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Effect of Light Spectra, Light Intensity, and HRT on the Co-Production of Phycoerythrin and Exopolysaccharides from Poprhyridium Marinum

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Abstract : Red microalga Porphyridium marinum CCAP 13807/10 has the potential to produce a broad range of commercially valuable chemicals such as PhycoErytrin (PE) and sulphated ExoPolySaccharides (EPS). Multiple abiotic factors influence the growth of Porphyridium sp., e.g. the wavelength of the light source and different cultivation strategies (one or two steps, batch, semi-, and continuous regime). The microalga of interest is cultivated in a two-step system. First, the culture grows photoautotrophically in a controlled bioreactor with pH-dependent CO2 injection, temperature monitoring, light intensity, and LED wavelength remote control in a semicontinuous mode. In the second step, the harvested biomass is subjected to mixotrophic conditions to enhance further growth. Preliminary tests have been performed to define the suitable media, salinity, pH, and organic carbon substrate to obtain the highest biomass productivity. Dynamic light and operational conditions (e.g. HRT) are evaluated to achieve high biomass production, high PE accumulation in the biomass, and high EPS release in the medium. Porphyridium marinum is able to chromatically adapt the photosynthetic apparatus to efficiently exploit the full light spectra composition. The effect of specific narrow LED wavelengths (white W, red R, green G, blue B) and a combination of LEDs (WR, WB, WG, BR, BG, RG) are identified to understand the phenomenon of chromatic adaptation under photoautotrophic conditions. The effect of light intensity, residence time, and light quality are investigated to define optimal operational strategies for full scale commercial applications. Production of biomass, phycobiliproteins, PE, EPS, EPS sulfate content, EPS composition, Chlorophyll-a, and pigment content are monitored to determine the effect of LED wavelength on the cultivation Porphyridium marinum in order to optimize the production of these multiple, highly valuable bioproducts of commercial interest.

Keywords : red microalgae, LED, exopolysaccharide, phycoerythrin
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