

Potential of Lactic Acid Bacteria (LAB) Postbiotic in Degrading Benzo[a]pyrene

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Structured Abstract

Background: Food packaging plays an essential role in maintaining food quality and safety. However, recycled paper-based packaging materials may contain hazardous contaminants such as polycyclic aromatic hydrocarbons (PAHs), which originate from additives like carbon black and extender oils used during production. These PAHs are persistent, bio-accumulative, and toxic (PBT), posing risks of food contamination and public health issues due to their carcinogenic and mutagenic properties. Previous research has shown that lactic acid bacteria (LAB) possess the ability to degrade PAHs, but the application of live bacteria is limited by their unstable viability. Therefore, this study investigates the use of LAB-derived postbiotics as a more stable and safer alternative for degrading benzo[a]pyrene (BaP) - a representative PAH from food packaging.

Methods: Postbiotic of LAB strains (*Lactobacillus acidophilus*, *L. casei*, *L. fermentum*, *L. plantarum*) and a consortium were produced by cultured the strains in MRS broth. Their growth profiles were monitored using optical density measurements (OD₆₄₀). BaP solutions were prepared by dissolving BaP in acetonitrile and mixing it with postbiotics in phosphate-buffered saline (PBS). After incubation at 25°C for up to 120 hours, the remaining BaP was extracted using dichloromethane (DCM) and analyzed via High-Performance Liquid Chromatography (HPLC).

Results: Postbiotics from *L. acidophilus* and *L. plantarum* showed the highest BaP degradation rates at 43.09% and 26.11%, respectively after 48 hours. These strains also demonstrated strong growth profiles. *L. fermentum* and *L. casei* exhibited postbiotic moderate removal efficiencies, suggesting variability in postbiotic composition and activity. All strains showed some degradation potential, validating the use of postbiotics as effective agents for PAH bioremediation.

Conclusion: This study demonstrates that LAB-derived postbiotics are promising biological tools for degrading PAHs, particularly BaP, in food packaging. The use of postbiotics offers a sustainable, safe, and efficient alternative to live bacterial treatments, supporting the development of environmentally friendly food packaging technologies.

Keywords: Postbiotics, Polycyclic Aromatic Hydrocarbons, Lactic Acid Bacteria, Benzo[a]pyrene, Food Packaging

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