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Bioaccumulation of heavy metals in oyster (*Saccostrea cucullata*) from Chabahar bay coast in Oman Sea: Regional, seasonal and size-dependent variations

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ABSTRACT

The concentration of heavy metals was determined in tissues of oyster, *Saccostrea cuccullata*, phytoplanktons and water samples from intertidal regions of the Chabahar bay, Oman sea. Oysters were collected from 5 stations and during spring, summer and autumn seasons. The heavy metals content in oysters, planktons and water samples showed variations depending on season, sampling station and size of the oysters. The heavy metals in water, plankton and tissue of oyster were higher in summer and the lowest metal contents were observed in autumn. The oyster tissue samples of size-class had lowest concentrations of Co, Pb, Ar and Cu. The maximum tissue levels of Ar, Cu, Ni and Zn were observed in oysters of size-class II while the values of Cd, Co and Pb had maximum levels in those of size-class III. The minimum levels of Cd and also Ni and Zn were found respectively in tissue of the oysters of size-class II and size-class III. There were significant differences in heavy metal content of oyster tissue, planktons and water samples between sampling stations. In all sampling stations and during all sampling seasons, the concentrations of heavy metals (except Cu) were almost higher in soft tissues than in hard tissues of oysters especially in oysters of size-class II and III. Seasonal analysis of tissue heavy metal content of oysters showed no significant differences between sampling stations.

1. Introduction

Pollution of aquatic environments by heavy metals is of concern in many coastal regions of the world (Uluturhan and Kucuksezgin, 2007; Bidar et al., 2009; Boran and Altınok, 2010). Anthropogenic activities in the coastal regions including shipping, making marine facilities, oil exploration and land based industrial activates lead to release of different kinds of pollutants including heavy metals into the marine environments (Amin et al., 2009; Kamaruzzaman et al., 2008). The heavy metals can biologically be accumulated and biomagnified in aquatic organisms, water and sediment and thus threat marine food chain and finally human health (McGeer et al., 2000; Jones et al., 2001; Almeida et al., 2002; Sakan et al., 2007). Therefore, the quantity and distribution pattern of heavy metals in aquatic ecosystems must be always monitored. At now, a range of marine organisms such as algae and filter-feeding molluscs are used in order to biomonitoring of heavy metals in marine environments (Mashinchian Moradi, 2001; Topcuoğlu et al., 2003; Zelika et al., 2003; Nicholson and Lam, 2005; Hamed and Emara, 2006; Zorita et al., 2006; Stanly et al., 2008; Besada et al., 2009). Bivalves including oysters are widely distributed in aquatic ecosystems and can accumulate heavy metals in their tissue. Also, they are easy sampling, sessile and very resistant to physicochemical changes of the marine environment (Mashinchian Moradi, 2001; Saed, 2001; Elfwing and Tedengren, 2002; Zelika et al., 2003; Zorita et al., 2006; Thébault et al., 2008: Einollahi Peer et al. 2010; Peer et al., 2010). Thus, these properties make bivalve a suitable bioindicators for heavy metal monitoring in aquatic environments.

Furthermore, since the oysters have high nutritional and economic values, eating oysters with high concentrations of heavy metals is dangerous and threats human health. Therefore, the determination of heavy metal content of oysters is crucial from human nutritional standpoint (García-Rico et al., 2010; Zireva et al., 2007; Hejazi et al., 2009; Shirneshan et al., 2013).

The present study was aimed to monitor heavy metal pollution by assessing heavy metals in oyster, *Saccostrea cucullata*, phytoplanktons and water samples along intertidal regions of the Chabahar bay, Oman sea. Chabahar bay located in southeastern Iran, along Oman sea in which wide commercial and industrial activities have caused marine pollution with various pollutants specially heavy metals.

