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Encapsulation of Phytase Using Freeze-Drying Method to Enhance Performance and Stability

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Abstract

Phytase is a critical enzyme in the feed industry for livestock, poultry, and aquaculture, as it facilitates phosphorus absorption and improves the digestibility of other nutrients. Given its essential role, extensive research has been conducted on encapsulation techniques to preserve and stabilize phytase activity under harsh environmental and gastrointestinal conditions. We investigated a novel phytase enzyme that demonstrates optimal activity for reducing phosphorus-related pollution. By analyzing soil samples with an enhanced selective culture medium, we successfully isolated bacterial phytase producers. We extracted enzymes from these bacterial isolates and measured their phytase activity. Our characterization of the phytase included optimal pH, temperature, and substrate specificity. In the current study, we used chitosan, gum Arabic, and gelatin as encapsulation materials. Freeze-drying, a widely recognized and industrially practical method, was employed to dry the encapsulated enzyme samples. This encapsulation strategy aims to enhance the enzyme's resistance to temperature and pH fluctuations, ensuring its functionality throughout the storage and digestive processes. To confirm the encapsulation of phytase, the enzyme was labeled with FITC, and fluorescence microscopy images validated the successful encapsulation. The encapsulated phytase demonstrated superior activity and stability compared to the free enzyme, showing better performance in terms of enzyme activity retention and prolonged shelf life. The results of this study have significant implications for the development of more efficient and stable phytase supplements, potentially enhancing nutrient absorption and reducing environmental phosphorus pollution from animal waste.

Key words: Enzyme Encapsulation, Freeze-drying, FITC, enhancing nutrient absorption and environmental phosphorus pollution, Phytase

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