Determination of Aromatic Hydrocarbons in the Gill Extract of Five Different Fish Species Along the Red Sea Coast of Jeddah and Gizan

MOHAMMED M. ALMOHANNA

Dept. of Environmental Sciences, Faculty of Meteorology, Environment & Arid Land Agriculture, King Abdulaziz University, Jeddah, Saudi Arabia

ABSTRACT. The contamination of fishes by Polycyclic Aromatic Hydrocarbons (PAH) is posing a great threat to public health and marine life, wherever there is oil pollution. Five different species of fishes were studied from Gizan and two species from Jeddah area. The extract of gills of these fishes were examined for the content of eleven different hydrocarbons. They were estimated by HPLC and quantification was achieved by individual standard hydrocarbons. It was observed that gills extract contained all the aromatic hydrocarbons. In the fishes from Jeddah region the range of these hydrocarbons was found to be from 0.001 ppm (for biphenyl) to 1.7 ppm (for o-xylene). While in the fishes from Gizan this range was 0.001 ppm (for biphenyl) up to 2.0 ppm for p- and m-xylene. All these fishes were found to be contaminated and it is urgently needed to control the source of contamination.

Introduction

Polycyclic aromatic hydrocarbons (PAH) are widely distributed in the aquatic environment. Oil spills and incomplete combustion of fossil fuels (Andelman and Sondgrass, 1974) are major sources of PAH. Industrial and domestic effluents, terrestrial contributions and biosynthesis by plants and microorganisms are also the sources. Marine organisms are known to absorb and accumulate PAH from water. Fishes, due to their widespread distribution in seawater, have been studied in many laboratories and field experiments were conducted for their response to PAH exposure. The present work was undertaken to present the pre-
liminary data regarding the accumulation of some aromatic hydrocarbons in the gills of various fish species along the Red Sea Coast of Jeddah and Gizan. Five species were selected from Gizan area, that are most commonly used for edible purpose, among these two species were collected from Jeddah. A 12-month study was carried out to examine the effect of eleven different hydrocarbons on the gills of these fishes. During the last two decades, there have been various suggestions and warnings that petroleum hydrocarbons entering the marine environment may constitute a health hazard to humans. These concerns have been raised as a result of several major maritime transportation production accidents over the past few years. It has been recognized for many years that some PAH can cause cancer in mammals and possibly man. The ubiquity of these compounds in the human environment indicates that the PAH could be important causative agent of human cancer (Bingham et al., 1979). The chemistry of all these compounds have been well studied due to their potential carcinogenicity.

Most of the studies, which have been carried on the Red Sea fishes, were concentrated in the coastal regions north of Jeddah. No investigation have been carried out in the southern part, which is very important, because of the presence of some oil refineries, industrial complexes, wastewater treatment and desalination plants, in addition to its potential as a rich fishing ground. The environment of Red Sea, especially its coastal areas, is seriously threatened by oil pollution. The danger of oil pollution in coastal waters is not restricted to the biological resources in the affected areas but it can be directly hazardous to man himself. However, a considerable amount of work in that concern has been done in the other parts of the world (Meador et al., 1995; Tuvikene, 1995; Lin et al., 1994).

**Materials and Methods**

The fishes were collected either from the fish market of Jeddah or from the local fisherman. The samples from Gizan were collected with the help of Saudi Fisheries Company from two different locations. The locations of their catch were 41°45′-42°31′ and 16°31′-16°45′. The following fishes were selected for PAH analysis: Parrot (Scarus strongylocephalus); Safi (Lutjanus johui); (Caranx melampygus); Jack (Alepes djeddaba); and Shoar (Lethrinus lentjan).

Ten specimens of each fish species were selected. Each fish was weighed, its width length measured and then dissected to take out the gill portion. The length and width of fishes were as follows: Jack, length 10.22 ± 1.69 cm, 340.17 ± 28.42 g, Shoar 10.5 ± 1.65 cm, 492.92 ± 50.4 g, Parrot 12.79 ± 1.45 cm, 672.33 ± 60.8 g and Safi 8.67 ± 1.82 cm, 244.08 ± 25.28 g. The PAH analysis was done in 4 steps: (i) Preservation, (ii) Tissue extraction, (iii) Chromatographic separation for saturated and unsaturated hydrocarbon, and (iv) analysis on Gas Chromatograph.
Map of the Red Sea showing the location of ● Jeddah and ■ Gizan cities.
The following methods were checked for the analysis of PAH in the fish tissue. For all methods, the preservation and dissection procedures were similar.

