

Bioconcentration of petroleum hydrocarbons in four species of plants near Shatt Al-Arab River

Naif M. Aziz

Department of Biology, College of Science,
University of Basra , Basra-Iraq

Abstract

The concentrations of hydrocarbons were determined in leaves of four species of plants from Shatt Al-Arab River. The mean concentration of petroleum hydrocarbons in *Phoenix dactylifera* cv.Sayer, *Zizphus spina-christi* cv.Bambawi, *Cordia myxa* and *Nerium oleander* were (in $\mu\text{g/g}$ dry wt.): 6.03, 4.14, 4.00 and 2.1 respectively. The highest values of petroleum hydrocarbons were near parts of Shatt Al-Arab River comparing with the far parts. Oil refined station in Muftia, human and boat activities were the most important sources of pollution in this region.

التركيز الحيوي للهيدروكربونات النفطية في أربعة أنواع نباتية مختلفة قرب شط العرب

نايف محسن عزيز

قسم علوم الحياة-كلية العلوم/جامعة البصرة

الخلاصة

حدد تركيز الهيدروكربونات النفطية في أربعة أنواع نباتية مختلفة من منطقة شط العرب. بلغت معدلات تركيز الهيدروكربونات النفطية في نخيل التمر صنف السابر و أشجار السدر صنف البمباوي ونباتي البمبر و الدفلة (مقدره بالمايكغم/غم وزنا جافا): 6.03 و 4.14 و 4.00 و 2.1 على التوالي. ظهرت أعلى القيم من الهيدروكربونات النفطية عند الأجزاء القريبة من شط العرب مقارنة بالأجزاء الأبعد منه. إن من أهم مصادر التلوث في منطقة الدراسة كانت وجود منصة تحميل نفط في منطقة المفتية فضلا عن الفعاليات البشرية و حركة القوارب.

Introduction

Petroleum hydrocarbons may be released into environment in a variety of situations including natural seeps, accidental spills, refinery emissions, pipelines leakage, urban run-off and municipal wastewater discharges. Spills of petroleum hydrocarbons are having attention in recent years. Aquatic spills, because of their rapid spreading characteristics resulting in contamination of widespread areas, have attracted great publicity.

Shatt Al-Arab River receives continuous low levels of pollutants such as petroleum hydrocarbons (Al-Saad, 1995); the matter makes organisms in and around the river accumulate certain pollutants in its tissues. Terrestrial plants can accumulate certain pollutants from the environment (Thomas *et al.*, 1984), thus many workers select different species of plants from different localities in order to have information about organic micropollutants that are present in its environment.

The study of Aziz *et al.*, (2000) gave many data about the ability of date palm trees to accumulate hydrocarbons from the environment around Shatt Al-Arab River, while Aziz (2002) discussed the variation between two species of plants including *Cordia myxa* and *Solanum tuberosum* to bioconcentrate petroleum hydrocarbons in its tissues from diverse sources in the study area.

The aim of this study is to determine the concentration of petroleum hydrocarbons in different species of plants, including *Phoenix dactylifera* cv. Sayer, *Zizphus spina-christi* cv. Bambawi, *Cordia myxa* and *Nerium oleander* through different distances from Shatt Al-Arab River in order to provide more data in monitoring programs in this region.

Materials and methods

Samples of leaves of four species: A, B, C and D (*Phoenix dactylifera* cv. Sayer, *Zizphus spina-christi* cv. Bambawi, *Cordia myxa* and *Nerium oleander*) were collected from different distances (300m, 900m, and 1200m away from Shatt Al-Arab River) from Shatt Al-Arab region (Fig.1). The

samples were dried in oven at 50C°. The extraction procedure was based upon that of Goutx and Saliot (1980), which have previously been used by UNEP (1992).

The samples were placed in pre-extracted cellulose thimble and soxhlet extracted with 150 ml methanol: benzene (1:1) mixture for 24 hours. At the end of this period, the extract was transferred to a storage flask and the samples were further extracted with a fresh solvent. The combined extracts were reduced in volume to ca. 10 ml and saponified for 2 hours with a solution of 4N KOH in 1:1 methanol: benzene. After extracting the unsaponified matter with hexane, the extract was analyzed with UVF analysis. The basic quantitative measurements for total petroleum hydrocarbons were made by measuring emission in intensity at 360 nm with extraction set at 310 nm and monochromator slits of 10 nm. All blanks, standards and samples were run at identical instrumental condition. For this work a Shimadzu RF-540 spectrofluorometer equipped with a DR-3 data recorder was used. However, procedural blanks consisting of all reagents and glass-ware were used during the analysis were periodically determined. Fat content was done upon that of AOAC (1984).

