Ecofriendly biosorption of atrazine herbicide in aqueous solution by *Moringa oleifera* Lam: kinetics, equilibrium and thermodynamics

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**Abstract**

The water contamination by herbicides, such as atrazine, causes negative impacts, affecting animal's and human's health. The *Moringa oleifera* Lam seed is proposed as a material for atrazine biosorption from water. The initial atrazine concentration was 5 mg L⁻¹, the adsorption assays showed that the relevant parameters to the process were the effect of pH and the adsorbent mass. Models of pseudo first order and pseudo second order and intraparticle dissemination were applied in the experimental results. The kinetic model of first-order Lagergren (pseudo) explained the experimental adsorption results; the kinetic equilibrium was reached in 20 minutes, and atrazine removal was 76%. The maximum sorption capacity was calculated to the Langmuir (0.653 mg g⁻¹) and Freundlich (0.125 mg g⁻¹ L¹⁰⁻¹ mg⁻¹⁰) isotherms models. The thermodynamic parameters ΔG° (kJ mol⁻¹), ΔH (kJ mol⁻¹), and ΔS (kJ mol⁻¹ K⁻¹) (Gibbs free energy, enthalpy, and entropy), showed negatives values, such as –3.98 to –5.09, –21.76, and –0.056, respectively. The interaction of functional atrazine groups with the adsorbent surface was confirmed by Fourier-transform infrared spectroscopy analysis. As the seed is a complex and heterogeneous biomass, it is suggested that the Freundlich model is more appropriate to explain how the atrazine biosorption occurs.

**Keywords:** Atrazine; Adsorption; *Moringa oleifera*; Water treatment