

- 1) Recent interest in the development of new extraction techniques is associated with the shortcomings of, quote - conventional techniques involving the extensive use of toxic organic solvents and high energy usage while providing low selectivity and low extraction yields – unquote.
- 2) Supercritical Fluid Extraction (SFE), quote – a technique based on the use of solvents at temperatures and pressures above their critical points ... can be a fast, efficient, and clean method for the extraction of compounds of interest – unquote.
- 3) The solvent properties of supercritical fluids was first investigated by Charles Cagniard de la Tour in 1822. The term Critical Point was defined in 1869 by Thomas Andrews. Quote – some years later, the first application of this knowledge to extraction was introduced by Hannay and Hogarth – unquote.
- 4) Quote – the critical point ... is a particular property of a substance; when these values are reached, some changes are induced that effectively modify its physical properties...a homogeneous supercritical fluid is obtained in which no distinction can be found between phases – unquote.
- 5) Many compounds are able to achieve a supercritical state given the necessary pressure and temperature, but many are either toxic or require such great pressure or temperature as to make them non-viable.
- 6) Carbon Dioxide is an intriguing option for SFE because of its relatively, quote – mild critical temperature and pressure values – unquote, the fact that it is, quote – generally recognized as a safe solvent for the food industry – unquote, and the extraction process itself does not produce additional CO₂ and as such it's use is not restricted as a greenhouse gas.
- 7) One of the most beneficial characteristics of CO₂ as a SFE medium for many applications is the fact that it is a gas at room temperature. When the supercritical environment is reduced to standard temperature and pressure, the carbon dioxide evaporates off leaving a pure extract.
- 8) One drawback of CO₂ is its, quote – very low polarity – unquote, which hinders its ability to extract polar compounds. The addition of a cosolvent, such as ethanol can be used to improve the solvency of polar compounds.
- 9) Carbon Dioxide's supercritical characteristics are as follows: solubility = 15.34 MPa^{1/2}; density = 470 kg/m³; temperature = 31.2C (88.2F), pressure = 7.38 MPa (1,071 psi).
- 10) For comparison water's supercritical characteristics are as follows: solubility = 27.61 MPa^{1/2}; density = 322 kg/m³; temperature = 374C (705F), pressure = 22.05 MPa (3,200 psi).
- 11) When extracting solids, the, quote - particle size and porosity will have a great impact on mass transfer by increasing the surface contact – unquote.
- 12) When extracting liquids, quote – counter-current extractions are commonly employed to increase contact between the sample and the supercritical fluid – unquote.
- 13) Quote – extraction pressure and temperature are probably the most influencing parameters in terms of solubility of a substance, unquote. In general, higher pressures will equate to higher SF density and higher solubility of the sample. Higher temperatures will lead to lower SF density, but will at the same time, quote – promote the transfer of solutes from the sample to the supercritical fluid du to the increment on their vapor pressure – unquote.
- 14) In addition to ethanol, quote - oils mixed with CO₂ at very low proportions – unquote, can be used as cosolvents. Some examples include: almond, peanut, hazelnut, olive, and sunflower seed oil.
- 15) SFE is currently employed in the food industry to accomplish two primary tasks: quote – removal of unwanted compounds and extraction of valuable compounds – unquote.
- 16) Quote – SFE is probably the technique of choice to isolate pesticides from low fat food – unquote.
- 17) SFE is frequently used to extract caffeine from coffee. In this case, both the caffeine extract and decaffeinated coffee are both desirable products. SFE decaffeination requires relatively low pressures but temperatures near 60C (140F).
- 18) SFE has also been used to investigate the extraction of target compounds from animal sources. For example, quote – Later, Hardardottier, and Kinsella studied the extraction of lipids from rainbow trout in a range of pressures and temperatures – unquote. They found that the addition of a 10 percent ethanol cosolvent significantly increased yield.
- 19) SFE has been shown to be a viable and efficient means of extracting carotenoids. Quote – lycopene is the most studied pigment and antioxidant extracted from food by products, it is the most abundant carotenoid in tomatoes – unquote.
- 20) SFE use in the pharmaceutical industry is, quote – linked to the reduced complexity of the process which stems from a reduction of the number of steps as well as to the improved process understanding and control – unquote.
- 21) SFE is also, quote – a promising technique for metal recovery – unquote.
- 22) Overall this text offers insight into Supercritical Fluid Extraction: how it is defined, how it is put to use, its benefits, the characteristics that can be controlled to produce a desired outcome, as well as some future applications that are still in development.

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