POTENTIAL TOXICITY OF SEAWATER ALONG ADRIATIC COAST, CROATIA

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Abstract

The potential toxicity of organic extracts from 12 seawater samples per 24 sampling sites, collected during 1999-2001 period along Adriatic coast, Croatia, was analyzed by Microtox[7] bioassay. Discrimination between sampling sites according to their potential seawater toxicity was achieved by cluster analysis. The water quality of selected sites could be described as excellent at one sampling site (mean EC50 > 625), good at 15 sampling sites (375 < mean EC50 < 625) and fair at 8 sampling sites (EC50 < 375).

Keywords: Adriatic Sea, Microtox[7], seawater toxicity

Introduction

The Adriatic sea, as a semienclosed part of the Mediterranean Sea is of special interest for an evaluation of environmental pollution. We hypothesized that by assesing the potential toxicity of seawater collected at 24 sites along Adriatic coast (Croatia) four times per year for 3 years, one could get a better insight into the general seawater quality at each sampling site. Physical-chemical properties of the Split region waters showed to be the most polluted along the Croatian Adriatic coast (1). The levels of PCBs from the Adriatic Sea sediment samples (1976-1992) were significantly lower compared to samples from areas of the south coast of France, west coast of Italy and east coast of Greece (2).The aim of the study was to determine the potential toxicity load of the main "hot spots" along the Adriatic coast, Croatia. Cluster analysing was introduced for discrimination between groups according to their toxicity load.

Materials and methods

The investigated sites were along Adriatic coast, Croatia, in the vicinity of urban and industrial areas (Rijeka, Zadar, Šibenik, Split, Dubrovnik) under the influence of human activities. For potential toxicity testing, seawater was collected at: mariculture (site 1), protected (sites 2, 3), urban (sites 8, 9, 10, 11, 13, 14, 15, 18), industrial (sites 16,17), harbour (sites 4, 5, 6, 7, 12, 19, 24) and brackish (sites 20, 21, 22, 23). Surface seawater was collected at 0.5 m depth at each sampling site in March, June, August and October from 1999 - 2001. Non-polar compounds were extracted (3), dissolved in DMSO (300 µl) and stored at -20 °C. Decline in luminescence of marine bacterium Vibrio fischeri NRRL B-11177 (DIN EN ISO 11348-3) was measured in the Microtox[7] bioassay. Maximal tested amount corresponded to 1250 ml of seawater.The results were expressed as ml of seawater causing a 50% reduction of bioluminescence after 15 minutes (EC50). To detect groupings in EC50 data (minimum, maximum, mean and median) a cluster analysis (complete linkeage method, Euclidean distances) was applied. To verify the groupings K-means clustering was performed.

Results and discussion

Microtox[7] bioassay provides a response to a single toxicant or a combined effect of many toxicants when their concentration exeeds treshold limit. It was succesfully applied for detection of sediment and seawater toxicity (4, 5, 6) as well as for accidental toxic events (7).We observed broad range and high variation of EC50 values at each investigated site. Due to the high standard deviations at each sampling site, Kruskal-Wallis test showed no statistical differences between sampling sites. Therefore, the cluster analysis as a multivariate procedure for detecting natural grouping of data was performed. Hierarchical tree sorted samling sites in clusters in such a way that sites with similar toxicity data appear in the same cluster while sites with dissimilar toxicity data in different clusters (Fig. 1). Three-group K-means method produced partitioned clusters identical to 3 clusters (each case p<0,05) separated at 60% similarity in the joining tree. First cluster comprise sampling site 21 with mean EC > 625 ml (Fig. 2), second cluster 15 sampling sites (2, 3, 6, 7, 8, 9, 10, 12, 13, 16, 18, 19, 22, 23, 24) with 375 < mean EC50 < 625 and third cluster comprised 8 sampling sites (1, 4, 5, 11, 14, 15, 17, 20) with mean EC50 < 375. Our investigation based on determination of potential toxicity of seawater organic extracts mirrored the present status of seawater quality and background levels of potential toxicity at 24 selected sites along Adriatic coast, Croatia.

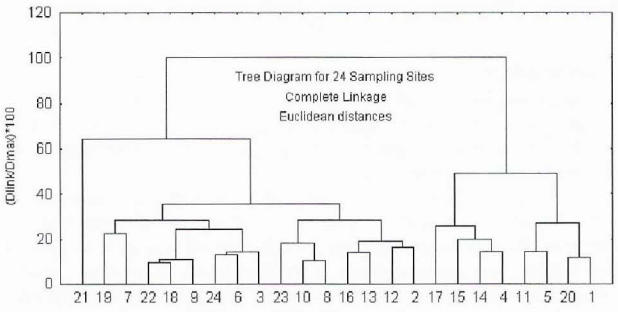

Fig. 1. Cluster analysis tree diagram of toxicity data (EC50) obtained from 12 samplings at 24 investigated sites along Adriatic coast, Croatia.

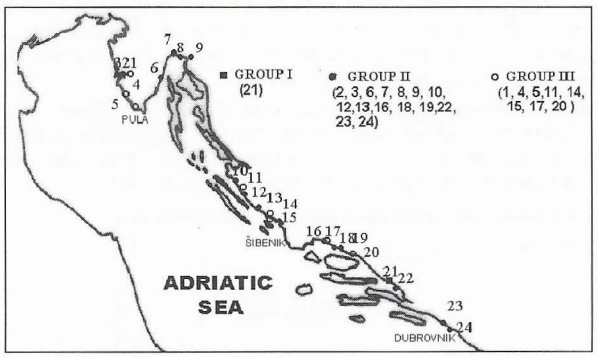

Fig. 2. Classification of 24 sampling sites along Adriatic coast, Croatia according to seawater toxicity: group I - mean EC50 > 625, group II - 375 < EC50 < 625, group III - EC50 < 375.

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