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Impact of Water Pollution on Aspects of Aquatic Life in the Euphrates at Kufa City

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Abstract: The Euphrates river in Iraq face a challenge of receiving a verity of pollutants, mainly come from wastes discharged into the river. Although industrial effluents and drainage from farm lands impose considerable pollution load, effluents of municipal wastewater treatment plants represent an effective source of pollution to the Euphrates. The study area of this paper was selected as 12.55 km long of the Euphrates River of the branch "Shatt Al-Kufa" just downstream Kufa city within Najaf Governorate in the middle of Iraq. Upper and lower boundaries of the study area were water monitoring stations belong to the Iraqi Ministry of Water Resources. The upper (upstream) boundary was Kufa Station, while the lower (downstream) boundary was Manathera Station. Water temperature, pH and electric conductivity (EC) were measured in the field. Water samples collected daily from the river at the two stations (Kufa and Manatherah) along three intervals as 23-30 April 2019, 1-7 July 2019 and 10-18 November 2019, and tested in lab for total dissolved solids (TDS), total suspended solid (TSS), dissolved oxygen (DO), biochemical Oxygen demand BOD_5, calcium (Ca), magnesium (Mg), sulphate (SO_4), Nitrite (NO_2), Nitrate (NO_3) and phosphate (PO_4). Observations were made at dates 23rd April, 1st July and 10th November 2019 for some aspects of aquatic life like plants, fish and amphibians. According to results and observations of this study, the effluent of Kufa wastewater treatment plant had a slight local effect on some water quality parameters of the Euphrates river like EC, TDS, BOD_5, DO, PO_4, SO_4, NO_2 and NO_3 that affected some aspects of aquatic life downstream the discharge point of the plant. Some kinds of fish like *Sharpeyi Barbus*, *Barbus xanthoptrrus*, *Barbus grypus*, *luteus Barbus* and *Liza abu* were observed with lower number just downstream the effluent discharge point.

Keywords: Impact, Water Pollution, Aquatic, Euphrates.

I. INTRODUCTION

Iraq relies on surface water rather than groundwater for different uses like drinking, irrigation and industry. Surface water bodies like reservoirs, lakes, marshes and streams represent 15% of the total area of Iraq [1]. However, the two rivers Euphrates and Tigris represent the most important resources feeding other surface water bodies. They pass through Iraq and supply cities with drinking water and farms with irrigation water after passing through Turkey and Syria. The annual average discharge of the Euphrates River is continuing to decline due to the construction of large dams in upstream countries Turkey (GAP project) and Syria [2] [3]. In addition to this challenge, the Euphrates face another challenge of receiving a verity of pollutants, mainly come from wastes discharged into the river. Although industrial effluents and drainage from farm lands impose considerable pollution load, effluents of municipal wastewater treatment plants represent an effective source of pollution to the Euphrates [4]. Constructing the dams in Turkey with associated filling periods lead to decrease flow rates, which in turn, lead to decrease dilution factor of the river for the pollutants received. As a result of flow rate reduction, salinity is reported to increase in the river [1], however, organic pollutants and heavy metals come mainly from wastewater treatment plants effluent represent important concern [5] [6] [7] [8].
Some previous studies directed towards tracking the effect of certain pollution sources on water quality in the river by means of mathematical models and GIS. Such sources were often to be wastewater treatment plant effluent [9],[10],[11]. However, other studies focused on biological effect of the pollution [12], [13], [14]. Others investigated the climatic and thermal effect on river water quality [15], [16]. This paper is focusing on the effect of water pollution on some aspects of aquatic life in the Euphrates River within Kufa city.

II. STUDY AREA

The study area was selected as 12.55 km long of the Euphrates River of the branch "Shatt Al-Kufa" just downstream Kufa city within Najaf Governorate in the middle of Iraq. Upper and lower boundaries of the study area were water monitoring stations belong to the Iraqi Ministry of Water Resources. The upper (upstream) boundary was Kufa Station located at 32° 0'58.73"N, 44°25'32.50"E, while the lower (downstream) boundary was Manathera Station at 31°55'24.41"N, 44°29'22.11"E. The Euphrates is divided at 15 km north of Kufa city into two branches; Shat Al-Kufa branch and Abbassiyah branch, Fig. 1.

