

Study of Bacterial Indicators in Water and Sediments from Al- Hilla River, Iraq

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Abstract

The present study was conducted to study of some microbial pollution indicators such as - total count, total coliforms, fecal coliforms, *E.coli* and fecal streptococci from water and sediment of Al-Hilla River in middle of Iraq. Samples were collected over a period of twelve months from March, 2010 to February, 2011. The results showed variation in the number and density of microbial indicators between seasons and study sites. A highest number of bacterial pollutants recorded through spring and summer seasons. Many environmental factors affect the bacterial indicators such as solar radiation, temperature, water flow and organic matter. The present study showed high variation in quantitative and qualitative of bacterial indicators, also they could be used as a bio-indicator for pollution of both water and sediment in Hilla River.

Keywords: Bacterial indicators; Water pollution; Euphrates river; Hilla river-Iraq

Introduction

Pollution of the surface water by liquid and solid wastes is widespread in many countries. Most of wastewaters are disposed directly to rivers without any treatment. Today water has become the most exploited natural systems since man stored the earth [1]. Biological pollutants (human and livestock) as well as physical and chemical pollutants (temperature, oxides, salts and pesticides) have negatively influences on the microbial community in the water and sediments [2].

Bacteria are ideal sensors for microbial pollution of surface water because of their fast response to environmental changing [3]. The use of bacteria as water quality indicators can be viewed in two ways, which were suggested by Baghel et al. [4] as the presence of such bacteria can be taken as an indication of fecal contamination of water and an indication of potential danger of health risks.

There are no unanimous opinions about microbial pollution indicators in aquatic systems, however, coliform group bacteria, especially total coliform bacteria (TCB) and fecal coliform bacteria (FCB), have been selected as water microbial indicators traditionally [5]. Coliform group bacteria generally don't cause danger to peoples or animals, but it indicates to presence of other disease causing bacteria in aquatic systems, FCB are a good indicator for human and warm-blood animals wastes tracking in to the aquatic systems [1].

The coliform bacteria are widely used indicators, which may be the total coliform that got narrowed down to the *Fecal coliform* and *Fecal streptococci* [6].

Many authors attempted to distinguish differences between faecal pollution of animals and human origin based on different resistance of isolated bacteria to antibiotics [7]. Also, they use the exposure of various animals and humans groups to antibiotics that changed markedly over time [7]. In this field US-EPA [8] has established FCB concentration limit of (200 CFU/100mL) in the water for recreational and contact usages and equal to (0 CFU/100mL) for drinking water.

Contamination of water by enteric pathogens has increased world wide [4,9-11]. Otherwise, Irvine and Pettibone [9] found the fecal

coliform densities in water sample from the Buffalo river reach were several logs lower than in the sediment, but the bacteria densities in sediment were weakly correlation with particle size and organic matter.

Indicator bacteria levels fluctuated seasonally with an average of 79 of total coliforms and enterococci occurring during summer months [11].

Al-Hilla River has been studied by many authors especially in the sense of water quality such as heavy metals and PAHs [12,13]. Therefore, this study aimed to investigate the incidence of the bacterial indicator in water and sediments of Al-Hilla River that lies in Iraqi middle.

Materials and Methods

Study area

Euphrates River it is one of main irrigation systems in Iraq, especially in its middle sites. Al-Hilla River branch out from Euphrates River, after crossing the Al-Hindiya barrage. Six sites were selected along Al-Hilla River (Figure 1):

Site 1: in Al-Mussayab district before Euphrates branching.

Site 2: in Al-Shujaireia region after the branching and represent first site in Al-Hilla River, it is widely and slows river flow.

Site 3: in Sinjar region near Ancient Babylon city, it exhibit low discharge to the river in this site.

Site 4: in Al-Hilla city center, the river flow increase and the discharge to the river also increased.

