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Biological pretreatment: a green technology for the delignification of lignocellulosic biomass and enhancing biogas production

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Amassment of lignocellulosic biomass in colossal amount not only presents disposal issues but also results in deterioration of the environment and loss of valuable resources that can be utilized in biofuels production, composting, paper manufacture, human and animal feed among others. The effectual transformation of bountiful renewable resources into bio-based products has a remarkable propensity in meeting the ever escalating energy demands. The ligninolytic enzymes play a remarkable contribution in commercial status of biotechnology. Versatile peroxidase (VP) is a hybrid peroxidase, able to oxidize phenolic and non-phenolic aromatic substrates. In the present study, VP production efficiency of *Pleurotus ostreatus* MTCC 148 was investigated using paddy straw under solid state fermentation and the effect of crude enzyme on biogas production was also analysed. Initial screening of *Pleurotus ostreatus* for the production of extracellular lignolytic enzymes was carried out by agar plate method and for quantitative studies a pilot scale fermentation experiment was conducted for 10 days, wherein paddy straw (5 mm) to water ratio was optimized to 1:10 for the production of enzyme and enzyme activity (Units/ml) was determined spectrophotometrically at 300 nm. Response surface methodology with central composite design was adopted to optimize the cultural conditions to maximize VP production and enzymatic pretreatment of paddy straw was carried out to study the effect of pretreatment on delignification. Presence of halo/transparent zone around the fungal colony confirms the presence of lignolytic enzymes. The maximum VP activity measured after optimization was 1013U/ml, obtained at 20°C, pH 6.5 and incubation time 5 days. The crude extract was used for the biological pretreatment of paddy straw and the preliminary results suggested that bio-pretreatment could be a cost-effective and environmentally sound method for enhancing biogas production. Biological pretreatment involves degradation of the substrate by the action of extracellular ligninolytic enzymes produced by the microbes. In biofuel production, the ligninolytic enzymes have two principal purposes, delignification and detoxification. The application of ligninolytic fungi and enzymes is an option to overcome the issues related with biomass pretreatment.

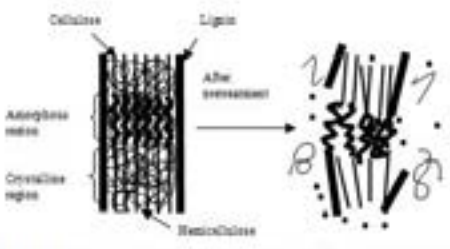

Figure 1: Effect of pretreatment on lignocellulosic biomass.

Recent Publications

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Biography

Manisha Parmar is a PhD research scholar in Department of Microbiology at Punjab Agricultural University, Ludhiana, India. She has received her Bachelor degree in Agriculture (Hons.) from CSKHPKV Palampur, India. She holds a Master's degree in Microbiology that focuses on screening and characterization of ureolytic bacteria for improving the strength of cement concrete. During her Master's she has explored the microbiologically induced calcite precipitation to check the improvement of bacterial concrete over control cement concrete. Her current doctoral research investigates the production of Versatile Peroxidase enzyme from *Pleurotus ostreatus* and the effect of fungal pretreatment on biogas production from paddy straw. She intends to broaden her knowledge of the major benefits, limitations and future prospects in using lignocellulosic biomass for biofuels production.

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