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RSM-Optimized Spray-Dried Microencapsulated *Lactiplantibacillus plantarum* LP-RB5: Enhanced *In-Vitro* Survivability and Storage Stability

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Abstract

This study aims to optimize microencapsulation of *Lactiplantibacillus plantarum* (LP-RB5) and with maltodextrin using spray drying. The microencapsulation efficiency of LP-RB5 was significantly affected by probiotic concentration, wall material content, and inlet air temperature. The response surface methodological-based optimal microencapsulation parameters were 31% probiotic concentration, 18% maltodextrin, and spray drying conditions with an inlet air drying temperature of 147 °C, feed flow rate (10 mL/min), and an outlet air temperature of 90 °C. The impact of microencapsulation on encapsulation efficiency, physicochemical properties of microcapsules, and cell survivability in simulated gastrointestinal digestion during six-month storage were evaluated. The findings revealed that LP-RB5 cells encapsulated with maltodextrin in a 1.5:1 (w/w) core-to-wall ratio offered the highest yield (28.53%) and encapsulation efficiency (88.38%). The optimized LP-RB5 powder demonstrated final viability (9 Log_{10} CFU/g), microbial reduction (1.3 Log_{10} CFU/g), 4.56% moisture content, 0.29 a_w water activity, and 94.72% water solubility index. Scanning electron microscope observations of LP-RB5 and LP-8014 powders possessed smooth and dent spherical microcapsule morphologies with uniform particle sizes ($D_{[3,2]}$)=28.77 and 29.40 µm, respectively. *L. plantarum* cells in LP-RB5 had a survival rate of 80.11% during digestion and 93% after storage at freezer and chiller temperatures, indicating better survivability and stability. Understanding the survivability of microencapsulated LP-RB5 under these circumstances is crucial for assessing its potential as a functional ingredient in food and nutraceutical products.

Keywords: *Microencapsulation, spray-dried powder, morphological characterization, SEM, microbial stability, cell viability.*