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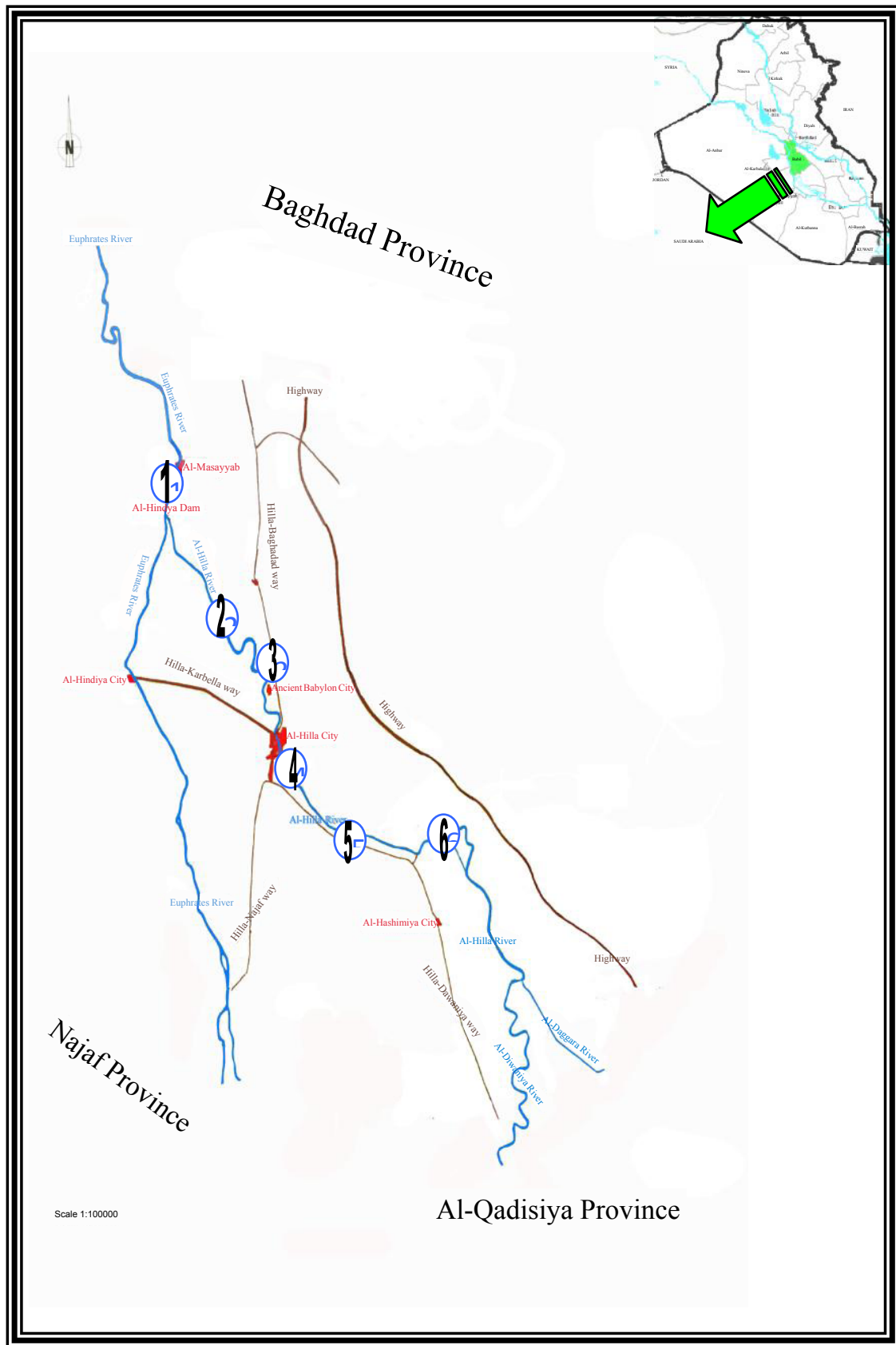


Figure 1: Map shows the studied sites in Al-Hilla River.

