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Bioethanol productions from pine needles using bacterial isolate HCB-21

Ravi Kant, Vishal Ahuja, Nidhi Rana, Vaishali Sharma, Sumita Thakur and **Arvind Kumar Bhatt**
Himachal Pradesh University, India

Bio-ethanol, acclaimed as a potential alternative to petroleum-based fuels, not only offers a sustainable source of energy but also helps in environment conservation by reducing greenhouse gas emission. The fermentable sugar for bioethanol production can be obtained from lignocellulosic biomass through enzymatic hydrolysis of cellulose, hemicellulose and lignin. In the present study, pine needles, which besides being one of the major causes of forest fires during summers and adversely affecting biodiversity, were used for bioethanol production. Initially, cellulose degrading microorganisms isolated from various locations of Himachal Pradesh were screened for their ability to degrade lignocellulosic material so as to select the best organism for fermentation and ethanol production. Isolate HCB-21exhibiting highest cellulase activity i.e. 0.39 U/mg protein was used for further study. In order to enhance the cellulose degradation potential of this isolate, various culture conditions were optimized which resulted in 20 fold increase in the cellulolytic activity i.e. 7.80 U/mg protein. Besides the bacterial isolate HCB-21, other microbes previously isolated were also used to analyze the hydrolytic potential and the efficiency of various yeast to produce ethanol and the results are quite encouraging. Efforts are being made to find out a stable microbial consortium of cellulose and hemicellulose degrading microorganisms for maximum yield of fermentable sugar from pine needles for production of ethanol. The outcome of the present work will result not only in providing a safe and environment friendly source of energy, but also in the conservation of environment and biodiversity due to reduction of frequent forest fires.

ravibiotech07@gmail.com

Optimized separation strategies for butanol, IPA and ethanol fermentation broth

Daira Aragon, Franz Ehrenhauser and **Peter Gaston**
LSU Agricultural Center, USA

Butanol is regaining importance in the area of biofuels and bio-based chemicals because of its characteristics as "drop-in" fuel and its applicability as a solvent in diverse industries. One way to obtain bio-butanol is the isopropanol-butanol-ethanol (IBE) fermentation by *Clostridium* bacteria. The dilute solvent mixture (~10 g/L) contains mainly butanol (~64%) and isopropanol (~35%) and contains only very small quantities of ethanol (<1%). Both butanol and isopropanol are high-value products as industrial solvents and butanol (or butanol+isopropanol) could be used as "drop-in" fuel. These components can be separated from the fermentation broth and purified using a combination of centrifugation, filtration, adsorption/desorption and distillation steps. In particular, desorption with steam occurs as a pulse, in which the majority of the mixture is obtained in a brief interval. Because distillation is an energy-intensive process, it is important to determine if there is a point when desorption is no longer valuable and to find a configuration that maximizes recovery of each component. This work proposes a simulation model in Aspen Plus for the purification of butanol, isopropanol and ethanol, assuming the solvent mixture has been already recovered from the fermentation broth. Furthermore, different alternatives are simulated to determine the optimal distillation scheme, including recycle streams, for the separation of butanol, isopropanol and ethanol after the adsorption desorption steps.

daragon@agcenter.lsu.edu