

Food-Derived Biohybrid Probiotic Extracellular Vesicles for Synergistic Therapy of Inflammatory Bowel Disease

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Abstract

Inflammatory bowel disease is a chronic gastrointestinal disorder characterized by persistent intestinal inflammation, microbiota dysbiosis, and impaired mucosal barrier function [1-4]. Conventional treatments, including pharmacological agents, biologics, and fecal microbiota transplantation, are limited by adverse effects, immune suppression, recurrence, and low patient acceptance [5-8]. In this study, food-derived probiotic extracellular vesicles (EVs) from *Lactiplantibacillus plantarum* with dietary polysaccharide (chitosan) and polyphenol (tannic acid) are developed for the synergistic therapy of inflammatory bowel disease. The engineered biohybrid with dual-functional coating confers gastrointestinal stability and colon-targeted delivery, meanwhile scavenging reactive oxygen species and preserving the intrinsic microbiota-regulating properties of probiotic EVs. Multi-omics approach reveals correlations among microbial community shifts, short-chain fatty acids, oxidative stress modulation, inflammatory cytokine profiles, and disease severity indices. This work provides a promising approach and reveals the synergistic mechanisms of engineered probiotic EVs in reshaping gut microbiota, modulating metabolic networks, and improving the inflammatory microenvironment for the treatment of inflammatory bowel disease.

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