Site 5: in Al-Farisi region south of Al-Hilla city, high rate of effluent to the river, and

Site 6: in Al-Hashymiya city represent last sites in Al-Hilla River.

Sample collection

Water and sediments samples were collected monthly from March2010 to February2011 at six different sites. Samples were collected by using sterilized glass bottles, the collected samples were transport to the laboratory by ice box for analysis.

Bacterial identification

Total Viable Bacterial Counts (TVBCs) were determined by using the spread plate method and incubated at 22°C and 37°C [5]. The Total Count Bacteria (TCB) and Fecal Coliform (FCB) were determined by using Most Probable Number (MPN) method. One milliliter from each dilution was added to each of triplicate tubes containing 5ml of MacConkey broth, these tubes had been incubated at 37°C for 48hrs for Total Coliforms Bacteria and at 44°C (in water bath) for 24hrs for Fecal Coliforms Bacteria, positive result by formation gas that lead to rise derhum tubes, these tubes were complete the identification by microscopic examination and biochemical tests. Faecal Streptococci was determined by using of Azide Dextrose broth by MPN method at 37°C for 48hrs, positive tubes was indicated by dense turbidity and formation of purple [2,5].

Three decimal dilutions for each sample were established with three tubes for each dilution. MacConkey broth as presumptive tests determinations of TC and FC. The confirmation of TC test by using of brilliant green bile, finally this test is completed by Gram stain. In case of FC, confirmation test was use EC medium at 44.5±0.5°C (by water bath).Fecal Streptococci was identify by MPN method that used azide-dextrose broth in the presumptive test and was confirm by ethylviolet azide broth.

Results and Discussion

The distribution and seasonal variation of the Total Bacterial Count in the water and sediment of Al-Hilla river are shown in the Table 1 and Figure 2.

TVBC in this study ranged between 9×10³ CFU/100ml at the site2 and 68×10³ CFU/100ml at the site4 in the water samples and ranged between 11×10³ CFU/100ml at the site2 and 70×10³ CFU/100ml

at the site1 in the sediment samples. This results indicating that the high values were recorded in the July and August-2010, respectively. Figure 2 reflecting the effect of high content of organic matter due to flourishing of phytoplanktons which increased active multiplication of bacteria [14].

The results revealed high level of TCB at different sites and seasons of current study (Table 1).The highest number of TCB was recorded during spring and summer ,which might be the consequence of the high level of suspended solid and nutrients in the drainage water which affected the survival of aquatic microflora [15], or due to the positive relationship between temperature and bacterial levels suggests that heat induced growth may be a contributing factor to seasonally high bacteria levels [11].Wastes from agricultural processes, which are usually discharged into surface water have been reported to serious environmental and human health concern [16] .In this field, the results revealed high number of fecal coliform in the water and sediments from all study sites ranged between 11-155cell/100mL from water and 21-211cell/100mL from the sediments, respectively. Whitman et al. [17] attributed a gradual increase of *E.coli* bacteria in water and sediment during hot seasons to higher survival and growth at warmer temperature. Fecal coliforms are the best indicators for the assessment of recent fecal pollution, mainly caused by raw and treated sewage, and diffuse impacts from the farm land and pasture [3].

In this study fecal indicator bacteria abundance were measured in samples collected in large river located in rural areas. Data showed that this river which flowing through pastures was more contaminated than those rivers which flowing through agricultural areas [18]. The MPN of *E. coli* and fecal streptococci as indicator bacteria were ranged between 11-155cell/100mL and9-20cell/100mL respectively in the water, and between2-211cell/100mL and 14-311cell/100mL respectively in the sediments.

The results showed the high variability in levels and number of bacterial indicators in seasons and sites in Al-Hilla River may be due to the variation of environmental conditions such as solar radiation, turbidity, temperature, salinity, dissolved oxygen and organic matter [1]. The minimum counts of the indicator bacteria were recorded in the warmer seasons, which might be attributed to the rapid die-off with increasing of solar radiation and high temperature [19].

