Biorefinery for Valorization of Organic Wastes into Biofuels & Biochemicals

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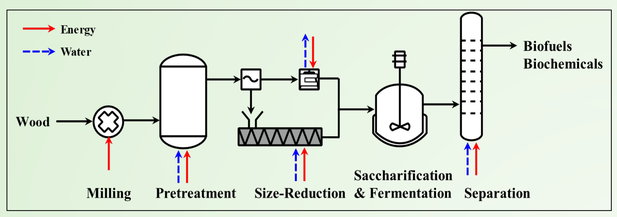
Biorefinery and Biofuels

Global warming and depletion of fossil fuel resources have urged our research team to enhance the utilization of renewable resources for biofuel and biochemical production. Green bio-based technologies (e.g., biorefinery) have created growing opportunities to support industries for bioconversion of organic wastes, mainly food residues, sewage sludge, and lignocellulosic biomass (Fig.I). The major unit processes in biorefinery include pretreatment, saccharification, fermentation and separation (Fig.II).

Fig. I

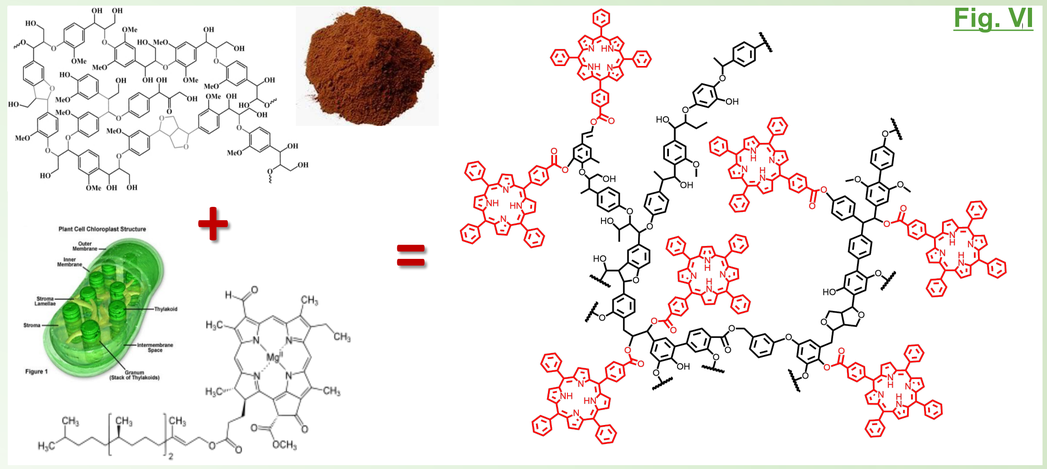
Fig. II. Major Biorefinery Units.



Synthesis of Functional Chemicals from Lignin

Fermentation residues such as lignin can serve as a source of aromatic nano-materials (Fig. VI) to substitute the functional polymers from fossil fuels (Tse, Leu et al., 2019).

Fig. VI



Pretreatment for Plant Cell Wall Fractionation

Biomass can be converted into hydrolysable substrates and functional lignin (Fig. III) by various solvent and catalysts (Dong, Leu et al., 2019).

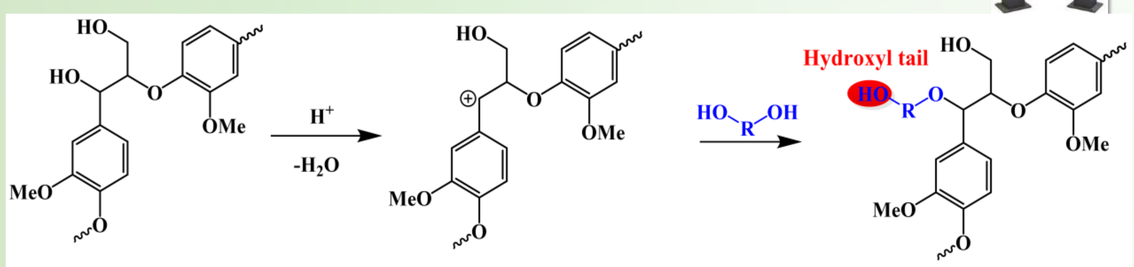


Fig. III

Enzymatic Saccharification

Substrates are hydrolyzed by enzyme mixtures to form mono-sugars (Fig. IV), i.e., glucose cellobiose, and xylose (Lai et al., 2021).

