HEALTH AND HUMAN SCIENCES

Comparative Developmental Toxicity of Perfluorooctanesulfonic Acid (PFOS) and Its Alternative Perfluorobutanesulfonic Acid (PFBS)

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Perfluoroalkyl substances (PFAS) are synthetic compounds that are composed of a fluorinated carbon chain. PFAS are persistent in the environment and bioaccumulate in organisms. The concerns of PFAS toxicity led to voluntarily phasing out of perfluorooctanesulfonic acid (PFOS) by its manufacturer. Shorter chain PFAS, such as perfluorobutanesulfonic acid (PFBS), are suggested to be less toxic alternatives with decreased environmental persistence. In this project, zebrafish embryos were used to compare developmental toxicity of K-PFOS and its replacement K-PFBS. To determine the LC50 (concentration at which 50% lethality is observed) for K-PFOS and K-PFBS, embryos were exposed to a range of concentrations of each chemical within one hour post-fertilization (hpf). The toxicity of these compounds was assessed by monitoring survivability every 24 hours through 120 hpf. LC50s were deter-

mined using GraphPad Prism software. Behavioral analysis using a visual motor response (VMR) test was performed at 120 hpf after exposure to sublethal concentrations during embryogenesis (1-72 hpf). All data obtained was analyzed with a repeated measures analysis of variance (ANOVA) by phase ($\alpha = 0.05$). Results showed that LC50s for K-PFOS and K-PFBS were 23.24 and 2,409 ppm, respectively, supporting that K-PFOS is more lethal. Behavioral analysis showed that an embryonic exposure to K-PFOS or K-PFBS induced hyperactivity in larvae. These results indicated that although K-PFOS is more lethal, at the more subtle functional endpoint of behavior, K-PFBS has similar impacts as K-PFOS. This finding is significant to public health in that PFBS appears not to be a less toxic alternative to K-PFOS.

Research advisor Jennifer Freeman writes: "Hanna's research project is providing information on comparative developmental toxicity of longer and shorter chain PFAS chemicals. Shorter chain PFAS are currently replacing the longer chain compounds in consumer products under the assumption they are less toxic, but minimal data is available for most toxicity endpoints including neurobehavioral alterations."

Alterations in behavior at 120-hour post-fertilization (hpf) in zebrafish larvae exposed to K-PFOS (A) or K-PFBS (E) during embryogenesis (1-72 hpf). (B-D) K-PFOS exposure caused hyperactivity in all dark and light phases (* $p < 0.05$, $n = 8$ with ~19 subsamples per treatment per replicate to total 149-155 samples/treatment). More significant changes were observed at all three endpoints in the dark phases. (F-H) K-PFBS also caused hyperactivity in all dark and light phases in a clear dose response (* $p < 0.05$, $n = 6$ with ~19 subsamples per treatment per replicate to total 111-113 samples/treatment). Error bars represent standard deviation.