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A COMPARATIVE STUDY ON THE STATE OF AROMATIC HYDROCARBON POLLUTION IN ABU QIR BAY AND THE WESTERN HARBOUR OF ALEXANDRIA, EGYPT

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ABSTRACT

A spatial Intercomparison were established for determination the actual level of hydrocarbon pollution in both Abu Qir Bay and Western Harbour of Alexandria. The study revealed that the western harbour sediments were heavily polluted with hydrocarbon (2.76 - 32.63μg/gm) than of Abu Qir Bay sediments (0.00 - 7.07μg/gm). Accumulation factor (AF) of hydrocarbon were in the range of 1690-26890 times for different locations of western harbour. The preliminary data obtained in this study indicate that, the levels of hydrocarbon concentrations in muscles of the studied fish species in the two regions are rather low relative to other areas of the Mediterranean Sea.

INTRODUCTION

During recent years, the public and authorities have paid more attention to the ever increasing problem of water pollution by oil. Oil pollution in the two studied areas arises from refining and routine handling of petroleum at parts. Contamination by oil could originate also from heavy maritime transport of crude and refined oil through the region, as a result of the discharge of ballast water from tankers. Oil pollution presents special problems via its toxic effects on marine life and to shore damage (Burns ***at al*** 1982, El- Samra ***et al***, 1986 and Guzzella ***et al***, 1994).

The aim of the present study was to establish a spatial Intercomparison of the actual level of oil pollution (aromatic fraction) released to the environment from tankers and other sources in both Abu Qir Bay and the Western Harbour of Alexandria (Fig. 1). This estimation will serve as a baseline study to compare the present with the future and should be considered as a preliminary information of oil pollution in the intertidal zone of the Mediterranean.

MATERIAL AND METHODS

Water samples were collected seasonally at one meter depth from sixteen stations Covering Abu Qir Bay and from eight stations in the Western Harbour as shown in Fig. 1. during the period from January 1996 to February 1997 using 2.5 L/glass bottle.

Sediment samples were collected during September 1996 from the above mentioned stations. The sampling was carried out using a modified Ekman bottom sampler.

Fish samples were collected during September 1996 from the local commercial fishermen in the two studied areas and kept frozen (-20°) Prior to analysis.

1- Sediments

Sediments were tested according to ROPME, 1983. As soon as the samples were collected, they were packed with aluminum foil and conserved in a portable freezer stocked with sufficient dry-ice. On arrival the laboratory, the samples were air dried. About 5 grams of dried samples was extracted in a soxhlet with n-hexane. The siphon cycle was around 20-30 min. and it was repeated at least 10 times. After complete extraction, the solvent was concentrated using rotary evaporator under low heat (40°C) to a volume of less than 20 ml. The extract was then transferred to 25 ml measuring flask. The soxhelt extraction flask was rinsed with n-hexane and the rinse was used to make the volume up to 25 ml. Three ml of extract were transferred to a 10 ml measuring flask and the volume was made up to the 10 ml mark with n-hexane.

