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Distribution of Polycyclic Aromatic Hydrocarbons in Water (Persian Gulf) (Iran)

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Abstract: In this study, three creeks of Musa estuary were analysed in order to determine the concentration of the potentially harmful PAHs including anthracene, pyrene and benzo(a)pyrene. HPLC was applied to measure the level of the PAHs. Each creek was divided into three parts including upper, middle and lower parts. The highest level of anthracene, pyrene and benzo(a)pyrene was 0.169, 0.142 and 0.119 µg/l respectively. The results of one-way ANOVA indicated that there were no significant differences among three parts of each creek. Between three creeks, Jafari creek and Zangi creek showed the highest concentration of the PAHs. Jafari creeks receives huge amount of petrochemical waste water and other pollutant from surrounding area. In comparison to WHO (1998), Our results for PAHs were lower than those obtained by WHO (1998).

Key words:

INTRODUCTION

Polycyclic aromatic hydrocarbons are potentially toxic to marine organisms and persistent in environment [1, 2]. They are well known to be potentially carcinogenic mainly in breast and lung [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, 6] such as benzo[a]anthracene, benzo[a]pyrene, benzo [b] fluoranthene and chrysene. Aquatic organisms living in PAH-polluted water can absorb these contaminants through gills, skin and mainly through food [7, 8]. Present of PAHs in food depends on bioavailability of these compounds, environmental condition and ecological characteristic [9].

Mosa estuary is located in the northwest of the Persian Gulf. It is a complex waterway system and consisted of different creeks. This estuary cross Mashahr and Sarbandar cities in southwest of Iran. It has been famous as one of the most metal contaminated estuary in the Persian Gulf [10, 11]. The heavy metals are discharged from several anthropogenic activities such as petrochemical wastewater, tankers traffic and urban effluent in the area [12]. On the other hand, this estuary is considered as an important place for fisheries and seafood. In this study, three PAHs (Antrasen, pyrene and benzo (á) pyrene) have been selected. The concentration of these components were measured in water in order to find the most contaminated creek in Musa estuary.

MATERIAL AND METHODS

The study was carried out in three creeks in Musa estuary including Jafari, Zangi and Tangestan (Fig. 1). Three sampling sites were selected in each creek. The first one was located at the upper part of each creek and called S1. The second one was located at the middle of each creek and called S2 and the last one was located at the

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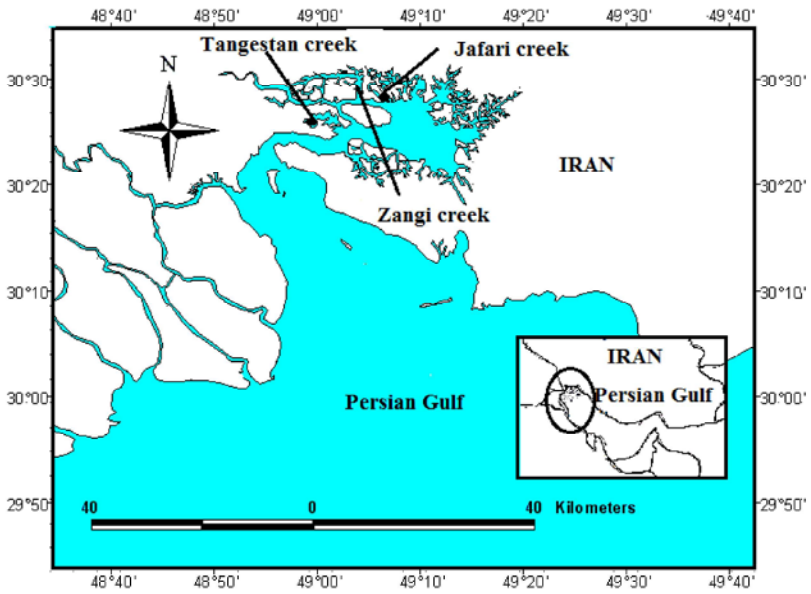

Fig. 1: A map showing Musa estuary and the creeks

downstream part of each creek and called S3 (Fig. 1). Surface water samples were collected from each site, transferred to the laboratory using icebox and kept frozen at -20°C prior to analysis.

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 (QTM[4] PAH Mix) of SUPELCO were used in order to determine the concentration of anthracene, pyrene and benzo (a) Pyrene.

Liquid-liquid extraction method was carried out in order to extract the samples. The separating funnel was washed with water, dried over a night in 150°C and rinsed with cyclohexane. Twenty ml of water samples with 20 ml of cyclohexane was transferred to funnel and shaken for 2 minutes. After 10 minutes, the organic layer was divided and the process repeated with the aqueous layer twice. The organic phase evaporate in rotary to reach 1 ml. After preparation, the water 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 pos hoc were performed in order to find the significant difference of PAHs among stations and creeks.

