Optimization of Fermentation Culture Conditions for Salt-Tolerant *Azotobacter chroococcum* Strain A4 from the Rhizosphere of *Lycium ruthenicum* Using AI-Assisted Design

Huiqiang Liu[1, *], Jingtao Zou[1], Alisher Abdullaev[2], Narimanov Abdujalil[3]

[1]College of Life Science and Technology, Xinjiang Normal University, Urumqi, China

[2]Center for Advanced Technologies, Ministry of Innovations Development of the Republic of Uzbekistan, Tashkent, Uzbekistan

[3]The Institute of Genetics and Plant Experimental Biology of the Academy of Sciences of Uzbekistan, Tashkent, Uzbekistan

Email address:

358920548@qq.com (Huiqiang Liu)

[*]Corresponding author

Abstract

Xinjiang has a vast area of saline-alkali soil, accounting for one-third of China's total saline-alkali land, and soil salinization severely restricts sustainable agricultural development. *Lycium ruthenicum*Murr., a pioneer plant in Xinjiang's saline-alkali regions, exhibits strong salt tolerance and medicinal value, but its growth is still limited by nitrogen availability. *Azotobacter chroococcum*, an aerobic free-living nitrogen-fixing bacterium, can convert atmospheric N_2 into plant-available nitrogen, secrete plant growth regulators, and solubilize insoluble soil nutrients, making it a promising candidate for saline-alkali soil improvement and crop yield enhancement. A salt-tolerant *Azotobacter chroococcum*strain A4 isolated from the rhizosphere of *Lycium ruthenicum*shows excellent salt tolerance and nitrogen-fixing ability, but its unoptimized fermentation conditions limit large-scale application. This study combined AI-assisted design with single-factor experiments and response surface methodology to optimize the fermentation medium for strain A4, aiming to improve its biomass and nitrogenase activity, and provide theoretical and technical support for the development of nitrogen-fixing microbial agents dedicated to saline-alkali lands.

Keywords

Lycium ruthenicumMurr, *Azotobacter chroococcum*, Fermentation Condition Optimization, Response Surface Methodology, Cost-benefit Analysis