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New report of *Halamphora subtropica* (Bacillariophyta) from the Strait of Malacca and its growth and biochemical characterisation under nutrient deprivation

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ABSTRACT

A symmetrical bi-raphid pennate diatom isolated from tropical coastal waters in the Strait of Malacca was identified as *Halamphora subtropica*, which is significant given that the distribution of this species was until now limited to subtropical waters in western Atlantic Ocean and western Pacific Ocean, hence its etymology. To assess its potential as biodiesel feedstock, the alga was cultivated, and its growth and biochemical composition compared under nutrient replete and nutrient (N, P, Si) deprived conditions. The growth of *H. subtropica* was more suppressed under N- conditions but was less affected under P- and/or Si- conditions. The highest biomass and lipid productivity of 19.7 ± 0.8 and 4.0 ± 0.4 mg L^{-1} day^{-1} respectively, were achieved under nutrient replete condition followed by P- and Si- conditions. Cells grown in nutrient-deprived media contain higher monounsaturated fatty acids while higher polyunsaturated fatty acids were observed in the complete medium. Palmitic acid, palmitoleic acid and stearic acid accounted for over 60% of the total fatty acids. The strain used in this study showed comparable values of biomass productivity, lipid productivity and lipid content (≈30% dw) to diatom strains reported previously, suggesting that *H. subtropica* may be considered as a candidate for biofuel feedstock. These results contribute additional evidence on the potential of using tropical marine diatom strains as feedstock for biofuel, given that existing literature tend to focus on subtropical or temperate strains.

1. Introduction

Microalgae have gained popularity as a source of food, animal feed, pharmaceuticals, nutraceuticals, and biofuel in recent years (Khan et al., 2018). Microalgal biomass is a great alternative energy source since it can be used to replace fossil fuels while also reducing greenhouse gas emissions (Walsh et al., 2016). Microalgae need simple requirements (light, water, CO_2, and minerals) for growth through photosynthesis (Masojídek et al., 2013). Phylogenetically, microalgae are divided into four groups: Cyanophyceae, Chlorophyceae, Bacillariophyceae, and Chrysophyceae (Formighieri and Bassi, 2013). Diatoms from the class Bacillariophyceae are thought to give as much as 20% to the global primary productivity of biomass (Malviya et al., 2016).

Diatoms, as opposed to their green algae counterparts, have gained considerable consideration as a major sustainable feedstock for biodiesel production due to their huge diversity and great storage capacity for biochemicals, particularly lipid and fatty acids. Triacylglycerol (TAG) is a carbon storage metabolite that can be rapidly converted to biodiesel by some diatom species (Butler et al., 2020). However, the fatty acid profile of a particular diatom would be critical in determining its suitability as a biodiesel feedstock. When compared to polyunsaturated fatty acids (PUFA) with the same number of carbons, diatoms primarily store saturated fatty acids (SFA) and monounsaturated fatty acids (MUFA), which give more energy when oxidised (Abomohra et al., 2021). In marine diatoms, palmitoleic acid (C16:1) is the most

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