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Measurement of pollution of water and sediment of the Gharraf River for some heavy elements

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Abstract

Study was conducted to determine, at the beginning of this month, the environmental factors and the original sweat levels of the water and sediments of the Al-Sariq River in Dhi- Qar Governorate, approaching the Al-Jarifik River located within the city of Al-Rifai along the river from November 2023 AD to April 2024 AD. The current study concludes by measuring some physical and chemical gains. Air and water temperature, turbidity, sponge, electrical conductivity, dissolved oxygen, and element concentrations: lead, Pb, zinc, Zn, and copper, Cu, in river water and sediments. The following depiction is that the element concentrations follow the following order: zinc < copper < lead, their concentrations in the sediments and their accumulation in them are the following types: zinc < copper < lead. The results showed that the water of the Gharraf River is suitable for human consumption, but the sediment levels were high.

I. introduction

Rivers are exposed to pollution with heavy elements, such as copper, lead, and zinc, resulting from two sources, one natural from dirt rocks and the other industrial from factory waste, agricultural waste, or household waste (Fahd, 2014). The percentage of heavy elements is affected by environmental changes such as water temperature, high pH, and turbidity (Jawda and Fahd, 2014). 2023). Because of the importance of water and the danger of heavy metals**.** There have been many studies on them because heavy metals have clear and direct effects on aquatic organisms, especially fish, varying in severity between the acute effect, whose symptoms appear immediately, and the chronic effect, whose symptoms appear after a period of time. Among their effects is the reduction of fish communities, their increased sensitivity, and their decreased resistance to change. Environmental conditions Vidal, 2009). The increase in industrial activities such as artisanal mining, illegal refining, the use of leaded gasoline, airborne dust, the burning of toxic waste, and the development of productive industries led to the emergence of heavy metal pollution unparalleled in recent years (Yabe et al., 2010). Heavy metals are the most important sources of pollution in water, and to address this problem, we must know the sources of their pollution and the standards related to them (Al-Shamilawi, 2020.(

II. Materials and methods

The study was conducted on the Al-Gharraf River, located within the city of Al-Rifai, north of Dhi Qar Governorate, about 100 km from the center of Dhi Qar Governorate. Location coordinates: 31.4226°E, 46.0612N. This station was chosen to determine pollution levels and evaluate water characteristics. The station receives wastewater and is surrounded by With orchards, agricultural farms, and the site of the Al-Gharraf oil field, which is located between the city of Al-Rifai and Qal'at Sukkar. The Al-Gharraf River is one of the main branches of the Tigris River, with a length of 530 km and irrigating three governorates of Dhi Qar, Basra, and Wasit (Hussein and Fahad, 2008). The width of the river at the study site is 60 m.

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Collect water samples

Water samples were collected from the study site to conduct chemical and physical tests and to measure heavy metals in polyethylene plastic containers with a capacity of 250 ml for each sample (APHA, 1985). Take 50 ml of water and put it in a clean 100 ml glass beaker, and add 5 ml of concentrated nitric acid to it. Heat the beaker on a hot plate and leave it on the hot plate to continue heating until the pre-drying stage. Add 5 ml of nitric acid to the sample. Concentrate and continue heating to obtain a precipitate, and after cooling, add the volume to 25 ml with deionized distilled water رشح.) باستخدام المرشح الغشائي(0.20 µm Filtration membrane The water temperature was measured with a thermometer graduated from 0-100 when taking samples. The thermometer was immersed in water for two minutes to ensure an accurate reading, and the results were expressed in degrees Celsius. Electrical conductivity was measured using a conductivity meter, the unit of measurement is Siemens/cm. Use a pH meter to measure pH values after calibrating them using Buffer Solution with pH (9.7.4) calibrating every two months. Use an Oxygen meter to measure the percentage of dissolved oxygen and express the results in mg/L. Turbidity was measured using a turbidity meter, and the results were expressed in NTU.

