INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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The usage of second-generation bioethanol as an eco-friendly, cleaner transport fuel has gained momentum due to its potential to mitigate environmental pollution and global warming. However, challenges encountered at different stages of bioconversion process such as pretreatment, enzymatic hydrolysis, and fermentation, demanding solutions to enhance economic viability and efficiency. To tackle these challenges, the objective the studies were framed to develop an acid pretreatment strategy for the low-cost agricultural waste i.e., rice straw. Rather than relying on commercial cellulase for enzymatic hydrolysis, cellulase production was carried out by using cellulolytic fungus using rice straw. This was aimed to optimize the bioethanol production by an integrated process in a single vessel system through an *in situ* cellulase production, saccharification, and fermentation (ICPSF) strategy employing fungus and yeast culture. Additionally, a novel cyclic shifting of temperature strategy (CSTS) was developed and implemented throughout the simultaneous saccharification and fermentation (SSF) process to improve the bioethanol titre. This strategy aimed to replace the conventional approaches like prolong prehydrolysis followed by fermentation or SSF at mutual optimum temperatures. The application of CSTS 30^{o}C(1.7h)-40^{o}C(2h) for SSF process using *S. cerevisiae* in the ICPSF using tri-culture system of *P. janthinellum*, *T. reesei* and *S. cerevisiae* resulted in the maximum bioethanol titre of 17.05 g/l from BAP-RS (10% w/v). Moreover, to utilise the sugars present in the hemicellulosic fraction, co-fermentation of yeast *Saccharomyces cerevisiae* and *Pichia stipitis* was applied in the pretreated rice straw hydrolysate aimed to utilise both glucose and xylose. By a sequential co-culture approach with an intermediate heat inactivation resulted in a maximum bioethanol titre of 12.39 g/l. This study underlines the potential of the cyclic shifting of temperature technique in advancing lignocellulosic bioethanol synthesis, while also spotlighting scopes for future research aimed at elevating bioethanol titers.