A ratio between faecal coliforms and faecal streptococci were used to indicate the origin of bacterial pollution in the surface and ground

Tests Sites	Total Count(×10 ³) Cell/100ml		Total Coliform Cell/100ml		Faecal Coliform Cell/100ml		<i>E.coli</i> Cell/100ml		Faecal Streptococcus Cell/100ml	
	Water	Sediments	Water	Sediments	Water	Sediments	Water	Sediments	Water	Sediments
1										
2	10-62.3 (30.41 ± 16.63)	14-70 (39.08 ± 20.42)	35-122 (82.58 ± 35.76)	41-207 (132.75 ± 72.08)	18-111 (66 ± 39.68)	22-200 (84.33 ± 54.68)	18-111 (66 ± 39.68)	22-200 (84.33 ± 54.68)	11-132 (79.08 ± 50.46)	28-193 (102.16 ± 58.68)
3	9-60 (30.06 ± 17.10)	11-62 (37.46 ± 20.81)	31-123 (79.5 ± 38.46)	40-208 (133.83 ± 73.49)	15-114 (66.33 ± 43.71)	27-187 (83.08 ± 53.21)	15-114 (66.33 ± 43.71)	27-187 (83.08 ± 53.21)	12-140 (84.25 ± 51.47)	29-180 (103.33 ± 55.83)
4	17-68 (35.08 ± 14.71)	19-60 (42.29 ± 15.77)	36-133 (88.5 ± 37.65)	47-320 (162.66 ± 103.8)	20-125 (77.25 ± 41.08)	31-188 (108.58 ± 61.2)	20-125 (77.25 ± 41.08)	31-188 (108.58 ± 61.2)	22-201 (94.75 ± 57.55)	37-207 (118 ± 67.33)
5	19-66 (39.5 ± 14.22)	23-64 (47.75 ± 15.46)	38-138 (96.58 ± 41.04)	55-397 (214.91 ± 133.4)	28-155 (91.25 ± 46.86)	39-211 (125.75 ± 68.3)	28-155 (91.25 ± 46.86)	39-211 (125.75 ± 68.3)	32-200 (107 ± 58.13)	41.311 (141.5 ± 81.88)
6	18-61 (36.41 ± 13.62)	23-61 (46.25 ± 15.55)	42-130 (93.66 ± 36.04)	50-390 (222.58 ± 142.86)	24-140 (89.08 ± 48.68)	40-208 (126.08 ± 70.41)	24-140 (89.08 ± 48.68)	40-208 (126.08 ± 70.41)	25-183 (110.16 ± 62.61)	43-288 (140.33 ± 80.34)

Table 1: The bacterial indicator count rang (Mean ± SD) in water and sediments in Al-Hilla river during study period (March 2010- February 2011).

