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Total Hydrocarbons in Water, Sediments and some Aquatic Plants at Al-Chibayish Marsh in Southern of Iraq

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Abstract - Concentration and distribution of total petroleum hydrocarbons in water, sediment and two merged aquatic plants species (*Phragmites australis* and *Typha domingensis*) have been detected. The samples were collected from four selected stations at Al-Chibayish marsh in Thi-Qar province, southern Iraq seasonally from August, 2017 to April, 2018. Spectroflurometer (Shimadzu-RF-540) was used for this purpose. Results showed that the lowest concentration in water was 1.91 µg/l recorded in summer season, whereas the highest concentration was 6.79 µ/l recorded in winter season. In sediments, the highest concentration 17.98 µg/g dry weight was recorded in winter season, while the lowest concentration was 2.98 µg/g dry weight was recorded in summer. The range of hydrocarbons concentrations in two aquatic plants species was 6.00-34.91 , 5.25-30.68 µg/g dry weight, for P*hragmites austeralis, Typha demingensis* respectively. The present study indicated that there are concentrations of hydrocarbons exist in the study area were the permissible range

الهيدروكربونات الكلية في الماء والرواسب وبعض النباتات المائية في هور الجبايش جنوب العراق

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المستخلص - تم الكشف عن تركيز وتوزيع المركبات الهيدروكربونية الكلية في الماء والرواسب ونوعين من النباتات المائية البارزة (*Phragmites australis* و *Typha domingensis*) جمعت العينات من أربع محطات مختارة في اهوار الجبايش في محافظة ذي قار جنوب العراق موسميا من آب 2017 الى نيسان 2018 تم استخدام مقياس التألق الطيفي نوع (Shimadzu-RF-540) لهذا الغرض. أظهرت النتائج أن أقل تركيز في الماء سجل في فصل الصيف 1.91 ميكروغرام/لتر، بينما أعلى تركيز سجل في فصل الشتاء 6.79 ميكروغرام/لتر. وفي الرواسب سجل أعلى تركيز 17.89 ميكروغرام/غرام وزن جاف في فصل الشتاء بينما سجل أقل تركيز2.98 ميكروغرام/غرام وزن جاف في فصل الصيف. وكان مدى تراكيز الهيدروكربونات في نوعين من النباتات المائية 6.00 – 34.91 و 5.25 – 30.68 ميكروغرام/غرام وزن جاف في نبات *Phragmites austeralis* و *Typha demingensis* على التوالي. أشارت الدراسة الحالية إلى وجود تراكيز للهيدروكربونات في منطقة الدراسة ولكن مستوياتها كانت ضمن الحدود المسموح بها.

الكلمات المفتاحية: الجبايش، النباتات المائية، الهيدروكربونات الكلية، الماء.

Introduction

Water pollution is one of the serious problems as a result of the intricate structure of pollutant materials that become more intricate when exposed to various climate conditions, as well as their

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effects and their relationship with all kinds of life (Kadhaim, 2017). Oil pollution has occupied an important site among the sources of environmental pollution, and this importance comes due to the increase in expansion worldwide oil production rates (Abha and Singh, 2012).

Crude oil and oil derives are the main origins of hydrocarbons in the aquatic system. Other sources are the ones which are referred to as natural or biogenic hydrocarbons (Al- Saad, 1995; Karem, 2017).

Hydrocarbons compounds are commonly conveyed into the aquatic environment in the form of solutions either as tempest waters, domestic wastes, urban runoffs, or industrial discharges, but only a little portion of the load ultimately remains in solution. Instead, they are scavenged from the water column to the bottom sediments through flocculation and sedimentation, giving increase to concentrations in the sediment greater in amount than in the water column (Olver, 2008). In aquatic ecosystem, hydrocarbons tend to connect with particulate organic matter because of their hydrophobic nature, then they are deposited in the underlying sediments (Qiu *et al*.,2009). Marshes system can act as a sink of various compounds either through sedimentation or bio-accumulation. The Mesopotamian marshlands are known as sink for different pollutants like hydrocarbons compounds (Mitsch and Gosselink, 2007; Commendatore *et al*., 2012).