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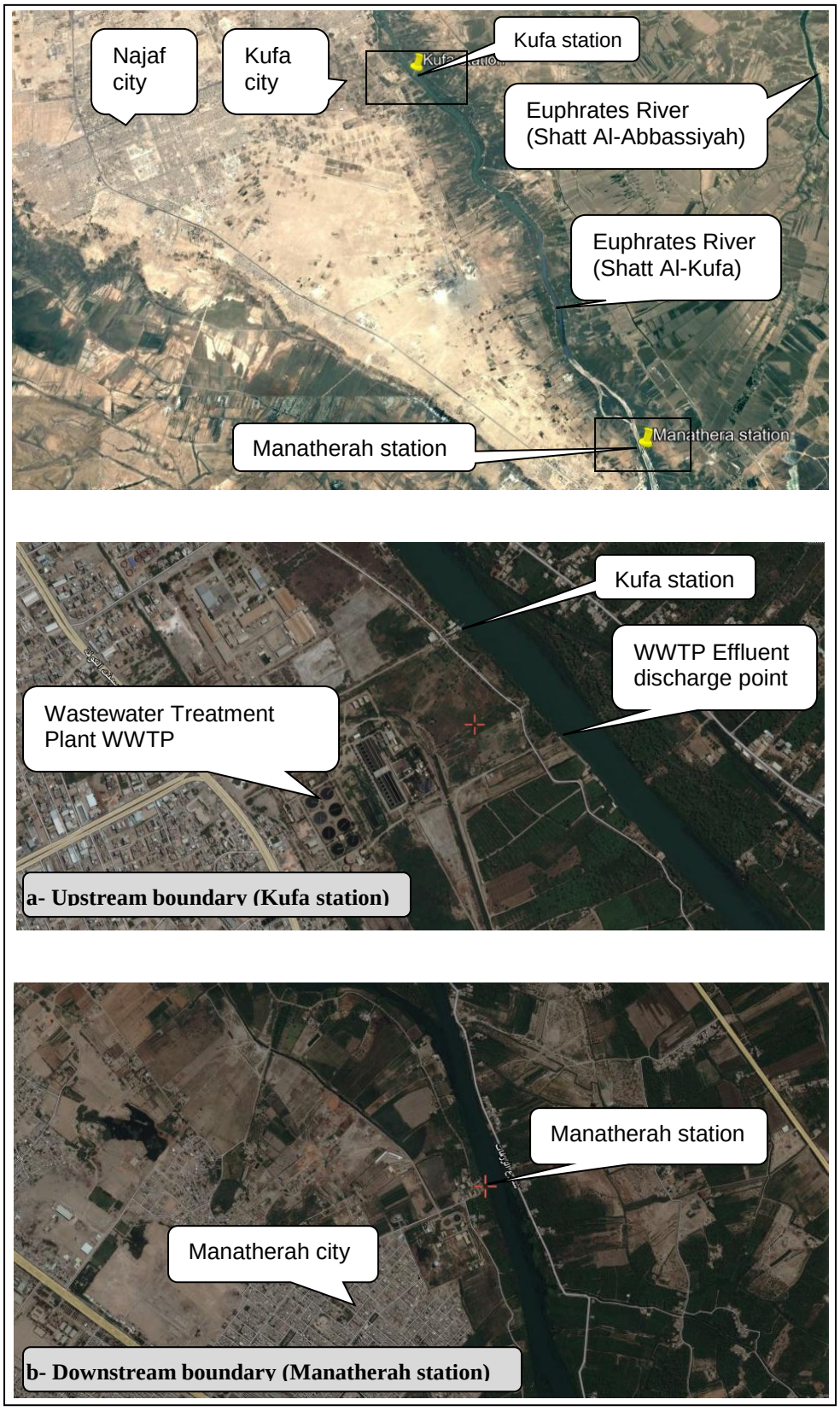

