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Applicability of dragon fruit (*Hylocereus polyrhizus*) peels as low-cost biosorbent for adsorption of methylene blue from aqueous solution: kinetics, equilibrium and thermodynamics studies

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ABSTRACT

This study evaluated the feasibility of utilizing agricultural waste dragon fruit (*Hylocereus undatus*) peels (DFP) as natural low-cost adsorbent to remove cationic dye methylene blue (MB) from aqueous solution. The physicochemical compositions of the DFP were characterized using CHNS-O analysis, X-ray diffraction, scanning electron microscopy, Fourier transform infrared spectroscopy and point of zero charge (pH_{pzc}) method. Batch mode adsorption studies were carried out by varying the operational parameters, namely adsorbent dosage (0.02–0.20 g), pH (3–10), initial MB concentration (50–400 mg/L) and contact time (0–120 min). The adsorption kinetic data showed that the process was best described by the pseudo-second-order kinetic model. The equilibrium data were discovered to better obeyed the Langmuir isotherm model than the Freundlich with maximum monolayer adsorption capacity, q_m, of the DFP towards MB was found to be as high as 192.31 mg/g. The thermodynamic adsorption parameters such as standard enthalpy ($\Delta H°$), standard entropy ($\Delta S°$) and standard free energy ($\Delta G°$) advocated that the adsorption of MB by DFP was endothermic and spontaneous under the tested conditions. These findings clearly indicated the viability of DFP as an effective adsorbent for elimination of MB from aqueous solution.

Keywords: Adsorption; Agricultural waste; Dragon fruit peel; Low-cost adsorbent; Methylene blue

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