**The Significance of *Trichoderma reesei* in Research**

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**Cellulase in *Trichoderma reesi* is known to be scarce in its beta-glucosidase and its cellobiohydrolase II. This leads to hindrance of energy combinations of components derived from cellulase. *Trichoderma reesi* has been engineered to enable an enhancement of cellobiohydrolase II and the production of cellulase. Even though these developments were made, *T. reesi* is still lacking high numbers of beta-glucosidase. *Aspergillus niger* was then acquainted with *T. reesi* to enable and improve the production of cellulase and increase the performance of enzymic hydrolysis.**

**Introduction**

*Trichoderma reesi* is well knownfor its ability to produce cellulases which its applications that are very significant when it comes to biofineries, which are refineries that are able to convert biomasses into energy that is useful for other byproducts (Zhao, Deng & Fang, 2018: 93-98). *T. reesi* has a wide-ranging arrangement of cellulase, which is reported to be about 100g/L. *T. reesi* components consist of, endo-beta-1, 4 glucanase (EG), cellobiohydrolase (CBH), and beta-glucosidase (BG). There are two factors that hinder the full potential of *T. reesi* whichis beta-glucanase (BG) and cellobiohydrolase II (CBH II). This constricts synergism, joining of two energies since the outcome is better than them separated, of *T. reesi* from occurring (Zhao, Deng & Fang, 2018: 93-98). Research done on *T. reesi* is to reduce the cost of the enzyme production, and the operational costs by removing the need to use off-site production of enzymes, as well as the production, transportation, purification, dilution (Klein-Marcuschamer & Blanch, 2015).

Since the shortage of BG is in existence, there are a few ways to combat the issue (Zhao, Deng & Fang, 2018: 93-98). *Aspergillus niger* is another fungus that is added to the cellulase that comes from *T. reesi.* After futher experimentation, the combination of both *A. niger* and *T. reesi*, the mixed cultures demonstrated that the strains of *A. niger* were effective and improved the performance of the composition involving cellulase that increased the enzymatic activity and hydrolysis (Zhao, Deng & Fang, 2018: 93-98). Through genetic enhancing of *T. reesi*, the BG levels were corrected to remove any form of deficiency of BG. *T. reesi* is also deficient in CBH II, to combat this issue, the promoter *cbh1* was used to overexpress the gene *cbh2*, this allowed the synergism between CBH I and CBH II to be strengthened (Zhao, Deng & Fang, 2018: 93-98).

Main focus of the study was on the deficiency factors of *T. reesi,* which are BG and CBH II (Zhao, Deng & Fang, 2018: 93-98). They are not taking any other potential factors into consideration. If there is a solution on the issues on the deficiency of both factors listed above this will allow a better synergism in *T. reesi* cellulase. Even with the recombinant of *T. reesi* containing deficiency in CBH II, it still will lack BG. Vice versa (Zhao, Deng & Fang, 2018: 93-98).

In this research, scientists mixed a recombinant *T. reesi* with a version of CBH II that was enriched to perform better and A. niger was able to produce a better form of cellulase (Zhao, Deng & Fang, 2018: 93-98). With the combination of genetically engineered organisms mixed with fermentation allows for a powerful outcome because it allows both products to combine =++easily). For *T. reesi* to be efficiently selected, transformants are selected based on their strong expressions of their cassettes. Two steps to screen for them is based on the resistance of a marker and the ability for *T. reesi* to decompose of it and use the microcrystalline cellulose. The first step to assure of this is that the nitrocellulose filters, which were laden with a cultivation of both *T. reesi* germlings as well as the tranformants of *Aspergillus tumefaciens* were placed in a PDA agar plate. This agar plate contained cefotaxime to constrain the growth of the *A. tumefaciens* cells. Hygromycin B was used to select the possible tranformants of *T. reesi*. The transformants of *T. reesi* appeared on the expected agar contained selected PDA. These transformants were then relocated onto an agar that contained MMM to prepare it for the second part of the screening. On the second screening, the diameter of the growth of the transformants of *T. reesi* were measured. They were left on the agar plat, MCC plate, for about 48 hours. *T. reesi*  is fast growing, once grown on the agar plate, the transformants were selected to be tested in their production of cellulase (Zhao, Deng & Fang, 2018: 93-98)

**Recent Progress**

The production of CBH was effectively enhanced with the usage of Pcbh1 promoter that helped increase the cbh2 expression (Zhao, Deng & Fang, 2018: 93-98)*. T. reesi* went under genetic engineering that its CBA and FPA improved drastically. Despite all the new processes, the BG was not improved and it remained in low numbers. With the combination of both Aspergillus niger and *Trichderma reesi*, there was an improvement of in the production of cellulase. This allows for costs to be minimized for glucose and cellulase. The study states that other factors, excluding BG and CBHII, contribute to the outperformance of cellulase that is involved in a mixed culture (Zhao, Deng & Fang, 2018: 93-98, Druzhinina, & Kubicek, 2017).

Combining both *Aspergillus niger* and *T. reesi* has led to higher BG content, but there still is not enough to be produced with the combinations of both (Zhao, Deng & Fang, 2018: 93-98).

**Discussion**

Lignocellulosic biomasses are an abundant source of hydrocarbon resources on earth that are renewable. About two-thirds of the lignocellulosic biomasses are composed of cellulose and hemicellulose. Scientist have increased their efforts on trying to increase the protein yields in *A. niger* by reconstructing its transcription factors, reducing the extracellular protease activity, and identifying the durable promoters and the section signals of the protein (Gupta et al., 2016; Meyer, Wu & Ram, 2010).

Both *Aspergillus niger* and *T. reesi* have broad ranges of sugars (hexoses and pentoses) that are their carbon source (Klein-Marcuschamer & Blanch, 2015). They are used in the fueling industry to manufacture xylanses and cellulases. The downside to this is that continuing to genetically engineer these fungi so they can produce a large number of their enzymes (that are adequate for the economy) are costly since the process consumes too much time and money. This is due because their vegetative tissue (which is necessary to induce synthesis in the proteins) is expensive to cultivate, there are additions to the cost that involves the purification, concentration, and condition of the tissue as well as the distant sites that are used to engineer them, and the delivery of the processing sites (Klein-Marcuschamer & Blanch, 2015).

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