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Original Research Article

Environmental Assessment of Petroleum Hydrocarbons in fish species from North-West Arabian Gulf

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ABSTRACT

The levels of Total Petroleum Hydrocarbons (TPH) and lipid contents have been reported for fourteen commercially important fish species from the Iraqi coastal water in North-West Arabian Gulf during summer and winter (2014-2015). Samples have been extracted and analyzed for petroleum hydrocarbons using Ultraviolet Fluorescence (UVF) spectroscopy. Tenualosa ilisha showed the highest level of TPH in both season summer and winter (6.85 ± 0.29, 7.65 ± 0.31 µg g−1) respectively in the muscle tissue followed by Euryglossa orientalis (2.45 ± 0.3 , 2.64 ± 0.06 µg g−1) respectively also in both seasons.. Significant correlations were obtained between lipid contents and TPH levels in the muscles of the fish. Body weight of the fish was also found to be strongly correlated with TPH concentration in the muscle tissue. These data are very important for coming pollution monitoring programs to the Iraqi Environments.

Keyword: Petroleum hydrocarbons; fish; North-West Arabian Gulf

INTRODUCTION

The problem of oil pollution in various marine and estuarine environments has received considerable scientific attention with respect to the effects of petroleum spills, as well as inherent toxicities to specific biological ecosystem components and individual species. Petroleum products are carcinogens and affect a variety of biological processes and potent cell mutagens [1]. Total Petroleum Hydrocarbon (TPH) is environmental contaminants that are released into the marine environment through oil spills, industrial and domestic activities. TPH are readily transformed into more hydrophilic metabolites, which are accumulated in fish.

Iraq is a major oil producer and one of the largest oil producing country in the world. The Iraqi economy depends heavily on the oil sector where majority of the oil industries are located in south area. Shatt Al-Arab Delta fishing communities are adversely affected by petroleum production activities. Oil spillage and petroleum products are the major anthropogenic source of total hydrocarbon in the Shatt AL-Arab and North West Arabian Gulf [2].

The accidental discharge of hazardous materials such as petroleum and chemical solvents to the aquatic environment has become the focus of increasing regulatory and public concern because of the adverse impacts of such materials on human health and the environment [3].

TPH is released to the environment through accidents, as releases from industries, or as by products from commercial or private uses. When TPH is released directly to water through spills or leaks, certain TPH fractions will float in water and form thin surface films. Other heavier fractions will accumulate in the sediment at the bottom of the water which may affect bottom feeding behavior of fish and organisms [4 ; 5] .

Crude oil may also reduce growth, tissues, and organ damage in fish [4] . Spills oil put pressures on marine habitats, causing the spilled oil to bio-accumulate in mollusk, mussels, fish and other mammals. These aquatic organisms would ingest hydrocarbons through the food chain for a period of time, thus bio-accumulate hydrocarbons in their tissues [6].

In general, TPH are readily metabolized in fish. They undergo electrophilic substitution oxidation and reduction reactions. Biotransformation reactions are the major determinants for a hydrophobic molecule to be toxic to fish, to be distributed in tissues and to be excreted. Without these biochemical processes half-lives of hydrocarbon would be much longer in fish and other vertebrates [7].

The aim of the present study was to evaluate the distribution of petroleum hydrocarbons in fourteen commercial fish species in Iraqi coastal area North-West Arabian Gulf.

METHODS

Study Area: Basrah is one of the major cities in Iraq which is located south of the country. City with high human population density it has great diversification of industries in region. A variety of industries, including refineries and petrochemical complexes, from this area release their effluents into the water such as Abadan oil refinery there are number of ports where in the ship and cargo handling activities contribute to marine pollution in the area of North Arabian Gulf which the study occurred.

Sample Collection: Marine fish samples were collected during summer and winter (2014 – 2015). 14 Species of marine fish which were commonly available are collected with the help of local fisherman of the region from Iraqi marine water, named and the morphometric measurements were taken immediately (Table 1).

On collection, fish samples were stored in pollution-free sealed polythene covers and transported to the laboratory at Marine Science Center, in ice box and stored at −20◦C in the deep freezer until analysis.

