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A comparative study of phycobilliprotein production in two strains of *Pseudanabaena* isolated from Arctic and tropical regions in relation to different light wavelengths and photoperiods

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ABSTRACT

Phycobiliproteins, which include phycocyanin, allophycocyanin and phycoerythrin, are the group of coloured accessory photosynthetic pigments present in cyanobacteria (blue-green algae). *Pseudanabaena* is a genus of microscopic cyanobacteria, cosmopolitan in distribution and known to be rich in phycoerythrins. Cyanobacteria are photosynthetic organisms, thus, one of the factors that influences their metabolism is the quality and quantity of incident light. In order to determine the production of phycobiliproteins (mainly phycocyanin and phycoerythrin) in this genus, the quantity of these pigments was investigated in two different strains of *Pseudanabaena*, *P. catenata* USMAC16 isolated from an Arctic location (Svalbard) and *P. amphigranulata* USMAC18 from a tropical location (Tasik Harapan, USM, Malaysia). The aims of this study were twofold. First, to determine the influence of different light wavelengths (white, green and red) and exposure duration (photoperiod of 12–24 h (h)) on phycocyanin and phycoerythrin production in the two strains. Second, to compare the production of phycobiliprotein between the two strains. Highest phycocyanin production was obtained under red light, while phycoerythrin production was highest under green light. Highest production was achieved with photoperiod 24:00 h L:D (L: light, D: dark) in the polar strain and 12:12 h L: D in the tropical strain. *P. catenata* (Arctic strain) was a good producer of phycoerythrin when grown under green light.

1. Introduction

Cyanobacteria, also known as blue green algae, belong to the eubacterial domain, and are oxygenic, photosynthetic and Gram-negative prokaryotes, lacking defined nucleus and other intracellular membrane-bounded organelles (Seckbach and Oren, 2007). Photosynthetic pigments of cyanobacteria are positioned in thylakoids that lie free in the cytoplasm near the cell periphery (Mur et al., 1999). They possess a wide range of coloured pigments including carotenoids, chlorophyll-*a*, and the accessory pigments, phycobiliproteins. These accessory pigments are embodied in phycobilisomes, which are found on the outer surface of the thylakoids (Douglas, 1994). Phycobiliproteins (PBPs) are large water soluble supramolecular protein aggregates involved in light harvesting in cyanobacterial cells, and may comprise about 40–60% of the total soluble protein in these cells (Kumar et al., 2014). They can be classified broadly into three categories based on their spectral properties: phycoerythrin (λ_{max} 565 nm), phycocyanin (λ_{max} 620 nm) and allophycocyanin (λ_{max} 650 nm) (Glazer and Bryant, 1975). Nees Esenbeck (1836) first described an intensely blue-coloured pigment released in *in vitro* cultures of the cyanobacterium *Oscillatoria* sp. as 'saprocyanin'. Kützing (1843) renamed this pigment 'phykokyan' and also isolated a water-soluble red pigment, 'phykoerythrin', from a number of red algae. Later, these pigments were renamed as phycocyanin (blue pigment) and phycoerythrin (red pigment) by Sorby (1877). Sorby (1877) also provided the first evidence of the existence of allophycocyanin, based on thermal denaturation studies.

Phycobiliproteins have antioxidant, anti-inflammatory and hepatoprotective properties (Kulshreshtha et al., 2008; Patel et al., 2005; Paul et al., 2006). They have been widely used as natural pigments and fluorescent proteins in various applications (Mishra et al., 2012). Their colour, fluorescence and antioxidant properties, and prolonged shelf stability at low temperature make them preferred colourants in the food

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