Cassava Peel Powder: A Novel, Cost-Effective and Eco-Friendly Pharmaceutical Biosorbent

Goh, Alden Kai Ray (School: Chung Ling High School Penang)
Liew, Ze Wei (School: Chung Ling High School Penang)
Tan, Chun Rui (School: Chung Ling High School Penang)

Cassava (Manihot esculenta) is a staple crop with a total worldwide production of 298.8 million tons in 2020. However, its peel waste creates detrimental sanitation and environmental problems. The COVID-19 pandemic has increased the amount of pharmaceutical wastes substantially, compounding the disposal problem of pharmaceutical wastes and endangering human health as well as aquatic life. Existing methods to remove pharmaceutical wastes from water are complicated, expensive, and inefficient. Therefore, we propose using pre-treated Cassava Peel Powder (CPP) as a pharmaceutical waste biosorbent. Using paracetamol (acetaminophen) solution as a wastewater model, the optimum conditions to adsorb paracetamol with an initial concentration of 4.08 g/L while shaking with CPP at 200 rpm were 60 minutes ($F(2.5102)=7.6400$, $p=0.000$, 1-way ANOVA) and a CPP dosage of 1.0 g ($F(3.4780)=74.3600$, $p=0.000$, 1-way ANOVA). Results showed that CPP has a maximum adsorption capacity of 731.14 mg/g ($F(3.4780)=52.6700$, $p=0.000$, 1-way ANOVA) and a maximum removal efficiency of 98.9%. The dominant adsorption mechanism was chemisorption on a heterogeneous surface as the data correlated better with the Pseudo-second order kinetic model and Freundlich Adsorption Isotherm. Furthermore, regeneration test showed that CPP can be reused twice after desorption with a reduction in removal efficiency of 33.76% after the second cycle. FTIR spectra showed that the intensity of hydroxyl and carbonyl groups in CPP decreased after adsorption, suggesting their involvement during adsorption. Our study showed that CPP was a novel, cost-effective, and eco-friendly pharmaceutical biosorbent that benefits humanity, the environment, and aquatic life by solving problems of food waste and pharmaceutical waste in water.

Awards Won:
American Chemical Society: Third Award of $2,000
Fourth Award of $500