Skysong Innovations
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Engineered Bacteria for Hydrolysis of Cellulose and Hemicellulose

Limited fossil fuel resources and a global climate crisis have led to greater exploration into replacing conventional fuel sources with renewable energy. This in turn has resulted in a push for production of more sustainable and inexpensive biofuels. Agricultural waste, such as cellulose, hemicellulose and lignin, is a promising renewable feedstock option for biofuel production, however, the current industrial processes to degrade and utilize these polymers are costly and inefficient. Cost effective enzymatic hydrolysis of cellulosic and hemicellulosic biomass can play a vital role in making economical biorefineries viable.

Researchers at Arizona State University have developed a novel engineered bacterial strain, Bacillus subtilis, for efficient hydrolysis of cellulose and hemicellulose to sugars. This process uses engineered bacteria to produce enzymes, as opposed to using commercial enzymes, which breakdown biomass components during fermentation in a one pot process. The engineered bacteria contain a recombinant SacC-glucosidase gene that secretes greater amounts of glucosidase enzyme, and a SacC-xylanase gene that secretes greater amounts of xylanase.

This bacterial strain can help streamline the process of converting cellulose and hemicellulose to biofuels and other valuable commodities and provide a pathway to help transform the energy sector from fossil fuel-based to cleaner more reliable sources.

Potential Applications

- Fermentation processes
  - Ethanol fermentation (biofuels, food additives, alcoholic beverages, flavorings, etc.)
  - Lactic acid fermentation (food preservatives, curing agents, flavorings, cosmetics, pharmaceuticals, etc.)
  - Succinic acid fermentation (food additives, detergents, cosmetics, pigments, toners, pharmaceutical intermediates, etc.)

Benefits and Advantages

- More environmentally friendly approach vs utilization of harmful chemicals
- Greater efficiency due to high specificity
- Reduces production costs vs traditional industrial enzyme processes
- Xylan reduction by 65% in prototype system
- 2-fold higher reducing sugar yield
- One step process to simultaneously degrade and assimilate cellobiose and xylan
- Produces succinate, ethanol, lactate, etc.

For more information about this opportunity, please see

Kalscheur et al - FURI Abstract - 2020

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

Dr. Varman's departmental webpage