Best Practice

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Bioplastics production with the bacterium *Halomonas cupida* J9

Microbial productionof polyhydroxyalkanoates (PHAs) offers significant environmental benefits as a biodegradable alternative to petroleum-based plastics. However, commercial viability remains limited by high production costs, primarily due to the reliance on expensive carbon sources and the need for high-temperature sterilization during the fermentation of pure cultures. This study aimed to develop a low-cost PHA production platform using *Halomonas cupida*, a halophilic bacterium that naturally synthesizes PHA and thrives under high-salinity, avoiding the need for sterile conditions.

Project activity

A markerless genome-editing system was developed for *H. cupida* strain J9. The strain was genetically engineered to enhance xylose utilization for PHA biosynthesis through the introduction of a synthetic xylose metabolism module and the elimination of competing xylonate production by gene deletion.

The engineered strain, J9UΔxylD-P8xylA, achieved a PHA yield of 2.81 g/L using xylose as the sole carbon source—the highest yield reported to date for a *Halomonas* strain under these conditions. Notably, the strain produced a mixed PHA containing both short-chain-length (SCL) and medium-chain-length (MCL) monomers.

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Other results include:

- The engineered strain was capable of efficient co-utilization of glucose and xylose for PHA production.
- In fed-batch fermentation with a glucose/xylose co-feeding strategy, PHA production reached 12.57 g/L in a 5-L bioreactor under open, non-sterile conditions.
- When cultivated on corn straw hydrolysate (a lignocellulosic agricultural waste product), the engineered strain reached a cell dry weight (CDW) of 7.0 g/L and produced 2.45 g/L PHA under open fermentation conditions.

Key findings and recommendations

The engineered strain J9UΔxylD-P8xylA achieved the highest reported PHA yield (2.81 g/L) by *Halomonas* using xylose as the sole carbon source.

This is the first report of *Halomonas* synthesizing SCL-co-MCL PHA (short- and medium/long-chain-length monomers) from xylose. These copolymers have valuable thermoplastic and elastomeric properties, making them valuable for a wide range of applications.

The system developed here demonstrates the feasibility of low-cost PHA production from lignocellulose-rich agricultural waste, enabled by non-sterile production conditions and the use of inexpensive feedstocks.

References

Establishment of low-cost production platforms of polyhydroxyalkanoate bioplastics from *Halomonas cupida* J9. Biotechnol. Bioeng. 121(7):2106–2120.Wang S, Liu Y, Guo H, Meng Y, Xiong W, Liu R, Yang C, 2024.

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For more information about the AgriLoop Project, visit:

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