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Comparison of Inexpensive Cell Disruption Techniques for an Oleaginous Yeast

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Abstract : Palm oil is obtained from the flesh and kernel of the fruit of oil palms and is the most productive and inexpensive oil crop. The global demand for palm oil is approximately 75 million metric tonnes, a 29% increase in global production of palm oil since 2016. This expansion of oil palm cultivation has resulted in mass deforestation, vast biodiversity destruction and increasing net greenhouse gas emissions. One possible alternative is to produce a saturated oil, similar to palm, from microbes such as oleaginous yeast. The yeasts can be cultured on sugars derived from second-generation sources and do not compete with tropical forests for land. One highly promising oleaginous yeast for this application is Metschnikowia pulcherrima. However, recent techno-economic modeling has shown that cell lysis and standard lipid extraction are major contributors to the cost of the oil. Typical cell disruption techniques to extract either single cell oils or proteins have been based around bead-beating, homogenization and acid lysis. However, these can have a detrimental effect on lipid quality and are energy-intensive. In this study, a vortex separator, which produces high sheer with minimal energy input, was investigated as a potential low energy method of lysing cells. This was compared to four more traditional methods (thermal lysis, acid lysis, alkaline lysis, and osmotic lysis). For each method, the yeast loading was also examined at 1 g/L, 10 g/L and 100 g/L. The quality of the cell disruption was measured by optical cell density, cell counting and the particle size distribution profile comparison over a 2-hour period. This study demonstrates that the vortex separator is highly effective at lysing the cells and could potentially be used as a simple apparatus for lipid recovery in an oleaginous yeast process. The further development of this technology could potentially reduce the overall cost of microbial lipids in the future.

Keywords : palm oil substitute, metschnikowia pulcherrima, cell disruption, cell lysis
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