**Preservation**

The fish samples collected from Jeddah and Gizan were stored in deep freezer (– 20°C) till the dissection of the fishes. The fishes were dissected and the gills were removed and weighed separately for their total wet weight. The separation and HPLC analysis described by Krahn et al. (1988) was followed, in extraction, separation and HPLC analysis.

**Method 1**

1. Weight of the nearest 0.01 g (10 g ± 1 g) freeze dried fish tissue into 100 ml amber glass bottle.
2. Add recovery standard solutions to the bottle.
3. Add 100 ml CH$_3$OH/CH$_2$Cl$_2$ mixture (2:3) so that the volume (ml) of solvent is ten times the dried weight (g) of dry matter.
4. Tumble vigorously for 3 hr, stop.
5. Pour solvent into separatory funnel fitted with fritted glass.
6. Decant the extract under vacuum suction through fritted glass into pear-shaped evaporating flask.
7. Add 25 ml CH$_3$OH/CH$_2$Cl$_2$ mixture (2/3) to separatory funnel and shake manually 2 min., stop.
8. Decant extract into evaporating flask.
9. Repeat steps 6 and 7.
10. Store combined extracts into freezer.

**Florisil Conventional Column**

1. Pack a 50 ml chromatographic column (10 mm bore) with 15 ml of aluminium oxide deactivated by 5% of water in 15 ml of hexane, elute excess hexane and on the top of aluminum oxide 15 ml of florisil (deactivated by 5% of water) in 15 ml of hexane, elute excess hexane add on top of florisil 5 ml of anhydrous sodiumsulphate.
2. Rinse column with 20 ml hexane.
3. Pipette hexane extract onto column and elute until the liquid reaches the florisil layer discard eluted solvent.
4. Rinse flask containing extract with 1 ml of hexane, pipette onto column and let flow down to florisil; discard eluted solvent.
5. Repeat step 4.
6. Add 20 ml of hexane and let flow down to sand, discard the first 15 ml of eluted solvent and keep the following 5 ml.
7. Rinse flask containing extract with 1 ml hexane / CH$_2$Cl$_2$ mixture (1/1), pipette onto column and let flow down to sand. Collect the eluting 1 ml of pentane together with the 5 ml collected in step 6.

8. Repeat step 7.

9. Add 10 ml hexane / CH$_2$Cl$_2$ mixture (1/1) and elute.

10. Collect saturated and dichloroethylene fraction in the first 10 ml of solvent together with the 7 ml collected in steps 6, 7 and 8 and keep 17 ml in a small flask as F1.

11. Add 20 ml of hexane / CH$_2$Cl$_2$ mixture, collect aromatic fraction in the following 20 ml of solvent in another small flask as F2.

The samples were concentrated to 1 drop (0.5 ml) by rotatory evaporation at room temperature under reduced pressure.

**HPLC Analysis**

The first fraction is analyzed on the HPLC on normal-phase chromatic conditions taking a column of supelcosil LC-NH2 (5 µm packing), 25 cm × 4.6 mm. The mobile phase was as follows:

*Analytical program:* Hexane: CH$_2$Cl$_2$ isocratic (99.7 : 2.3) room temperature 1 ml/min flow rate.

*Fractional program:* CH$_2$Cl$_2$ in hexane: T$_1$: 0%, 3 min; T$_2$: 0% - 100%, 1 min; T$_3$: 100% - 100%, 20 min; T$_4$: 100% - 0%, 1 min. T$_{eq}$: 0%, 15 min 1 ml/min flow rate.

The second fraction is analyzed on the same column but different mobile phase as acetonitrile in water.

T$_1$ : 70% - 70%, 10 min.

T$_2$ : 70% - 100%, 5 min., linear.

T$_3$ : 100% - 100%, 30 min.

T$_{eq}$ : 70%, 12 min → at room temperature on 1 ml/min flow rate.

Quantification is made either by the internal standard procedure by determining relative response factor of standard PAH toward the internal standard selected, or by external standard procedure by determining absolute response factor of individual hydrocarbons.

**Method II**

*Tissue extraction*

3-10 grams of homogenized tissue were mixed with 4 ml 4N KOH in a 50 glass centrifuge tube having a cap. The sample was kept in oven at 30ºC for 20
hr and shaken thoroughly from time to time. It was then cooled to room temperature and shaken vigorously for 1 min with 15 diethyl ether. After centrifuging at 2000 rpm for 10 min on DAMON/IEC HT centrifuge, the ether layer was withdrawn with a 20 ml syringe and added to a 50 ml narrow mouthed glass bottle with a cap. The remaining aqueous layer in the tube was re-extracted with a 20 ml ether in the similar manner. The extracts were combined and dried over anhydrous magnesium sulphate.

