

## Polycyclic aromatic hydrocarbons (PAHs) monitoring in sediments for some local regions southern Iraq

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**Abstract** - Polycyclic aromatic hydrocarbons (PAHs) are pollutants with a wide range of dangerous organic chemicals, which have received a considerable attention because they are widely distributed in the environment, many of which have a mutated potential, cause genetic toxicity and carcinogenic effects on natural ecosystems. Spatiotemporal variations of total hydrocarbons (PAHs) in sediments in some regions southern Iraq were measured during 2019, the highest concentration were 14.94 µg/g in Al-Burqa at Al-Hammar marsh, and the lowest was 2.05 µg/g in Al-Sadda station in East Hammar marsh too. These results were compared with previous studies since 1982 in the same region, these studies were calculated to estimate a bulk value for each study. results of the current study showed that PAHs concentration in water and sediments in Al-Hammar marsh, Al-Chibayesh marsh and Shatt Al-Arab river were within the permissible limits and there were no significant differences spatially and temporally in the study area. So we can say that there is no real polycyclic aromatic hydrocarbons pollution in these specific water bodies southern Iraq since 1982.

**Keywords:** Polycyclic aromatic hydrocarbons, sediments, Al-Hammar marsh, Al-Chibayesh marsh.

### Introduction

Water is one of the most important natural resources at all; it considered a fundamental factor in human life. Water sources have witnessed a significant deterioration recently in the absence of sufficient attention. The last twenty years have been marked by a great deterioration in the Iraqi environment from air pollution to water and soil pollution.

Iraq is experiencing a period of water-related decline due to multiple pollution sources, and the absence of the right strategies for developing and promoting the basis for providing a clean water (Al-Batat, 2009).

The real attention to oil pollution began in 1922 after the emergence of visible cases of oil stains on the surface of water in different seas and oceans and this prompted scientists to study this phenomenon and its effects on the aquatic environment (Al-Saad *et al.*, 2003).

Hydrocarbons could reach the aquatic environments through natural sources such as natural perfusion from the seabed, or unnatural sources which is the most influential and harmful, this could be happen by the transportation of oil and its derivatives using oil tankers, the balance water resulting from it, and the repairing of their reservoirs.

Oil exploration processes and extraction from the seas, as well as oil refineries discharges, the export ports and washing the loading platforms surly added quantities of hydrocarbons to water (NRC, 2003 and Nasir, 2007).

Large amount of hydrocarbons could be added to the aquatic environment by dumping industrial waste and power plants effluents, also by the atmospheric fallout and the emission of car exhaust (Zhu *et al.*, 2001; Liu *et al.*, 2019; Grmasha *et al.*, 2020).

The oil components vary in their degree of toxicity to the living organisms, the most dangerous and toxic compounds are aromatic compounds with low molecular weight due to their solubility in water. While polycyclic aromatic compounds PAHs are dangerous and toxic to the long term and a large part of them are carcinogenic followed by aromatic alkanes, olfins and alkanes (Zhu *et al.*, 2001; landis, 2003; Pulster *et al.*, 2020). PAHs have become a global concern in developed as well as in developing countries owing to their abundance, persistence, toxicity (included in lists of hazardous substances), long-lasting atmospheric transportation and detrimental health risks to aquatic life and human being (Kilunga *et al.*, 2017; Barhoumi *et al.*, 2019; Ukalaska and Smreczak, 2020).

In recent decades, PAHs concentrations and abundance, source apportionment and ecological risk to aquatic environment including humans have been widely investigated in sediment from riverine environments worldwide (Bo Li *et al.*, 2020; Souza *et al.*, 2018).

This study aimed to summarize the state of PAHs southern Iraq water since 1982, to give a better understand about our water bodies health, and a comprehensive image about these pollutants in sediments.