Results and discussion

There were variations in the concentration of petroleum hydrocarbons in leaves of four species of plant (table 1) that showed the ability of different plant to accumulate certain pollutant from the environment (Thomas *et al.*, 1984 and Ibrahim, 1998). Means of percentage were varied among plants sample with a direct relationship exist between hydrocarbons and fat content (table 2) due to that petroleum hydrocarbons are of the lipophilic pollutants. Variance in the fat content that acts a continuous sink of hydrocarbons may answer the variation among the four species of petroleum hydrocarbons (Aziz, 2002), so plants, beside effect of such factors such as physico-chemical properties of the pollutant and on the meteorological. From Fig. 2 we can notice that plant A recorded the highest values in the of petroleum hydrocarbons that reached 6.03 µg/g dry weight ,

while the lowest values were recorded in plant D that reached 2.10 µg/g dry weight.

Different concentration of petroleum hydrocarbons in the plant tissues during study period may come from different sources. The study area is closed to the city site of Basrah that having relatively human population density so urban run-off may increase the concentrations of the petroleum hydrocarbons (Zhou et al., 1996 and Aziz et al., 2000), beside the presence of oil terminal in Muftia in north of study area and discharge of engines exhaust (Al-Saad and Al-Timari, 1989). The study area received its water from Shatt Al-Arab River directly; this matter makes it exposure to hydrocarbons contamination. Floating hydrocarbons were spread into the study area from its sources resulting hydrocarbons movement by waves and wind, so we can observe from table 1 the variation between different distances in hydrocarbons concentration. The highest values of hydrocarbons concentration were recorded in location of distance 30 m, because it is the nearest one to hydrocarbon sources, while spreading and dilution of hydrocarbons in water makes locations of distance 900m and 1200m far away from large amount of hydrocarbons. This confirm results from a study by Youngblood and Blumer (1975) and the study of Herrmann and Baumgartner (1987) which showed a world wide uniform correlation between petroleum hydrocarbons and its sources in different sites. The study of Ibraim and Aziz (2001) on the levels of hydrocarbons in date palm cv. Sayer leaves showed that the variation between samples and studied stations may due to several factors such as amount of contaminant and weathering factors that agree with our result in this study.

Based on these results, it can be concluded that the different plants can reflect and accumulate different concentration hydrocarbons depending upon the species of plant and its site correlated with amount of hydrocarbon from its diverse sources.

Table 1: Concentration of Petroleum hydrocarbons in leaves of different species of plant with different distances. ($\mu\text{g/g}$ dry wt).

Distance (m)	Concentration			
	Species of plants			
	A	B	C	D
300	6.21	4.24	4.15	2.33
900	6.09	4.12	4.01	2.13
1200	5.79	4.06	3.84	1.84
RLSD (0.05)	0.15	0.10	0.10	0.15

Table 2: Fat content in leaves of four species of plants.

Plant	Fat %
A	0.82
B	0.62
C	0.50
D	0.31
RLSD(0.05)	0.10

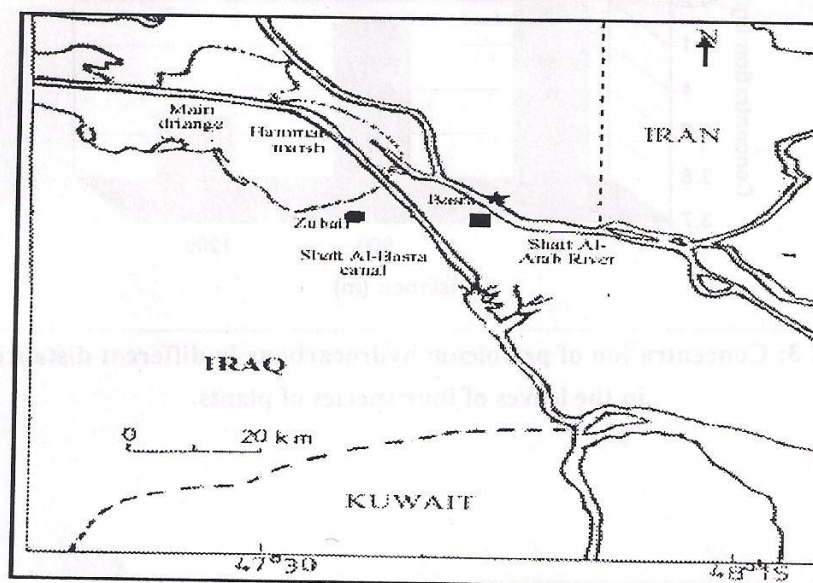


Fig.1 Locations sample

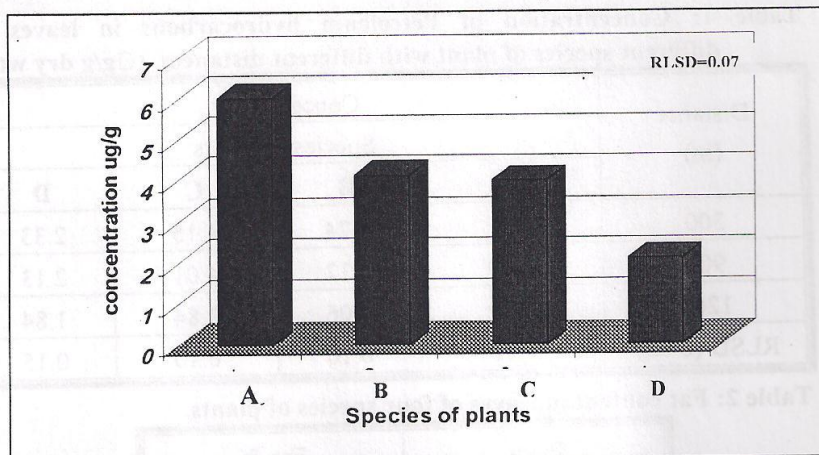


Fig. 2: Variation of accumulated petroleum hydrocarbons in leaves of different species of plants.