The extracts were then concentrated in 25 ml evaporating tubes with reflux column attached on a water bath, below 70ºC. The extracts were concentrated to 2 ml. The ether was replaced with hexane by adding 2 ml of hexane and concentrating it to one ml, aiming to remove the diethyl ether completely.

*Silica gel chromatographic separation*

The column was prepared immediately prior to use by plugging off a 100 ml burette with a piece of glass wool, 15 ml of methylene chloride was poured into the burette with its tap closed.

7 g of 100-200 mesh silica gel (activated at 150ºC for 24 hr) was mixed in a 500 ml beaker with 25 ml methylene chloride, swirling to make a slung and quickly poured into the column. When the settling front extended upwards about 2 cm from the glass wool, the stop cork was slowly opened to a flow of 1-2 drops per sec. Liquid was run slowly from the column to complete settling. An aluminum oxide layer of about 1 cm deep was added to the top of the gel and the wall of the burette washed down with methylene chloride. When the surface of the methylene chloride was just above the top of the sand, 1 ml of petroleum ether was added and allowed to drain through. When the liquid level again lay just above the top of the sand, 40 ml of petroleum ether was added and eluted until the solvent level reached the top of the column; the stop cork was then closed. The top of the burette was covered with a aluminum foil until required for use.

The concentrated extract was carefully transferred to the column, the stop cork opened and eluent collected in a 25 ml flask, 15 ml of petroleum ether was added to the column and when the liquid level reached the top of the sand, 3 ml of 20% (v/v) methylene chloride in petroleum ether was added. The first 18 ml of the eluent collected is referred to as fraction I, containing the saturated hydrocarbons. As the solvent again reached the top of the aluminum oxide layer, 25 ml of 40% (v/v) methylene chloride in petroleum were added and collected in another flask and referred to as fraction II containing the unsaturated aromatic hydrocarbons.
The two fractions were transferred to boiling tubes, again concentrated to 1 ml of 0.5 ml as described earlier. The concentrated samples were then transferred to small vials tightly closed and kept in a freezer.

The equation is modified to carry out calculation of the solute in compounds in ppm.

\[
\text{Conc. (A)} = \frac{\text{Area of } A \times \text{Area of STD}}{\text{Weight of sample (g)}} \times \text{Conc. of STD (ppm)}
\]

**Results and Discussion**

The studies were carried out for a period of 12 months, *i.e.* from July 1997 to June 1998, although fishes were collected from the same area but there were variations in the concentration of each compound in the gills of each species both in Jeddah and Gizan. In Safi, the gills extract showed a maximum of 1.02 ppm of ethyl benzene. This compound causes tremor and finally death of the fish due to respiratory failure (Sax, 1989), however it was found to be in highest amount in Shoar among the five species, it was found to be 1.6 ppm during June 1998. Naphthalene was found to be maximum in Beda and Shoar 0.85 and 0.9 ppm respectively. This aromatic hydrocarbon has also been reported to be present in the fishes in Brisbane river in Australia (Kayyal and Connell, 1995), while 2-methyl naphthalene was highest in Parrot (0.9 ppm) in the fishes from Gizan area. o-Xylene was consistently found to be maximum almost 12 months study in Shoar (range 0.9 to 1.0 ppm). If one takes an overall view of Figures 1 to 11, then one can see these aromatic hydrocarbons were in general in greater amount during the month of July 1997 to December 1997. This pattern was more clear and distinct in the fishes obtained from Gizan area, where these compounds ranged from 0.22 to 1.4 ppm. Xylene isomers were maximum in Shoar (Jeddah area), a similar pattern was also observed for n-propyl benzene and methylated benzene derivatives. Naphthalene and its methyl derivatives were again maximum in Shoar (0.35 and 0.28 ppm respectively) while biphenyl was found to be in very small amounts 0.01 ppm. All these fishes having been contaminated by these aromatic hydrocarbons. Since these fishes have a high economic value as there is a big demand by consumers for these species, therefore the source of contamination of these fishes should be established, and every possible step should be undertaken to control this contaminant, that can cause a threat to public health.

