Food Waste-Based Biocoagulants: A Novel Approach to Sustainably Remove Polystyrene Microplastics for Future Alternatives in Water Treatment

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The average American drinks over 39,000 microplastics (MPs) annually. Studies on human cells suggest MPs are potential neurotoxins and carcinogens, further emphasizing the need for better techniques to be developed to effectively remove MPs during water treatment (WT). Coagulation, flocculation, and sedimentation utilize synthetic chemicals called coagulants to remove suspended particles in WT. Aluminum sulfate (alum), a common synthetic coagulant, can be harmful to the environment. The purpose of this study is to determine a new, sustainable method utilizing food waste-based biocoagulants (FWBCs) to remove polystyrene microplastics in WT. Twelve FWBCs made of aloe, apple, avocado, banana, corn, cucumber, lemon, mango, okra, pepper, potato, and tomato were tested. Polystyrene was chosen for its similar density to water, making it difficult to remove in WT. Triplicate jar tests were performed to simulate a water treatment basin. A novel, more accurate method was created to measure MP removal rates utilizing dry mass. Average MP removal rates were calculated, and t-tests performed with banana, pepper, avocado, lemon, tomato, cucumber, potato, and corn having no statistical difference in MP removal rates compared to alum, proving each to be viable alternatives. A second round of experiments varying pH and FWBC combinations resulted in Banana-Pepper removing 96.9% of MPs at a pH of 8. Instead of food waste ending up in landfills emitting greenhouse gases, it can be reused to sustainably remove MPs in WT. This work is a starting point towards a low-cost, convenient, and sustainable solution to providing clean, accessible drinking water for all.