Adsorption Characteristics and Bioactivity of Bt (Bacillus Thuringiensis) Insecticidal Protein on Attapulgite

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Abstract: Kinetics and thermodynamics for the adsorption of insecticidal protein from *Bacillus thuringiensis* (Bt) on attapulgite under static conditions and the influence of adsorption time, temperature, pH and the initial ratio of protein to mineral on the adsorption were studied. Results indicate that Bt protein can be adsorbed by attapulgite rapidly, and the adsorption attains equilibrium within 30 min. The fitting extent of the adsorption for pseudo-first-order, pseudo-second-order, intrapartice diffusion and Elovich model is in the order of pseudo-second-order>Elovich>pseudo-first-order>intrapartice diffusion model. The adsorption amount decrease with increasing temperature. In the range of pH from 7 to 10, the adsorption amount decrease with increasing pH values. The adsorption amount increase but the adsorption percent decrease with increasing initial ratio of protein to mineral. The adsorption of Bt protein by attapulgite is a spontaneous and exothermic process, companying increasing entropy within the temperature range of 278 ~ 318K. The adsorption free energy (ΔG^0_{ads}) values are between −35.56 and −38.37 kJ mol^{-1}; the adsorption enthalpy (ΔH^0_{ads}) value is 16.16 kJ mol^{-1}, and the adsorption entropy (ΔS^0_{ads}) value is 69.47 J $mol^{-1} K^{-1}$. The adsorption complex is characterized by FTIR and XRD, and the results indicate that there is no significant change of protein structure before and after adsorption. The insecticidal activity and anti-ultraviolet of Bt protein increase after being adsorbed on attapulgite. The above results provide an experimental basis for the preparation of Bt efficient formulation and the application of attapulgite.

Keywords: attapulgite; protein of *Bacillus thuringiensis*; adsorption kinetics; adsorption thermodynamics; bioactivity