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Hydrothermal Liquefaction for Astaxanthin Extraction from Wet Algae

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Abstract : Algal biomass is not only a potential source for biocrude but also for high value chemicals like carotenoids, fatty acids, proteins, polysaccharides, vitamins etc. Astaxanthin is one such high value vital carotenoid which has extensive applications in pharmaceutical, aquaculture, poultry and cosmetic industries and expanding as dietary supplement to humans. Green microalgae Haematococcus pluvialis is identified as the richest natural source of astaxanthin and is the key source of commercial astaxanthin. Several extraction processes from wet and dry Haematococcus pluvialis biomass have been explored by researchers. Extraction with supercritical CO_2 and various physical disruption techniques like mortar and pestle, homogenization, ultrasonication and ball mill from dried algae are widely used extraction methods. However, these processes require energy intensive drying of biomass that escalates overall costs notably. From the process economics perspective, it is vital to utilize wet processing technology in order to eliminate drying costs. Hydrothermal liquefaction (HTL) is a thermo-chemical conversion process that converts wet biomass containing over 80% water to bio-products under high temperature and high pressure conditions. Astaxanthin is a lipid soluble pigment and is usually extracted along with lipid component. Mild HTL at 200°C and 60 bar has been demonstrated by researchers in a microfluidic platform achieving near complete extraction of astaxanthin from wet biomass. There is very limited work done in this field. An integrated approach of sequential HTL offers cost-effective option to extract astaxanthin/lipid from wet algal biomass without drying algae and also recovering water, minerals and nutrients. This paper reviews past work and evaluates the astaxanthin extraction processes with focus on hydrothermal extraction.

Keywords : astaxanthin, extraction, high value chemicals, hydrothermal liquefaction
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