, Basra, 510 p.

[2] Darwish, A. (1997) Water Treatment. 1st Edition, Dar Al-Maarifa, Syria.

[3] Abbas, A. and Majeed, M.A. (2008) Study to Evaluate the Quality of Shatt Al-Kufa Water for Domestic and Irrigation Uses. *University of Babylon*, *Iraqi Journal of Mechanical and Materials Engineering*, *Special Issue* (*C*), 399-407.

[4] Al-Saadi, H.A. (2006) Basics of Environmental Science and Pollution—Dar Al-Baroudi—Amman, Jordan.

[5] Mahmoud, T.A. (1988) Environmental Science and Technology. Dar Al-Kuttab for Printing and Publishing, Riyadh.

[6] Kalaf, J., Hoagland, K.D. and Parker (1982) Ecology of Fresh Water Algae.

[7] Al-Khalidi, S.K., Al-Dhafiri, M.I., Hamad, H.H., Al-Jubouri, K.S., and Al-Husseini, A.K. (2010) Evaluation of the Efficiency of Some Drinking Water Complexes in Najaf Governorate/Iraq. *Babylon University Journal of Pure and Applied Sciences*, **2**, 600-609.

[8] Raml, M.M. (2010) Evaluation of Drinking Water Quality and Efficiency of the Great Ramadi Water Project. *Al-Qadisiya Journal of Engineering Sciences*, **3**, 1-23.

[9] Al-Zarif, S.K., Abdul-Azim, K.M., and Shahid, A.I. (2010) A Study of Some Physical and Chemical Characteristics of the Water of the Kufa River. *Journal of the University of Babylon for Pure and Applied Sciences*, **4**, 1399-1411.

[10] Diwan, M.H. (2010) Study of Some Physical and Chemical Properties Affecting the Quality of Drinking Water in the City of Baqarah. *Diyala Journal of Pure Sciences*, **6**, 369-383.

[11] Allin, C. and Luchetti, R.J. (2012) Gnu Regression, Econometrics and Time-Series Library of Economics-Wake Forest University.

[12] Tebbutt T.Y. (1998) Principles of Water Quality Control. 5th Editon, Pergamon Press, Oxford.

[13] Al-Khazei, D.K.K. (2014) Chemical and Physical Characteristics of Common Water

in the Region and Evaluation of Its Suitability for Irrigation, Basra/Iraq. *Journal of Basra Research* (*Operations*), **40**, 26-44.

[14] The Central Organization for Standardization and Quality Control. The Iraqi Standard Specification for Drinking Water No. 417 of 2001, Amended in 2009, and the Standard Specification Amended in 2006.

[15] Hommer, U.T. (1971) Limnological Studies of the Lakes and Streams of the Upper Qu'Appelle River System, Saskatchewan, Canada. *Hydrobiologia*, **37**, 473-507. https://doi.org/10.1007/BF00018815

[16] Kazem, N.F. (2005) Algal Diversity and Its Relationship to Some Physical and Chemical Characteristics of the Hilla River. Master's Thesis, University of Babylon, Babylon.

[17] Health Canada (1996) Guideline for Canadian Drinking water Quality. 6th Edition, Canada Communication Publishing Group, Ottawa, 1-75.

[18] Taha, D.N., Amir, I.S.A. and Murad, A.F. (2011) Raw Water and Drinking Water in Babylon Governorate, Study and Analysis, Babylon University of Pure Sciences.

[19] Al-Rawi, M.A. and Mahmoud, S.M. (2010) Study of Some Physicochemical and Microbial Characteristics of Bottled Water Produced Locally and Imported in the City of Baghdad. *Iraqi Journal of Market Research and Consumer Protection*, **2**, 75-103.