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# Conclusions

*Cystobasidium oligophagum* was isolated with the intent to carry out consolidated bioprocessing of lignocellulosic waste. In this regard, the yeast exhibited all the desired characteristics such as the growth on cellulosic substrates like CMC, high oil content, suitable lipid composition, ability to grow on several complex & simple substrates, and also produce lipase. Simultaneous expression of these traits indicated that in a single step, both the feedstock and catalyst could be obtained from renewable resources like cellulose. Further characterization of the lipid extract with various analytical techniques showed that it was suitable for obtaining biodiesel with desirable fuel properties.

Further, the isolate was grown on cheese whey, a dairy industry waste. The lactose part of cheese whey was utilized while the isolate removed a substantial fraction of soluble COD. Growth on pretreated lignocellulosic biomasses such as sugarcane bagasse and corn cob was also tested. While the hydrolysates rich in xylose were utilizable, the insoluble cellulose fraction was not. The systematic optimization studies of the significant shake flask experiments (Response surface methodology) and scale-up studies to the bioreactors should be performed. The yeast did produce cellulase but at very low activity. The molecular identification of cellulase genes and enhancing their expression is necessary for its full-fledged exploitation. This also requires the isolation of a cellulase enzyme in its pure form.

The isolate also showed moderate resistance to the inhibitors released from lignocellulosic biomass pretreatment. It was highly sensitive to the mixture of them. Nevertheless, the yeast could grow and accumulate lipids on the undetoxified lignocellulosic hydrolysates. The lipid profile, as obtained through NMR experiments, was found suitable for biodiesel and other applications.

Lipase mediated transesterification is a promising alternative to chemical-based transesterification of lipids and methanol. The isolate can produce lipase at a decent activity level. Future studies must involve a bioprocess development so that the feedstock oils and lipase can work simultaneously to give biodiesel molecules. This can happen both *in vivo* as well as *in vitro*, with the former more desirable from an economics point of view.

Simultaneous utilization of C5 and C6 sugars, consolidated bioprocessing, and biodiesel/drop-in biofuel production will require genetic modification of the yeast. The genetic modification can be directed towards the overproduction of cellulases, production of ethanol pathway as a substitute for methanol, *in vivo* transesterification, *in vivo* hydrogenation/decarboxylation for the drop-in biofuels. Further, isolation of other usable high-value low titer products such as PUFA, carotenoids, and other antioxidants from the yeast can help to make the bioprocess attractive and economical.