Docket #: S20-111

Mutant strains of S. cerevisiae with improved heterologous secretion of fungal lignin-degrading heme peroxidases

Researchers at Stanford University have developed mutant yeast strains that can secrete lignin-degrading fungal enzymes. Given that there is no current way to degrade and recycle lignin on a large scale, these strains could change the way lignin is processed and convert it into a valuable source of chemicals.

Lignin is a major component of woody biomass but is so difficult to chemically degrade that the vast majority of it is burned as waste each year. If there was an efficient way to chemically process lignin, it could be a renewable source of valuable chemicals. To solve this problem, researchers have developed mutant yeast strains that produce fungal enzymes that efficiently degrade lignin. These strains express enzymes called heme peroxidases that naturally come from fungi that can degrade lignin. Although yeast strains expressing these enzymes were previously engineered, scientists were unable to produce large amounts of the desired enzyme.

Solving the problem of poor enzyme production, researchers at Stanford discovered that deleting two yeast genes called pmt2 and cyt2 leads to a 300-fold improvement in enzyme secretion. This technology is not only useful for one type of heme peroxidase, but for three different classes of enzymes, demonstrating that these yeast strains could be applied to production of a variety of enzymes. In addition, yeast is a commonly used organism in industrial applications, making efficient scale-up of this process a viable prospect. In a time when maximizing our use of renewable resources is of paramount importance, this technology could change the way wood is processed and recycled.

Stage of Development: Prototype

Applications

- Large-scale production of fungal lignin-degrading peroxidase enzymes.
- Enzymatic decomposition of lignocellulosic biomass into valuable chemical products.
- Improvement of saccharification yield in lignocellulosic biomass treatment.
- Research and scientific analysis of fungal lignin-modifying enzymes.

Advantages

- Recycles a renewable resource that is otherwise discarded and burned
- Mutant yeast strains have a 300-fold increase in levels of secreted enzyme compared to wildtype yeast strains
- Easy to scale production of enzyme for industrial applications
- Yeast is a commonly used organism for enzyme production; infrastructure currently exists to accommodate this technology

Publications

- Khlystov, N., Deletion of two genes improves heterologous secretion of fungal lignin-degrading heme peroxidases in S. cerevisiae

Patents

- Published Application: WO2021248137
- Published Application: 20230313257
- Issued: 12,703,877 (USA)

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