Research article

Levels of bacterial and chemical pollutants in Euphrates River in Samawah, Iraq

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ABSTRACT

In present study biological and chemical pollution of Euphrates River in Samawah city in Iraq were studies. Samples were collecting from three places; al-Majed area, Samawah city and al-Khader city. This study included analysis of five heavy metals in the river (Pb, Fe, Cu, Cd and Zn); the study also included some bacterial pollution in the river in the three places. The study involving total Plate Count of the aerobic microbes in addition to isolation and identification of some bacterial isolates that present in the stream of river in the studied places. The results showed difference in concentration of metals in the river and increase in the concentrations, especially in al-Khader city due to pollution in Samawah city also the bacteriological study showed presence of different bacterial species; *Escherichia coli* (24.5%), *Enterobacter aerogenes* (10.11%), *Salmonella spp* (4.79%), *Klebsiella pneumonia* (20.3%), *Proteus mirbalis* (11.45 %), *Proteus vulgaris* (7.55%), *Pseudomonas aeruginosa* (7.21), *Staphylococcus aureus* (8.91%), *Staphylococcus epidermids* (5.18 %), *E. coli* represented the main bacteria as compared with others bacteria. The study showed increase in the five studies heavy metals concentrations in AL-Khader city especifically in case of copper and lead.

Keywords: Al-Khader, Al-Majed, Euphrates, Heavy metals, Samawah,

INTRODUCTION

The Euphrates is the longest and one of the most historically important rivers of Iraq. Euphrates flows through Syria and Iraq to join the Tigris in the Shatt al-Arab, which empties into the Arabian Gulf. It is a vital resource to communities, agriculture and industry in Turkey, Syria and Iraq. Since 2013 the river has become a focus for conflict as forces of the Islamic State of Iraq and al-Sham (ISIS) have seized territory along its course and used control over its waters to exert influence, But the health of this river and its tributaries was already endangered well before the Syrian crisis began in 2011. Rapid and uncoordinated development has affected the river's flow. Some 32 dams and barrages have been constructed over the last 50 years. Growth in water-intensive agriculture, pesticide use and industry has wrought havoc on downstream water quality and ecology [1]. River sediments are a major carrier of heavy metals in the aquatic environment. Sediments are mixture of several components of mineral species as well as organic debris, represent as ultimate sink for heavy metals discharged into environment [2,3]. Chemical leaching of bedrocks, water drainage basins and run off from banks are the primary sources of heavy metals [4]. Heavy metals are serious pollutants because of their toxicity, persistence and non-degradability in the environ-

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ment [5,6]. To date, many researchers have conducted extensive surveys of heavy metal contamination in Euphrates [7,8]. The results demonstrated that accumulation of heavy metals has occurred in sediments of different regions. Limited surveys have been undertaken to study distribution of heavy metals in the Euphrates River [9,10]. The aim of this study is evaluating the chemical and biological contamination of Euphrates River in Samawah city, at three different location, first before river entering Samawah city, at al-Majed area, second place at Samawah city, third place after Samawah city at *Al-Khader* city. The concentration of chemical elements in ppm unit detected in the river depend on using atomic absorption, whereas biological method to evaluate bacterial presence (Total Plate Count), aerobic microbes in addition to isolation and identification of some bacteria that present in the stream of river in the three different places. The study aims, analysis bacterial and chemical pollution of Euphrates River in Iraq, Samawah city.

MATERIALS AND METHODS

Samples collection

Thirty water samples were collected from three places in Euphrates River during three months from January to march 2015: First ten samples were collected from first place located before river entering Samawah city at al - Majed area. Second ten samples were collected from the river in second place in Samawah city. Third ten samples were collected from the river in third place located after the Samawah city at al-khader city.

Heavy metals detection

Five elements, lead (Pb), Copper (Cu), Iron (Fe), Cadmium (Cd) and zinc were analysis by atomic absorption in Kufa university, College of Science. The concentration was determined by ppm .

