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Degradation and Reduction of Toxicity of Individual and Mixed Emerging Organic Pollutants

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Emerging organic pollutants pose significant concern due to their increasing presence in household and industrial effluents. The impact of nuclear techniques was investigated on four drugs (atenolol, carbamazepine, methylparaben, and sildenafil citrate), both individually and in combination dissolved in water (50 ppm), using electron beams (1-4 kGy – 1.4 MeV, 37.5 kW). Physical-chemical and toxicity parameters were analyzed. The results indicated minimal changes in pH, dissolved oxygen, conductivity, and TOC, but substantial reduction in UV-Vis absorption. Peak area comparisons demonstrated over 90% reduction in all compounds with a 2 kGy dose.

Toxicological assessments using *Daphnia similis* and *Vibrio fischeri* indicated methylparaben and sildenafil citrate as the most toxic compounds. In *V. fischeri*, methylparaben toxicity decreased with 4 kGy, whereas sildenafil citrate toxicity remained unchanged. Conversely, in *D. similis*, irradiation increased toxicity of carbamazepine, methylparaben, and sildenafil citrate at 2 kGy. However, irradiation of a mixture of methylparaben and sildenafil citrate (50 and 100 ppm) with doses ranging from 1 to 4 kGy significantly reduced toxicity in *V. fischeri*.

These findings highlight the potential of ionizing radiation treatments for integrating into effluent treatment plants to eliminate micropollutants effectively.