

Syntrophomonas wolfei CULTURE TECHNIQUE

Simultaneous production of biohydrogen (bioH₂) and poly-hydroxy-alkanoates (PHAs) by a photoheterotrophic consortium bioaugmented with *Syntrophomonas wolfei*

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Abstract

Dark fermentation of fruit and vegetable waste was run in a 5 L Winpact One FS-06 reactor with automatic pH and temperature control. Its effluent fed photofermentation by synthetic consortia of *Clostridium pasteurianum*, *Rhodopseudomonas palustris* and *Syntrophomonas wolfei*, which simultaneously produced 44.3 mmol bioH₂ and 50.46% PHA.



**Winpact Model: FS-06
(Winpact One)**

Introduction

Motivation: biohydrogen from dark fermentation (DF) alone gives low yield because organic acids accumulate; coupling DF with photofermentation (PF) converts those acids into additional bioH₂ and closes the production cycle.

Gap: bioH₂ is not yet commercially viable on its own, and the microbial interactions inside photoheterotrophic consortia — particularly the competition for reducing equivalents between bioH₂ and PHA — are poorly understood.

Objective: co-produce bioH₂ and PHA from dark-fermentation effluent, and test whether bioaugmenting a natural consortium with *S. wolfei* improves both.

Materials and Methods

Dark fermentation (bioreactor stage):

A 5 L Winpact One fermentation system (FS-06, Major Science) was filled with diluted fruit and vegetable waste and inoculated with a lactose-adapted consortium. The medium was sparged with N₂ for 30 min to ensure anaerobic conditions; pH was automatically held at 6.8 ± 0.2 and temperature at 30 °C over a 96 h run, with liquid and gas sampled throughout.

Photofermentation (controls):

Dark-fermentation effluent was used as carbon source for individual strains (*C. pasteurianum*, *R. palustris*, *S. wolfei*), the natural consortium NPC-C4, the same consortium bioaugmented with *S. wolfei*, and a designed three-strain consortium.

Analysis:

Hydrogen volumetric production rate, PHA content, organic acid consumption (lactic, butyric, acetic, propionic) and COD removal.

Results

Consortia gave higher hydrogen volumetric production rates (28–40 mL/L·h) than individual strains (20–27 mL/L·h). The designed consortium reached the highest output, 44.3 mmol bioH₂ with 50.46% PHA produced simultaneously; bioaugmenting the mixed culture with *S. wolfei* gave 32 mmol bioH₂ and 50% PHA, and the highest specific yield of 562 mL H₂ per gram COD. Organic acid consumption exceeded 50%, accounting for up to 55% of total COD removed. Fermentor relevance: automatic pH and temperature control through the 96 h anaerobic dark-fermentation stage produced a consistent organic-acid effluent, which is the feedstock the downstream photofermentation depends on.

References

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