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Model-based optimization of lignocellulosic bioprocesses for efficient production of biofuel

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The utilization of lignocellulosic biomass feedstock for bio-based processes is expected to contribute substantially to the future supply of fuels, chemicals and materials serving bio-based economy. We have developed modeling approach to describe cell-consortium and simultaneous saccharification and fermentation (SSF) of lignocellulose-based processes. The modeling tool is useful for rapid process design and optimization to meet the technical and economic requirement of industrial-scale lignocellulosic processes. To demonstrate the model-based approach, we have utilized the modeling for optimizing lignocellulosic ethanol production. The predicted fermentation kinetics and ethanol production performance agreed well with the experimental results, thus validating the model. By using model-based design of feeding profiles for substrate and yeast cell in fed-batch SSF process, an efficient ethanol production with high ethanol titer and yield was accomplished. The cell-consortium kinetic model was also applied to design optimal cell ratio for efficient conversion of biomass feedstock to ethanol at improving titer and productivity. The modeling is, therefore, considered as a promising approach for rapid optimization of efficient and sustainable production of bioproducts from lignocellulosic biomass.

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Exploiting polyhydroxyalkanoate as bioplastic: Problems and prospectives

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Major issues involved in the large scale production in economic ways and production of processable biopolymer similar to the synthetic plastic are still hindering polyhydroxyalkanoates (PHAs) to be the user's choice. These issues are majorly attributed to substrate cost and unfavourable properties associated with certain monomeric compositions e.g. homopolymers polyhydroxybutyrate (PHB). Properties determining the processability of PHAs e.g. thermal properties: Melting point, glass transition temperature and mechanical properties: Crystallinity, young's modulus, elongation to break and tensile strength are affected by monomer composition and molecular weight. PHA production is the outcome of metabolic capabilities of bacteria, thus the critical step is to select the suitable bacteria followed by other steps such as choosing the substrate, feeding strategies and conditions accordingly. PHA synthases (PhaC) present in the bacteria having specificities for particular HAs chain length as substrate determines the type of PHA produced. Other interconnected pathways e.g. glycolysis, TCA cycle, β-oxidation of fatty acids, fatty acid biosynthesis etc. also adds to the diversity of the monomers added. It has been observed that polymer with favourable properties can be obtained as the monomer composition becomes more diverse and the non-3HB content increases. Thus the basic approach to customize the polymer for desirable properties is to select a bacteria having PhaC able to incorporate non-3HB into polymer e.g. *Bacillus* and *Pseudomonas*, a cheap substrate such as bio-waste that bacteria can utilize efficiently in different metabolic pathways e.g. agro and oil industry waste, feeding strategies and conditions promoting the incorporation of non-3HB into polymer.

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