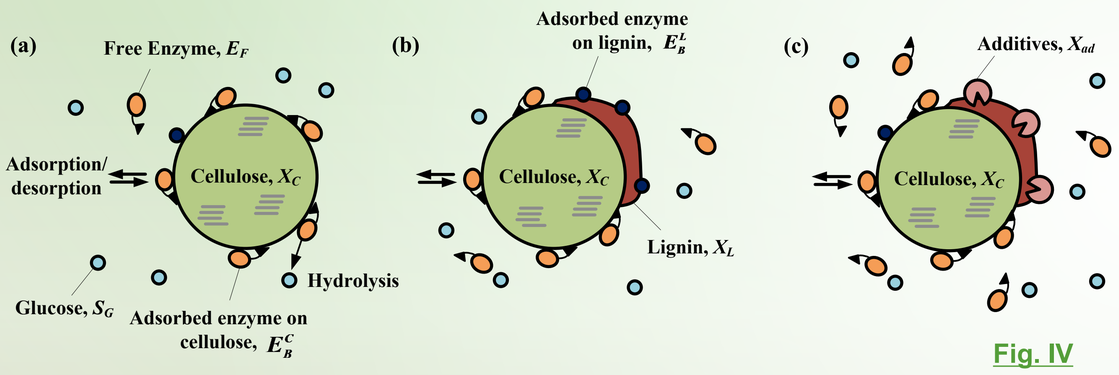


Fig. IV

Omics Studies on Biological Processes

High-throughput sequencing techniques are used to determine the insight mechanisms of biowaste degradation and their potential metabolic pathways via meta genomic and meta-transcriptomic studies (Fig. VII) (Zhuang et al., 2021).

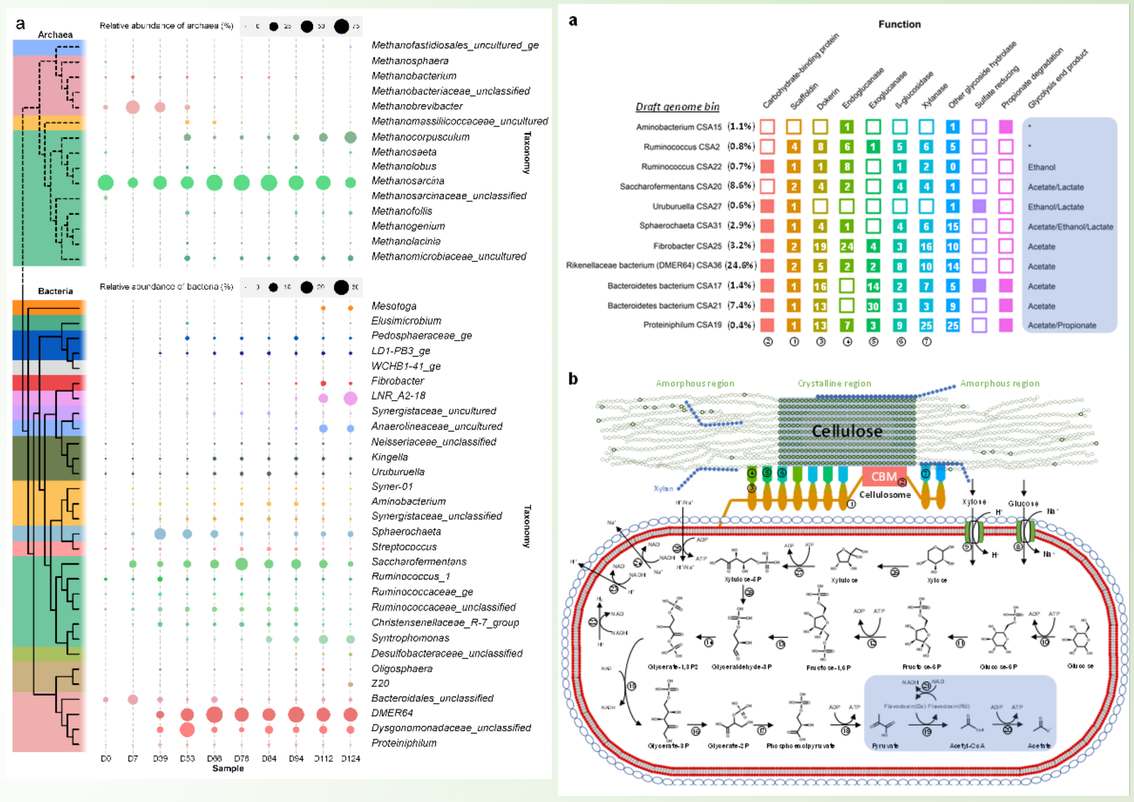
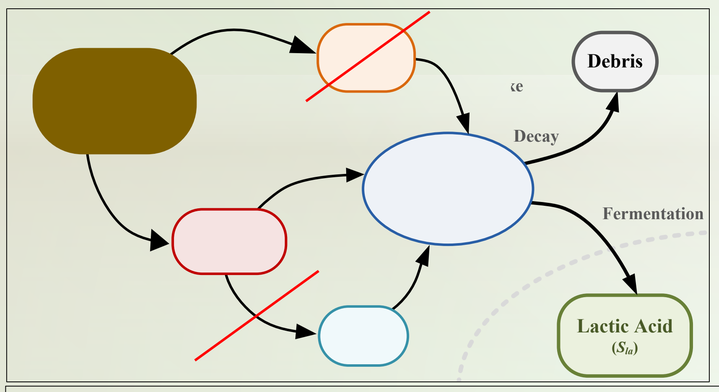