RESULTS AND DISCUSSION

The concentration of anthracene, pyrene and benzo(a)Pyrene in the water samples are given in Fig1 (A, B). Stations difference in the PAHs concentration were examined for each creek. There were no significant differences for the concentration of anthracene, pyrene and benzo(a)Pyrene between S1, S2 and S3 of each creek. The similarities in the concentration of the three components among the stations in each creek could be resulted from the movement of contaminants by tidal current and waves [13]. In addition, it could be resulted from the similarities in origin of the PAHs [9].

The results of one-way ANOVA for determine the differences among creeks exhibited that the highest concentration of anthracene and pyrene was observed in Jafari creek and followed by Tangestan creek. Jafari creek is affected by tremendous amount of petrochemical discharge taking place in the area [11, 12]. For this reason, petrochemical wastewater have received a significant attention in recent years in the area [10]. 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.

The results of our study were compared with those obtained by WHO (1998). Benzo(a)pyrene in our study was lower than WHO (1998). Nasr *et al*. (2010) studied PAHs in water of El-Sarsawia canal and El-Bagoria canal in Egypt. In comparison to Nasr *et al*. (2010),

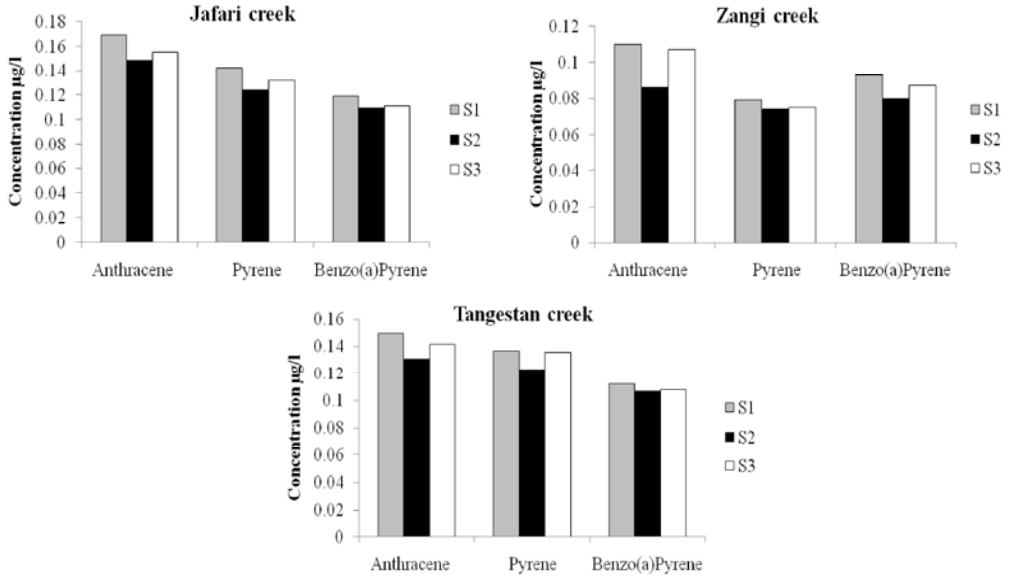

Fig. 1A, B: Differences of PAHs concentration among inter creeks stations

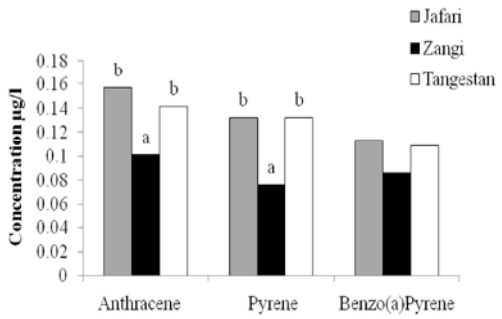

Fig. 2: Differences of PAHs concentration among creeks. a and b show significant difference among stations

the concentration of Anthracene (10.81 ng/l), pyrene (3.9 ng/g) and benzo(a)Pyrene (4.63 ng/g) in El-Sarsawia canal and El-Bagoria canal was higher than those in Jafari, Zangi and Tangestan creek.

CONCLUSION

Although, the current study was limited to a few amounts of PAHs, however the data available from our study are important result about Musa estuary for future studies. Jafari creek is more contaminated in comparison to the other creeks. Because it receive huge amount of petrochemical waste water, effluent of Bandar Emam port and other sources from surrounding areas. Generally, our findings do not exceed the permissible levels proposed by WHO (1998).

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