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Temperature and salinity effects on growth and fatty acid composition of a halophilic diatom, *Amphora* sp. MUR258 (Bacillariophyceae)

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Abstract

Diatoms are of great interest for large-scale cultivation due to their high lipid content. The ability to grow over a wide range of salinities is also of great advantage. We studied the effect of temperature and salinity on the growth, lipids and fatty acid profiles of a newly isolated halophilic diatom *Amphora* sp. MUR 258. *Amphora* sp. MUR 258 is unusual in that it grows over a wide range of temperatures (24–35 °C) and salinities (7–12% (*w*/*v*) NaCl). The highest specific growth rate (SGR; 0.607 ± 0.017 day^{-1}) was achieved at 7% NaCl at 35 °C, and the lowest SGR (0.433 ± 0.087 day^{-1}) was obtained at 9% NaCl at 25 °C. The cells contained more lipids in the exponential phase, except when grown at 12% NaCl where the lipid content was higher in the stationary phase. The alga achieved its highest lipid content (57.69 ± 2.039% ash-free dry weight (AFDW) when grown at 7% NaCl at 25 °C and the lowest (34.43 ± 3.955% AFDW) obtained at 12% NaCl at 35 °C. The highest biomass productivity (0.171 ± 0.017 g_{AFDW} L^{-1} day^{-1}) and the lipid productivity (0.062 ± 0.017 g_{AFDW} L^{-1} day^{-1}) were achieved when the *Amphora* were grown at 9% NaCl at 35 °C and 7% at 25 °C, respectively. Irrespective of the growth conditions, the predominant fatty acids of *Amphora* sp. MUR 258 were palmitic acid (C16:0), stearic acid (C18:0), palmitoleic acid (C16:1) and oleic acid (C18:1), as well as low quantities of eicosapentaenoic acid (C20:5).

Keywords Bacillariophyta · Microalgae · Halophilic diatom · Lipid · Fatty acids · PUFA

Introduction

Species selection is the first and most important aspect in bioprospecting microalgae for any commercial application (Borowitzka 2013). New microalgae species capable of reliable growth under outdoor conditions over a wide range of salinities and temperatures are of specific interest for large-scale production for biofuels or other products (Borowitzka and Moheimani 2013b).

When grown in outdoor open pond systems, cultures are exposed to varying temperatures, both diurnally and seasonally. For instance, in temperate locations with high insulation such as southern Western Australia, temperature can vary between −1 °C at night and up to 42 °C in the day (Bureau Meteorology, http://www.bom.gov.au/climate/data/?ref=ftr). Therefore, it is important that the alga of interest can grow optimally over a wide range of temperatures so that it can be cultured throughout the year. Almost all successful large-scale outdoor open pond cultures (e.g. *Dunaliella salina*, *Arthrospira* spp. and *Chlorella* spp.) experience broad temperature ranges (Béchet et al. 2013; Belay 2013; Borowitzka 2016). Optimal algal growth over a wide salinity range is another important criterion for successful cultivation in outdoor open ponds because salinity variation will occur due to evaporation and dilution caused by rain. Furthermore, in order to replace evaporation losses and maintain salinity, very large amounts of fresh water are needed. On the other hand, if saline water is used to replace evaporative losses, the salinity of the cultures will gradually increase (Borowitzka and Moheimani 2013a). Therefore, microalgae capable of grow over a wide salinity range and at high temperatures are highly desirable for

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