Sample Processing: Fish samples were taken out from the deep freezer, thawed, and well cleaned in tap water to remove any external dirt. Edible muscle tissue without the skin and bone were used in the chemical analysis .Dissection was performed on thawed fish, using solvent rinsed instruments and glass dishes. The scales were sloughed off and muscle tissues were taken .

Information regarding species, the length, and weight of fish presented in (Table 1).

Table 1: Detailed information of the collected fish samples from North West Arabian Gulf

Fish species	Common name	Feeding habit	No. of fish	Total weight (g)	Total length(cm)	fat %
Euryglossa orientalis	Lisan	Carnivores	32	480	30	2.03
Acanthopagrus arabicus	Shanak	Carnivores	40	410	23	3.22
Epinephelus coioides	Hamur	Carnivores	10	1152	61	4.1
Chirocentrus dorab	Hiff	Carnivores	15	819	75	11.1
Scomberoides commersonnianus	Dhala	Carnivores	15	1214	80	2.51
Ablennws hians	Musaffaha	Carnivores	35	1350	79	7.8
Scomberoides lysan	Khubbat	Carnivores	20	408	25	2.66
Otolithes ruber	Nuwaiby	Carnivores	30	517	33	12.17
Alepes diedaba	Hammam	Carnivores	25	219	22	9.1
Tenualosa ilisha	Sboor	Filter feeder	50	420	30	22.1
Parastromateus niger	Halwayuh	Carnivores	20	333	23	4.1
Pampus argentetus	Zubaidy	Carnivores	10	310	22	5.25
Eleutheronema sextarius	Cheem	Carnivores	10	837	43	2.84
Liza subviridis	Biah	Filter feeder	40	112	18	6.5

The lengths of fish were determined by using a ruler, while the weight measured by using a balance.

Muscle samples were freeze dried .then sample was ground, and twenty five grams weighed was packed in a thimble (Whitman) and desiccated overnight prior to extraction.

The desiccated thimble was loaded in a Soxhlet apparatus and extracted with Methanol: Benzene for 24 hrs according to the methods described by [8] . The solvent was reduced and an aliquot was taken for lipid estimation. Another aliquot was subjected to removal of other contaminants by passing the sample throw silica gel –alumina column .The instrumental analysis of TPHs was carried with UV Fluorescence, using Basrah crude oil standards. Quantification was performed at 310 and 360 nm as excitation and emission wavelengths, respectively [9].

Fat Content: The procedure used by [19]. was employed to determine the fat content of fish samples. Three grams of each freeze- dried sample was soxhlet extracted with a 2 : 1 mixture of petroleum ether and acetone for 24-hours. The extracts were reduced in volume in a rotary vacuum evaporator, and subsequently reduced to exactly 1 ml by a stream of Purified nitrogen. Ten µl of the concentrated extracts were taken by a Hamilton syringe and weighted after evaporation of the solvent. Fat% are presented in Table 1.

RESULT AND DISCUSSION

The results for the body weight, length, lipid contents and concentration of total petroleum hydrocarbons in the selected fish species *Euryglossa orientalis , Acanthopagrus arabicus, Epinephelus coioides, Chirocentrus dorab , Scomberoides commersonnianus, Ablennws hians , Scomberoides lysan , Otolithes ruber ,*

Alepes diedaba, Tenualosa ilisha, Parastromateus niger, Pampus argentetus, Eleutheronema sextarius and *Liza subviridis* are presented are presented in Table 1 & 2 and Fig.1 & 2 .