Fig. 1 Study area, a- Upstream boundary (Kufa station), b- Downstream boundary (Manathera station)

Shatt Al-Kufa is the main of the two branches. It passes through the historical Kufa city. Najaf and Kufa cities are supplied with water from Shatt Al-Kufa as a source for the drinking water, but they discharge into the river treated effluent of wastewater treatment plants that serve both of them. In fact, the plants are three. They adopt different treatment

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technologies as Trickling Filters, Activated Sludge and Integrated Fixed Film Activated Sludge. The total actual (working) capacity of the three plants is 82,000 m^3/day (serving 330,000 capita).

The upstream station (Kufa station) is located on 350 m upstream the discharge point of the treated effluent of wastewater treatment plant, whereas Manatherah station is located on 12.2 km downstream the discharge point. The selection of the upstream and downstream stations were to investigate the effect of the wastewater treatment plant on water quality and aquatic life of the river.

III. METHODOLOGY

The objective of this work was to investigate the effect of water pollution on some aspects of aquatic life. Independent variables studied were; the location of discharge point of WWTP treated effluent, flow rate of the river and season. Dependant variables (indicators) were water quality items and aquatic life response in the river. Location of the discharge point was downstream of Kufa station and upstream Manatherah station. So, comparing water quality parameters for water sample collected from the location of Kufa station and Manatherah station will explain the effect of the discharge point on water quality and then on aquatic life. Considering high and low flow rates of the river throughout the year counts for the effect of flow rate on both water quality and the life. Considering water quality for water samples collected through different seasons but with approximately equal flow rate will count for the effect of season. Extraneous variables like slightly varying quality and quantity of treated effluent discharged, other temporary local pollution sample. Although these variables are difficult to be controlled, but there effect is relatively limited.

A. *Field work*

Water temperature, pH and electric conductivity (EC) were measured using a thermometer, pH meter and EC meter in the field. Water samples collected daily from the river at the two stations (Kufa and Manatherah) along three intervals as 23-30 April 2019, 1-7 July 2019 and 10-18 November 2019. Boat was used to reach the centreline of the river for sampling. Sampling was carried out by means of polyethylene bottom sampler. Water samples were temporarily stored in one litre volume glass bottles with adding Hydrochloric acid drops to reserve the samples while transferring to lab. All plant species and vegetation cover values of all plant species were recorded in the study using the sectional method [17]. A survey of the aquatic vegetation cover was conducted through collecting plants within a specific area for qualitative analysis. Field surveys were conducted in the study and lists of all aquatic plants (salient, submerged and floating) were prepared, collected and classified. Marginal plants were also recorded in the study.
Several references have been adopted for the classification of aquatic plants, including Townsend et al.[18], Townsend and Guest [19], Saadi and Miah [20], and Al-Mayah and Al-Hamim [21]. During the botanical survey, the species in the study were photographed. The plant samples were collected after washing them with water in the study area to get rid of suspended materials. Samples were stored in plastic bags and in a container until they reached the laboratory.

B. *Laboratory work*

Water samples collected were analysed in lab for water quality parameters. Some of the parameters as total dissolved solids (TDS), total suspended solid (TSS), dissolved oxygen (DO), biochemical Oxygen demand BOD_5, calcium (Ca), magnesium (Mg) and sulphate (SO_4) were analysed according to the standard methods of the examination of water samples [22]. Other parameters as Nitrite (NO_2), Nitrate (NO_3) and phosphate (PO_4) were estimated following Parsons [23]. These parameters were tested to indicate the effect of discharging wastewater treated effluent in the river.

IV. RESULTS AND DISCUSSION

The results obtained from field laboratory work are discussed here according to two branches; water quality parameters and some aspects of aquatic life like plants, fish and amphibians.

