Consolidated Bioprocessing of Biomass to Chemicals Using Cellulosomes in Fermentative Microorganisms

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Bioethanol and most biochemicals are typically produced by converting the hexose sugars which are relatively expensive. On the other hand, the enzymatic saccharification of native, crystalline cellulose is potentially of great economic importance with a view to biotechnological applications, such as treatment of cellulosic wastes and conversion of cellulosic substrates into biofuels and commodity chemicals. Nevertheless, the enzymatic saccharification is not yet cost-effective. This process is difficult because it involves a set of cooperative enzymes which have to hydrolyze a substrate with a heterogeneous structure. Therefore, making highly efficient cellulases has emerged as an important issue in the development of integrated biomass conversion technology. Cellulase complexes (cellulosomes) are produced by *Clostridium sp.* to degrade biomass.

Our goal is the development of more efficient cellulase systems using cellulosomes in different fermentative microbes. Currently, we have a three-step strategy for the development of efficient cellulase systems: i. investigating the regulatory system for the formation of functional cellulosomes [1]; ii. optimization of the enzyme composition and the *in vitro* DNA recombination of cellulase gene to produce highly active and stable super enzymes [2]; iii. genetic manipulation of central metabolic pathways to develop industrial host strains [3-4]; iv. improvement of the property of the *in vivo* synthesis of the designer cellulosomes in recombinant fermentative microbial host which may be able to grow on biomass and produce valuable products [5].

We had made recombinant designer cellulosomes with specific functions. Both *Escherichia coli* and *Saccharomyces cerevisiae* was used as an expression host to produce miniCellulosomes. The *in vivo* construction of mini-cellulosomes in these strains suggests that it will be possible in the future to insert into industrially important microbes such as *Corynebacterium glutamicum* that will produce various designer cellulosomes with specific functions. Moreover, these recombinant strains are able to grow on lignocellulosic biomass and produce commodity chemicals such as biofules and commodity chemicals from inexpensive feedstock.

References

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