**Conclusions**

The gill extract of fish species was obtained. Five species were selected from Gizan (Shoar, Jack, Beda, Safi and Parrot) and two species were selected from Jeddah area (Shoar and Jack). Although all the fishes were found to be contaminated but their comparative ratio was different. These results are summarized in
Figures 1 to 11 and Tables 1 and 2. The fishes obtained from Gizan contained more amount of ethyl benzene (1.33 ppm), lowest amount of biphenyl (0.02 ppm), and maximum amount of p- and m-xylene (2.0 ppm). The amount of these hydrocarbons during the 12-month study was more during July 1997-October 1997. During the last eight months of the study, this amount steadily decreased. While in fishes from Jeddah, Shoar contained a maximum amount of ethyl benzene ranging from 1.44 ppm to 1.60 ppm, followed by p- and m-xylene with an average of 1.245 ppm. The lowest amount observed was that of biphenyl with a range of 0.001-0.006 ppm. Jack showed the same pattern, i.e. highest for ethyl benzene and lowest for biphenyl, however ethyl benzene range was from 1.28-1.42 ppm and biphenyl range was 0.001 ppm to 0.006 ppm during the 12-month study. It is suggested that immediate steps should be taken to control or stop this contamination of aromatic hydrocarbons in marine organisms.

FIG. 1. Ethyl benzene in gill extract for fishes from Gizan.

FIG. 2. p, m-xylene in gill extract for fishes from Gizan.
Fig. 3. O-xylene in gill extract for fishes from Gizan.

Fig. 4. n-propyl benzene in gill extract for fishes from Gizan.

Fig. 5. 1, 3, 5-trimethyl benzene in gill for fishes from Gizan.
Fig. 6. 1,2,3-trimethyl benzene in gill for fishes from Gizan.

Fig. 7. 1,2,4-trimethyl benzene in gill for fishes from Gizan.

Fig. 8. 1,2,4,5-trimethyl benzene in gill for fishes from Gizan.
Fig. 9. Naphthalene in gill extract for fishes from Gizan.

Fig. 10. 2-Methyl naphthalene in gill for fishes from Gizan.

Fig. 11. Biphenyl in gill extract for fishes from Gizan.
TABLE 1. Concentration of identified aromatic compounds (ppm) in gill extract of Shoar fish collected from Jeddah during July 1997 to June 1998.

