

Carotenoid production of *Botryococcus braunii* CCAP 807/2 under different growth conditions

by Indrayani Indrayani · Einar Skarstad Egeland Navid Reza Moheimani ·
Michael A. Borowitzka

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Carotenoid production of *Botryococcus braunii* CCAP 807/2 under different growth conditions

Indrayani Indrayani^{1,2} · Einar Skarstad Egeland³ · Navid Reza Moheimani^{1,4} · Michael A. Borowitzka^{1,5}

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Abstract

Botryococcus braunii CCAP 807/2 has been studied intensively for biofuel production due to its high hydrocarbon content. This strain is also capable of producing high value carotenoids. The aim of the study was to analyse the carotenoid production of *B. braunii* 807/2 under different growing conditions, first, by using different media and light intensities in indoors, and next, to examine the carotenoid composition between green, intermediately pigmented and red *B. braunii* grown in indoors and outdoors. The alga was cultured indoors under two different light intensities (100 and 500 $\mu\text{mol photons m}^{-2} \text{s}^{-1}$) using three different media: a control with complete modified CHU 13 medium, modified CHU 13 without N and modified CHU13 without N+2Fe. All cultures were grown at 25 °C with 12:12 h light:dark cycle and were mixed with magnetic stirrers. For the determination of carotenoid composition at different stages, the green, intermediately pigmented and red cells were collected from indoor and outdoor cultures and analysed for their carotenoid composition using HPLC. The cultures grown at high light intensity reached the highest biomass yield at 0.6 g L⁻¹ on day 16, whereas their counterparts at low light intensity took 30 days to reach the same biomass yield. The carotenoid production of *B. braunii* 807/2 at high light intensity increased up to twofold in 2 days compared to the ones grown at low light. *Botryococcus braunii* 807/2 accumulates lutein, canthaxanthin and astaxanthin and β,β -carotene as the main carotenoids. Whilst lutein was the major carotenoids of the green/intermediate cells, canthaxanthin and astaxanthin were the predominant carotenoids of the red cells under indoor and outdoor culture, respectively. This study suggests that *Botryococcus braunii* 807/2 is a potential candidate for the production of lutein and/or astaxanthin. It accumulates a high amount of lutein when grown under optimum conditions and a high amount of astaxanthin when grown under sub-optimum conditions outdoors.

Keywords Astaxanthin · Chlorophyceae · Light · Lutein · Outdoor culture

Introduction

Carotenoids are lipid-soluble pigments that give yellow, orange, or red colours of, e.g. plant leaves, fruit, flowers, feathers, crustacean shells, and skin of fish (Britton et al. 2004). They are produced de novo by all photosynthetic organisms, and more than one hundred carotenoids are found in microalgae (Egeland 2016), but only a few are used and produced commercially, the two main ones from algae being β,β -carotene and astaxanthin (Borowitzka 2018). Carotenoids have an important role in the photosynthetic apparatus and also serve to protect cells from oxidative damage and high light (Solovchenko 2013; Hashimoto et al. 2016).

Considering the potential market value as well as the range of potential applications of carotenoids especially β,β -carotene, astaxanthin, lutein and fucoxanthin, searching for new sources of carotenoids from microalgae with

✉ Indrayani Indrayani
indrayani@unm.ac.id; indrayani_tajudin@yahoo.com.au

¹ Algae R&D Centre, Environmental and Conservation Sciences, Murdoch University, Murdoch, WA 6150, Australia

² Study Programme of Agricultural Technology Education, Faculty of Engineering, Universitas Negeri Makassar, Makassar, South Sulawesi 90221, Indonesia

³ Faculty of Biosciences and Aquaculture, Nord University, Postboks 1490, NO-8049, Bodø, Norway

⁴ Centre for Water, Energy and Waste, Harry Butler Institute, Murdoch University, Murdoch, WA 6150, Australia

⁵ OzAlgae, PO Box 41, Cygnet, TAS 7112, Australia

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