Mussel DNase activity as a new biomarker for environmental contamination: response to model pollutants

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Introduction

Mussels adjust their function to environmental changes and serve as bioindicators of coastal water quality.

The aim of this study was to investigate the changes in the specific acid DNase activity in mussel *Mytilus galloprovincialis* exposed to three types of model pollutants, a detergent as a surfactant, gasoline as a polycyclic aromatic hydrocarbon mixture and copper as a heavy metal. Digestive gland as a detoxifying organ and hemocytes as a major internal defence tissue, were selected.

Materials and methods

The mussels (*M. galloprovincialis*) were obtained from mariculture and served as a control group and reference sample. Mussels (30 specimens) were exposed in 201 tanks to ariel detergent (0.05, 0.5 or 5 mg/l),gasoline (0.05, 0.5 or 5 mg/l) or copper sulphate, CuSO4x 7H2O (2.5, 25, or 250 mg/l) for 3 days.

DNase activity was measured fluorometrically by a method originally developed for neutral DNases [1] and adopted to acid DNases [2].

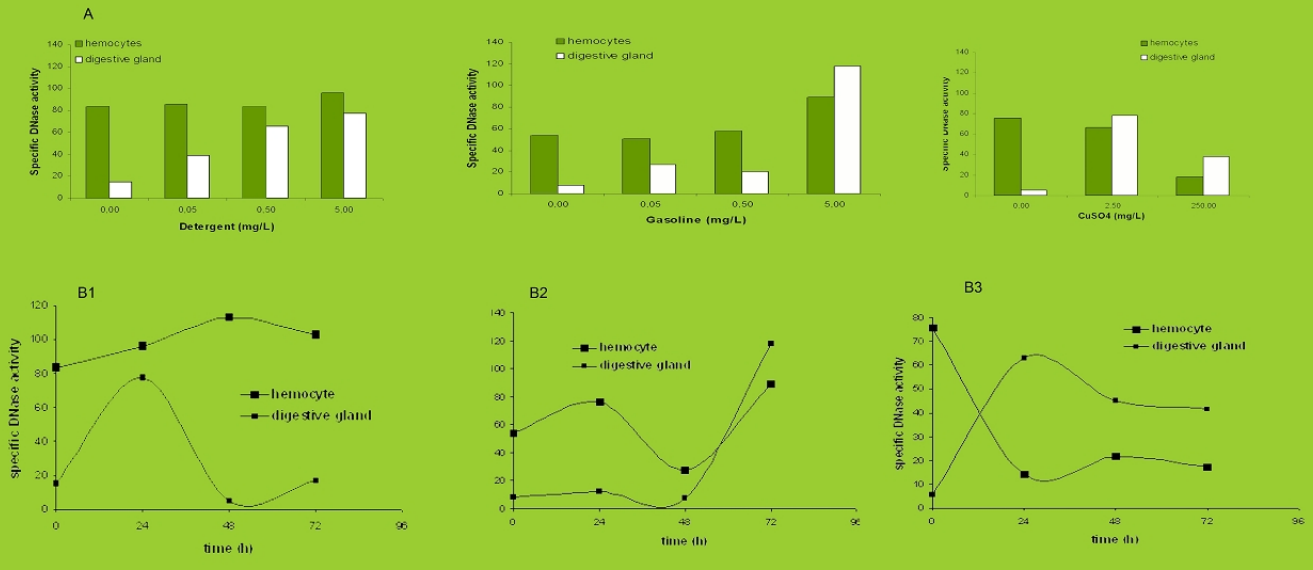

Fig.1. Dose (A) and time (B1, B2, B3) response of acid DNase activity of hemocytes and the digestive gland of the mussel Mytilus galloprovincialis to different pollutants. B1- detergent (5 mg/l), B2- gasoline (5 mg/l), B3- copper sulphate (250 mg/l).

Results and discussion

Comparison of specific acid DNase activity in hemocytes and digestive gland of control mussels revealed hemocytes as a tissue with the higher enzyme activity. In specimens exposed to detergent or gasoline the significant increase in enzyme activity was observed in both tissues. The highest enzyme activity was detected in mussels exposed to gasoline. A dramatic change in acid DNase activity was observed in the digestive gland of mussels exposed to gasoline and copper sulphate. Exposure to copper sulphate increased enzyme activity in the digestive gland but significantly suppressed it in hemocytes. Detergent and copper sulphate induced a fast response (24 h) of the enzyme activity in both tissues (Fig. 1B1, 1B3) while metabolic biotransformation of lipophylic constituents was probably the cause of the delayed enzyme response (48 h in hemocytes and 72 h in digestive gland) to gasoline (Fig. 1B2). Suppression of enzyme activity as a specific response of hemocytes acid DNase to copper sulphate is consistent with its effect on the cells of the immune system in bivalves [3].

Acid DNase activity response in hemocytes and digestive gland of mussels exposed to model pollutants was both tissue- and pollutant specific but the potential of acid DNase response in digestive gland of mussel to serve as an “all or nothing response” biomarker of contaminant exposure is promising.

References:

1. Choi, S.-J.,Szoka, F.C., 2000. Fluorometric determination of deoxyribonuclease I activity with Picogreen. Anal.Biochem. 281, 95-97.
2. Fafanđel, M., Bihari, N., Perić, L., Cenov, A., 2008. Effect of marine pollutants on the acid DNase activity in the hemocytes and digestive gland of the mussel Mytilus galloprovinciallis. Aquat. Toxicol. 86, 508-513.
3. Anderson, R., Mora, L., Thompson, S., 1994. Modulation of oyster (Crassostrea virginica) hemocyte function by copper as measured by luminal- enhanced chemiluminiscence. Comp. Biochem. Physiol. C 108, 218- 220.

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