Path to Product-Development of microbial cell factories for innovative bioproduction

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Abstract: Cell factories have been largely exploited for the controlled production of substances of interest for food, pharma and biotech industries. Moreover, increased concern for environmental issues and dependence of foreign reserves has also shifted the industrial focus increasingly to microorganisms as biocatalysts. Here, we aim at development of cost-effective and efficient microbial cell factory for Bioproduct synthesis. The strategy involves systems and synthetic biology approach to metabolically engineer the microbe for improved product formation. I have utilized Scrumpy based metabolic flux analysis for rationale design of pathways responsible for product synthesis e.g. 2,3-BDO. Further, metabolic system was redesigned using synthetic biology approach, including cofactor balance, knocking out side pathways and overexpressing the rate limiting step, to increase product yields. The engineered strain was optimized for its growth and fermenter parameters for optimal Bio-product synthesis, which was then extracted using downstream processing. As an another application of system engineering, process of Bio-product production was improved by employing abundant and renewable agricultural waste as carbon substrate for fermentation process. Saccharification of recalcitrant biomass was augmented using protein engineering strategy wherein cellulolytic enzymes were rationally modified for improved hydrolytic activity. The complete path from biomass to product production was optimized, which was used as platform for BDO production at 200L fermenter scale and 93% theoretical yield was obtained. Thus, with combined cell surface engineering and synthetic bioengineering approach, we have developed cells with improved metabolic ability for industrial applications.