Collect sediment samples

Samples were collected monthly from the bottom of the river at a depth of 20-40 cm. The samples were placed in clean bags and transported to the laboratory. They were dried. To estimate the concentrations of heavy metals in the sediment samples, a weight of 0.5 grams of dry soil was taken in a glass beaker and 5 ml of the digestion solution consisting of sulfuric acid was added to it. Concentrated $H2SO4$, concentrated nitric acid $HNO3$, and perchloric acid $HCIO4$ in a ratio of 3:1:1. A watch bottle was placed on the beaker to prevent evaporation of the concentrated acids. The samples were heated on a convector at 90°C for two hours, and in a hood they were diluted by adding ion-free distilled water to 25 ml It is now ready to be measured by flame atomic absorption spectroscopy. Measurement of heavy elements in the studied samples using a Flame Atomic Absorption Spectrophotometer (FAAS). Standard solutions of the elements were prepared (Standard Solution APHA, 2003). Conduct statistical analysis of the study data using the ready-made statistical program SAS (Statistical analysis system) (SAS, 2012). The significant differences between the means were compared using the Duncan multinomial test (Duncan, 1955) and using the complete random design (CRD).

III. Results and discussion

Table (1) shows the air temperature values during the experiment period. The highest value was recorded in the month of April, 38 °C during the spring season, and the lowest value recorded in the month of February was 21 °C during the winter season. The results of the current study shown in the table showed that the water temperature values recorded the highest value of 30°C during the month of April and the lowest value of 18°C during the month of January. There was a slight difference in the temperature of the water and air during the study period. This may be due to the fact that the water gains and loses heat slowly compared to the air, or it may be due to the slow movement of water flow in the study site .The adopted measurement method is the mercury thermometer, which does not give a clear or accurate impression of the fluctuations occurring in the values of this environmental factor. The results of the current study showed turbidity values between (6.35-70.7) NTU in the region. The highest value was 70.7 NTU in the month of January and the lowest value was 6.35 NTU in the month of February. The reason for the increase is attributed to the result of throwing waste into the water or due to a decrease in the speed of the water flow. It has been observed that there is an inverse correlation between water temperature and turbidity. Whenever the water temperature decreases, the turbidity value in the water increases. The reason may be attributed to the fact that the water flow is fluctuating depending on the water changes and the increase in river water flow coincides with the rise in water temperature in the spring وقيم التوصيلية الكهربائية.The lowest value was (0.847) microSiemens/cm in January and the highest value was (1.013) microSiemens/cm in February. The decrease in electrical conductivity values is

attributed to the decrease in evaporation rates, which is reflected in the increase and decrease of salts (Al-Tamimi, 2016). The rainfall that occurred during the months of the experiment diluted the water and reduced the salts. As for the pH values, the lowest value was 7 during the month of January and the highest value was 7.56 during the month of February in the water of the Garraf River. The values were within the light alkaline range. The reason for this is the presence of aquatic plants that lead to an increase in the effectiveness of photosynthesis and then to the consumption of carbon dioxide. In the water) *et al*

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.,2012 Patil (Aquatic plants and phytoplankton consume most of the carbon dioxide dissolved in the water, turning the water into a basic form. It is clear to us that the pH values fall within the permissible environmental parameters according to the World Health Organization, which has been estimated to be between (6.5-8.5) in the aquatic environment. WHO,2018). Dissolved oxygen values ranged between (6.1 - 8.4) mg/L, the highest percentage in April was 8.4 mg/L and the lowest percentage in December was 6.1 mg/L. The reasons for the decrease in dissolved oxygen values are attributed to the decrease in water levels The increase in organic decomposition in it, or as a result of the sewage whose water flows into the river, is loaded with organic materials that are decomposed by bacteria, and thus the percentage of dissolved oxygen decreases (Fahd, 2014). There is a relationship between temperatures and the percentage of dissolved oxygen, such that oxygen decreases in warm water (Kelly, 2013). : Bowyer et al., 2013). In a study (Salim, 2013), it was found that dissolved oxygen is the factor that most controls the level of organic pollution.

Table (1) Chemical and Physical Properties of Water.

