Biolubricants production via enzymatic conversion of microbial oil produced through the valorisation of sugarcane molasses

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Abstract

The present study is focused on the efficient valorisation of sugarcane molasses, the main side stream of the sugarcane production industry, for microbial oil production, which is subsequently used for the development of bio-based polyol esters with lubricant properties. The microbial oil was produced through batch fermentations of *Rhodosporidium toruloides* NRRL Y-27012 and *Rhodosporidium kratochvilovae* Y-43 cultivates on either cane sugar or molasses as carbon sources. The effect of mineral supplementation of the fermentation medium on the fatty acid composition of the microbial oil was also evaluated. The microbial oil was extracted from the oleaginous yeast cells and enzymatically hydrolysed into free fatty acids, which were then esterified with polyols by Lipomod 34-MDP for biolubricants production. The enzymatic hydrolysis and esterification were carried out in a solvent-free system. When cane sugar was used as substrate, the highest total dry weight (23.1 g/L) and intracellular lipid content (46%, w/w) were achieved by *R. kratochvilovae*. Batch fermentations were subsequently carried out using molasses and the highest lipid content (42%, w/w) and total dry weight (22 g/L) were achieved by *R. kratochvilovae*. The yeast *R. toruloides* achieved the highest total dry weight (17.2 g/L) and intracellular lipid content (49%, w/w) when the medium used contained only molasses, without any mineral addition. The microbial oil was mainly consisted of oleic and palmitic acids. The free fatty acids derived from microbial oil were efficiently converted into biolubricants with a conversion yield of 76%. The present study demonstrates the potential of microbial oil derived via fermentation using side streams from food industry as feedstock for the sustainable production of bio-economy products.