

Bioprocess Strategy of *Haematococcus lacustris* for Biomass and Astaxanthin Production Keys to Commercialization: Perspective and Future Direction

ABSTRACT

Haematococcus lacustris (formerly called *Haematococcus pluvialis*) is regarded as the most promising microalgae for the production of natural astaxanthin, which is secondary metabolism used as a dietary supplement, also for cosmetic applications, due to its high antioxidant activity. Astaxanthin has a wide range of biological activities and high economic potential, and currently dominates the market in its synthetic form. Furthermore, because of the difficulty of bioprocess and the high cost of cultivation, astaxanthin extracted from this microalga is still expensive due to its low biomass and pigment productivities. Large-scale biomass production in biotechnological production necessitates the processing of a large number of cultures as well as the use of both indoor and outdoor systems, such as open pond raceway systems and photo-bioreactors (PBR). The photo-bioreactors systems are suitable for mass production because growth conditions can be controlled, and the risk of contamination can be reduced to a certain extent and under specific culture parameters. This review discusses current technologies being developed to improve cultivation and operation efficiency and profitability, as well as the effect of parameter factors associated with *H. lacustris* cultivation on biomass and astaxanthin bioproduction, and even strategies for increasing bioproduction and market potential for *H. lacustris* astaxanthin.