Index No: – 95/19/Life sc. /26

Tittle: Evaluating the potential role of natural products from *Cleome gynandra* in urease inhibition and nitrogen utilization for enhancing soil health-A rhizosphere manipulation strategy

Abstract

Plant-derived natural products with urease-inhibiting properties have the potential to improve nitrogen fertilizer formulations in agriculture and the development of novel therapeutics for the treatment of infectious diseases. The main focus of this research was to evaluate the inhibitory impact of various parts of *Cleome gynandra* (Cleomaceae) on jack bean urease activity, identify the accountable compounds, and determine their mode of inhibition and interacting pattern with the targeted enzyme. Urease inhibitory capability by different plant parts of *C. gynandra* was analyzed using the phenol-hypochlorite method and mode of inhibition by double-reciprocal plot. LC-HRMS was carried out to identify the compounds in the active fractions. Molecular docking and simulations were executed to find out the binding affinity and interaction pattern of the isolated compounds with the catalytic site of urease and to verify the stability of protein-inhibitor complexes. The root of *C. gynandra* exhibited the highest urease inhibitory potential with an IC_{50} value of 1.529 mg/ml compared with the leaf and stem. Among different root fractions, the water fraction revealed maximum anti-urease activity with an IC50 value of 1.477 mg/ml, followed by methanol (1.655 mg/ml) and acetone fractions (1.955 mg/ml). Inhibition kinetics indicated that these fractions interfere with the enzymatic activity and exhibited a non-competitive mode of inhibition with Ki values of 184.911 µg/ml, 147.34 µg/ml, and 233.75 µg/ml, respectively, at a 1000 mg/L concentration. LC-HRMS analysis confirmed the existence of glucocapparin, fluticasone propionate, lauryl hydrogen sulfate, etc., in the water fraction. Molecular docking and simulation studies suggested stable interactions between the specified compounds of the water fraction and the active site of urease. Hence, the water fraction of *C. gynandra* roots represents a valuable source of natural urease inhibitors for possible therapeutic applications and sustainable agricultural practices.

Rajashree Dutta
Signature of candidate
Date: 30.04.2025

Suparna Mandal Biswas
signature of supervisor with seal
Date: 30.04.2025

Dr. Suparna Mandal Biswas
Head, Agric & Ecol. Res. Unit
Indian Statistical Institute
203, B.T. Road, Kolkata - 700108