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Thomas Alan Kwan, Sarah Elizabeth Kwan, Jordan Peccia, Julie Beth Zimmerman

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Selectively Biorefining Astaxanthin and Triacylglycerol Co-Products from Microalgae with Supercritical Carbon Dioxide Extraction

Thomas Alan Kwan,[a] Sarah Elizabeth Kwan,[a] Jordan Peccia,[a] and Julie Beth Zimmerman [a b]

[a] Department of Chemical and Environmental Engineering, Yale University, 17 Hillhouse Avenue, Connecticut 06511, United States

[b] School of Forestry and Environmental Studies, Yale University, 195 Prospect Street, New Haven, Connecticut 06520, United States

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Abstract

Clustering behavior of supercritical carbon dioxide, triacylglycerides, and astaxanthin solutes were analyzed using Kamlet-Taft solvatochromic properties of dipolarity/polarizability, π^*, and hydrogen-bond acceptance, β. Both parameters were decreased for supercritical carbon dioxide with TAG at low densities and with astaxanthin at high densities. These results indicated supercritical carbon dioxide could selectively extract triacylglycerides at low densities followed by astaxanthin at higher densities from microalgae. Accordingly, *Haematococcus pluvialis* microalgae were subject to a two-stage continuous extraction scheme where a density of 642 mg/ml was employed to extract triacylglycerides followed by a density of 971 mg/ml, by an increase in pressure, to extract astaxanthin. The first, lower density extract yielded over 78% of the total triacylglycerides and was composed of less than 1% astaxanthin. The sequential, higher density extract yielded less than 5% of the total microalgae triacylglycerides, over 70% of the total astaxanthin, and was composed of 60-76% astaxanthin by mass.