Table 2: Levels (means ±SD) and average of TPH (µg/g) during two seasons

Fish species	Mean winter	Mean summer	Mean Average
Euryglossa orientalis	2.64 ± 0.06	2.45 ± 0.3	2.545 ± 0.095
Acanthopagrus arabicus	3.89 ± 0.07	3.64 ± 0.29	3.765 ± 0.125
Epinephelus coioides	5.23 ± 0.12	4.36 ± 0.15	4.795 ± 0.435
Chirocentrus dorab	5.32 ± 0.24	4.93 ± 0.12	5.125 ± 0.195
Scomberoides commersonnianus	2.86 ± 0.7	2.52 ± 0.06	2.69 ± 0.17
Ablennws hians	5.01 ± 0.03	4.68 ± 0.16	4.845 ± 0.165
Scomberoides lysan	3.12 ± 0.06	2.94 ± 0.35	3.03 ± 0.09
Otolithes ruber	5.89 ± 0.09	5.12 ± 0.36	5.505 ± 0.385
Alepes diedaba	5.24 ± 0.2	4.89± 0.17	5.065 ± 0.175
Tenualosa ilisha	7.65 ± 0.31	6.85 ± 0.29	7.25 ± 0.4
Parastromateus niger	4.23 ± 0.15	3.45 ± 0.04	3.84 ± 0.39
Pampus argentetus	4.38 ± 0.07	3.83 ± 0.02	4.105 ± 0.275
Eleutheronema sextarius	3.68 ± 0.14	3.24 ± 0.16	3.46 ± 0.22
Liza subviridis	5.15 ± 0.14	4.68 ± 0.23	4.915 ± 0.235

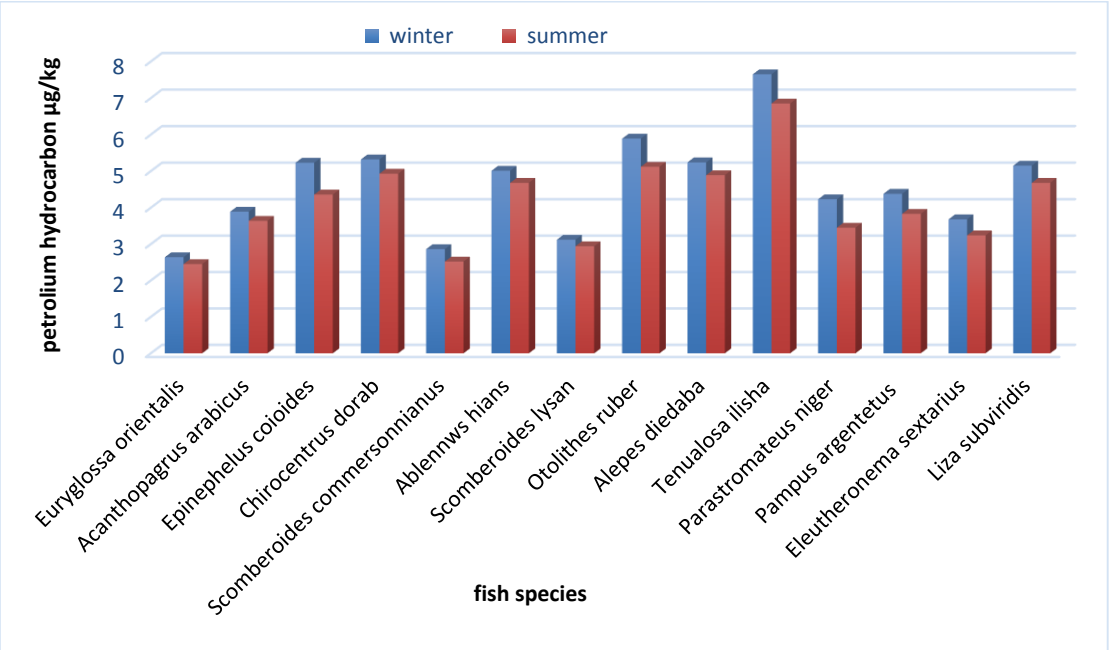

Fig. 1: Petroleum hydrocarbon in fish species (µg/g) from Iraqi marine water in summer and winter (2014 -2015).

