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Editorial

Cytochrome P450 as a Biomarker for Pollutant Exposure in Aquatic Organisms

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Introduction

Monitors or early warning premeditate to identify and define areas of contamination could be extremely important in analysis of groundwater aquifers, surface water lakes, reservoirs, rivers, and oceanic systems. The need for early detection and assessment of the impacts of pollution in the aquatic environment has led to the development of biomarkers. A biomarker can be defined as a measurable response at any level of biological organization that can be related to an impact of contaminants. The great advantage of biomarkers is providing evidence of the state of pollution in a thorough way based on the synergistic and antagonistic effects of all contaminants involved.

The fish plays an important role as a bioindicator species in the monitoring of water pollution because it responds with great sensitivity to changes in the aquatic environment [1]. However, the physiological values of many parameters may vary in relation to the species of fish, their age, sex and seasons of the year. It is, therefore, very important to seek and make use of indicators independent of such physiological fluctuation [2-4].

Cytochrome P450- dependent monooxygenase activities have been useful for some years as biomarkers of exposure of aquatic organisms to water pollution. They comprise one family of the phase I enzymes, which oxidize, reduce, or hydrolyze xenobiotic substances. Their primary task is to add or expose functional groups, which then leads to further metabolism of the compound (phase II reactions, i.e., conjugations or synthesis). Phase I reactions normally transform lipophilic xenobiotics to more water soluble compounds, which is a first step toward detoxification and excretion. However, some of the intermediates are highly reactive and may ultimately result in enhanced toxicity and carcinogenicity [5].

The induction of specific isoenzymes of cytochrome P450 is a sensitive response to exposure of an organism to certain types of chemicals. For example, the CYP1 genes have been successfully employed as biomarkers of HAH and PAH exposure in fish species [6-9]. They respond to water contamination at very low levels or at the time when the contaminant is not dissolved in water yet but persists in the living matter, such as residues of biocidal agents.

Assessment of Cytochrome P450 for determination of the degree of surface water pollution was done by determining the amount of mRNA induced in the fish species most common in the region investigated. Several methods have been used to detect the induction process by using mainly three techniques: 1. Enzymatic methods at the catalytical level, 2. Immunochemical approaches (ELISA, Western blotting) and 3. Molecular technique (Real Time- PCR, Northern blotting). Recently, Real time-PCR has been developed for quantitation of CYP1s mRNA in tissues; this technique circumvents the disadvantages associated with other two techniques that face troubles with destruction of enzymatic activity/protein with the time lapse after the catch and can substantially increase the sensitivity of the detection systems [10,11].

Study on regulatory region structure and drug induction mechanisms of CYP1s genes may be useful as a preparatory stage for using them in the transgenic fish like Japanese medaka as an animal model in toxicity and carcinogenicity testing which will be useful for further functional analysis of the effects of these regulatory regions on gene expression. This abundant native small freshwater fish perhaps deserves more attention because it may be used to directly correlate laboratory findings with field studies in warm waters.

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