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The Use of a Postbiotic Consortium in Degrading Benzo[a]pyrene (BaP)

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Structured Abstract

Background: Benzo[a]pyrene (BaP) is a carcinogenic polycyclic aromatic hydrocarbon which may be released into food by environmental exposure and by migration of plastic food packaging materials, especially in hot and fatty conditions. Traditional ways of removing BaP like chemical oxidation and thermal treatment, are usually expensive, unreliable to the environment and cannot be used in food contact. Postbiotics have become promising alternatives due to the development of biological approaches in which postbiotics are nonviable microbial metabolites that are safer and more stable than living microorganisms. Nevertheless, limited information is available on BaP toxicity toward *Lactobacillus* species and the effectiveness of postbiotic consortia in BaP degradation. Therefore, this study evaluates BaP degradation by individual *Lactobacillus*-derived postbiotics and a postbiotic consortium. In addition, the effects of postbiotic production duration and incubation time on BaP degradation efficiency are assessed.

Methods: This study investigated the toxicity of BaP toward *Lactobacillus acidophilus*, *Lactobacillus plantarum*, and *Lactobacillus casei* using the agar well diffusion assay. Postbiotics were produced from individual strains and a consortium at different fermentation durations of 0, 24, and 48 hours. The free cell postbiotics were incubated with BaP under controlled conditions, and samples were collected over defined incubation periods. Residual BaP was extracted and quantified using high performance liquid chromatography to determine degradation efficiency.

Results: BaP showed no detectable inhibitory effects on the growth of all three *Lactobacillus* species, indicating compatibility with these food grade bacteria. BaP removal increased with longer postbiotic production and incubation times. The postbiotic consortium consistently demonstrated higher degradation efficiency compared to postbiotics derived from individual strains. A plateau in BaP removal was observed at extended incubation periods, suggesting that the saturation of postbiotic and BaP interactions.

Conclusion: This study demonstrates that *Lactobacillus* derived postbiotics can effectively reduce BaP without the involvement of viable cells, with consortium based postbiotics showing superior performance. Hence, these findings highlight the potential of postbiotic consortia as a safe, sustainable, and food compatible strategy for BaP mitigation in food related systems.

Keywords: Benzo[a]pyrene, Postbiotics, *Lactobacillus*, Consortium, Food Safety, PAH Degradation

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