

Distribution of Oil-Related Polycyclic Aromatic Hydrocarbons in Sediment of Musa Estuary, Persian Gulf (Iran)

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Abstract: In this study, sediment of three stations from Musa estuary were analyzed in order to determine the concentrations of three carcinogens PAHs including anthracene, pyrene and benzo (a) pyrene. Each station was divided into three parts including upper, middle and lower parts. The highest level of anthracene, pyrene and benzo (a) pyrene was 87.65, 33.21 and 107.54 ng g⁻¹ respectively. The results showed that there were significant differences among the three parts of each station. The results also indicated that there were significant differences between the stations. Jafari and Zangi showed the highest concentration of the PAHs. Jafari receive huge amount of petrochemical wastewaters and other pollutant from surrounding area.

Key words: PAH • Musa Estuary • Persian Gulf • Sediment

INTRODUCTION

Extraordinarily rapid industrial development and population growth in coastal areas of Musa estuary has resulted in significant growth in the concentration of pollution and environmental damage in the aquatic environment in this estuary [1, 2]. Petrochemical activities, oil-related transportations and agricultural irrigations are well known to be potentially the sources of pollution in the area. Heavy metal, PAHs and PCBs are of the most dangerous contaminants that discharged from these activities [3, 4]. PAHs originate from different sources including burning of organic matter, fossil fuels and oil refining [3, 5]. The United States Environmental Protection Agency (USEPA) designates 16 PAHs as primary contaminants [5-8] such as benzo [a] anthracene, benzo[a]pyrene, benzo [b] fluoranthene and chrysene.

Musa estuary has more than ten branches that flow in Mashahr city, Sarbandar city and Hendijan city. This estuary is located in the northwest of the Persian Gulf. It is surrounded by more than 19 petrochemical units and 2 main oil terminals [9-11]. On the other hand, this

estuary is considered as an important place for fisheries and seafood in south of Iran, because it has suitable ecological conditions and various habitats for different species. Fish, shrimp, bivalve and crab are of the commercial species in the area. In this study, three PAHs (Anthracene, pyrene, benzo (a) pyrene) have been selected. The concentrations of these compounds were measured in sediment of three branches along Musa estuary in order to find the most contaminated branch in Musa estuary.

MATERIALS AND METHODS

The study was carried out in three branches in Musa estuary including Jafari, Zangi and Tangestan (Fig. 1). Three sampling sites were selected in each branch. The first one was located at the upper part of each branch (S1). The second one was located at the middle of each branch (S2) and the last one was located at the downstream part of each branch (S3). Surface sediment samples were collected from each station, transferred to the laboratory using icebox and kept frozen at -20°C prior to analysis.

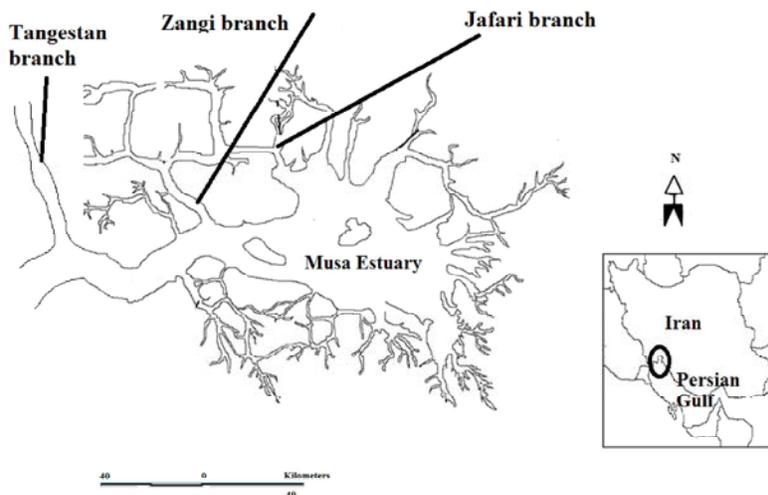


Fig. 1: A map showing Musa estuary and the branches

Glassware was rinsed with distilled water, methanol, acetone and hexane in sequence then oven-dried at 70°C for 2 hrs.

All solvents used in this study were of HPLC grade. Standard solutions (QTM⁴ PAH Mix) of SUPELCO were used in order to determine the concentration of anthracene, pyrene and benzo (a) Pyrene.

About 40 g of dried sediment were weighted and homogenized in mortar. The homogenized samples were placed in conical flask then orbital shaker used for shaking samples for 2 hrs with 150 ml dichloromethane. After that the extract was dried through 50 g of anhydrous sodium sulfate. The obtained organic phase was evaporated to about 1ml using rotary vacuum evaporator on water bath set at 35°C. After preparation, the samples were injected to HPLC (model KANUER) with UV detector in order to determine PAHs concentrations. The mobile phase (acetonitrile and water) gradient consists of 40% water and 60% acetonitrile (flow rate 0.7 ml min⁻¹) and after 40 min change to 100% acetonitrile.

