ABSTRACT

In order to assess the level of oil pollution in the cockle culture areas along the Straits of Malacca, water, sediment and cockle samples were collected from the culture beds of Kuala Sepetang and Kuala Selangor, two of the largest cockle producing areas of Malaysia. The samples were analysed for petrogenic hydrocarbons by employing a spectrofluorometric technique which measures the content of polycyclic aromatic hydrocarbons (PAH) in oil. The content of aliphatic straight chain hydrocarbons were measured by using gas chromatography-mass spectrometry (GCMS) which also allowed for the estimation of carbon preference indices and hence providing a means of estimating biogenic /petrogenic inputs.

Petrogenic hydrocarbons were observed in all the environmental samples collected from the two sites as evidenced by the spectrofluorometric measurements. The level of hydrocarbons in water at both sites ranged from 30.82 μg/L to 92.59 μg/L Seligi crude oil equivalents (1.195-3.075 chrysene equivalents). The highest level of hydrocarbons in Kuala Sepetang was recorded at Station 2: 92.59 μg/L and 3.075 μg/L expressed as Seligi crude oil and chrysene equivalents respectively. The levels of petrogenic hydrocarbons in surficial sediments were higher than those in the water column by three orders of magnitude, ranging from 2.42-45.50 μg/g Seligi crude oil equivalents (0.092-1.614 μg/g chrysene equivalents). Relatively higher levels of petrogenic hydrocarbons were found in Kuala Sepetang (average: 30.37 μg/g Seligi crude oil equivalents) compared to Kuala Selangor (average: 12.49 μg/g Seligi crude oil equivalents). Concentrations of petrogenic hydrocarbons in cockle tissues were noted to be in the same order of magnitude to those found in the sediments. Petrogenic hydrocarbons in cockle tissues ranged from 4.427 to 38.48 μg/g Seligi crude oil equivalent (0.176-1.514 μg/g chrysene equivalent) for the two sites. However, unlike the levels in the sediments there were no significant differences between the average concentration of petrogenic hydrocarbons in Kuala Sepetang (average: 17.75 μg/g Seligi crude oil equivalent) and that found in Kuala Selangor (16.45 μg/g Seligi crude oil equivalent).

There does not appear to be a correlation between hydrocarbon levels in sediments and those in the cockles. There was also an absence of correlation between hydrocarbon levels in tissues and those in the water column.

GCMS analysis of the extracts from water, sediments and cockles revealed the presence of hydrocarbons as low as C_{14} up to C_{30} based on available standards. Carbon preference indices (CPI) were also estimated using higher ranges of n-alkanes, as they are less susceptible to evaporation. For water samples from both sites, the CPIs were found to be close to unity, indicative of petrogenic hydrocarbon pollution. Extracts from sediment samples had CPI values exceeding 1, in many cases substantially so. This observation was attributed to the nature of the mud being highly biological and productive in nature characteristic of the mudflat ecosystem. CPI values in cockle tissues were also found to exceed 1 indicating the predominance of biogenic hydrocarbons in the tissues.

The present study also examined the uptake and depuration of oil by the cockles. In a laboratory-controlled experiment cockles were exposed to water-soluble fractions (WSF) of a crude oil and refined oil in a semi-static manner whereby the water was renewed every 24hrs. Analysis of aliquots of the WSFs gave initial concentrations of 1.32 μg/L and 1.71 μg/L for the Seligi crude oil and the refined oil respectively. The uptake of aromatic hydrocarbons as measured by fluorescence spectroscopy was clearly observed from the 1st day of exposure when compared to control animals. Cockles appear to take up greater amounts of crude oil compared to refined oil even though the initial concentration of the crude oil was lower than the refined oil. At the end of the 7th day exposure period the concentrations of petrogenic hydrocarbons in the cockles were 48 ng/g and 26 ng/g Seligi crude oil equivalents from crude oil and refined oil respectively. When removed into clean water, depuration was observed to take place. At the end of 12 days in clean water the levels of aromatic hydrocarbons in the tissues were still significantly higher than those of control animals. Crude oil-exposed animals had 38 ng/g Seligi crude oil equivalents of petrogenic hydrocarbons (78 % of the concentration following 1-day exposure) while refined oil-exposed animals had 18 ng/g Seligi crude oil equivalents (78 % of the concentration following 1-day exposure).