Months / Characteristics	November	December	January	February	March	April	Unit
Air temperature	29	28	22	21	25	38	°C
Water temperature	25	22	18	19	22	30	°C
Turbidity	13.1	11.35	70.7	6.35	7.79	22.2	NTU
Electrical conductivity	0.932	0.997	0.847	1.013	1.002	0.997	Ms\cm
Dissolved oxygen	6.54	6.1	6.7	7.5	6.6	8.4	Mg\I
pH	7.36	7.36	7.0	7.56	7.42	7.55	-

The results of the current study showed changes in the concentrations of the heavy elements lead, zinc, and copper in the water of the Gharraf River during the months of the study, as shown in Table (2). The highest value for the lead element was 0.0417 mg/L in the month of February, and the lowest value for the heavy elements, lead, was 0.00004 micrograms/L in the month. December, and these results are consistent with the results of (Fahd, 2014) regarding the study of the Gharraf River. The results were within the limits permitted by the World Health Organization (2004-2011) and the Iraqi specifications for the system and maintenance of rivers and water from pollution .(2011) Table (2) shows the concentration of zinc if the highest value reached 0.0663 mg/L in the month of February and the lowest value reached 0.00001 mg/L in the months of November and December. The results of the statistical analysis showed that there were significant differences at the level of 0.01 P≥P between the month of February and the rest of the months. The results were within the limits permitted by the World Health Organization (2004-2011) and the Iraqi specifications for the system and maintenance of rivers and water from pollution (2011). And the concentration of the copper element if the highest value reached 0.0346 micrograms/liter in the month of January and the lowest value was 0.00001 micrograms/liter in the months of November and December. The results of the statistical analysis showed that there were significant differences at the level of

0.01 P≥P between the month of February and the rest of the months .The results fall within the limits permitted by the World Health Organization (WHO) (2004-2011) and the Iraqi specifications for the system and maintenance of rivers and water from pollution (2011). The reason for the decrease in

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heavy elements in the water is attributed to the continuous flow of water in the river, which helps transport the elements or deposit them at the bottom, and also the amount of rain during the study period, which reduces heavy elements through rising water levels and diluting the elements, in agreement with the study (Hadi and Fahad). ,2021. The low solubility of heavy elements in water and the tendency to adsorption with suspended particles increases the sedimentation process at the bottom ,alkalinity of river water contributes to reducing the solubility of heavy metals and increasing the adsorption process (Al-Asadi, 2016; Al-Asadi et al, 2019; Al-Asadi et al, 2020Table (2) shows that there is very little variation between the months of the study in the concentrations of heavy metals, and the concentrations are high in the month of February during the winter compared to the other months. The reason is attributed to the change occurring in some environmental factors, including temperature and pH, and due to the factor of evaporation and precipitation. Which increases heavy elements in water, as confirmed by a study (Khudair, 2022). Water pollution is not limited to human pollutants only, because heavy elements can reach the river environment from natural sources such as the dissolution of rocks, the exposure of soil to water erosion, erosion factors, dust, etc., in addition to the activities of the population, including untreated sewage and industrial wastewater to chemical and agricultural water in all its forms (Al-Taie and Al-Quseir 2013; Akoto et al. 2008. heavy elements were arranged according to their presence in water as follows: zinc > copper < lead, the general rate was 0.012, 0.012, and 0.010 micrograms/liter dry weight, respectively.

Table (2) Heavy elements in water

Months / Items	November	December	January	February	March	April
Lead	**0.0115**± 0.00028 **b**	**0.00004 ± 0.00003 d**	**0.0006 ± 0.00005 d**	**0.0417 ± 0.00005 a**	**0.0027 ± 0.00005 c**	**0.0040 ± 0.0025 c**
Zinc	**0.00001 ± 0.00005 c**	**0.00001 ± 0.00005 c**	**0.0007 ± 0.00005 c**	**0.0663 ± 0.00026 a**	**0.0015 ± 0.00005 b**	**0.0042 ± 0.00005 b**
Copper	**0.00001 ± 0.00005 c**	**0.00001 ± 0.00005 c**	**0.0346 ± 0.00025 a**	**0.0285 ± 0.00003 a**	**0.0006 ± 0.00005 c**	**0.0100 ± 0.0057 b**
Moral	**	**	**	**	**	**
Averages with different letters within the same column indicate a significant difference **0.01 ≥P						

