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High pressure extraction of materials by near critical liquid solvents

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The critical point of a substance represents the highest combination of temperature and pressure at which the separation between the gaseous and liquid phases remains continuous. Beyond this critical point, a state known as a supercritical fluid emerges, unifying the gaseous and liquid states and displaying properties that fall between those of gases and liquids. These distinct characteristics include reduced viscosity, diminished surface tension, enhanced diffusivity, and heightened compressibility. These attributes render supercritical fluids as effective solvents and eco-friendly alternatives to traditional organic solvents. It is crucial to note that these property shifts do not occur at a scale change at the critical point, instead, they exhibit a continuous variation in response to alterations in temperature and pressure (T/P). Making so the near-critical under conditions of liquid-vapor equilibrium substances, such as CO2, NH3, HCF2Cl, or combinations like CO2 and EtOH, to serve as extraction solvents in processes similar to Soxhlet extraction. This approach offers notable advantages, including enhanced safety of operation conditions, decreased energy requirements for compression and decompression, as well as heating and cooling of the liquid. Extraction times using Soxhlet-like extraction with near-critical substances typically range between 2 to 12 hours, and fractionation of the extract can be achieved by collecting the extract overtime to separate different groups of components.
Utilizing two commonly used herbs rich in bioactive compounds, such as Sage (Salvia officinalis L) and Lavander (Lavandula angustifolia) we conducted an extraction with near-critical liquid CO2 under liquid-vapor equilibrium. The temperature gradient of the autoclave was between 285 K to 313 K and the pressure inside the vessel was in the range of 60-64 bar. The entire extraction process duration was 6 hours, with 20 minutes of Soxhlet cycles each.

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