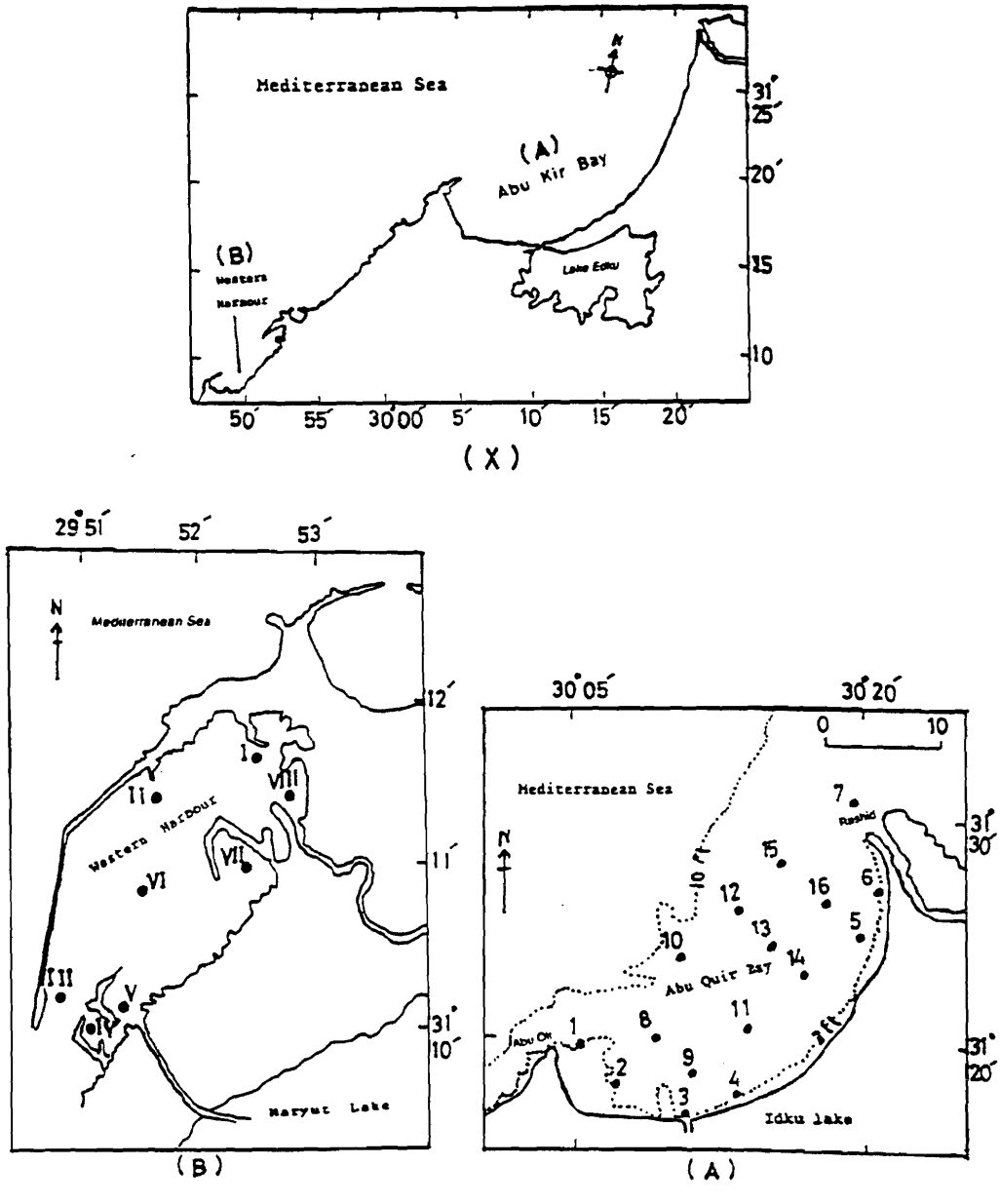

Fig. (1) : Location map showing both areas of investigations (X)
(A) Abu Qir Bay
(B) Western Harbour

Concentration of hydrocarbons $\mu g\ g^{-1} = BC/D$

where: B = Concentration of hydrocarbons in the sample extract in $g\ ml^{-1}$.
C = Volume of the extract in ml.
D = Weight of the original sediment in gm which equals 3/25 times the weight of the sample used for the soxhlet extraction.

2- Water

The method used for measuring dissolved/dispersed hydrocarbons in the water that given in IOC Manual for Monitoring of oil and petroleum hydrocarbons in marine waters on beaches (IOC, 1977).

Petroleum hydrocarbons in the sample were extracted successively with 120 ml n-hexane. The extract is evaporated to about 10 ml at 30°C using the rotary evaporator under reduced pressure. The extract measured fluorometrically at 415 nm after excitation at 360 nm. Chrysene was used for standard calibration graph using n-hexane as a diluent.

Hydrocarbon concentration $(\mu g\ L^{-1}) = C/R\ (Rs - Rb)\ u/v$

where: C = Concentration of the standard Chrysene.
R = The fluorometer reading of the standard Chrysene.
Rs = The fluorometer reading of the sample.
Rb = The fluorometer reading of the blank.
u = The volume of n-hexane in ml.
v = The volume of the original sample in ml.

3- Fishes

Seven species of edible fishes from Abu Qir Bay namely ***Sardinella aurita, Pagrus pagrus, Dicentracus labrax, Dicentrachus punctatus Pleuronectes platessa, Trigla lyra,*** and ***Trachinus draco*** and sex species from Western Harbour of Alexandria namely ***Lithognatus mormyrus, Dicentracus labrax, D. punctatus, Sparus auratas, Diplodus sargus,*** and ***Mugil capito*** were selected for this study. Total weight and total length for each individual fish were recorded to the nearest gram and mm respectively.

