Diplazium esculentum (Paku Pakis) adsorption characteristics toward toxic Brilliant green dye

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A B S T R A C T

Diplazium esculentum, an edible fern, was investigated for its potential as a low-cost and effective biosorbent for the removal of toxic Brilliant green (BG) dye. Batch experiments were performed to investigate parameters such as contact time, ionic strength, kinetics, isotherm, and pH on the adsorption capacity. The Pakis adsorbent reached equilibrium within 2 h of contact time with BG dye, and of the five adsorption isotherm models tested, the Sips model gave the best fit with a maximum adsorption capacity (q_{max}) of 347.5 mg g^{-1}. Kinetics study revealed that the pseudo-second-order model was best fitted to the experimental data, suggesting that chemisorption could be involved. Analyses of adsorption isotherm and kinetics were carried out using linear and nonlinear regressions and compared. ANOVA tests revealed a significant difference between the two methods of analyses for adsorption kinetics. The experimental data of both kinetics and isotherm fitted better when nonlinear regression was used, as compared to the corresponding linear regression analysis. The adsorbent maintained its effective adsorption of BG with varying pH solutions and salt concentrations. Treatment with 1.0 M NaOH of spent Pakis adsorbent could remove >80% BG dye even after five consecutive cycles. High adsorption capacity, relative stability, ability to be regenerated, and reused all lend support to the possible future application of Pakis as a potential low-cost adsorbent in wastewater treatment.

Keywords: Adsorption isotherm; Brilliant green dye; Kinetics; Pakis adsorbent; Regeneration; Nonlinear regression

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