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Fatty acid production of tropical thraustochytrids from Malaysian mangroves

DOI 10.1515/bot-2016-0031
Received 13 April, 2016; accepted 19 August, 2016; online first 21 September, 2016

Abstract: A total of 33 tropical thraustochytrid isolates were isolated from fallen leaves of Malaysian mangroves. Phylogenetic analysis based on the 18S rRNA gene revealed that the majority of the 33 isolates belonged to the genus *Aurantiochytrium*, and only one isolate belonged to *Parietichytrium*. The specific growth rate and biomass productivity of the strains ranged from 0.17 to 0.93 day^{-1} and 0.03 to 0.62 g l^{-1} day^{-1}, respectively. Lipid productivity ranged from 1.27 to 70.86 mg l^{-1} day^{-1}. Fifteen fatty acids, dominated by C16:0 [19.5%–71.6% total fatty acid (TFA)], C15:0 (3.3%–43.1% TFA), C22:6n3 (1.5%–38.4% TFA) and C18:0 (2.9%–28.6% TFA), were identified. The total carotenoid content was shown to be a better chemotaxonomic character than fatty acid composition for the isolates. *Aurantiochytrium* sp. UMACC-T024 had the highest lipid productivity (70.86 mg l^{-1} day^{-1}), and this was selected for an optimisation study. The optimal conditions for lipid production of *Aurantiochytrium* sp. UMACC-T024 were salinity 32, pH 7.5, 1% w/v glucose and 0.5 g l^{-1} yeast extract, which resulted in an enhanced lipid productivity of 263.37 mg l^{-1} day^{-1} at day 5.

Keywords: *Aurantiochytrium*; biomass and lipid productivity; biotechnology; fatty acid; thraustochytrids.

Introduction

Thraustochytrids are marine fungus-like organisms which have been traditionally referred to as 'lower marine fungi' (Jones and Pang 2012). Recently, based on phylogenetic studies, thraustochytrids have been placed under the super group: Stramenopiles, Alveolates, Rhizaria (SAR) proposed by Adl et al. (2012). There is presently a total of 40 species in 12 genera of thraustochytrids including *Althornia* E.B.G. Jones et Alderman, *Aurantiochytrium* R. Yokoy. et D. Honda, *Botryochytrium* R. Yokoyama, B. Salleh et D. Honda, *Diplophrys* J. Barker, *Elina* N.J. Artemczuk, *Japonochytrium* Kobayasi et M. Ookubo, *Oblongichytrium* R. Yokoyama. et D. Honda, *Parietichytrium* R. Yokoyama, B. Salleh et D. Honda, *Schizochytrium* S. Goldst. et Belsky emend. T. Booth et C.E. Mill., *Sicyoidochytrium* R. Yokoyama, B. Salleh et D. Honda, *Thraustochytrium* Sparrow emend. Johnson and *Ulkenia* A. Gaertn (Yokoyama and Honda 2007, Yokoyama et al. 2007, Liu et al. 2014).

Thraustochytrids have a wide geographical distribution, stretching from the tropical to the polar regions. They inhabit neritic and oceanic water columns, and in the sediments of mangroves, estuaries and the deep sea (Raghukumar 2002, Atienza et al. 2012), they are associated with plant debris such as fallen mangrove leaves (Leaño et al. 2003).

Thraustochytrids are characterised by fast growth rate and high biomass and lipid production. *Aurantiochytrium* and *Schizochytrium* species were found to be good producers of biomass and fatty acids (Liu et al. 2014). Many fatty acids produced by thraustochytrids, both saturated and unsaturated, have potential applications in the biofuel industry, including saturated fatty acids (SFAs), palmitic acid (C16:0) and monounsaturated fatty acids (MUFAs), oleic acid (C18:1), and the low carbon fatty acids (LCFAs) myristic acid (C14:0) and pentadecylic acid (C15:0) (Lee Chang et al. 2012).

Factors such as salinity, pH, glucose concentration (% w/v) and yeast extract concentration (g l^{-1}) affect biomass and lipid production of thraustochytrids. Salinity ranging between 15 and 60 (Yaguchi et al. 1997) and a pH range from 5 to 8 were required to produce good growth (Arafiles et al. 2011). Glucose as a carbon source (Yokochi et al. 1998) and yeast extract as a nitrogen source (Armenta and Valentine 2013) were used to improve biomass production.

Although Malaysia has abundant mangroves, there have been few reports on thraustochytrids from these habitats. This study aimed to isolate and identify thraustochytrids from the west coast of Peninsular Malaysia and to profile their lipid and fatty acid composition. One strain UMACC-T024 which had the highest biomass and lipid productivity was selected for an optimisation study.

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