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Single cell oil production by a novel yeast *Trichosporon mycotoxinivorans* for complete and ecofriendly valorization of paddy straw

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ABSTRACT

Background: Oleaginous yeasts can be grown on different carbon sources, including lignocellulosic hydrolysate containing a mixture of glucose and xylose. However, not all yeast strains can utilize both the sugars for lipogenesis. Therefore, in this study, efforts were made to isolate dual sugar-utilizing oleaginous yeasts from different sources.
Results: A total of eleven isolates were obtained, which were screened for their ability to utilize various carbohydrates for lipogenesis. One promising yeast isolate *Trichosporon mycotoxinivorans* S2 was selected based on its capability to use a mixture of glucose and xylose and produce 44.86 ± 4.03% lipids, as well as its tolerance to fermentation inhibitors. In order to identify an inexpensive source of sugars, nondetoxified paddy straw hydrolysate (saccharified with cellulase), supplemented with 0.05% yeast extract, 0.18% peptone, and 0.04% $MgSO_4$ was used for growth of the yeast, resulting in a yield of 5.17 g L^{-1} lipids with conversion productivity of 0.06 g L^{-1} h^{-1}. Optimization of the levels of yeast extract, peptone, and $MgSO_4$ for maximizing lipid production using Box–Behnken design led to an increase in lipid yield by 41.59%. FAME analysis of single cell oil revealed oleic acid (30.84%), palmitic acid (18.28%), and stearic acid (17.64%) as the major fatty acids.
Conclusion: The fatty acid profile illustrates the potential of *T. mycotoxinivorans S2* to produce single cell oil as a feedstock for biodiesel. Therefore, the present study also indicated the potential of selected yeast to develop a zero-waste process for the complete valorization of paddy straw hydrolysate without detoxification.
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1. Introduction

Oils, fats, and lipids, present in our food are an important source of energy and have various industrial applications, including biodiesel production. Vegetable oils, nonedible oils, and waste cooking oils serve as potential feedstocks for biodiesel production. At world exhibition of Paris in 1898, Sir Rudolf Diesel demonstrated first compression ignition engine using peanut oil as a fuel [1]. Triglycerides from vegetable oils (Soybean, palm oil seeds, and rapeseed) are usually considered as prominent feedstocks for biodiesel production. The use of vegetable oils as feedstock for biodiesel has led to "food or fuel" controversy and prompted the use of nonedible oil resources like jatropha, jojoba and waste cooking oil, grease and animal fats. But these oils are not abundant to meet the global energy needs and animal fats perform poorly in cold weather. Moreover, if vegetable oil or animal fat is used for biodiesel production, the cost of substrate will be 70–85% of the total expenses, thus making it unsuitable to compete with fossil fuels. These limitations in the use of vegetable and animal fats paved the way for the development of microbial oil; so-called single cell oil (SCO) which represents a fascinating feedstock for the development of biodiesel. The term "SCO" was extended to all fatty acid-containing lipids from microorganisms including algae, bacteria, yeasts and filamentous fungi. Lipids are synthesized by all microorganisms for their essential functions, but there are certain oleaginous microorganisms that can accumulate more than 20% of their dry cell weight as lipids. The

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