One-way ANOVA and Tukey post hoc were used in order to find the significant difference of PAHs in sediment among stations and branches.

RESULTS AND DISCUSSION

The concentration of anthracene, pyrene and benzo (a) Pyrene in the sediment samples are given in Fig. 2. The differences among stations of each branch were examined for each compound. There were significant differences for the concentration of anthracene, pyrene and benzo (a) Pyrene between S1, S2 and S3 of each branches. Highest concentration of anthracene, pyrene

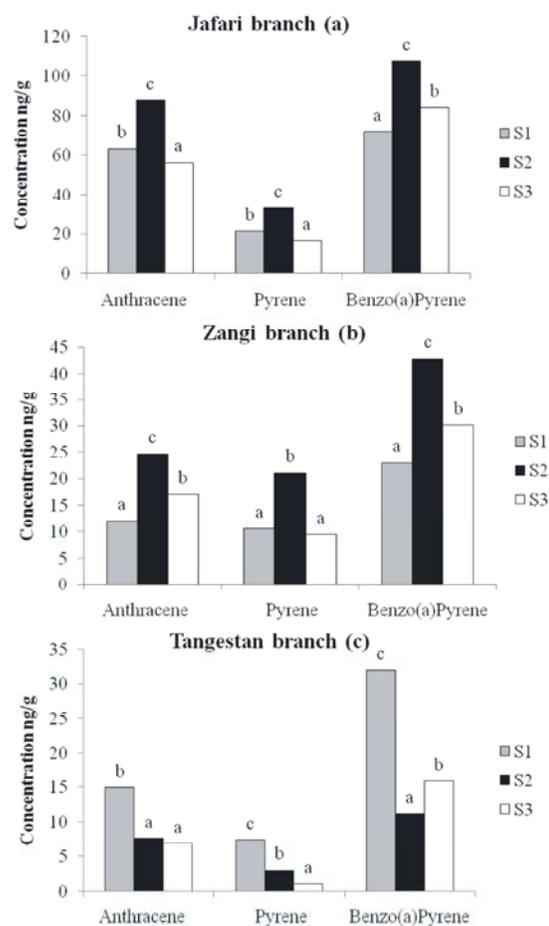


Fig. 2: Differences of PAHs concentration among inter branch stations, a= Jafari, b= Zangi and c= Tangestan.

Different letter show significant differences among stations

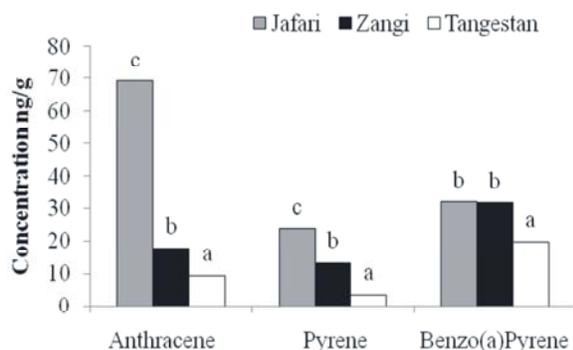


Fig. 3: Differences of PAHs concentration among branches. Different letter show significant differences among stations

and benzo (a) Pyrene was observed in S2 of Jafari, S2 of Zangi and S1 of Tangestan. S2 of Jafari and S2 of Zangi are close to petrochemical units where the wastewater of this plants discharge into the environment.

The results of one-way ANOVA for determine the differences among creeks indicated that the highest concentration of anthracene and pyrenewas observed in Jafari and followed by Zangi. Khor-Jafari and Khor-Zangi originate from Musa Estuary and are stretched along PETZONE (Petrochemical Special Economic Zone) up to Mashahr and Sarbandar cities. These branches are used as municipal wastes receptors. Moreover, they receive copious amount of petrochemical wastewater along their courses [11, 12]. High concentration of the three components in the upper part of Tangestan could be resulted from the movement of contaminants by tidal current and waves that carry petrochemical wastewater [13]. In addition, it could be resulted from the traffic of tankers in the mouth of this branch [9].

For this reason, petrochemical wastewater has received a significant attention in recent years in the area [10, 14]. In addition, traffic of oil tankers and ships of Bandar Emam port in the area could increase in the amount of PAHs in Jafari creek.

CONCLUSION

Although, the current study was limited to a few amounts of PAHs in sediment, however the data available from our study are important result about Musa estuary and the branches for future studies. Jafari branch is more contaminated in comparison to the other branches. Because it receive huge amount of petrochemical waste water, effluent of Bandar Emam port and other sources from surrounding areas.

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