Microbial Fermentation for Value-Added Production of Rhubarb Anthraquinones and Derived Potential in Parkinson's Disease Treatment

Tzu-Kuan Lien

MSc Graduate Student, Department, Chemical and Materials Engineering, National I-Lan University, Taiwan

Bor-Yann Chen

Department, Chemical and Materials Engineering, National I-Lan University, Taiwan

Po-Wei Tsai

Department, Food Science, National Taiwan Ocean University, Keelung, Taiwan

Cheng-Yang Hsieh

Department, Chemical and Materials Engineering, National I-Lan University, Taiwan

Chung-Chuan Hsueh

Department, Chemical and Materials Engineering, National I-Lan University, Taiwan

Abstract:

Literature indicated that anthraquinone-derived compounds could possess potential for treating Parkinson's disease (PD). However, clinical medication was popularly used by dopaminergic medications such as L-DOPA may still have side effects. To provide alternative medication with less side effects, this study applied the utilization of microbial fermentation to the processing (Pao Zhi) of herbal species-rhubarb to augment value-added production of the target electron shuttle compound rhein and its related anthraquinone derivatives. The performance of bioelectricity generation served as overall metabolic indicator to respond whether food-originated microorganisms could effectively augment bioelectrochemical activity and properly maximize target bioenergy yields. Molecular docking simulations demonstrated that anthraquinone compounds exhibit superior binding affinity to PD-related proteins compared to popularly used drugs like L-DOPA, suggesting their promising potentials as novel therapeutic compositions for PD. Approximately two weeks of acclimatization for fermentation, anthraquinone contents markedly increased 2 - 2.5 fold of the initial level (from 80 to 160-200 mg/L). These all pointed out the promising treatability of acclimatized fermentation for maximal value-added production. In addition, transient dynamics analysis of metabolic intermediates with kinetic modelling can elucidate the underlying mechanisms, thereby suggesting optimal operation strategy to maximal production.