P.A.H. (Polycyclic Aromatic Hydrocarbons) Mixtures: Using Zebrafish to Elucidate Mechanisms of Toxicity

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Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous non point source aquatic contaminants derived from various combustive and fossil fuel sources, causing sublethal cardiotoxic effects in fish. PAHs' toxic mechanisms, especially in complex mixtures, are poorly understood. To elucidate these and develop diagnostic biomarkers to assess fish populations' health, a simplified model of an environmentally-relevant PAH mixture was examined by combining cardiotoxic Phenanthrene (PHN, three-ringed), and non-toxic Chrysene (CHR, four-ringed). Effects on morphology and metabolism were examined in relation to the cytochrome p450 enzyme detoxification metabolic model. Zebrafish embryos (<52 hpf) were exposed to increasing CHR concentrations in synergism with a stable PHN concentration. Morphological abnormalities were observed with increased doses of CHR and heart-rate measurements decreased dose-dependently ($p<0.05$). Then, PAH metabolites were analyzed with high performance liquid chromatography(HPLC) with fluorescence detection. Gene expression analysis of both cyp1a and cardiac-specific genes in the PHN+CHR exposures was conducted with qPCR and compared with expression levels from individual PHN and four/five-ringed PAH exposures to find biomarkers of PAH toxicity. Results indicate increased toxicity with the PHN+CHR mixture. HPLC method allowed measurement of PAH metabolites in exposed fish embryos, providing a novel method to examine metabolic interactions; results suggest the existence of an alternative metabolic pathway involved in PHN metabolism with toxic products. Though the examined genes were not bioindicators of non-toxic vs. toxic PAH exposure, some could distinguish between three and the four/five-ringed individual PAH exposure and should be further studied.

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