## Materials and Methods

### Study Area:

Southern part of Iraq included different kinds of water bodies; small and big natural rivers like Shatt Al-Arab which depending with its water majorly on Tigris and Euphrates, as well as some tributaries out of Al-Howaiza and Al-Hammar marshes (Al-Hejuje, 2014; Qzar *et al.*, 2021). Marsh lands which covers almost 3000-4000 Km<sup>2</sup>, represented by Al-Hammar, Al-Chibayesh and Al-Howaiza marsh. As well as estuary, and a marine line along the Arabian gulf.

### Sediments Sampling and Extraction:

Samples have been collected from seven stations; four of them in Shatt Al-Arab river; Al-Dayr and Al-Shafi which represent the upper part of it, while Al-Haritha and Al-Mohamadyat represent the middle part of it, Al-Gibayish marsh, and Al-Hammar marsh in tow sampling sites Burqa and Sadda (Fig. 1).

Surface sediments samples were dried out, grind finely, sieved with mesh pore size 0.64μ, extracted according to (UNEP, 1992) to evaluate the concentration of polycyclic aromatic hydrocarbons (PAHs), using soxhlet intermittent extraction and mixture of Methanol:Benzen (1:1 v:v) for 48 hours. PAHs concentration were measured by using Gas Chromatography. The results were tested under significant of 5% using SPSS statistics version 22.

## Results and Discussion

The results of the current study showed that PAHs concentration in the sediments were within the permissible limits according to CCME (1999).

The higher concentration was 14.94 μg/g in Al-Burqa station, followed by Al-Muhamadyat which was 10.72 μg/g, while the lowest concentration was 2.05 μg/g in Al-Sadda station (Table 1).



Figure 1. Location map of study area.

Table 1. PAHs concentrations in sediments ( $\mu\text{g/g}$  dry weight) at the studied stations.

Stations		PAHs ( $\mu\text{g/g}$ )
Upper part of Shatt Al-Arab	Al-Dayer	4.78
	Al-Shaffi	8.26
Middle part of Shatt Al-Arab	Al-Haritha	3.29
	Al-Muhamadyate	10.72
Al-Hammar Marsh	Al-Burqa	14.94
	Al-Sadda	2.05
Al-Chibayesh Marsh		4.16

Riverbed sediments are an important historical indicator of water pollution in rivers and watershed over time, considering that it is a sink of most pollutants in the sediment, which has impacts on the life of benthic communities (Qiao *et al.*, 2006).

The distribution of PAHs in surface sediments particularly in 0-5 cm segment, has an importance to studies of oil pollution, and in understanding temporal variations in the aquatic environment (Sen Gupta *et al.*, 1993).

The highest concentration of PAHs were found in Shatt Al-Arab river (Table 2), this could be due to oil spillage and engine exhaust from a number of small fishing boats moored nearby and also contamination by power boat activity, whereas low concentrations in some stations could be due to higher rate of microbial degradation or volatilization.

Table 2. Comparison between total hydrocarbons PAHs ( $\mu\text{g/g}$ ) content in sediments for the present study with the other previously studies.

Location		Total Hydrocarbons ( $\mu\text{g/g}$ )	Ref.
Shatt Al-Arab river		13.93 $\pm$ 143	Douabul 1984
Shatt Al-Arab	Upper part of Shatt Al-Arab	12.4	Al-Imarah <i>et al.</i> , 1995
		11.08	Al-Imarah <i>et al.</i> , 1995
		16.54	Al-Hejuje, 2015
		46.125 $\pm$ 4	Al-Saad, 2017
	Lower part of Shatt Al-Arab	74.27 $\pm$ 44.63	Ibrahim, 2004
		34.855 $\pm$ 5	Al-Saad, 2018
Upper part of Shatt Al-Arab	6.52	Current study	
Middle part of Shatt Al-Arab	7.01		
Arabian Gulf		4.7	Al-Samra and El-Zawahry, 1991
		3.66	Al-Saad, 2000
		50.17 $\pm$ 13.72	Nasir, 2007
		89.25	Al-Imarah, 2007
		25.8 $\pm$ 6	Al-Saad, 2007
Khor Al-Zubiar		14.76 $\pm$ 13.78	Al-Hamdi, 1989
		4.88 $\pm$ 0.36	Al-Saadon, 2002
		11.91	Al-Saad, 2008
		6.89	Al-Shawi, 2010
		41.9	Al-Saad, 2017
Marshes	Al-Howaiza Marsh	19.4	Al-Khatib, 2008
	Al-Chibayesh Marsh	0.19	Talal, 2008
	Al-Hammar Marsh	8.5	Current Study
	Al-Chibayesh	4.16	
Shatt Al-Basrah		2.49 $\pm$ 1.63	Al-Saadon, 2002
		25 $\pm$ 18	Aziz, 2005
Al-Kahlaa River (Missan)		34.56 $\pm$ 19.56	Jazza, 2015
Umm Qasser		26.27	Al-Saad 2017