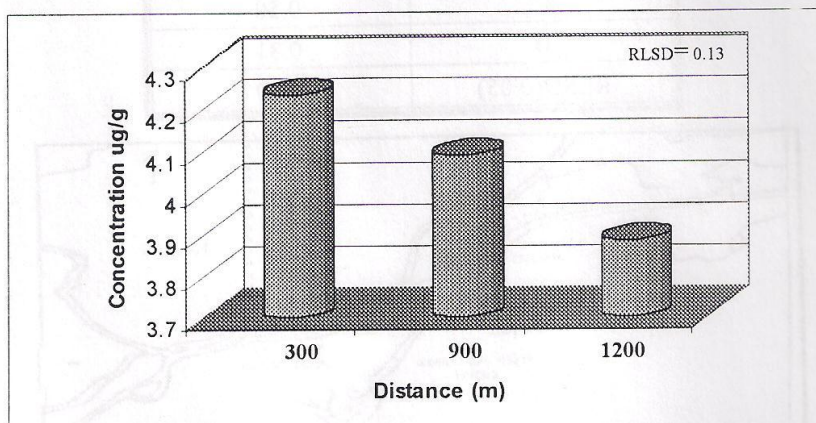


Fig. 3: Concentration of petroleum hydrocarbons in different distances in the leaves of four species of plants.

References

- Al- Saad, H. T. (1995). Distribution and source of hydrocarbons in Shatt Al-Arab estuary and N. W. Arabian Gulf Ph. D. thesis, Basrah University, 186p.
- Al-Saad, H.T. and Al-Timari, A.AK. (1989). Distribution of polycyclic aromatic hydrocarbons (PAHs) in marsh sediment, Iraq. Bull. Environ. Contam. Toxicol. 43:864-869
- AOAC. (1984). Official method of nalysis. 14th ed. Association of Official Analytical. Chemists, Inc. S. William, Ed. U.S.A. 1141 p.
- Aziz , N.M. (2002) *Cordia myxa* and *Solanum tuberosum* plant leaves as bio indicator to petroleum hydrocarbons pollution along Shatt alarab River .J. Basrah Res. 28 (2) : 20-24
- Aziz, N. M., Ibrahim, A.O. and AL- Saad, H. T. (2000). Seasonal and regional variation of petroleum hydrocarbons in date palm (*phoenix dactylifera* L.) cv. Sayer along Satt AL- Arab River, Southern Iraq, Basrah. J. Sci. B, 18 (1): 123- 132.
- Goutx, M. and Saliot, A. (1980). Relation ship between dissolved and particulate fatty acids and hydrocarbons, Chlorophll (A) and Zooplankton biomass in Villefranche bay, Mediterranean Sea. Mar. Chem. 8: 299- 318.
- Herrmann,R.& Hubner, D.(1984). Concentration of micropollutant (PAH, Chlorinated hydrocarbons & trace metals) in the moss *Hypnum Cupressiforme* in and around a small industrial town in southern Finland. Ann. Bot. Fennici,21:337-342.

- Ibrahim, A. O. (1998). Hydrocarbons pollution in date palm (*Phoenix dactylifera*) cv. Hillawi along Shatt Al – Arab River in Basrah. Iraq. Mar. Meso. 13 (1): 107 – 114.
- Ibrahim, A.O. and Aziz, N. M. (2001). Variation in aromatic hydrocarbons as indicated by their content in leaves of *phoenix dactylifera* cv. Sayer, soil and water from Abu Alkhasib region, sothern Basrah. Mar. Meso (Accepted for publication).
- Thomas, W. S.; Ruhling, A. and Simon, H. (1984). Accumulation of air borne pollutants (PAH, Chlorinated hydrocarbons & heavy metals) in various plant species and humus. Environ. Pollut. 36: 295 – 310.
- UNEP (United Nations Environment Programme) (1992) .Determination of petroleum hydrocarbons in sediment .Reference Method for Marine Pollution Studies No. 20 , pp.75.
- Youngblood,W. and Blumer,M.(1975).Polycyclic aromatic hydrocarbons in the environment: Homologous series in soils and recent sediments.Geochimica Acta,39:1303-1304.
- Zhou,S; Ackman,R.g. and parson,J.(1996).Verylong chain aliphatic hydrocarbons in lipids of mussels suspended in the water column near petroleum operation of Sable Island.Nova Scotia. Canada. Mar. Bio. 126: 494-507.