A. Water Quality Parameters

Results of water quality parameters tested as indicators are listed Table 1. The values written in this table are averages (mean values) for 4 – 6 daily test values. The main observation form Table 1 is the influence of flow rate in the river. As the flow rate increased during July, levels of EC, TDS, BOD_5, PO_4, SO_4, NO_2 and NO_3 decreased obviously in both Kufa and Manathera stations (the whole study area). This is attributed to the fresh water released from Tharthar Lake. Iraqi Water Resources ministry, usually, release more flow rate in the Euphrates from Tharthar lake along the period of July month to support irrigation of certain crops (rice) in the middle parts of Iraq. The decrease in EC and TDS refer to increasing dilution capability of the river for the salt loading comes from neighbouring farm lands. The same attribution is accepted for BOD_5, PO_4, SO_4, NO_2 and NO_3 decreased values, which was due to increasing river dilution factor for the organic loads added locally. The main distinguished source of organic load within the study area is the discharge point of treated effluent of Kufa Wastewater Treatment Plant. The effect of the plant may recognized by comparing the values

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of BOD_5, PO_4, SO_4, NO_2 and NO_3 of Kufa station with Manathera station, even for July month. Values of DO certify the effect of the wastewater treated effluent. DO decreases with increasing organic load in water.
Values of TSS increased during July may due to increasing flow rate that caused some effect of scouring fine sediments from river bed. Parameters of water temperature, pH, Ca and Mg did not show clear effect or trend. However, slight increase in Ca and Mg concentrations at Manathera when compared with Kufa in April and November may refer to the effect of the treatment plant.

TABLE I WATER QUALITY RESULTS (MEAN VALUES OF 4-6 READINGS)

Parameter	23-30 April, 2019		1-7 July 2019		10-18 November 2019	
	Kufa st.	Manathera st.	Kufa st.	Manathera st.	Kufa st.	Manathera st.
Flow, m^3/sec	84.1	83.3	205.8	205.7	62.3	61.5
Water temp. C^0	16.2	16.3	38.0	38.2	13.7	13.6
pH	7.2	7.4	7.5	7.6	7.2	7.3
EC, µs/cm	825	881	463	486	709	732
TDS, ppm	1065	1023	632	680	1012	995
TSS, ppm	4.8	9.3	16.8	16.2	8.1	8.4
DO, ppm	5.6	4.8	9.8	9.6	7.4	6.8
BOD_5, ppm	4.2	6.6	0.9	1.8	1.2	1.6
Ca, ppm	96.6	120	108	96.2	92.5	110.8
Mg, ppm	69.7	88.4	81.5	78.3	73.8	112.5
PO_4, ppm	0.21	0.48	0.05	0.1	0.09	0.21
SO_4, ppm	676	730	87.4	107.4	452	486
NO_2, ppm	28.3	26.6	4.5	5.7	28.6	36.2
NO_3, ppm	0.08	0.9	0.02	0.06	0.15	0.4

B. Aspects of Aquatic Life

Observations were made at dates 23rd April, 1st July and 10th November for some aspects of aquatic life like plants, fish and amphibians as shown in Table 2, Table 3 and Table 4, respectively. Table 2 show that *australis Phragmatis, Typha domingenis* and *Cyratophyllum demersum* were higher at Manathera station when compared with Kufa station. This observation may belong to the organic content of water downstream of the wastewater plant discharge point. These plants make use of some sources of organic matter as fertilizers whiten certain concentrations. Other plants (*L Syperus, pectinatus Potamogeton* and *Potamogeton crispus*) did not show clear response for the wastewater effluent discharge point location.