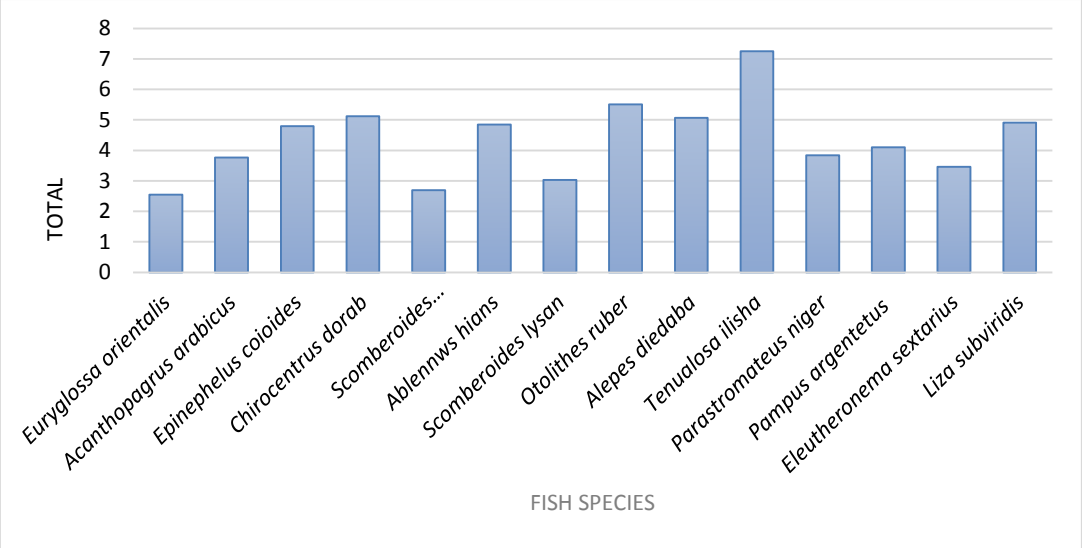

Fig. 2: average of total petroleum hydrocarbons (µg/g)

PHC residues in fourteen fish species varied between 2.45 and 6.85 µg/g (dry wt) in summer and 2.64 and 7.65 µg/g (dry wt) in winter. Among the fourteen fish species *Tenualosa ilisha* has a high PHC concentration (6.85 , 7.65) µg/g (dry wt) in both season summer and winter while the lowest concentration found in *Euryglossa orientalis* (2.45 , 2.64) µg/g (dry wt) also in both seasons . the concentration arranged as fellow : (*T. ilisha*) > (*O. ruber*) > (*C. dorab*) > (*A. diedaba*) > (*L. subviridis*) > (*A. hians*) > (*E. coioides*) > (*P. argentetus*) > (*P. niger*) > (*A. arabicus*) > (*E. sextarius*) > (S*. lysan*) > (S*. commersonnianus*) > (*E. orientalis*) . This due to different lipid content, feeding habit, temperature, size, age and sex of fishes [10; 11; 12; 3]

This study suggests that *T. ilisha* can be used as a good biological indicator for petroleum hydrocarbon pollution in water.

Using fish muscle is very important to determine the levels of hydrocarbons because the analysis of fish's muscles would give good information about petroleum hydrocarbon [13; 14].

Higher TPH concentration in the muscle of the fish may also reflect differences in the marine habitat, feeding habits and the different depths in which they live in the marine environment. This showed strong positive evidence that ability of fish to accumulate hydrocarbons in their tissues is directly related to lipid content and body weight.

The uptake and release patterns have been particularly remarkable especially when the organisms are exposed to petroleum hydrocarbons. In areas where persistent discharges occur, organisms may be subjected to physiological stress, gill and skin infections and subsequent death [15; 1]

However hydrocarbons can enter fish through the water or from their food. Entrance from the water is primarily through the gills, but some oil, including tar particles, can enter during drinking or feeding [16].

T. ilisha fasting when enter Shatt Al-Arab River and they feed mainly on diatoms, green and blue green algae and, to lesser extent, on zooplankton [17]. The food of *T. ilisha* may contain hydrocarbons which already accumulated in great amount [18]. Since marine organisms can also synthesis hydrocarbons. Al-Saad HT et al [19] Found that many species of biota have the ability to synthesize some of hydrocarbon compounds in their bodies and then release them to the aquatic environments

High percentage of lipid contents was found in *T. ilisha* (22.1%) in while the lowest fat was in *E. orientalis* fish (2.03 %) . there are significant correlation between lipid contents , body

weight , and body length . which indicate that ability of fish to accumulate hydrocarbons in their tissues is directly related to lipid content and body weight . the same conclusion have been observed by [19] and [20]. AL-Saad HT et al [16] observed a positive relationship between PHC and fat content.

However, concentrations of hydrocarbons in different fish species from various marine environments are reported. Hydrocarbons concentrations (µg.g–1 wet weight) reported by [21] in *Epinepehelus tauvina* (2.5 ± 0.3) and *Lelhrinus miniatus* (0.19 ± 0.02) from the Mina al-Fahal of Oman, and those reported by [22] in fish tissues of Argyrops sp. (24.7) and Malio sp. (53.4) from the eastern and southern coast of Qatar.

