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Polycyclic Aromatic Hydrocarbons (PAHs) in the Surface Sediments of Shatt Al-Arab River, Basrah City, Southern Iraq

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Abstracts
Sediment samples collected from nine sampling sites along the Shatt Al-Arab River, Basrah City, Iraq were analyzed by gas chromatography-flame ionization detector in order to determine the degree and sources of PAHs contamination. The total organic carbon (TOC) content and grain size of sediments were also analyzed. The Shatt Al-Arab River sediments content of PAHs were relatively moderate compared to other world-wide locations contaminated by oil. The total concentrations of PAHs ranged from 30.86 ng/g dry weight in the IX site to 87.79 ng/g dry weight in the VI site with highest content of PAHs were found in the Shatt Al-Arab River sediments near potential oil pollution sources, close to sites II, IV, VI, and VIII. The % TOC was varied from 0.32 to 1.64 %. The concentrations of PAHs in the Shatt Al-Arab River sediments appeared to be related to % TOC or grain size. The selected marked PAHs, the PAHs compounds ratios and the principal component analysis (PCA) suggest that the PAHs have originated from at least three different sources: (1) Pyrolytic-from different combustion processes, (2) petrogenic-from inputs petroleum and petroleum products, and (3) biogenic-from situ organisms. The potential ecosystem risk assessment indicated that PAHs will not cause immediate adverse biological effects in the Shatt Al-Arab River.
Keywords: PAH compounds, Sediments, Shatt Al-Arab River, TOC, Basrah.

1.Introduction

Polycyclic aromatic hydrocarbons (PAHs) are a major class of hazardous organic chemical that in the recent years have received much attention because they are widely distributed in the environment, and many of them have mutagenic and genotoxic potential and carcinogenic effects on natural ecosystems (Wang *et al*., 2011). This is especially true for highly stressed areas such as harbours, estuaries and other shallow coastal zones exposed to anthropogenic influence and various contamination sources.

There are several pathways of PAHs in aquatic environments, including petroleum contamination, direct aerial fallout, and terrestrial runoff. Some PAHs can also be derived from biogenic precursors such as pigments and steroids (Yang 2000; El Nemr *et al*., 2007; Wang *et al*., 2011). Perra *et al*., (2009) stated that PAHs in the environment originate mainly from the accidental spills, partial combustion of fuels, forest and grass fires, biosynthesis by marine or terrigenous organisms, and early diagenetic transformation of non-hydrocarbon natural products to hydrocarbons.

A variety of processes including volatilization, sedimentation, adsorption, chemical oxidation, bioaccumulation, photodecomposition, leaching, and biodegradation are important mechanisms for environmental loss of PAHs (Wang and Fingas, 2003; Venkatachalapathy *et al*., 2011; Zrafi *et al*., 2013). The simple aromatics are rapidly lost, but higher molecules weight PAHs are little affected and can be particularly useful in source investigations.

Due to their hydrophobic nature and limited water solubility, most PAHs in aquatic ecosystems rapidly become associated with particles and are deposited in sediments (El Nemr *et al*., 2007). Therefore, the sediments represent the most important reservoir of PAHs in the marine environment (Perra *et al*., 2009). Resuspension or bioturbation of sediment into the water column are believed to play a significant role in bioaccumulation of these compounds in the food web (Lee *et al*., 2005). Since marine sediments are repositories for many of pollutants, many researchers had been studied the relative content of the PAHs in sediments (NRC, 2003). For that reason, sediments are economically attractive in environmental assessment of aquatic ecosystems and can represent an useful tool for monitoring inputs of pollutants in marine environment.

Shatt Al-Arab River is the most important river in Iraq, because of its economical, social and ecological values. It is the main source of surface water in Basrah City, southern of Iraq. It's water has been used for various purposes including potable water supply, irrigation, fisheries, navigation, and industrial uses. Moreover, Shatt Al-Arab River is the prime fresh water source and pours about $5x10^9$ m^3 nutrient rich water into the Arabian Gulf each year (Ali *et al*., 2013). It is also has a particular ecological relevance due to the peculiar multiplicity of aquatic habitats and the presence of species that typically breed in the Arabian Gulf area, nevertheless it is characterized by considerable inputs of different contaminants originated from the urbanized