DISSERTATION ABSTRACT

Ronisz, Zbigniew Dan, 2003. **EROD, Phase II, and Antioxidant Enzyme Activities as Biomarkers in Eelpout and Rainbow Trout.** Department of Zoology/Zoophysiology, Göteborg University, Box 463, SE-405 30 Göteborg, Sweden.

Biomarkers are biological responses used in effect and exposure assessment of pollutants in the aquatic environment. Preferably, they should be measurable at a low biological level, before any damage is done to the population, community or an entire ecosystem. Changes in the activitites of some detoxification and antioxidant enzymes in fish liver are being used as biomarkers for different pollutants, e.g. the activity of the Phase I enzyme CYP1A (EROD) is an established marker for polycyclic aromatic hydrocarbons (PAH), planar polychlorinated biphenyls, dioxins and aromatic amines, all part of anthropogenic pollution. The activities of the Phase II enzyme GST and antioxidant enzymes GR, GPx and catalase are being used as a marker of oxidative stress-inducing chemicals. In polluted environments there can be interactions between chemicals, e.g potentiation, resulting in an effect larger than the additive effect of the single compounds. The model PAH isosafrole (ISF) injected intraperitoneally in rainbow trout and eelpout together with another model PAH and CYP1A inducer β-naphthoflavone (BNF) caused a markedly stronger than additive induction of EROD activity and CYP1A protein level when BNF doses were submaximal. The mechanism possibly includes inhibition of CYP activity and stabilisation of the CYP protein increasing the effective doses of BNF, but this must be investigated further.

The flame retardant TBBPA, induced the activity of GR in rainbow trout, indicating that it can cause oxidative stress in this fish at high doses. The flame retardant HBCDD inhibited EROD activity in vivo and seemed to down regulate CYP1A protein. After 28 days HBCDD elevated slightly LSI and in some experiments it also induced the activity of catalase indicating a possibility of HBCDD being a peroxisome proliferator in fish. Neither of the compounds affected any of the biomarkers in eelpout. More long-term, low-dose studies should be performed in order to better emulate the environmental conditions.

When biomarkers levels in fish are measured in the field it is critical to know how those levels vary due to biotic and abiotic factors, such as sex, nutrition status, season and temperature. Eelpout is considered well suited for biomonitoring since it is stationary, abundant and easy to catch. An annual cycle of biomarkers in eelpout was measured: Phase I and Phase II enzyme activities showed clear seasonal variations, while the activities of GPx, GR and catalase were more stable. This study provided an intra-annual baseline for biomonitoring of pollutant effects at the Swedish west coast using eelpout.

A long-term eelpout monitoring project at a reference station of Fjällbacka at the Swedish west coast is ongoing. The level of chloride in blood plasma, percentages of lymphocytes, the activities of GST and GR were relatively stable between 1989 and 2001, while e.g. EROD and catalase activity showed stronger variations. The study provided an inter-annual baseline for biomonitoring at the west coast and also, with respect to most of the biomarkers, showed that there probably was no long-term, large-scale pollution affecting the site.

Key words: biomarker, CYP1A, EROD, GST, GR, catalase, PAH, HBCDD, TBBPA, β-naphthoflavone, isosafrole, potentiation, oxidative stress, eelpout, rainbow trout.