About 20 gm of the homoginized muscle samples (wet weight) for the same species was used in the analysis and then recalculated for the corresponding weight. The following method and its modification that soxhlet extraction apparatus was used in place of the cold extraction procedure described by

Warner (1974). In the extraction steps n-hexane (pesticide grade) was used which continued for more than 16 hrs. The n-hexane lipid extract was then evaporated to a volume Ca. 30 ml in a rotary evaporator. Clean up procedure of the hydrocarbon extract was facilitated by eluting the lipid extract from the top of a 0.9 cm diameter glass column, containing 20 cm deactivated silica gel covered with 1 gm anhydrous sodium sulphate. Hydrocarbon extract was reconcentrated to 10 ml. The intensity of fluorescence of hydrocarbon extracts was measured using a spectrofluorometer (Sequoia-Turner model 450 Flourometer).

Calculation of total aromatic hydrocarbon TAHC in the samples as chrysene equivalents was achieved using the formula:

$$TAHC = \frac{F \times C \times V}{W}$$

where: TAHC = Concentration of total aromatic hydrocarbon in fish tissue in $\mu g\ g^{-1}$ wet weight.

C = Concentration of hydrocarbon in samples extracts in $g\ ml^{-1}$

V = Volume extract in ml.

W = Weight of the wet fish tissue in gm.

RESULTS AND DISCUSSION

The mean values of total hydrocarbons estimated in water, sediments and fish muscles from Alexandria Western Harbour are shown in Tables (1 & 2) and the corresponding values for Abu Qir Bay are shown in Tables 3 & 4 respectively.

Accumulation factor (AF) obtained in table (1) indicates that petroleum hydrocarbons are concentrated in the sediments of different locations of Alexandria Western Harbour in the range 1690 - 26890 times as that recorded in the water of the same area.

Table (3) gives the hydrocarbon content of the sediment samples of Abu Qir Bay in µg/gm Chrysene equivalent. As clear from the table, dissolved hydrocarbons are higher for near shore samples than for offshore ones, although the near shore figures are those important from the fisheries and recreational point of view.

Table (1): Accumulation of total aromatic hydrocarbon (TAC) in the sediments (μg/gm) and in water (μ g/l) of Alexandria Western Harbour.

Station number	TAC in sediments (g/gm)	TAC in water (μg/l)	Accumulation factor (AF)
I	11.2138	2.1979	5102
II	9.7778	1.3187	7415
III	5.5453	1.5238	3639
IV	2.7634	0.8791	3143
V	31.52010	1.1722	26890
VI	9.1629	5.4219	1690
VII	25.0749	2.3443	10696
VIII	32.6353	11.3113	2885
Mean ± s.d.	15.9617 ± 11.14	3.2711 ± 3.32	76882.5 ± 7750.9

Table (2): Concentration of petroleum hydrocarbon (TAC) in the muscles of different fish species from Alexandria Western Harbour.

Fish species	No. of samples	Total length range (cm)	Total weight range (gm)	Mean ± s.d. TAC (μ g/gm)
Lithognathus mormyrus	14	15 - 17	35.5 - 46	4.7666 ± 0.394
Dicentrachus labrax	11	17 - 23	49.7 - 135	3.4174 ± 0.364
Sparus auratas	11	15 - 19	88.3 - 118	4.1845 ± 0.244
Dicentrachus punctatus	16	12.5 - 16	22.5 - 43.5	2.8489 ± 0.257
Diplodus sargus	15	11 - 13	27.5 - 31.5	19.691 ± 0.392
Mugil capito	12	20 - 26	68 - 195	13.4575 ± 0.446

It is noticeable that variations in hydrocarbon contents in the studied fish samples (Tables 2 & 4) were ranging between 2.8 - 19.6 $\mu g/g^{-1}$ and 0.22 - 10.7$\mu g/g^{-1}$ wet weight Chrysene equivalent for Western Harbour of Alexandria and Abu Qir Bay fishes respectively.

Comparing the results of total aromatic hydrocarbon TAHC obtained from the studied fishes in the two regions, it is clear that, they are lower than those recorded for the flesh of the estuarine fish ***Callionymus lyra*** found in European and North American waters which were 123.1 - 216.0 ppm (wet weight)

respectively (Burns & Teal, 1973 and Farrington ***et al.***, 1972, 1973). The pelagic tuna fish showed relative higher hydrocarbon concentrations (45.5 - 51.5 $\mu g/g^{-1}$ wet weight) (Farrington ***et al.***, 1974) than all studied fishes in both of Alexandria Western Harbour and Abu Qir Bay.