TABLE 2 OBSERVATION RESULTS FOR PLANTS IN STUDY AREA

Plant name	23rd April, 2019		1st July 2019		10th Nov. 2019		Common Intensity
	Kufa st.	Manathera	Kufa st.	Manathera	Kufa st.	Manathera	
Phragmatis australis	1500	1750	1700	2000	1500	1750	Medium
Typha domingenis	1000	1200	1300	1500	1200	1200	Medium
Cyratophyllum demersum	250	500	200	400	200	300	Few
Syperus L	200	200	150	200	150	150	Few
Potamogeton pectinatus	300	250	250	250	300	200	Medium
Potamogeton crispus	400	500	300	300	400	400	Medium

Table 3 show that *Sharpeyi Barbus, Barbus xanthoptrrus, Barbus grypus, luteus Barbus* and *Liza abu* observed with higher numbers at Kufa station when compared with Manathera station. This may reflect the trend of fish species to prefer zones of more fresh water upstream the discharge point of wastewater treatment plant effluent. This observation did not match what observed regarding *Aspius vorax* and *Cyprinus carpio*. The increased flow rate and dilution factor mentioned in (A) above may affect the trend of *Barbus luteus* during July.

General trend regarding the observed amphibians when compared with plants and fish. Table 4 show that all of the three amphibians (*Bufo bufo spinosus, Testudo leprosa* and *Vepera lebetina*) were observed with higher numbers at Manathera station as compared with Kufa station. This case may related to local other causes regarding life conditions of the three amphibians considered.

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TABLE 3 HUNTING AVAILABILITY OF FISH IN STUDY AREA

Fish type	23rd April, 2019		1st July 2019		10th Nov. 2019		Common Intensity
	Kufa st.	Manathera.	Kufa st.	Manathera	Kufa st.	Manathera	
Sharpeyi Barbus	3500	2800	4200	3500	2900	2250	High
Barbus xanthoptrrus	1000	850	1500	700	800	550	Medium
Barbus grypus	250	50	500	350	200	250	High
Barbus luteus	1200	500	2000	2300	1500	1250	Medium
Aspius vorax	25	30	60	45	30	35	High
Cyprinus carpio	35	40	20	40	50	35	Few
Liza abu	4000	3600	5200	4200	3600	3500	High

TABLE 4 OBSERVATION RESULTS FOR AMPHIBIANS IN STUDY AREA

Amphibians	23rd April, 2019		1st July 2019		10th Nov. 2019		Observed number
	Kufa st.	Manathera.	Kufa st.	Manathera	Kufa st.	Manathera	
Bufo bufo spinosus	2000	2500	1300	1500	1800	2200	High
Testudo leprosa	50	65	60	75	45	60	Medium
Vepera lebetina	10	15	5	17	12	15	Few

V. CONCLUSION

According to results and observations of this study, the effluent of Kufa wastewater treatment plant had a slight local effect on some water quality parameters of the Euphrates river like EC, TDS, BOD_5, DO, PO_4, SO_4, NO_2 and NO_3 that affected some aspects of aquatic life downstream the discharge point of the plant. Some kinds of fish like *Sharpeyi Barbus*, *Barbus xanthoptrrus*, *Barbus grypus*, *luteus Barbus* and *Liza abu* were observed with lower number just downstream the effluent discharge point.

