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

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8 **Keywords:** Solvatochromism, Kamlet-Taft, Bio-active compounds, Separations,
9 *Haematococcus pluvialis*

10 **Abstract**

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

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