Marine fish and shellfish tend to concentrate polynuclear aromatic hydrocarbons within their tissues when exposed to oil, but do not retain these levels indefinitely (GESAMP, 1982).

The present preliminary data in this study indicate that the levels of hydrocarbon concentrations in the tissues of the studied fish species in the two regions are rather low. The relatively high values found in ***Pleuronectes platessa*** and ***Pagrus pagrus*** from Abu Qir Bay and ***Diplodus sargus*** and ***Mugil capito*** from Alexandria Western Harbour could be attributed to its relatively higher lipid content and possibly to other physiological characters.

Comparing location results for sediment samples of Alexandria Western Harbour (Table 1) with those of Abu Qir Bay (Table 3), it could be noted that the western harbour sediments are considered polluted with aromatic hydrocarbon (2.76 - 32.63 μg/gm) relavant to Abu Qir Bay (0.00 - 7.07μg/gm). This could be attributed to heavy maritime transport of crude and refined oil through the harbour as a result of the discharge of ballast water from tankers.

It may be helpful to compare the levels of dissolved hydrocarbons in the areas of similar surrounding condition to define the present status of western harbour waters. Table (5) records such comparison in which it seems that, the status of the studied area in the present investigation is under control if the world pollution measures are considered.

Table (3): Accumulation of total aromatic hydrocarbon TAC in the sediments of Abu Qir Bay (μ g/gm).

Station numbers	TAC (g/gm)	Locality
1	4.9226	Near shore
2	1.0732	
3	0.0000	
4	1.2075	
5	0.4424	
6	7.0752	
7	2.1949	
8	0.0000	Offshore
9	0.0000	
10	0.2015	
11	0.7438	
12	0.3224	
13	0.9126	
14	0.4243	
15	0.8859	
16	0.3362	
Mean ± s.d.	1.2964 ± 1.898	All area

Table (4): Concentration of petroleum hydrocarbon TAC in the muscles of different fish species from Abu Qir Bay.

Fish species	No. of samples	Total length range (cm)	Total weight range (gm)	Mean ± s.d. TAC (μ g/gm)
Sardinella aurita	12	10.0 - 11.5	10.0 - 12.4	5.695 ± 0.389
Pagrus pagrus	10	8 - 12	11.3 - 27.8	10.677 ± 0.249
Dicentrachus labrax	5	17 - 18	42.2 - 60.5	0.276 ± 0.021
Pleuronectes platessa	14	13.5 - 16.5	20.0 - 34.0	8.432 ± 0.275
Trigla lyra	11	15 - 21	60.0 - 90.0	1.144 ± 0.162
Dicentrachus punctatus	15	12.5 - 16.5	25.0 - 44.0	0.221 ± 0.029
Trachinus draco	13	35 - 47	28.0 - 42.0	2.254 ± 249

Table (5): A comparison of the data obtained in the water of Alexandria Western Harbour with those available from other Mediterranean areas.

Area	TAC content (µg/l)	Reference
Western Harbour of Alex.	0.88 - 11.3	Present study
Alexandria	av. 3.7	Abu El-Dahab & Halim (1980)
Alexandria Coast	0.65 - 41.4	Wahby & El-Deeb (1980).
Rijeka Bay	1.6 - 4.7	Ahel & Picer (1979)
Western Mediterranean	1 - 123	Ahel & Picer (1979)
Alboran Sea	7.9	Ahel & Picer (1979)
North western Medit.	4.3	Faraco & Ros (1979)
South western Medit.	17.0	Faraco & Ros (1979)
Tyrrhenian Sea	9.3	Faraco & Ros (1979)
Lesvos Island, Greese	0.8 - 3.2	Faraco & Ros (1979)
Kriti Island	0.9 - 11.2	Mimicos (1980)
Rhodos Island	0.9 - 4.9	Mimicos (1980)
Malta	0.292 - 0.023	SAMMUT (1980)
Turkey	8.2 - 34.4	BALKAS (1980)
Suez Canal	0.5 - 14	Amin Abdallah *et al.* (1993)
Suez Bay	0.39 - 10.28	Amin Abdallah *et al.* (1993)

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