Isolation and Identification of Bacteria

Bacterial isolates were identified according to Bergeys manual using different morphologic and biochemical tests [11]. The samples were inoculated in Brain heart infusion broth, incubated at 37 ℃ for 24 h. The growing bacteria on the medium were sub cultivated on MacConkey plates agar, Blood agar plates, nutrient agar, *Salmonella Shigella agar*, Mannitol salt agar and Thiosulfate-citrate-bile salts-sucrose agar (TSBS agar) and Eosin Methylene Blue agar (EMB agar), all plates were incubated in aerobic and anaerobic condition at 37 ℃ for 24 h. Microscopic examination such as motility test, morphology, and staining reactions [12] were determined under the compound light microscope. Biochemical tests included Indole test Methyl red (IMVIC) test, Voges-Proskaur test and Citrate utilization test, Triple sugar iron test (TSI) and oxidase test were demonstrated.

RESULTS and DISCUSSION

Bacteriological analysis

In current study, many members of *enterobactercease* such as *Escherichia coli* (24.5%), *Enterbacter aerogenes* (10.11%), *Salmonella spp* (4.79%), *Klebsiella pneumonia*

(20.3%), *Proteus mirbalis* (11.45 %), *Proteus vulgaris* (7.55%), *Pseudomonas aeruginosa* (7.21%), *Staphylococcus aureus* (8.91%) and *Staphylococcus epidermids* (5.18 %) .

Cultural Characteristics

The samples were inoculated on blood agar and MacConkey's agar, EMB agar, Nutrient agar, S.S agar, MSA agar using standard techniques. Culture plates were incubated at 37 ℃ overnight. Next day, colonies obtained on the culture plates were further studied on the basis of colonies morphology, and biochemical reactions [13], the results were shown in **Fig 1**.
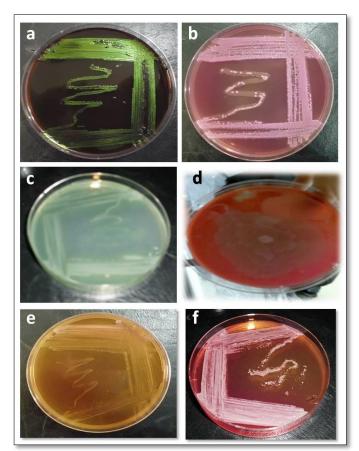

Fig 1. Morphological characteristecs of bacterial colonies on different culture media. a, *E.coli* on EMB agar; b, *K. pneumonia* on MacConkey agar; c, *P. aeruginosa* on nutrient agar (produced pyocyanin pigments); d, *Proteus spp* on blood agar (swarming phenomenon); e, *S. aureus* on mannitol salt agar; f, *S. epidermidis* on mannitol salt agar.

Biochemical tests

The results of biochemical tests for bacteria were summarized in **table 1**. According to the results species of *enterobacteriaceae* were isolated from the studied samples that collected from the river at Al-Majed area, Samawah city and Al -Khader city due to fecal pollution in those areas, as well as to the sewages and lack the good treatment of waste before split the water into the river. In addition Al-Majed area is an agriculture area known as the place of store the wastes of human and animals, as well as the dead animals in the river that consider main reason of water pollution by *E. coli*. These results were agreed with Ahmed 2009 [14] who isolated the bacteria and identified

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Table 1. Biochemical tests results of different bacteria isolated from different places of Euphrates River.

Bacteria	Indole test	MR test	VP Test	Simon citrate	Oxidase	TSI
E. coli	+	+	-	-	-	A/A(- H_2S), (+ gas)
Salmonella spp	-	-	+	-	-	AK/A(+H_2S), (+ gas)
klebsiella spp	-	-	-	+	-	A/A(+ H_2S), (- gas)
P. mirbalis	-	+	-	+	-	AK/A(+ H_2S), (+ gas)
E. aeruginosa	-	-	-	+	-	A/A(- H_2S), (+ gas)
P.vulgaris	+	+	-	+	-	AK/A(+ H_2S), (+ gas)
P. aergenosa	-	-	-	+	+	K/NC (- H_2S), (- gas)

pathogenic bacteria such as *E. coli, E. aerogenes, Shigella sp, Salmonella sp, Klebsiella sp, Pseudomonus sp, Aeromonus sp*. and *Vibrio cholera* from samples of drinking water which supplied to the citizens in five different sectors in Salah AL-Deen province: Samara, AL-Dour, AL-Alam, Alouja, and Hammad Shihab village. Our results were agreed with Mohammed 2010 [15] who studied Kufa river pollution with intestinal bacteria during the summer months and he was found the Kufa river was highly contaminated with *enteric E. coli.*