The sources of PAHs in Shatt Al-Arab estuary and North-West Arabian Gulf were dominated by both pyrogenic and petrogenic input, but rarely of biogenic origin (Al-Saad *et al.*, 1997).

There are many factors that affect the distribution of PAHs such as flushing, sedimentation, bacterial degradation and photo oxidation, exposing a solution of water-gasoline to natural sun light could lead to generation of PAHs compounds, many organisms such as fungi, bacteria and algae could oxidize some PAHs. Degradation of PAHs may occur either by biological metabolism or chemical oxidation (Ehrharat and Burns, 1993; Obayori and Salam, 2010).

The range of PAHs compounds found in particulate matter is more extensive than that in dissolved phase, higher levels in sediments probably due to the deposition of compounds adsorbed onto particulate matter because of PAHs are lipophilic compounds with very low water solubility and therefore, their concentration in water is low (Qiu *et al.*, 2009; Nasr *et al.*, 2010).

As a consequence of their hydrophobic nature, PAHs in aquatic environments rapidly tend to become associated to the particulate matter ending in sediment. Therefore, sediments represent the most important reservoir of PAHs in the marine environment, this was in agreement with Lealy and Colwell (1990), Al-Saad *et al.* (1997) and Al-Saad (1998).

The statistical analysis for the results of previous and present studies, showed no significant differences in the concentrations of PAHs in sediment samples among study years and stations.

## Conclusion

According to these results it could be said that southern Iraqi sediments were unpolluted with polycyclic aromatic hydrocarbons since 1982.

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## تقدير مستويات المركبات الهيدروكربونية الاروماتية في رواسب بعض المناطق المحلية جنوب العراق

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**المستخلص -** تتميز الهيدروكربونات العطرية متعددة الحلقات (PAHs) باحتوائها على مجموعة واسعة من المواد الكيميائية العضوية الخطرة، والتي حظيت باهتمام كبير نظرا لانتشارها على نطاق واسع في البيئة، تمتلك العديد من هذه المركبات القدرة على احداث الطفرات الوراثية مما يسبب السمية الوراثية وتأثيرات مسرطنة على النظم البيئية الطبيعية. قيست التغيرات الزمانية والمكانية لإجمالي الهيدروكربونات (PAHs) في رواسب جنوب العراق خلال عام 2019، إذ بلغ أعلى تركيز 14.94 ميكروغرام/غرام في منطقة البركة في هور شرق الحمار، وأدناها 2.05 ميكروغرام/غرام في محطة السدة في هور شرق الحمار ايضا. قورنت هذه النتائج مع الدراسات السابقة منذ عام 1982 لنفس المنطقة، وتم تقدير القيمة الإجمالية لكل دراسة منها. أظهرت نتائج الدراسة الحالية أن تركيز الهيدروكربونات العطرية متعددة الحلقات في رواسب احوار شرق الحمار والجبايش فضلا عن شط العرب كانت ضمن الحدود المسموح بها ولم تكن هناك فروق معنوية مكانية أو زمانية في منطقة الدراسة. لذلك يمكننا القول أنه لا يوجد تلوث حقيقي للهيدروكربونات العطرية متعددة الحلقات في هذه المسطحات المائية المحددة جنوب العراق منذ عام 1982.