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Genetic Manipulations to Increase Biomass Conversion

Transportation fuels and many chemical products are derived from and depend on petroleum, which has one of the biggest impacts on our unsustainable way of living. Production of cost-competitive fuels and chemicals by microbial fermentation using renewable feedstock is a desirable alternative to petroleum-based production. Woody/plant biomass, especially agricultural wastes, represent an important renewable feedstock. Unfortunately, utilization of glucose and xylose, the most abundant sugars in plant biomass, in a cost-effective manner remains a challenge. Simultaneous conversion of glucose and xylose is desired for biomass conversion; however, microbial catabolism of xylose is not very efficient and is repressed in the presence of glucose.

Researchers at Arizona State University have developed recombinant bacterium which can efficiently catabolize xylose for woody/plant-based biomass conversion. They have demonstrated that directed mutagenesis of key genes leads to significant improvement of xylose utilization in different E. coli strains. Glucose repression is significantly reduced and xylose utilization can be increased up to 3.5 fold by these genetic manipulations. These mutations are introduced in a manner that doesn't require the use of plasmids and the mutated genes are conserved in many different bacteria, so they could apply to different hosts.

These mutations have the potential for wide applications in microbial catalysts for converting woody biomass into valuable biofuels and chemicals.

Potential Applications

- Conversion of xylose to biomass
  - Production of biofuels (bioethanol, biobutanol, etc.)
  - Production of chemicals (succinate, lactate, 1,4 butanediol, etc.)

Benefits and Advantages

- Can simultaneously convert glucose and xylose
- Can be applied to different production processes using woody biomass as a feedstock - bioethanol, biobutanol, etc.
- Xylose utilization increased up to 3.5 fold even in the presence of glucose
- High proficiency
- Highly effective - can consume roughly 50 g/L glucose and 40 g/L xylose within four days
- Simplicity - simple to implement the proposed genetic changes
  - Does not require the use of plasmids
- Adaptability - the mutations could apply to other bacterial hosts

For more information about the inventor(s) and their research, please see Dr.

Wang's directory webpageDr. Cartwright's directory webpage