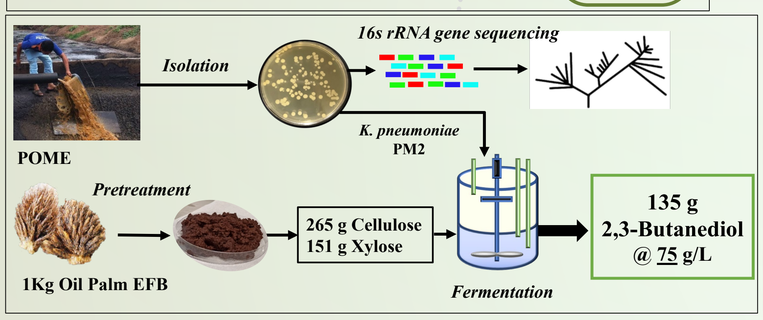
Fig. VII

Fermentation

Sugars can be converted into useful products, e.g., ethanol, butanol, butanediol, and lactic acid (Fig. V) (Wang et al., 2019; Rehman et al., 2021).

Fig. V





Techno-Economic Evaluation

Techno-economic evaluation of a biorefinery applying food waste for biofuels/bio-chemicals production are conducted to determine the economic feasibility of the bioprocess design and operation (Fig. VIII) (Wang et al., 2020).

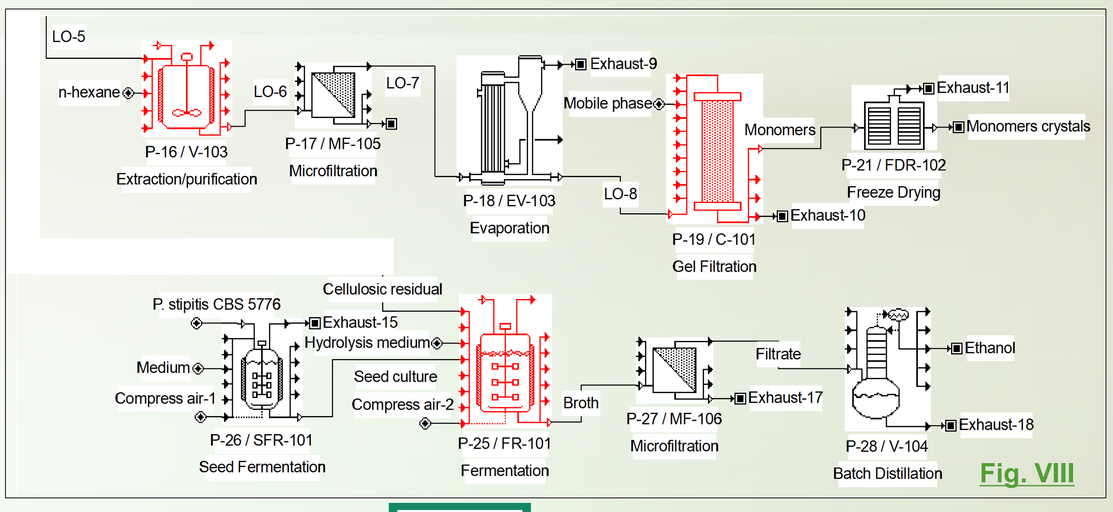


Fig. VIII

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