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Optimisation of biomass and lipid production of a tropical thraustochytrid *Aurantiochytrium* sp. UMACC-T023 in submerged-liquid fermentation for large-scale biodiesel production

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ABSTRACT

A tropical thraustochytrid, *Aurantiochytrium* sp. UMACC-T023, was optimised for high biomass and lipid production in submerged-liquid fermentation (SLF). Biomass and lipid production were optimised based on glucose, polypeptone, and yeast extract concentration using response surface methodology (RSM). In RSM, the applied central composite design (CCD) showed that the optimisation model was significant for all variables studied. Yeast extract and polypeptone were associated with significant effects in UMACC-T023 biomass production with $p < 0.05$. The model was validated by employing the optimised media composition in shake flasks and in 1.4-L stirred-tank bioreactors. The optimised media composition for both biomass and lipid production was 10 g L^{-1} glucose, 15.08 g L^{-1} polypeptone, and 13.56 g L^{-1} yeast extract. Biomass production in the bioreactor increased 2.12-fold compared with the shake flask culture utilising the same optimised media composition. This study demonstrates the potential of large-scale lipid production of UMACC-T023 as biodiesel feedstock.

1. Introduction

Increasing energy usage for transportation and industrialisation signifies a greater demand on energy supply (Chu and Majumdar, 2012). At present, energy supplies are primarily generated from fossil fuels. However, fossil fuels are non-renewable and are showing signs of depletion, and the use of biofuels such as biodiesel and bio-ethanol may represent a solution to this problem (Mata et al., 2010). However, the use of biofuel to replace fossil fuels is not without limitations, which are mostly related to the source from which the biofuel is obtained Sohedein et al., 2020. First-generation biofuels have been generated from crop plants, which also serve as a food supply for human consumption (Mathimani and Pugazhendhi, 2019). This issue leads to research on producing biodiesel using oils from inedible seed such as sweet basil seed (Amini et al., 2017). The extensive use of food crops as a source of biofuel can also lead to an increase in land use for plantation, which can lead to biodiversity loss (Mata et al., 2010). Second-generation biofuels are generated from plant or animal biomasses, which are more sustainable, although the lipid extraction process is more challenging. Researchers have subsequently turned their focus to third-generation biofuels generated from microalgae biomasses such as methane, biodiesel, and biohydrogen (Chisti, 2007). Open or closed cultivation systems such as raceways and enclosed photobioreactors can be used for microalgae cultivation and their biomasses can be harvested for lipid

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