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REFERENCES

[1] Al-Fatlawi A., Al-Jassani M. and Al-Rifaie J." Pollution assessment of Euphrates River in three governances of Iraq", MATEC Web of Conferences 162, 05022 (2018), doi.org /10.1051 / matecconf /201816205022.
[2] Food and Agriculture Organization (FAO)," Water resources", 2017, available at: http://www.fao.org/nr/water/aquastat/water_res/index.stm.
[3] Abbas, A. A. and Hassan, F.M. "Water Quality Assessment of Euphrates River in Qadisiyah Province (Diwaniyah River), Iraq", *Iraqi Journal of Agricultural Sciences* –1028:49(2):152-162.
[4] Al-Ansari, N., Jawad S., Adamo N. and Sissakian V." Water Quality and its Environmental Implications within Tigris and Euphrates Rivers", *Journal of Earth Sciences and Geotechnical Engineering*, 9(4), 2019, 57-108
[5] Issa M. and Qanbar A.,"Assessment of Heavy Metal Contamination in Euphrates River Sediments from Al-Hindiya Barrage to Al-Nasiria City, South Iraq", *Iraqi Journal of Science*, 2016, 57 (1) A, pp: 184-193
[6] Hassan F. H, Saleh M. M. and Salman J. M. "A Study of Physicochemical Parameters and Nine Heavy Metals in the Euphrates River, Iraq", *E-Journal of Chemistry*, 2010, 7(3), 685-692.
[7] Tweij Z.A.T, "Estimating of Some Heavy Metals in the River Water East of Kufa, The Province of Najaf", *Drug Invention Today*, 13 (5), 2020.
[8] Al-Jwahery Z. A. W. and Hameed M. H. "Water Pollution in Karbala Province", International Journal of Advanced Research, 3 (2), 2015, pp. 433-455.
[9] Salman H. M. and Jasim M. N. "A GIS Assesment of Water Quality in Euphrates River/Iraq", *Journal of Babylon University/Engineering Sciences*, 23 (20), 2015.
[10] Ali khan H.A "Evaluation of Surface Water Quality in Al Kufa River Station", Al-Qadisiya Journal For Engineering Sciences, 5. (4), 2012, pp: 451-465.
[11] Noori M. M., Abdulrazzaq K. A. and Mohammed A. H." Evaluation of Water Quality using Bhargava Water Quality Index Method and GIS, Case Study: Euphrates River in Al-Najaf City", *International Journal of Science and Research*, 6 (7), 2017, pp: 1286-1295.
[12] Dahmoshi A. O. M. and Alhadrawi H. A. N. "Bacteriological Study of Municipal Water Discharged in Al-Kufa River, Najaf, Iraq", *Journal of Environmental Treatment Techniques*, 8 (3), 2020, pp. 1168-1172.
[13] Bachmann A., Tice V., Al-Obeidi L. A. and Kilc D. T. "Tigris-Euphrates River Ecosystem: A Status Report", Paper for the Mesopotamia Water Forum 2019, Sulaymaniyah, Kurdistan Region of Iraq.
[14] Nashaat M. R., Rasheed K. A. and Hassan H. A."Rotifera Abundance and Species Diversity in Al-Kufa River, Iraq", *Global Journal of Science Frontier Research: H Environment & Earth Science*, 16 (5), 2016.
[15] Ali M. F., Salman A. H., Guda M. A., Abojassim A. A. and Almayahi B." The Hydro Climatic Effects of Thermal Pollution on Surface waters in Iraq and its Biological Effects", *Prensa Med Argent*, 106 (2). 189.

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[16] Al-Ansari N., Admo N. and Sissakian V. K., "Hydrological Characteristics of the Tigris and Euphrates Rivers", *Journal of Earth Sciences and Geotechnical Engineering*,9 (4), 2019, pp.1-26.
[17] Canfield, R. "Application of Line Interception Method in Sampling Range Vegetation. *Journal of Forestry*, 39, 388-394, 1941.
[18] Townsend W.E., L.P. Witnauer, J.A. Riloff, C.E. Swift, "Comminuted meat emulsions: Differential thermal analysis of fat transitions", Food Technol., 22, 1968, pp. 319-323.
[19] Evan Guest and Townsend C., "Flora of Iraq. Volume 8, Monocotyledones Excluding Gramineae", Ministry of Agriculture & Agrarian Reform, 1985.
[20] Al-saadi, H. A., & Al-Mayah, A. A. "Aquatic plants of Iraq". Cent. Arab. Gulf. Univ. Basrah. 1983, (Arabic).
[21] Al-Mayah, A. A, & Al- Hamim, F. I. (1991). "Aquatic plant, and the Algae (pp. 699-701). Univ. of Basra 1991, (Arabic).
[22] APHA, "Standard Method for the Examination of Water and Wastewater". 20th Ed., American Public Health Association, Washington, DC, 1985.
[23] Parsons T R, Mait Y and Laulli C M, A manual of chemical and biological methods for seawater analysis, Pergamone Press Oxford, 1984.

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