Elucidating the Mechanisms of Enhanced Lignin Bioconversion by an Alkali Sterilization Strategy

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Background

- Biological lignin valorization is emerging as a promising green platform for lignin conversion.
- Lignin generally exhibits poor solubility and inhomogeneous distribution in aqueous fermentation media. Specifically, heat processing during conventional thermal sterilization promotes lignin particle aggregation and deteriorates lignin dispersion.
- Poor lignin dispersion in fermentation media limits biological conversion efficiency significantly.

Approach

- We develop an alkali sterilization strategy to replace thermal sterilization for lignin bioconversion, which integrates alkaline solubilization and sterilization functions effectively.

Outcomes

- Lignin dispersion is significantly improved. The volume of colloidal lignin particles decreased by 96%.
- Complete aseptic effect is achieved.
- Alkali sterilization modifies lignin molecular structure (increased hydrophilic carboxyl groups, lower weight-average molecular weight, and narrower molar-mass dispersity).
- Lignin bioconversion is significantly enhanced. *Rhodococcus opacus* PD630 cell growth, lignin degradation, and lipids production are improved.

ASL: alkaline sterilized lignin, ATSL: alkaline and thermally sterilized lignin, NSL: non-sterilized lignin, TSL: thermally sterilized lignin

Significance

- Facile alkali sterilization strategy without any heat input makes lignin dispersion no longer a bottleneck.
- This work provides a platform technique for efficient biological lignin valorization.

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