Detection of Trifluoroacetic Acid in Commercial Water Filters and Its Toxicological Impacts on Keystone Aquatic Species

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Polyfluoroalkyl substances are present in 45% of U.S. drinking water, threatening human and environmental health due to their high polarity and persistence. Trifluoroacetic acids (TFAs), a type of short-chain PFAS, comprise approximately 90% of PFAS but are difficult to detect and remove. This study evaluated the efficiency of three commercially available water filtration systems in remediating TFA from drinking water and assessed the ecological impact of TFA on Daphnia magna. Heart rate and egg production of Daphnia magna were assessed at TFA concentrations of 100 ppm, 1 ppm, 0.01 ppm, and 0.0001 ppm. Heart rate was measured immediately after exposure and again after 48 hours. Egg production was quantified by counting eggs in five individuals per concentration over a 48-hour period to assess reproductive effects. Filtration efficiency varied across systems, with reverse osmosis and ion-exchange systems demonstrating high removal capacity. Immediate TFA exposure decreased the heart rate of Daphnia magna, indicating an acute stress response, whereas prolonged exposure increased heart rate at higher concentrations, suggesting a compensatory physiological response. Statistically significant differences in heart rate were observed across concentrations both immediately and after 48 hours ($p = 0.0001819$; $p = 0.017$). Egg production declined as TFA concentration and exposure time increased ($p = 0.02476$; $p = 5.661 \times 10?7$), indicating reproductive inhibition. These findings highlight the persistence of TFA in aquatic systems and underscore the need for improved water treatment strategies to protect ecosystem and human health.

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