# Biosynthesis of poly(hydroxybutyrate-co-hydroxyvalerate) using the volatile fatty acid produced from food waste

Xuefeng Wang[1], Xue Sun[1], Yan Jin[1], Chao Song[1], Chang Chen[1*], Guangqing Liu[2*]

[1]College of Chemical Engineering, Beijing University of Chemical Technology, Beijing 100029, China
[2]State Key Laboratory of Chemical Resource Engineering, Beijing University of Chemical Technology, Beijing 100029, China
**Keywords:** Food waste, Biosynthesis, PHBV, *Burkholderia cepacia*, Volatile fatty acid
Presenting author email: gqliu@buct.edu.cn or chenchang@buct.edu.cn

## Abstract

Nowadays, food waste is largely generated in daily life. The inappropriate disposal of food waste without proper treatment cause environmental problems like disgusting odor, water and soil pollution (Guo *et al*, 2024). Anaerobic digestion (AD) is one of the most effective methods to deal with such organic wastes, which can not only produce clean energy in the form of methane but also reduce uncontrolled carbon emissions, making considerable contributions to environment protection. However, producing biomethane by AD also has advantages like low methane purity and poor economic efficiency (Li *et al,* 2019). This urges the need for new, high-value disposal and utilization methods

Polyhydroxyalkanoates (PHAs), which is regarded as promising alternatives to traditional petroleum-based plastics due to their excellent properties (Cai *et al,* 2024). However, the expensive carbon resource limits their large-scale production and application (Nguyenhuynh *et al*, 2021). If a coupling process combining anaerobic fermentation and aerobic fermentation can be utilized to convert food waste into VFAs and subsequently synthesize high-value PHA products, it would enhance engineering efficiency and economic benefits while addressing the pollution problem and providing low-cost substrate for PHA production.

In this study, poly(3-hydroxybutyrate-co-3-hydroxvalerate (PHBV) was successfully synthesized using acidified liquid from food waste as the raw material by *Burkholderia cepacia*. The research explored the production of PHBV from food waste acidified liquid under various fermentation conditions, including adding $Ca(OH)_2$, pH adjustments, pH buffering, and bioaugmentation. The results demonstrated that the highest PHBV conversion rate of 0.30 gPHBV /gVFA was obtained using the food waste-derived VFA, which proved that a high butyric acid concentration favored PHA synthesis. The products synthesized by *B. cepacia* were characterized to be PHBV with excellent biodegradability. These findings provided an integrated strategy that enabled the production of PHBV on a large scale while reutilizing food wastes and alleviating the environmental pollution of traditional plastics, contributing to the eco-friendly and sustainable economics.

## Reference

Cai, F., Sun, X., Cui, K., Jin, Y., Liu, G., Chen, C., 2024. A novel approach for poly(hydroxybutyrate-co-hydroxyvalerate) production from vegetable wastes and pig manure: Potential in economy, environment and sustainability. Resour. Conserv. Recycl. 209, 107789. https://doi.org/10.1016/j.resconrec.2024.107789

Guo, R., Cen, X., Ni, B.-J., Zheng, M., 2024. Bioplastic polyhydroxyalkanoate conversion in waste activated sludge. J. Environ. Manage. 370, 122866. https://doi.org/10.1016/j.jenvman.2024.122866

Li, Y., Jin, Y., Borrion, A., Li, H., 2019. Current status of food waste generation and management in China.

Bioresour. Technol. 273, 654–665. https://doi.org/10.1016/j.biortech.2018.10.083
Nguyenhuynh, T., Yoon, L.W., Chow, Y.H., Chua, A.S.M., 2021. An insight into enrichment strategies for mixed culture in polyhydroxyalkanoate production: feedstocks, operating conditions and inherent challenges. Chem. Eng. J. 420, 130488. https://doi.org/10.1016/j.cej.2021.130488

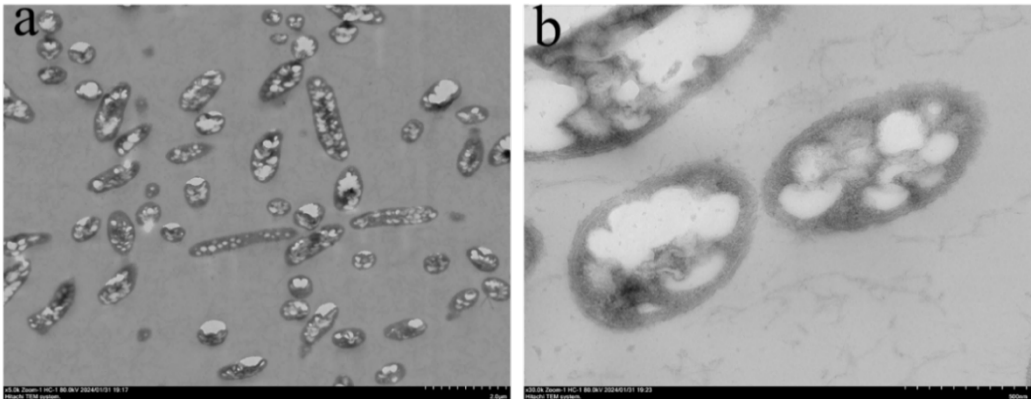


Figure 1. TEM observation photos of *B. cepacia* from mixed VFA of food waste: (a) 5000× magnification; (b) 30000× magnification.

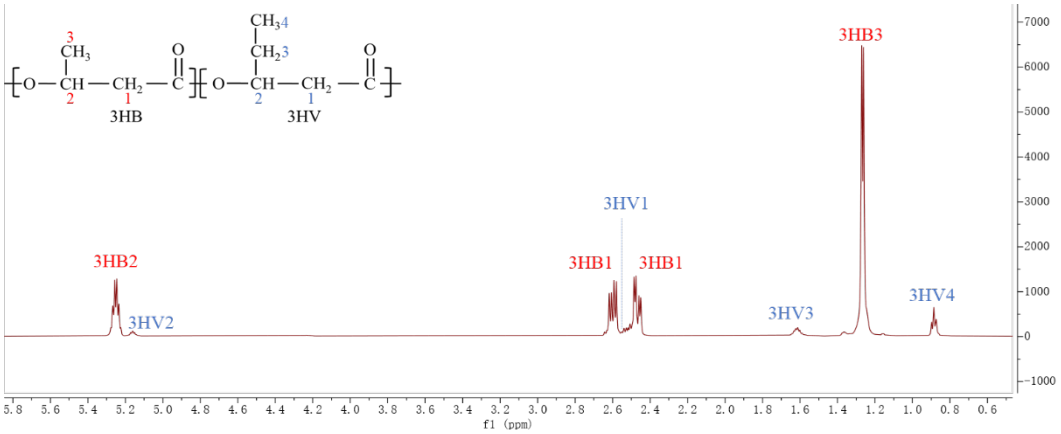


Figure 2. $^{1}$H NMR spectrum of PHA products synthesized by *B. cepacia* using VFA from food waste.