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Monitoring of Total Petroleum hydrocarbons (TPHs) in the sediments of some local regions of southern Iraq

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Abstract - Petroleum hydrocarbons 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 petroleum hydrocarbons (TPHs) in the sediments of some regions of 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 the East of Al-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. The results of the present study showed that TPHs concentration in water and sediments at 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 conclude that there is no real total petroleum hydrocarbons pollution in these specific water bodies southern Iraq since 1982.

Keywords: Total petroleum hydrocarbons (TPHs), sediments, Al-Hammar marsh, Al-Chibayesh marsh, Southern Iraq.

Introduction

Water is one of the most important natural resources at all; it is considered as 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 are 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.

Hydrocarbons 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 (Ukalaska and Smreczak, 2020).

In recent decades, Hydrocarbons 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).

The present study aims at summarizing the state of total petroleum hydrocarbons (TPHs) in the south of Iraq water since 1982, to give a better understanding of 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 whose water is majorly depending on the Tigris and Euphrates Rivers, as well as some tributaries out of Al-Huwaiza and Al-Hammar marshes (Al-Hejuje, 2014; Qzar *et al.*, 2021).

The marsh lands which covers almost 3000-4000 Km^2, are represented by Al-Hammar, Al-Chibayesh and Al-Huwaiza marshes, as well as an 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 river, while Al-Hartha and Al-Mohamadya represent the middle part of it, Al-Chibayish marsh, and Al-Hammar marsh with two sampling sites; Al-Burga and Al-Sadda stations as shown in Figure (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 total petroleum hydrocarbons using soxhlet intermittent extraction and mixture of Methanol:Benzen (1:1 V:V) for 48 hours.

Total petroleum hydrocarbons concentration were measured by using Spectroflurometer. The results were tested at the 5% significant level using SPSS statistics version 22.

Results and Discussion

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

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

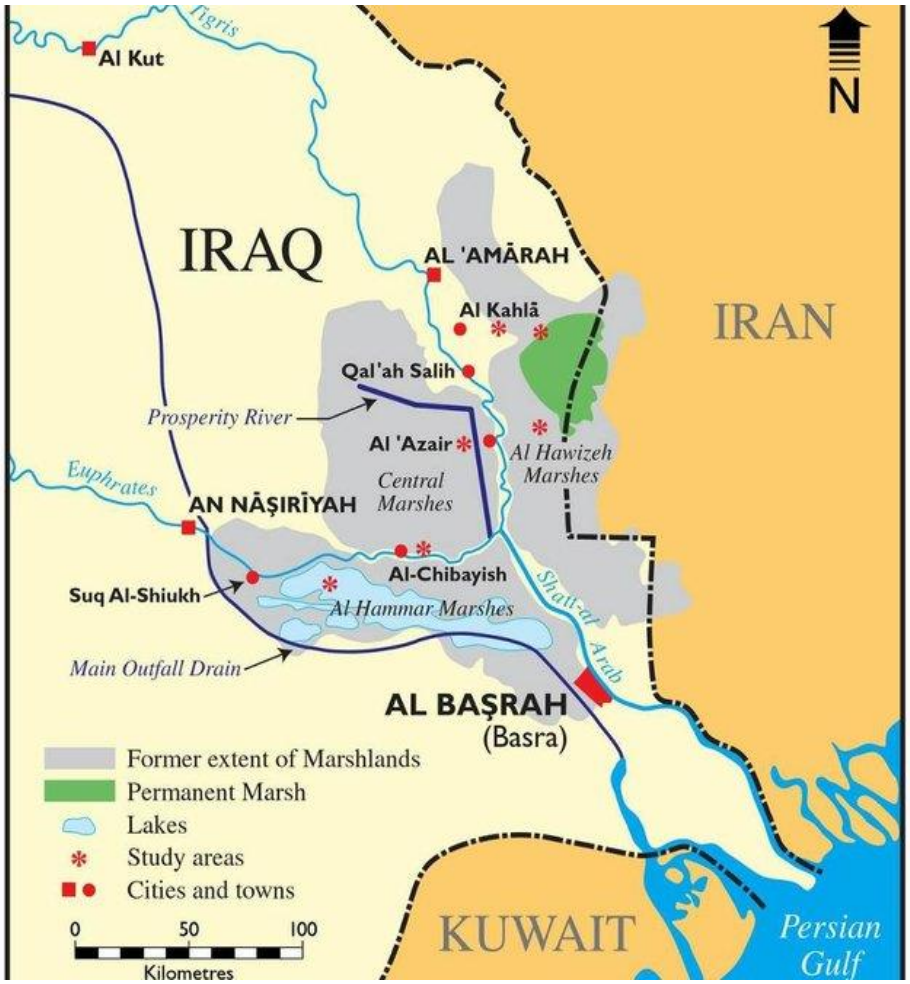

Figure 1. Location map of the study area.

