CONTAMINATION OF LEBANON COAST BY POLYCYCLIC AROMATIC HYDROCARBONS AFTER JIYEH OIL SPILL IN 2006: THREE YEARS STUDY

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Abstract

The bombardment in July 2006 of the fuel tanks of the electric power plant in Jiyeh by the Israel military resulted in a major oil spill, polluting about 120 km of the Lebanon shoreline, as far as the border with Syria. The spillage estimates vary from more than 10,000 tonnes to almost 20,000 tonnes of heavy fuel oil released into the Eastern Mediterranean Sea [1, 2]. The prevailing currents, water masses circulation and wind trajectories in July 2006, favored oil slicks transport to the north from the Jiyeh plant. We report here an assessment into the chemical contamination of marine organisms (fish and shellfish) resulting from this oil spillage, as a complimentary part of scientific surveys carried out for the evaluation of the ecological consequences of this oil spill.

Keywords: Petroleum, Pah, Mollusca, Bio-Indicators

Materials and methods

The intertidal mussel (*Brachidontes variabilis*) samples were taken in October 2006, in May 2007 and in April 2008 at 9 sampling stations along Lebanon coast, from the south (Itanieh, 33°21'298 N 35°14'846 E) up to the north, near the Syrian border (Qlaiaat, 34°35'663 N, 35°59'269 E). The temporal survey started in August 2006, and several mussel samples have been collected since that time in Batroun (northern coast). Caged mussels were also moored for three months in the water column at four Lebanon stations and three Syria stations in 2007. About 300 specimens of controlled shell sizes were pooled as a composite sample representative of each sampling location. Shellfish sampling was performed so as to avoid any contamination by coated fuel. The GC-MS analysis made it possible to identify and quantify parent unsubstituted PAHs, alkyl-substituted PAHs (C-PAH) and sulfur heterocycle unsubstituted and alkyl substituted compounds (SPAH and C-SPAH). Multivariate analysis and receptor modeling were applied for a better identification and apportionment PAHs originating from Jiyeh fuel oil in the mussel samples from the Lebanon coast.

Results and discussion

The spatial and temporal changes in the compositional patterns of PAHs and their levels in the intertidal mussel samples after the Jiyeh oil spill are reported. It appears that in October 2006 all intertidal mollusks sampled along the Lebanon coast north to the Jiyeh power plant were heavily contaminated by PAHs from Jiyeh fuel oil, and that this contamination extends at least to the Syrian border. This is clearly demonstrated by the increase in the concentration levels and by the drastic change in the distribution pattern of compounds in the shellfish inhabiting the northern part of Lebanon, compared to the mussel samples from the south. Furthermore, the strong spatial gradients in PAH concentrations in intertidal mollusks matches the extent of the shoreline contamination by the spilled fuel revealed by satellite images. Whereas PAH concentrations in the mussels from southern Lebanon (station Itanieh) are indeed very low and do not show, either by their levels or by their chemical fingerprints any significant contamination by PAHs from Jiyeh fuel oil. At that time, in October 2006, in this area, there were no visible traces of the spilled oil, and mussel samples collected south of the power plant probably came from an area outside of the influence of the oil spill. Indeed, the prevailing currents, water masses circulation and wind trajectories in July 2006 favored oil slicks transport to the north, away from the Jiyeh plant. The levels of PAHs found in caged mussels deployed offshore, in the water column, between May and August 2007 were also significantly lower than levels determined in the samples in intertidal mollusks. These results, as well as strong spatial gradients between stations, suggest probably weaker sub-tidal and benthic habitats contamination by PAHs from Jiyeh fuel. Furthermore, the concentrations of PAHs in subtidal oysters (*Ostrea edulis*) from Lebanon coast, reported elsewhere [3, 4], are definitely lower than PAH levels in the intertidal mussel samples. Consistent temporal decline (2006 to 2009) in PAH concentrations in intertidal shellfish were also distinguished, however in heavily contaminated locations such as Jiyeh and Byblos chemical fingerprints were still characteristic of Jiyeh oil induced contamination even three years after the disaster. Finally, in order to better scale the PAH levels and patterns determined in the mussels after the Jiyeh oil spill, the results were also compared with PAH data in mussels (*Mytilus galloprovincialis*) collected in the Western Mediterranean along the coast of France. These later data were obtained within routine chemical monitoring and provide external reference for the PAH chronic contamination in the Western Mediterranean Sea.

In conclusion, the PAH data in the intertidal mollusks from Lebanon represent both sensitive and accurate qualitative and quantitative indicator of the environmental impacts of the Jiyeh oil spill along the Lebanon coast.

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