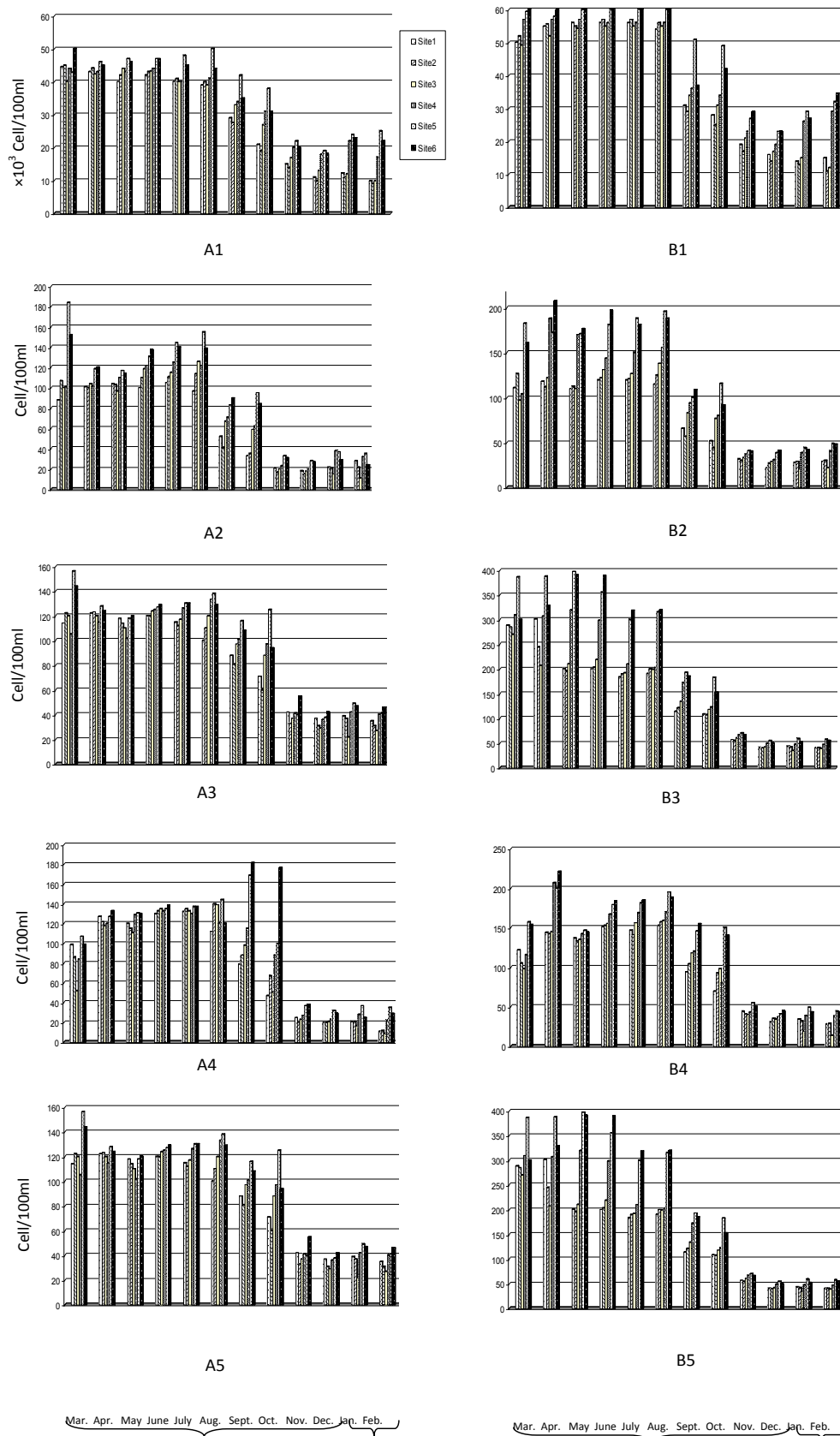


Figure 2: Bacterial Indicators in Water and Sediments of Al-Hilla River.

water samples [7]. If the ratio is 4 or greater that indicate the human source of pollution, ratio between 0.1-0.6 indicate the domestic animal source, where as when the ratio is less than 0.1 that indicate the wild animal source of pollution. The results of current study indicate there is a mixed origin of fecal pollution in Al-Hilla river, because the domestic and agricultural wastes are discharged to the river [12,20]. According to WHO [21], the water and sediments of Al-Hilla river contain a high level of bacterial pollution; WHO recommended a mean value of 1000MPN/100mL fecal coliforms in the wastewater used for irrigating of vegetable, whether using of Al-Hilla river water for irrigation may increase the risk of spreading infection [22].

Conclusion

The microbial pollution of Al-Hilla River was assessed by monitoring of fecal indicator bacteria (*E.coli* and Enterococci) for the contamination in the water and sediments. Sediments of studied river contained high levels of bacterial indicators, where the maximum number of TCB and FCB were recorded in the spring and summer.

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