Biological Sensing of Polychlorinated Biphenyls by

Bioluminescence Zebrafish

HUNG Wing Yee

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Principal Supervisor: Prof. Ken Yung Kin Lam

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Abstract

Zebrafish (*Danio rerio*) is a common species employed in assessment of water quality and is also a good model for toxicological studies. Polychlorinated biphenyls (PCBs) are environmental toxins and found in industrial wastes which cause contaminations to the global ecosystems. Recent researches also indicate that PCBs are potential neurotoxins. In the present study, transgenic zebrafishes were produced to investigate the possibility using these transgenic zebrafishes as biological sensors for PCB contamination and toxicology.

In the first part of experiments, transgenic zebrafishes were produced using a cytochrome P450 1A1-green fluorescent protein (CYP-GFP) construct. CYP is a key enzyme in degradation of PCBs. In the first part of experiments, the CYP-GFP construct was microinjected into the zebrafishes embryos at one-cell stage. The protein expression of GFP is then driven by the CYP1A1 promoter. The transgenic fish embryos showed low intensity of fluorescence under the confocal microscope. The GFP expressions were observed in liver, starting from 3dpf (days post fertilization). After exposure to polychlorinated biphenyls (PCBs), the intensity of green fluorescence increased significantly. The CYP1A was expressing as early as 3 hours of exposure.

Tyrosine hydroxylase (TH) catalyzed the first step of biosynthesis of catecholamine, in
which tyrosine is converted to dopa, and to dopamine. In the second part of experiments, the TH-GFP construct was microinjected into the zebrafish embryos instead. Signs of GFP were found as early as 24 hpf (hours post fertilization). The distribution of GFP was found to coincide with that of TH. When the transgenic fish were exposed to PCBs, green fluorescent signals reduction shows the depletion of dopaminergic neurons. The transgenic zebrafish works as a biomarker which allows live imaging and monitoring of aquatic contaminations of PCBs and related compounds and also their toxic mechanisms.

TH is therefore the biomarker of dopaminergic cells in the nervous system. Damages to dopaminergic neurons cause neuronal diseases such as Parkinson’s disease.
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