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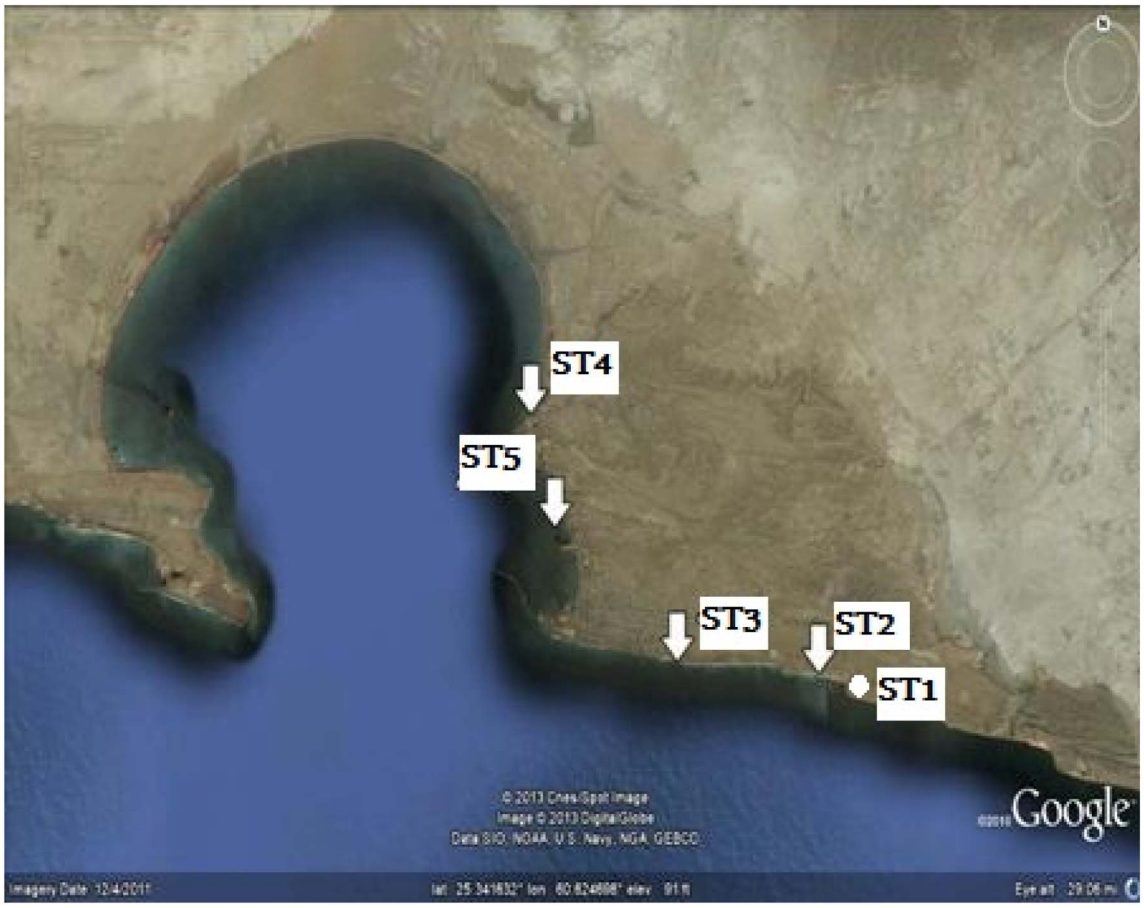

Fig. 1. Map of sampling station along Chabahar bay, Oman sea, Iran. ST1: station 1, ST2: station 2, ST3: station 3, ST4: station 4, ST5: station 5.

2. Materials and methods

The samples of water, plankton and oysters were collected during spring to autumn from 5 coastal stations along Chabahar bay, Oman Sea, Iran (Fig. 1). Sampling stations were: station 1 (ST1), station 2 (ST2), station 3 (ST3), station 4 (ST4), station 5 (ST5). Oyster sampling was carried out at the time of low tide. Totally 45 oysters with length range of 1–9 cm were collected (Keenan et al., 1998). Oysters were separated from cliffs using stainless steel hammer and Rod. The collected oysters were placed in polyethylene containers and then transferred on ice to laboratory. In the laboratory, after cleaning the oysters from debris's, oysters were washed by double distilled water and then stored at − 20 °C until further considerations (Orescanin et al., 2006; Yap et al., 2002).

Biometric indices of oysters were measured by a vernier caliper (precision of 0.01 cm). the biometric indices were: standard length, shell height, shell width, shell wet weight, shell weight and total oyster weight. Finally, oyster were classified into the three length classes including: Class I: < 3 cm length, Class II: 3–5 cm length, Class III: > 5 cm length.

After biometry, soft and hard tissue of oysters were separated using stainless steel knife and both soft and hard tissues were oven dried at 80 °C for 24 h until constant weight was obtained. The dried soft and hard tissue samples were powdered separately using glass mortar and were stored in polyethylene pill boxes until chemical digestion (Yap et al., 2003).

Chemical digestion was performed using 7 ml nitric acid 65% and 3 ml choleric acid per 1 g tissue sample. The samples were predigested first for 1 h in 40C° and then digestion was continued for 4 h at 140C° (Yap et al., 2002). After digestion, the samples were cooled in laboratory temperature and diluted to certain volume (25 ml) using double distilled water and filtered by filter paper (Whattman 42 μ). Heavy metals analysis was carried out using an atomic absorption spectrophotometer Unicom model 919.

Water sampled were collected from depth < 1 m by 50 ml falcon and then sampled stored at 4C° until heavy metal assays. 100 ml water samples of water.

In each station, the plankton samples were collected from depths < 10 m in three replicates using plankton net with mesh of 100 μm. After collection, 10 ml ethanol 96% was added to samples in polyethylene bags and then samples stored at − 20 °C until heavy metal assays. Free zed samples were thawed and filtered by filter paper (Whattman 42 μ). Then, samples were dried in desiccator, weighted and finally subjected to chemical digestion. The digestion was performed using 6 ml nitric acid 65% according to Yap et al. (2002). Finally, the heavy metals analysis was performed using an atomic absorption spectrophotometer Unicom model 919.

2.1. Data analysis

SPSS software was applied for data analysis. The data normality was examined with Kolmogorov-Smirnov test. Two-way analysis of variance (ANOVA) was used to compare the means. When significant F-ratios were significant, the tukey were applied to identify which groups were different.

3. Results

The concentrations of heavy metals in oyster tissue, planktons and water samples showed significant differences depending on season,

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