Heavy elements in sediments

The results of the current study showed in Table (3) the rate of changes in the concentrations of the heavy elements lead, zinc, and copper in the muddy sediments of the Gharraf River during the months. The highest value for lead was 14.154 micrograms/liter, dry weight, in January, and the lowest value was 5.939 micrograms/liter, dry weight. In the month of November, the results of the statistical analysis showed that there were significant differences at the level of ≥P 0.01 between the month of January and the study months. Therefore, the heavy elements were arranged according to their presence in the sediments as follows: zinc < copper < lead. The general average concentrations of zinc, copper, and lead

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are 33.78, 19.51, and 10.69 micrograms/liter dry weight, respectively. concentrations of zinc in the muddy sediments of the Gharraf River reached the highest concentration of 42.256 micrograms/liter dry weight in November and the lowest value of 21.597 micrograms/liter dry weight in February. The results of the statistical analysis showed that there were significant differences at the level of P≥0.01 between the months January and the rest of the school months. The concentrations of copper in the muddy sediments of the Gharraf River reached the highest value of 25.073 micrograms per liter dry weight in November and the lowest value reached 16.666 micrograms per liter dry weight in January .results of the statistical analysis showed that there were significant differences at the level of ≥P 0.01 between the month of November and the rest of the study months. It is noted that there is a clear and significant discrepancy between the concentrations of heavy elements present in river sediments and those present in river water. The reason may be attributed to the fact that sediments are considered the largest reservoir for concentrations and levels of heavy elements. Therefore, sediments are considered a good indicator of pollution with heavy elements due to the heaviness of these elements and their tendency to accumulate. At the bottom of the river, for the element lead, there was a slight increase between the months of the study, while the increase in the element zinc in the months of November and April is due to changing temperatures or untreated sewage water and waste from the power station .high concentration of copper in the months of November and February is due to the presence of scrap structures and the corrosion of the bridge's iron columns in the river. The variation is due to physical and chemical properties, as well as the size of the sediment. All of these factors contribute to the high concentration of elements in the sediment. The elements studied were within the Iraqi limits, but the concentrations were higher than what was recorded in previous studies, and this is a sufficient indicator of the pollution of the river with these elements (Akbar, Al-Khazali, 2012) in estimating the concentrations of heavy elements in the sediments and water of the Gharraf River. The results are consistent with the study (Al-Shamilawi, 2020), which included some concentrations of heavy metals such as lead, cadmium, manganese, and nickel in the water and sediments of the Shatt al-Arab in southern Iraq.

Table 3: Heavy elements in sediments

Months / Items	November	December	January	February	March	April
Lead	**5.939 ± 0.0028 f**	**13.680 ± 0.0057 b**	**14.154 ± 0.0005 a**	**10.833 ± 0.0005 d**	**8.333 ± 0.0005 e**	**11.250 ± 0.0057 C**
Zinc	**42.256 ± 0.0005 a**	**21.597 ± 0.0005 F**	**41.664 ± 0.0005 b**	**34.084 ± 0.0005 c**	**29.673 ± 0.0005 e**	**33.432 ± 0.0005 d**
Copper	**25.073 ± 0.0005 a**	**17.648 ± 0.0005 e**	**16.666 ± 0.0057 F**	**19.770 ± 0.0005 b**	**18.566 ± 0.0005 d**	**19.366 ± 0.0025 c**
Moral	**	**	**	**	**	**
Averages with different letters within the same column indicate a significant difference **0.01 ≥P						

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Conclusions and recommendations

We conclude from the results of the current research that the water of the Gharraf River has basic characteristics, and most of the variables and heavy elements fall within the limits permitted by the international organizations and bodies concerned with this regard, and based on the values of the total turbidity of the water, it is classified as soft, and thus it is possible to classify the water of the Gharraf River as good. For drinking, watering crops and plants, and industrial and household uses, based on the measurements obtained through this study and within the specified study period .Study the effect of other pollutants in rivers and give more space to these studies. And knowing the levels of pollution for the purpose of knowing the extent of its contamination with various heavy elements in order to prevent its access to the food chain and increase environmental awareness

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