Table 1. Total petroleum hydrocarbons (TPHs) (µg/g dry weight) concentrations in the sediments at the studied stations, Southern Iraq.

Stations		TPHs (µg/g)
Upper part of Shatt Al-Arab	Al-Dayer	4.78
	Al-Shaffi	8.26
Middle part of Shatt Al-Arab	Al-Hartha	3.29
	Al-Muhamadyat	10.72
Al-Hammar Marsh	Al-Burga	14.94
	Al-Sadda	2.05
Al-Chibayesh Marsh		4.16

Riverbed sediments are 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 petroleum hydrocarbons in surface sediments particularly in 0-5 cm segment, is of a special importance in the studies of oil pollution, and in understanding temporal variations in the aquatic environment (Sen Gupta *et al.*, 1993).

The highest concentration of total petroleum hydrocarbons 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 activities, whereas low concentrations in some stations could be due to higher rate of microbial degradation or volatilization.

Table 2. Comparison between total petroleum hydrocarbons (µg/g) content in the sediments of the present study with other previous studies, carried out in the south of Iraq.

Location		Total Hydrocarbons (µg/g)	Ref.
Shatt Al-Arab river		13.93 ± 143	Douabul (1984)
Shatt Al-Arab	Upper part of Shatt Al-Arab	12.4	Al-Imarah *et al.* (1995)
		11.08	Al-Imarah *et al.* (1995)
		16.54	Al-Hejuje (2015)
		46.125 ± 4	Al-Saad (2017)
	Lower part of Shatt Al-Arab	74.27 ± 44.63	Ibrahim (2004)
		34.855 ± 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 ± 13.72	Nasir (2007)
		89.25	Al-Imarah (2007)
		25.8 ± 6	Al-Saad (2007)
Khor Al-Zubiar		14.76 ± 13.78	Al-Hamdi (1989)
		4.88 ± 0.36	Al-Saadon (2002)
		11.91	Al-Saad (2008)
		6.89	Al-Shawi (2010)
		41.9	Al-Saad (2017)
Marshes	Al-Huwaiza 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 ± 1.63	Al-Saadoon (2002)
		25 ± 18	Aziz (2005)
Al-Kahlaa River (Missan)		34.56 ± 19.56	Jazza (2015)
Umm Qasser		26.27	Al-Saad (2017)

The sources of TPHs in the 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 TPHs such as flushing, sedimentation, bacterial degradation and photo oxidation, exposing a solution of water-gasoline to natural sun light could lead to generation of TPHs compounds. Many organisms such as fungi, bacteria and algae could oxidize some TPHs. Degradation of TPHs may occur either by biological metabolism or chemical oxidation (Ehrharat and Burns, 1993; Obayori and Salam, 2010).

The range of TPHs 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 TPHs are lipophilic compounds with very low water solubility and therefore, their concentration in water is low (Qiu *et al.*, 2009; Nasir *et al.*, 2010).

As a consequence of their hydrophobic nature, TPHs in aquatic environments rapidly tend to become associated with the particulate matter ending in sediment. Therefore, sediments represent the most important reservoir of TPHs 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 of the results of the previous and the present studies, showed no significant differences in the concentrations of TPHs in the sediment samples among the different years and stations.

Conclusion

According to the present results it could be suggested that southern Iraqi sediments were unpolluted with total petroleum hydrocarbons since 1982.

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مستويات الهيدروكربونات النفطية الكلية في رواسب بعض المناطق المحلية جنوب العراق

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المستخلص – تتميز الهيدروكربونات النفطية 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 طفرات وراثية مما يسبب السمية الوراثية وتأثيرات مسرطنة على النظم البيئية الطبيعية. قيست التغيرات الزمانية والمكانية لإجمالي الهيدروكربونات 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 الحمّار 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 النفطية الكلية في رواسب اهوار 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 النفطية الكلية في هذه المسطحات المائية المحددة جنوب العراق منذ عام 1982.