MAN-MADE EVOLUTION OF COASTAL BIOTA

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Abstract.
We examined the health parameters of different species from foraminifera to fish, especially Mediterranean molluscs. The parameters included measurements of (1) activity of anti-xenobiotic defense mechanisms; (2) cell and tissue viability; (3) frequencies of DNA and chromosome damages; (4) frequencies of cyto- and histopathological alterations. All studied species exhibited similar numerous anti-xenobiotic defense mechanisms, particularly transport systems for xenobiotics' elimination in external epithelia. Their activities mediate effects of pollutants and the health of biota. Selection of the most protected phenotypes of molluscs and fishes dwelling in the polluted sites shows a possible direction of this man-made evolution.

Keywords: population dynamics, export pumps, selection

Everybody knows that all living organisms protect themselves against microscopic enemies but only few scientists know that all organisms protect themselves also against xenobiotics. Anti-xenobiotic defense mechanisms, especially export pumps in aquatic species are studied very fragmentarily (1-5). Therefore, we studied these anti-xenobiotic defense mechanisms and main health parameters in specimens and populations from sites with different pollution history using specific fluorescent probes and novel pilot devices, particularly contact microfluorometers (6,7). Briefly, we detected *in vivo* the activities of main anti-xenobiotic defense mechanisms, signs of cell viability, frequencies and intensity of cytogenetic, cyto- and histopathological alterations in selected marine molluscan and fish species from the North Sea, Baltic Sea and especially Mediterranean Sea (2,3,7). Also Mediterranean benthic foraminifera and fishes from the Israeli stream, Yarqon River, were examined (3,8). All investigated species exhibited similar numerous anti-xenobiotic defense mechanisms. The first line of anti-xenobiotic defense was formed by multisubstrate transport systems for xenobiotic elimination (export pumps) in external epithelia. The multixenobiotic resistance-mediated transporter (MXRtr) pumps out numerous lipophilic and amphiphilic xenobiotics; system of active transport of organic anions (SATOA) eliminate hydrophilic anionic xenobiotics and by-products (1-8). The mean activities of the MXRtr and SATOA in external epithelia of molluscs and gill epithelium of fishes were significantly higher in animals from the polluted sites then from the clean sites. The activities of MXRtr and SATOA in molluscs and fish closely correlated with their environmental health parameters, particularly frequency of chromosome break (2,3).

The export pumps are well studied in cancer cells and some mammalian tissues (1, 9). However, some homologous export pumps and corresponding gene families were also detected in bacteria, protozoa, sponges, coelenterates, worms, molluscs, insects and lower vertebrates (1-9).

The frequency polygon of MXRtr activities in *D. trunculus* from the clean site was the widest with a maximum at the low activities. The specimens from very polluted sites exhibited narrower polygons with the maximum at higher activity, i.e. a shift of the maximum proportional to level of pollution. Frequency polygons of gill SATOA activities in *D. trunculus* from the same sites showed similar regularities. Marked shifts on frequency polygons for MXRtr were detected in the Mediterranean gastropod *P. coerulea* from the polluted sites and in the Red Sea bivalve *C. florida* and gastropod *C. rota* from the polluted site.

Kinetic analysis demonstrated a decreased K_M and increased V_{max} in *D. trunculus* from the polluted sites. All mentioned data demonstrate an "industrial selection" of certain MXRtr and SATOA phenotypes in the molluscs from the polluted sites along the Mediterranean and Red Sea shores. Similar selection of the most protected phenotypes was detected also in the fishes from the polluted sites (7).

It is known that environmental pollutants can select some allozyme phenotypes in molluscan and fish populations (10,11). Our results provide the first direct evidences that "industrial selection" produced general resistance of populations to environmental xenobiotics. Laboratory studies of acute sensitivity of molluscs to high concentrations of pollutants and field experiments with transplantation of the molluscs confirmed this conclusion.

Thus, specimens and species with high activities of the export pumps can survive in polluted environment with or without some alterations of their health and form the multixenobiotic-resistant populations. Such multixenobiotic-resistant biota, especially bacteria, protozoa, worms and insects may be more dangerous for human health than direct action of pollutants and decreased biodiversity.

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