The different components of hydrocarbons vary in their toxicity to organisms. The most hazardous and toxic compounds are aromatic compounds with low molecular weights like benzene, toluene and zeolins because of their solubility in water (Boelsterli, 2000), PAHs are toxic and dangerous in the long term and a large proportion of them are carcinogenic (Zhu *et al*., 2001) such as Benzo (a) Pyrene, Anthracene, Florenthene, Benzo (a) Anthracene, Chrycene, Benzo (bck) Flouranthene, Dibenzo (ah) anthracene), followed by cycloalkane compounds in terms of toxicity, olefins and then normal alkanes (Landis, 2003).

Many organisms are capable of assembling hydrocarbons in their bodies at high concentrations (Ackman *et al*., 1996). Aquatic plants play an important role in the treatment of environmental pollution with hydrocarbons through its ability to accumulate these compounds. plants can uptake hydrocarbons compounds from sediment through their roots and translocate them to other parts of plant (Zhong *et al*., 2011). Uptake rates are generally governed by concentration, water solubility, physicochemical state, also the concentrations of hydrocarbons within the bodies of plants depend on the amount of fat as there is a correlation between the amount of fat and the concentration of hydrocarbons in plan tissues (Nasir, 2007).

The technique can be used plants for the removal of environmental pollutants such as organic pollutants that includes polychlorinated biphenyls (PCBs), poly aromatic hydrocarbons (PAHs) and pesticides is refer to as phytoremediation (Greipsson, 2011), which method is novel, cost effective and ecofriendly (Vithanage *et al*., 2012).

The aim of this study is to determine the concentration, sources and distribution of total hydrocarbons compounds in water and sediments. Also to detect the ability of aquatic plants to accumulate these compounds in their tissues and the possibility to purify the marsh from hydrocarbons pollutants.

Materials and Methods

Samples were collected seasonally from August, 2017 to April, 2018 from four stations were selected at Central marshes (Al- Chibayish), sampling points were geo-located using geographical positioning system (GPS) at the following coordinates: 31˚ 00- 34.7= N and 47˚ 01- 50.3= E (Abusubat , station 1); 31˚ 01- 57.5= N and 47˚ 02- 7.7= E (Al-Baghdadiya 1, station 2); N 31˚ 02- 58.4= and 47˚ 00- 57= E (Al- Baghdadiya 2 , station 3); 31˚ 04- 32.4= N and 47˚ 00- 58.5= E (Al-Hammara , station 4).

Water samples were collected from each stations at least 20 -30 cm under the water surface, about 5 liters were collected directly by dark glass bottles, which preserved in situ with 20 ml chloroform.

Sediments samples were taken by using a Van veen grab sampler, the water was allowed to drain off, and stored in aluminum foil, and then the samples were placed in ice box until reaching the lab. While plant samples were collected by hand and washed several times with marsh water to remove the adherence particulate as possible.

In laboratory the sediment and plant samples were dried in air, grinded finely in an electrical stainless steel mortar and sieved through a 63 µm mesh sieve, stored in glasses containers until analysis.

The hydrocarbons in water sample were extracted according to UNEP (1989).The extraction method of hydrocarbons in sediment and plants samples were using soxhlet intermittent extraction according to (Goutex and Saliot,1980).

Calibration:

Basrah Regular Crude oil was used as a reference sample for the preparation of standard solutions by dissolving 0.003g of crude oil in pure n-hexane10ml**.** Spectrofluorometer (Shimadzu-RF-540) was used to quantify the total petroleum hydrocarbons in the extracted water, sediments and plants samples, at 360nm emission intensity, 310 nm excitation, and monochromatic slits of 10 nm.

