AN OVERVIEW OF NUTRIENTS AND HEAVY METALS IN THE IZMIR BAY, TURKEY, 1996-2002

F. Kucuksezgin *, A. Kontas, O. Altay, E. Uluturhan, E. Darilmaz
Institute of Marine Sciences&Technology, inciralti, 35340-Izmir - * filiz.ksezgin@deu.edu.tr

Abstract

The nutrient concentrations ranged between 0.01-0.19, 0.01-10 for o-PO_4-P; 0.10-1.8, 0.13-27 for TNO_x-N, 0.34-8.0, 0.43-39 µM for silicate in the outer and middle-inner bays, respectively. Heavy metals found in sediment varied for Hg: 0.05-1.3; Cd: 0.004-0.82; Pb: 14-113;Cr: 29-316 μgg^{-1}. High values were observed in the inner bay. Outer and middle bays show low levels of metal enrichments except Gediz River estuary. The levels gradually decreased over the sampling period. The metals found in fish varied for Hg: 4.5-928, Cd: 0.10-14, Pb: 0.10-918 μgkg^{-1}.

Key words: nutrients, heavy metals, sediment, fish, Izmir Bay

Introduction

Izmir Bay is one of the great natural bays of the Mediterranean. The Gediz River, which flows to the outer bay, is the biggest river in the bay. Inner bay intensely industrialized compared to outer bay and is heavily polluted by nutrients, organic material. Eutrophication of the inner bay is a serious problem throughout the year and red tide events are becoming more frequent. A number of studies have been carried out on the concentrations of nutrients, metals in the bay during a year, but no long-term and seasonal data are available. The main aim of this study was to monitor levels, temporal variability, distribution of nutrients, metals in edible fishes and sediments before and after wastewater plant.

Materials and methods

Data were collected during cruises of R/V *K. Piri Reis* in the bay. Sediment samples were taken using Van-Veen Grab from surface sediments. Samples were digested in microwave digestion system with an HNO_3-HF-$HClO_4$-HCl mixture. Tissues were digested with HNO_3-$HClO_4$ in a microwave system. All analyses were performed by flame (Cr), cold vapour (Hg), graphite furnace (Cd, Pb) AAS, using the manufacturer's conditions with background correction. The detection limits for heavy metals are Hg:0.05 μgl^{-1}, Cd:0.10 μgl^{-1}, Pb:0.10 μgl^{-1}, Cr:0.06 $mgkg^{-1}$.

Results and discussion

Nutrients

In the periods of 1996-2002, during autumn, TNO_x-N, o-PO_4-P levels were generally higher than the other periods (Table 1). Maximum values were recorded during autumn because of low consumption by phytoplankton. High levels of nutrients were observed during summer and autumn due to bacterial degradation in the inner bay. The phosphate concentrations in inner bay were higher than values observed in clean waters, a clear indication of the role of domestic waste. Higher chlorophyll-a values were determined in spring and autumn periods. The ratio of TNO_x to phosphate was lower than the Redfield's ratio. A two-way ANOVA was used to compare the nutrient concentrations among seasons and sampling stations. The nutrient concentrations significantly varied among season and sampling stations. Izmir wastewater treatment plant (WTP) was constructed in the beginning of 2000. The concentrations of TNO_x-N have been reduced after WTP except sudden discharges, while increases were recorded for the levels of o.PO_4-P in the middle-inner bays. The capacity of WTP has not been found enough for the phosphate. High levels of ammonia were found in the middle-inner bays due to the intensive rain.

Table 1. Range, mean values of nutrients (µM) in Izmir Bay.

	Year	Outer Bay		Middle-Inner Bays	
o.PO_4P	96-98	0.01-0.19	0.06±0.001	0.01-10	0.83±0.06
	00-02	0.01-0.19	0.05±0.003	0.13-4.4	1.2±0.17
TNO_xN	96-98	0.11-1.8	0.48±0.01	0.13-27	2.6±0.25
	00-02	0.10-1.4	0.44±0.02	0.15-18	2.4±0.55
NO_2N	96-98	0.01-0.23	0.03±0.001	0.01-18	0.53±0.09
	00-02	0.01-0.16	0.04±0.003	0.01-12	0.85±0.29
NH_4N	96-98	0.10-0.96	0.30±0.02	0.10-21	2.5±0.18
	00-02	0.10-0.79	0.25±0.01	0.10-50	3.6±1.3
Si	96-98	0.30-4.1	1.5±0.02	0.50-39	4.2±0.28
	00-02	0.38-4.8	1.3±0.05	0.43-26	5.5±0.83

Heavy metals in sediment

The highest concentrations of metals were found in the inner bay. The maximum level of Hg (1.3 μgg^{-1} dry wt) was measured at harbour in 2000. High levels of mercury were found in the NW part of the outer bay due to old center of mercury mining. The highest cadmium (0.82 μgg^{-1}) was also found at harbour in 1997. Lead (113 μgg^{-1}) and chromium (316 μgg^{-1}) were quite high in the sediments of middle-inner bays. The main source of lead is probably the traffic, since the great majority of the cars have no catalytic converters and burn leaded fuel. Maximum levels of Cr were observed at the Gediz River estuary due to the leather tanning plants. Metal concentrations decreased in 2002 at all sampling stations in the bay except Cr depending on the treatment of wastewater by WTP. The concentrations of metals in the outer bay were generally similar to the Aegean except chromium (1). The levels of metals are lower in the inner bay than polluted areas of Mediterranean (2).

Heavy metals in fish

Mullus barbatus was recommended by FAO/UNEP as monitoring species. *Solea vulgaris* was also selected as monitoring species because it is important commercially and commonly consumed by humans. In *M.barbatus* Hg level increased in 2002, while decreases were recorded for the values of Pb. All metal levels were significantly lower in *S.vulgaris* than *M.barbatus*. Regression between Hg concentrations and the fish length was statistically significant ($p<0.05$). An increase in Hg with increasing length was noted for *M.barbatus*, in good agreement with results from the Aegean Sea (3). ANCOVA was used to compare metal concentrations among seasons, no significant differences were detected. Metal concentrations found in this study were higher than those from clean areas of Aegean Sea (3), and are likely due to natural and industrial inputs to Izmir Bay. On the other hand, metal concentrations in Izmir Bay are considerably lower than those found in polluted areas of Mediterranean, such as Tyrrhenian Sea and Saranikos Gulf (4,5).

References

1 - Friligos N., Moriki A., Sklivagou E., Krasakopoulou E., and Hatzianestis I., 1998. Geochemical characteristics of the surficial sediments of the Aegean Sea. *Rapp. Comm. int. Mer Médit.*, 35: 260.

2 - Zvonaric T., and Odzak N., 1998. Distribution of Hg,Cu,Zn,Cd and Pb in surface sediments from the coastal region of the central Adriatic. *Rapp. Comm. int. Mer Médit.*, 35: 312.

3 - Kucuksezgin F., Altay O., Uluturhan E., and Kontas A., 2001. Trace metal and organochlorine residue levels in red mullet (*Mullus barbatus*) from the eastern Aegean, Turkey. *Water Res.*, 35: 2327-2332.

4 - Taliadouri-Voutsinouu F., 1980. Trace metals in marine organisms from the Saronikos Gulf (Greece). *Ves Journées Etud. Pollutions, CIESM*, 275-280.

5 - Barghigiani C., and De Ranieri S., 1992. Mercury content in different size classes of important edible species of the Northern Tyrrhenian Sea. *Mar. Pollut. Bull.*, 24: 114-116.