[3] Found concentrations in fish of Red Sea of Yemen were in the range: (0.03-6.8). While the concentrations in fish from the Gulf of Aden were scattered in the range :(0.04-6.9 ug/g). while [1] found that the Among the ten fish species which they studied, *Sardinella longiceps* have high PHC concentration from all the location and The petroleum hydrocarbon concentration (PHC) in and fish species varied between 0.52 and 2.05 µg/g suggests that *S. longiceps* can be used as a good biological indicator for petroleum hydrocarbon pollution in water

It is clear that hydrocarbons found in tissues of the fourteen fish species studies here are similar or lower than most of the reported levels from the Shat Al-Arab , Khor Al-zubair , and other marine ecosystems Table (3) .

Table 3: Comparison of petroleum hydrocarbon concentration (µg/g d.w) in fish samples from Iraqi marine water with those from selected marine areas

Area	TPHs	Reference
Bay of Bengal, India	0.52–2.05 (w.w)	(1)
Arabian Gulf	0.33–1.38 (w.w)	(27)
Iran	0.57–3.67	23
Benin City Nigeria	30.40 mg/kg	5
Saudi Arabian	31 - 9.6	28
Bahrain	3.8 - 0.8	28
Bahrain	15.8 – 11.7	29
Oman	7.3 – 2.4	28
Oman	34.0 – 10.8	29
Qatar	15.9 – 4.01	29
UAE	3.6	28
UAE	16.1 – 2.07	29
Kuwait	6	28
Shat Al-Arab	45.9 – 29.6	16
Shat Al-Arab estuary and Arabian gulf	1.7 - 10.91	26
Shat Al-Arab estuary and Arabian gulf	2.6- 12.55	14
Khor Alzubair	8.3 - 40.6	30
Iraqi marine water	11.44 - 48.16	12
Al Fao and Khor Abdullah	0.23 - 54.46	25
Iraqi marine water	2.545- 7.25	current study

Nozar et al [23] Found total Petroleum hydrocarbons in 18 edible marine biota species from northern Arabian Gulf showed narrow variation, ranging from 0.67 to 3.36 µg/g dry

weight. The maximum value was observed in silver pomfret. Anchovy and the range of TPH in fish 0.57–3.67 µg/g dry weight. And [24] found that Scarus Ghabon showed the highest level of TPH (7.4±3.2 µg-g-1) in the muscle tissue followed by Epinephelus Tauvina (6.8±3.6 µg-g-1) from Arabian Gulf. While [25] found in fish from Iraqi marine waters varied between 0.23 and 54.46 µg-g-1. And [26] found TPH in fish from Shatt Al-Arab estuary 1.7 and 10.91. µg-g-1 and the study of [14] from Shatt Al-Arab estuary and North West of Arabian Gulf (2.6 - 12.55)

Expected values for the TPHs in marine fish from unpolluted areas, generally, ranged from 0.1 µg/g wet weight to 10 µg/g wet weight, whereas it reaches to 10–1000 times more, as hazardous levels in fish from contaminated areas [31 ; 32 ; 33;1;34 ;

23]. petroleum hydrocarbon residue levels in all fish samples analyzed in this study are considerably lower than hazardous levels ranged between 2.545- 7.25 µg/g dry weight.

As a conclusion the results will also be useful for pollution monitoring programs for Iraqi Environments , This study presents a baseline distribution assessment of petroleum hydrocarbons levels in Iraqi marine region . petroleum hydrocarbon residue levels in all analyzed fish samples in this study are considerably within the expected range and lower than the hazardous levels . Total petroleum hydrocarbons found with high levels in *T. ilisha* than other studied fish varying between 6.85 ± 0.29 and 7.65 ± 0.31 (µg/g dry weight).

CONCLUSION

This study suggests that *T. ilisha* can be used as a good biological indicator for petroleum hydrocarbon pollution in water. There are needing to farther study to formulated and conducted the continuous monitoring program to ensure that the concentrations of petroleum hydrocarbons is within the baseline levels established in the present study

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interests.

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