Statistical Analysis:

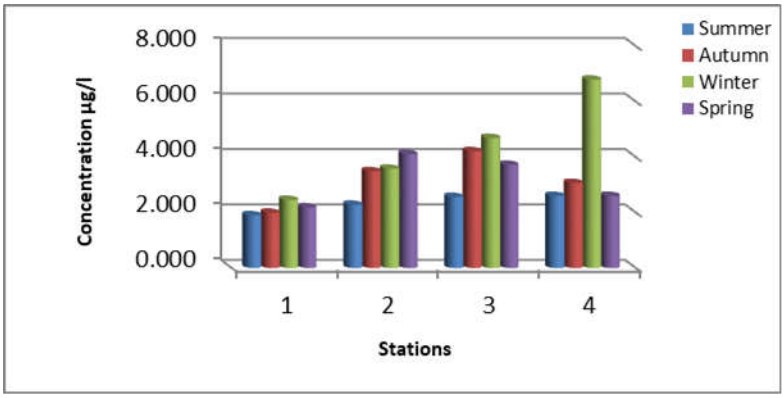
Analysis Of Variance (One –Way ANOVA) was applied by Minitab ver . 16.1 software to identify the existence of spatial and temporal significant differences

Results and Discussion:

Distribution and concentrations of petroleum hydrocarbons are a good indicator for the study state of the aquatic environment. It can indicate the source of the pollutant that deserve special emphasis or needs more control (Talal, 2008; Jazza, 2015).

In water samples the concentrations of total petroleum hydrocarbons ranged from 1.91µg/l at station 1 in summer to 6.79 µg/l at station 4 in winter, non-significant differences ($P \geq 0.5$) were found among seasons or stations (Fig.1). While the concentration of total petroleum hydrocarbons in sediments samples ranged from 2.98 µg/g at station 2 in summer to17.98 µg/g at station 4 in winter, non-significant differences ($P \geq 0.5$) were found among seasons or stations (Fig.2).

The levels of TPHs in water and sediments samples were showed during winter greater than summer season may be attributed to the low temperatures during winter which lead to decrease the evaporation and biodegradation processes by microorganism, in addition to the entrance of these compounds to the water environment from the atmosphere during rain, which are usually the products of fuels combustion and oil derivatives (Jazza, 2015).

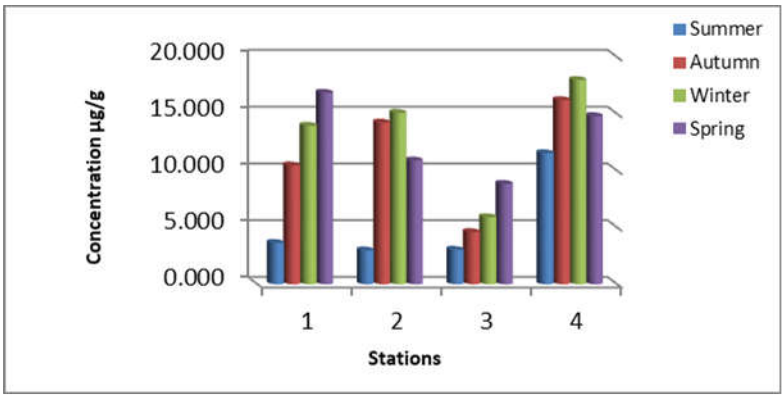


(Figure 1) Seasonal concentrations of TPHs (µg/l) in water from different sampling stations.

The other factor is photo-oxidation, which results in the breakdown of oil compounds in the water column, so that this process is very important to change these compounds into simple ones (Ehrhardt and Patric,1993).

As well as the high death of aquatic plants and phytoplankton during winter which cause to increase hydrocarbons concentrations in sediments (Al-Timari *et al*., 2003; Al-Imarah *et al*., 2006).

