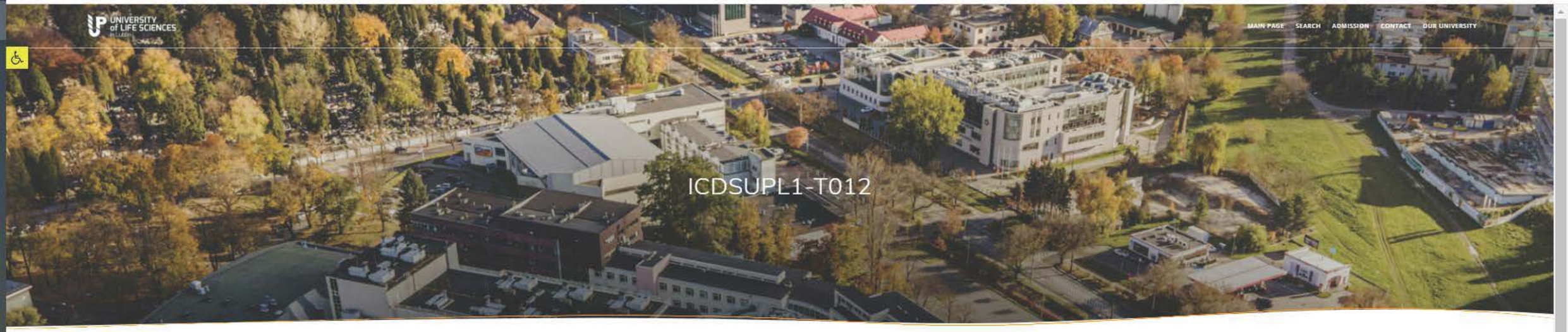

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Supercritical CO_2 extraction from milk thistle: The effect of pressure and temperature

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Abstract

Plant milk thistle (*Silybum marianum*, Asteraceae) is a source of valuable bioactive compounds such as essential fatty acids and flavonolignans, that are commercially used in food and phytopharmaceuticals. These bioactive compounds are separated from plant material by conventional extraction methods using organic solvents such as *n*-hexane and high temperatures. In this manner bioactive compounds can be thermally degraded, organic solvent can remain in final products, and organic waste is generated. A green alternative to conventional extraction techniques is the supercritical extraction process (SCE), which employs CO_2 as a solvent. Supercritical CO_2 ($scCO_2$) has GRAS status and relatively mild critical parameters (P_c~ 7.3 MPa and T_c~31.1 °C). Due to high diffusivity, low viscosity, and near-zero surface tension, it is widely used for the separation of bioactive compounds from plant material. It can be easily separated from the final product and fully recycled. In order to produce a high amount of valuable extract from milk thistle seeds in an environmentally friendly manner, the SCE process was tested at pressures of 10, 20, 30, and 45 MPa and temperatures 40, 60, and 80°C. Obtained extracts were characterized using a gas chromatograph equipped with mass spectroscopy (GC-MS), a gas chromatograph equipped with flame ionization detector (CG-FID), as well as by Folin-Ciocalteu and DPPH assays. It was shown that variation of the extraction pressure and temperature led to a significant variation in extraction yields (from 0.1 to 31.5%). Furthermore, the content of dominant essential fatty acid (linoleic acid) present in extracts ranged from 445 to 514mg/g. It was shown that the extract separated at 10 MPa and 40°C contained the highest amount of total phenolic compounds (138.0 mg GAE/g). The highest DPPH radical scavenging activity (IC_{50}~12.66 mg/mL) showed the extract obtained at 30MPa and 60°C. Obtained results gave valuable insights into the optimization of the SCE process for the production of solvent-free and biologically active extracts from milk thistle seeds.

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