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Biosorption potential of *Thapsia transtagana* stems for the removal of dyes: kinetics, equilibrium, and thermodynamics

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ABSTRACT

In this work, a low-cost and eco-friendly biosorbent developed from *Thapsia transtagana* stems (TTS) was investigated as an alternative to the current expensive methods for removing dyes from textile wastewater. Biosorption potential for the uptake of methylene blue (MB) and methyl violet (MV) was evaluated in batch mode under different condition. The experimental results show that biosorption yield increases with an increase in the biosorbent dosage. Maximum biosorption occurred at neutral to basic pH values. Kinetic data were properly fitted with the pseudo-first-order model instead of pseudo-second-order model. Equilibrium uptake was increased with an increase in the initial dye concentration in the range of 20–200 mg/L according to Langmuir isotherm model. The maximum monolayer biosorption capacities were 183.23 and 222.82 mg/g for MB and MV, respectively. The biosorption of the dyes was exothermic in nature ($\Delta H°$ = –21.07 kJ/mol for MB and –16.85 kJ/mol for MV). The reaction was accompanied by a decrease in entropy ($\Delta S°$ = –40.35 J/K.mol for MB and –50.41 J/K.mol for MV). The Gibbs energy ($\Delta G°$) increased from –4.91 to –3.74 kJ/mol and from –5.57 to –4.22 kJ/mol, respectively for MB and MV, when the temperature was increased from 25°C to 55°C. The surface of TTS has been thoroughly characterized by FTIR spectroscopy, scanning electron microscopy–energy-dispersive X-ray spectroscopy, Boehm titration, and point of zero charge.

Keywords: Biosorption; *Thapsia transtagana* stems; Textile dyes; Remediation

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