We were isolated *S. aureus* and *S. epidermids* and this finding agrees with Ghaida et al, 2014 [16] who diagnosed four types of bacteria which included *E. coli, P. aeruginosa, S. aureus* and *S. saprophyticus* in water of Shatt Al-Arab and Quar AL-Omia in Basrah city. The present study were

disagreed with Tahseen et al, 2009 [17] who studied about the pollution of environment in Euphrates River and involving Habbanyah and Therthar lakes and he was found *Enterobacter spp* represented the highest percentage (24%) followed by *K. Pneumoniae* (17.6 %), *Pseudomonas spp* (16.2%), *Citrobacter* (12.5%), *E. coli* (12.1%), *P. mirabilis* (5.5 %), *Salmonella spp* (5%), *Shigella spp* (3.7%), *Flavimonas Oryzihabitas* (2.8%). The present study concluded that the Euphrates River at the Samawah area is highly contaminated with bacteria.

Chemical analysis

Chemical analysis of elements by atomic absorption collected from three places in Euphrates Rivers was show in **table 2**.

Table 2. Concentrations of elements in ppm collected from three places in Samawah, Iraq**.** The standard concentration of elements according to world health organization (WHO) was included. N, 10 and $p < 0.05$.

Type of element	Standard concentration (WHO) in ppm	Concentration of elements in ppm at three places		
		Al-Majed area	Samawah city	Al- khader city
Lead (Pb)	0.01	0.0102 ±0.0032	0.0108 ± 0.0035	0.0203 ±0.0031
Copper (Cu)	1.0	0.0781 ±0.0016	0.0798 ±0.0029	0.0839 ± 0.0021
Iron (Fe)	0.3	0.1125 ± 0.0052	0.1212 ± 0.0061	0.1277 ±0.0073
Cadmium (Cd)	*0.003*	0.0130 ± 0.0013	0.0150 ± 0.001	0.0175 ± 0.0019
Zinc (Zn)	3.00	0.0024 ± 0.0001	0.0109 ± 0.0003	0.0118 ± 0.0001

The results in **table 2** showed there is no significant change in concentration of lead in Euphrates at AL-Majed area and Samawah city. However, at AL-Khader city there is change in concentration of lead may be due to increased rate of non-treatment industrial waste which discharged to River [18]. In case of concentrations of Copper there is no significant change at AL-Majed area and Samawah city but there is increase at AL-Khader city that due to the flow of the dredged materials from upper regions of the river, dilution and increase of water flow, direct drainage from farmlands, sewage disposal plants [19]. There is slight increase in concentration of iron between three places, same thing was found in case of Cadmium, slight increase in concentration of Cd in three sites due to the anthropogenic activities such as agricultural runoff, urbanization and industrialization. The anthropogenic sources play a significant role in increasing the concentration of Cd and Cu in the Euphrates River. These sources include discharging of irrigation water, rich in phosphate fertilizers, to the river and discharging untreated municipal heavy water to the river without treatment from highly populated cities [20]. Zinc elements increased in Samawah city compared to AL-Majed area due to sewage water split in rive that cross the Samawah city [21]. The concentrat-

ion of Zn increased in AL-Khader city due to the increase of many chemical pollutants like trace elements and PAHs (polycyclic aromatic hydrocarbons) agrochemicals Abundance that throw into the river [22].

From current study it can be concluded that found the biological pollution in Euphrates River in Samawah city due to the pollution in al-Majed area, high percentage of bacteria in Al-Majed area. *E. coli* is the highest bacteria present in the river water due to an organic pollution, increase in concentrations of heavy metals in AL-Khader city specifically in copper and lead concentrations in Samawah city .

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