<table>
<thead>
<tr>
<th>Compounds</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Mean</th>
<th>Std</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethyl benzene</td>
<td>1.600</td>
<td>1.600</td>
<td>1.580</td>
<td>1.440</td>
<td>1.450</td>
<td>1.450</td>
<td>1.440</td>
<td>1.460</td>
<td>1.450</td>
<td>1.450</td>
<td>1.440</td>
<td>1.450</td>
<td>1.485</td>
<td>0.063</td>
</tr>
<tr>
<td>p, m-xylene</td>
<td>1.260</td>
<td>1.240</td>
<td>1.230</td>
<td>1.460</td>
<td>1.200</td>
<td>1.210</td>
<td>1.200</td>
<td>1.220</td>
<td>1.240</td>
<td>1.230</td>
<td>1.240</td>
<td>1.245</td>
<td>1.245</td>
<td>0.067</td>
</tr>
<tr>
<td>O-xylene</td>
<td>1.440</td>
<td>1.320</td>
<td>1.330</td>
<td>1.660</td>
<td>0.750</td>
<td>0.740</td>
<td>0.750</td>
<td>0.760</td>
<td>0.780</td>
<td>0.780</td>
<td>0.760</td>
<td>0.750</td>
<td>0.985</td>
<td>0.330</td>
</tr>
<tr>
<td>n-propyl benzene</td>
<td>1.240</td>
<td>1.020</td>
<td>1.290</td>
<td>1.260</td>
<td>0.700</td>
<td>0.710</td>
<td>0.700</td>
<td>0.710</td>
<td>0.720</td>
<td>0.710</td>
<td>0.720</td>
<td>0.720</td>
<td>0.876</td>
<td>0.239</td>
</tr>
<tr>
<td>1,3,5-trimethyl benzene</td>
<td>0.980</td>
<td>0.940</td>
<td>0.960</td>
<td>0.920</td>
<td>0.700</td>
<td>0.680</td>
<td>0.680</td>
<td>0.690</td>
<td>0.730</td>
<td>0.710</td>
<td>0.720</td>
<td>0.710</td>
<td>0.785</td>
<td>0.118</td>
</tr>
<tr>
<td>1,2,3-trimethyl benzene</td>
<td>0.680</td>
<td>0.640</td>
<td>0.770</td>
<td>0.640</td>
<td>0.650</td>
<td>0.650</td>
<td>0.660</td>
<td>0.660</td>
<td>0.650</td>
<td>0.650</td>
<td>0.655</td>
<td>0.630</td>
<td>0.662</td>
<td>0.035</td>
</tr>
<tr>
<td>1,2,4-trimethyl benzene</td>
<td>0.660</td>
<td>0.620</td>
<td>0.680</td>
<td>0.660</td>
<td>0.040</td>
<td>0.040</td>
<td>0.030</td>
<td>0.040</td>
<td>0.060</td>
<td>0.050</td>
<td>0.050</td>
<td>0.040</td>
<td>0.248</td>
<td>0.289</td>
</tr>
<tr>
<td>1,2,4,5-tetramethyl benzene</td>
<td>0.720</td>
<td>0.760</td>
<td>0.740</td>
<td>0.780</td>
<td>0.042</td>
<td>0.042</td>
<td>0.041</td>
<td>0.044</td>
<td>0.045</td>
<td>0.045</td>
<td>0.043</td>
<td>0.042</td>
<td>0.279</td>
<td>0.334</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>0.340</td>
<td>0.360</td>
<td>0.380</td>
<td>0.320</td>
<td>0.040</td>
<td>0.030</td>
<td>0.020</td>
<td>0.030</td>
<td>0.043</td>
<td>0.042</td>
<td>0.041</td>
<td>0.041</td>
<td>0.141</td>
<td>0.149</td>
</tr>
<tr>
<td>2-methyl naphthalene</td>
<td>0.280</td>
<td>0.270</td>
<td>0.260</td>
<td>0.220</td>
<td>0.030</td>
<td>0.020</td>
<td>0.010</td>
<td>0.020</td>
<td>0.035</td>
<td>0.034</td>
<td>0.035</td>
<td>0.034</td>
<td>0.105</td>
<td>0.109</td>
</tr>
<tr>
<td>Biphenyl</td>
<td>0.001</td>
<td>0.002</td>
<td>0.010</td>
<td>0.010</td>
<td>0.005</td>
<td>0.004</td>
<td>0.005</td>
<td>0.005</td>
<td>0.006</td>
<td>0.005</td>
<td>0.006</td>
<td>0.005</td>
<td>0.005</td>
<td>0.003</td>
</tr>
</tbody>
</table>
**TABLE 2.** Concentration of identified aromatic compounds (ppm) in gill extract of Jack fish collected from Jeddah during July 1997 to June 1998.

