Developing microbial oils from rice straw residue

Munish Puri and Wendy Quayle

Centre for Chemistry and Biotechnology, Deakin University, Victoria, Australia

Centre Regional and Rural Futures, Deakin University, Hanwood, NSW, Australia

Contact: munish.puri@deakin.edu.au

Extended abstract:

Various fermentation substrates such as glycerol, wastewater from the food industry, wheat straw, bagasse and corncob have been explored for microbial lipid production [1]. In this direction, rice straw is another abundant agriculture residue that could be used for oil production [2]. Since the world's annual cereal production is over 2 billion tons per year with straw making up 50% of that weight, straw is one of the largest lignocellulose biomass available as an agricultural by-product. Approximately 50% of wheat straw is used for a variety of purposes, but 90% of rice straw is burned in the field at the end of the harvest period [3]. This is a widespread, traditional practice that allows the farmers to rapidly remove the rice straw from the field, but it leads to severe annual peaks of air pollution. The surplus of straw is more than 1.2 Mt per year, this quantity being composed of 67% rice straw and 33% wheat straw. This material is available at an affordable price for biorefining purposes [4].

Rice straw, like many lignocellulosic biomass (LCB), consists of cellulose (32-47%), hemicellulose (19-27%) and lignin (5-24%). To overcome recalcitrant nature of biomass, pretreatment step plays a key role and breaks the complex structure and release sugars (pentoses and hexoses) that are suitable for biochemical conversion to ethanol [5]. Pretreatment is one of the most expensive steps in the process and contribute about 30 % of total cost [6]. Numerous processes such as physical and chemical have been studied for the pretreatment of rice straw however are often limited by the selectivity to the cell wall components and produced undesired polymers [7].

The objective of the proposed work, is to develop processes enabling conversion of rice straw biomass (lignocellulose) to sugars and then to higher value biobased products. This will involve optimisation of rice straw pretreatment followed by enzymatic saccharification to produce sugars [8]. This will be followed by optimisation of microbial systems on hydrolyzed sugars for the biosynthesis of high value lipids and co-products (such as carotenoids). The focus will be on marine microalgae and their potential in the production of lipids such as unsaturated fatty acid EPA (C20:5n3) and DHA (C22:6n3) from rice biomass sugars. Marine microalgae have been selected as a companion host for this research work as these organisms are known to be rich sources of high value omega-3 fatty acids [9]. The use of Deakin university *in house* strain is that they can be maintained by fermentative culture and typically don't require a light source for its growth [10]. Therefore, the proposed research has the potential to introduce a novel product into an existing commercial market. Thus, developing a process that will allow this inexpensive material to be converted to a high value product. This will have a major impact on several levels including creating additional income for farmers, reducing air pollution and creating a high quality nutritional supplement.

References

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