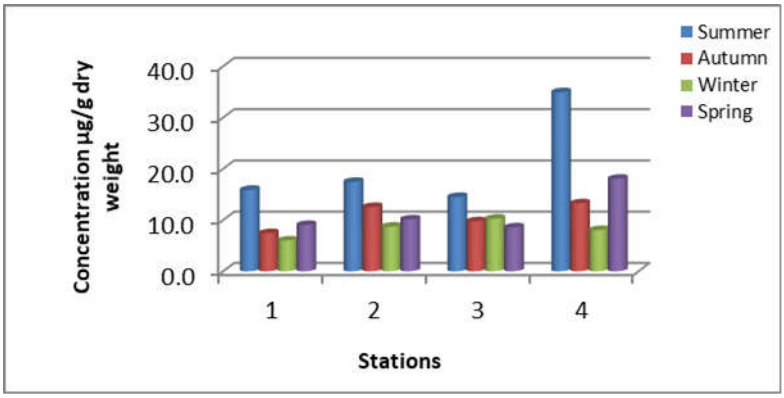
Also the results of the present study noticed the concentrations of TPHs in sediments samples were greater than those in water samples, that due to these pollutants in aquatic ecosystem tend rabidly to adsorption on particulates and suspended substances in the water column, then sink to the bottom (Al-Hejuje, 2014). As well hydrocarbons compounds enter living organisms through the food chains and eventually reach the sediment during death of these organisms(Al-Saad, 1995). The TPH concentrations of water and sediments samples in the present study agree with Al-Khatib (2008) and Al-Saad *et al*., (2009).



(Figure 2) Seasonal concentrations of TPHs (µg/g d.w) in sediments from different sampling stations.

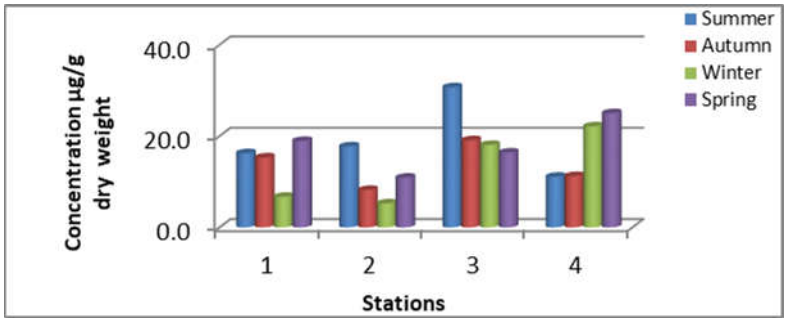
Aquatic plants, accumulate chemical compounds such as hydrocarbons, so they are used as bio- indicators to identify environmental changes in the region (UNE, 2001).

In present study the TPHs concentrations in *Phragmites. australis* species ranged from 6.00µg/g dry weight at station 1 in winter to 34.910 µg/g dry weight at station 4 in summer. Non–significant differences were found among stations. While significant differences ($P \leq 0.05$) were found among seasons, the highest mean value 20.67 µg/ g dry weight was recorded in summer and the lowest mean value 8.25µg/ g dry weight was recorded in winter (Fig.3). This may be due to the fact that summer is considered as the growth season of the plant (Al-Imarah *et al.,* 2006).



(Figure 3) Seasonal variations of TPHs (µg/gd.w) *P. australis* from different sampling stations.

While *Typha. domingensis* species the concentrations of TPHs during the four seasons ranged from 5.25µg/g dry weight at station 2 in winter to 30.68 µg/g dry weight at station 3 in summer. Non–significant differences were found among stations or among seasons. (Fig.4).



(Figure 4) Seasonal variations of TPHs (µg/gd.w) *T. domingensis* from different sampling stations.

The concentrations of TPHs in two species of aquatic plants may be attributed to the abilities of plants specie to accumulate of certain pollutants from the environment. Also the accumulation processes of pollutants may depend on some physical and chemical properties like temperature, pH, salinity, dissolved oxygen and concentration of nutrients in the surrounding environment (Thomas *et al*., 1984; Al-Saad,1994). In this study the concentration of TPHs were less clear difference between two selected plants, this was may be due to these plants are grow in the same area, and they exposure to similar pollutants source like oil split from boats, sewage and chemicals used for fishing (Talal, 2008). The concentration of TPHs at the current study noticed within studied plants tissues are higher than their concentration in water, which is consistent with the study of Al-Saad (1996) and Talal (2008).

Conclusion

This study provided data on the total hydrocarbon compound concentrations in the water, surface sediments of Al-Chibayish marshes. The results shown that the concentrations of these compounds in sediments higher than in water column which indicated that the sediments acted as a sink and source for these compound.

Also, the ability of aquatic plants to accumulate hydrocarbons compound higher than the concentration in water column, thus an indicator of the use of aquatic plants in the process of treatment of this type of pollutants in aquatic environment.

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