<table>
<thead>
<tr>
<th>Compounds</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Mean</th>
<th>Std</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethyl benzene</td>
<td>1.280</td>
<td>1.000</td>
<td>0.980</td>
<td>0.980</td>
<td>0.410</td>
<td>1.420</td>
<td>1.410</td>
<td>1.400</td>
<td>1.420</td>
<td>1.420</td>
<td>1.420</td>
<td>1.430</td>
<td>1.298</td>
<td>0.183</td>
</tr>
<tr>
<td>p, m-xylene</td>
<td>1.000</td>
<td>1.400</td>
<td>1.220</td>
<td>1.320</td>
<td>1.000</td>
<td>1.020</td>
<td>1.030</td>
<td>1.040</td>
<td>1.060</td>
<td>1.060</td>
<td>1.060</td>
<td>1.050</td>
<td>1.105</td>
<td>0.127</td>
</tr>
<tr>
<td>O-xylene</td>
<td>0.940</td>
<td>0.920</td>
<td>0.960</td>
<td>0.980</td>
<td>0.800</td>
<td>0.820</td>
<td>0.820</td>
<td>0.830</td>
<td>0.830</td>
<td>0.830</td>
<td>0.830</td>
<td>0.830</td>
<td>0.863</td>
<td>0.063</td>
</tr>
<tr>
<td>n-propyl benzene</td>
<td>0.920</td>
<td>0.910</td>
<td>0.880</td>
<td>0.860</td>
<td>0.860</td>
<td>0.840</td>
<td>0.820</td>
<td>0.830</td>
<td>0.840</td>
<td>0.860</td>
<td>0.850</td>
<td>0.861</td>
<td>0.029</td>
<td></td>
</tr>
<tr>
<td>1,3,5-trimethyl benzene</td>
<td>0.840</td>
<td>0.800</td>
<td>0.780</td>
<td>0.760</td>
<td>0.350</td>
<td>0.340</td>
<td>0.350</td>
<td>0.360</td>
<td>0.380</td>
<td>0.380</td>
<td>0.380</td>
<td>0.370</td>
<td>0.508</td>
<td>0.204</td>
</tr>
<tr>
<td>1,2,3-trimethyl benzene</td>
<td>0.680</td>
<td>0.700</td>
<td>0.680</td>
<td>0.720</td>
<td>0.250</td>
<td>0.240</td>
<td>0.240</td>
<td>0.260</td>
<td>0.260</td>
<td>0.270</td>
<td>0.270</td>
<td>0.260</td>
<td>0.403</td>
<td>0.207</td>
</tr>
<tr>
<td>1,2,4-trimethyl benzene</td>
<td>0.740</td>
<td>0.760</td>
<td>0.780</td>
<td>0.820</td>
<td>0.220</td>
<td>0.210</td>
<td>0.220</td>
<td>0.240</td>
<td>0.240</td>
<td>0.245</td>
<td>0.245</td>
<td>0.240</td>
<td>0.413</td>
<td>0.257</td>
</tr>
<tr>
<td>1,2,4,5-tetramethyl benzene</td>
<td>0.680</td>
<td>0.660</td>
<td>0.680</td>
<td>0.680</td>
<td>0.120</td>
<td>0.120</td>
<td>0.120</td>
<td>0.125</td>
<td>0.130</td>
<td>0.130</td>
<td>0.130</td>
<td>0.135</td>
<td>0.310</td>
<td>0.258</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>0.340</td>
<td>0.360</td>
<td>0.320</td>
<td>0.330</td>
<td>0.030</td>
<td>0.030</td>
<td>0.025</td>
<td>0.035</td>
<td>0.030</td>
<td>0.030</td>
<td>0.035</td>
<td>0.035</td>
<td>0.133</td>
<td>0.145</td>
</tr>
<tr>
<td>2-methyl naphthalene</td>
<td>0.280</td>
<td>0.270</td>
<td>0.290</td>
<td>0.280</td>
<td>0.010</td>
<td>0.010</td>
<td>0.013</td>
<td>0.014</td>
<td>0.015</td>
<td>0.015</td>
<td>0.015</td>
<td>0.014</td>
<td>0.102</td>
<td>0.126</td>
</tr>
<tr>
<td>Biphenyl</td>
<td>0.002</td>
<td>0.001</td>
<td>0.004</td>
<td>0.006</td>
<td>0.001</td>
<td>0.001</td>
<td>0.002</td>
<td>0.002</td>
<td>0.003</td>
<td>0.002</td>
<td>0.002</td>
<td>0.002</td>
<td>0.002</td>
<td>0.001</td>
</tr>
</tbody>
</table>
References


تعيين بعض الملوثات الهيدروكربونية الأروماتية في خمسة أنواع من الأسماك من جدة وجازان

محمد مهنا المهنا
قسم البيئة – كلية الأرصاد البيئية وزراعة المناطق الجافة
جامعة الملك عبد العزيز
جدة – المملكة العربية السعودية

المستخلص: يشكل تلوث الأسماك بالهيدروكربونات الأروماتية خطرًا عظيمًا على الصحة العامة والحياة البحرية، ويشير تلوث البحري.

وفي هذه البحث تم دراسة خمسة أنواع مختلفة من الأسماك في منطقة جيزة ونوعين من منطقة جدة. فلقد تم اختيار إحدى عشرة مادة هيدروكربونية في خلاصة ذاكرشيوم الأسماك المدروسة. وتم تقديرها بواسطة HPLC، وعرفت كميتها بواسطة هيدروكربونات قياسية مفردة. وفي هذه الدراسة لوحظ احتواء خلاصة ذاكرشيوم على جميع الهيدروكربونات الأروماتية المدروسة. ففي الأسماك المأخوذة من منطقة جدة كانت الذروة في الحدود مابين 01000 جزء في المليون (باي فنابل) بينما كانت هذه الحدود بالنسبة لأسماك منطقة جيزة بين 01000 و 01000 جزء في المليون (باي فنابل). وأيضاً 01000 جزء في المليون ل (بارا، ميتا زايلين). ولهذا أثبتت هذه الدراسة أن ذاكرشيوم جميع الأسماك المدروسة ملوثة.

وأي هناك حاجة ملحة لضبط مصادر هذه الملوثات.