SIMULTANEOUS EXTRACTION BY SUPERCRITICAL CO_2 AND COLD PRESSING

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Extraction with the supercritical fluid of raw-materials with high yields can result in long processes to achieve satisfactory bed exhaustion. In this context, supercritical extraction has been modified/merged with other technologies to improve extraction efficiency by increasing mass transfer rates. Two supercritical extraction modifications are available in the literature: Ultrasound-Assisted Supercritical CO_2 Extraction (UASCE) and Supercritical Fluid Extraction Assisted by Pressing (SFEAP). Both options are convenient for obtaining oily extracts rich in bioactive. Still, extraction by SFEAP is more convenient than extraction assisted by ultrasound due to its simplicity of implementation and operation. The SFEAP was developed because extraction via cold pressing presents disadvantages on an industrial scale. After all, the exhausted solid material still contains a significant amount of extractable analyte via solvent extraction. The extract obtained by pressing is less aromatic and presents major impurities due to the plant matrix's cellular breakdown. Considering the mechanical pressing (MP) process and the supercritical fluid (SFE) that require high pressures, either from the pressing piston or the extraction solvent, represent a factor that makes it challenging to combine these two methods in a single process. As it is common applied in two stages, first a pressing process and then the exhausted solid is used to perform an extraction with solvents, as is done in the SFEAP method. A movable piston was inserted into the extraction vessel in the one-step extraction process equipment developed, containing both unit operations MP and SFE. Supercritical CO_2 initially pressurized the upper piston end, causing the piston's displacement towards the end bottom, where it found the raw-material that the piston will compress. After the piston compresses the raw-material, another flow of supercritical CO_2 will be fed through the lower part of the extraction vessel to a predefined pressure. This pressure is lower than that of the upper end to obtain a pressure gradient between the piston's upper and lower parts. The piston was constructed in such a way as not to allow the solvent to pass between the two parts of the extraction vessel. The upper part was filled only with the solvent, and the lower part was filled with the mixture of raw-material and solvent extractor. The CO_2 feed flows at the bottom and the top without mixing. The upper feed stream gets out only with CO_2, and the lower stream gets out with a mixture of CO_2 and extract. The pressure at the top of the extractor was maintained using a Back-pressure valve. The upper part pressure was higher than in the lower part of the mobile piston; this allowed the pressing and extraction with supercritical solvent to be developed simultaneously, obtaining a faster and more efficient extraction process. The simultaneous extraction process (SFE + MP) allowed increasing the overall extraction yield obtained by SFE. A preliminary assay was carried out with 15 g of the dry pulp of the fruit of *Mauritia flexuosa*, and the extraction was carried out at 40 °C, 25 MPa at the top of the piston, and 15 MPa at the bottom of the piston where it found the raw-material. Under these conditions, a yield of approximately 30 g oil/100 g pulp was obtained, higher than that obtained by SFE (23 g oil/100 g pulp) for close extraction conditions (40 °C and 20 MPa). This preliminary result is promising, but it is necessary to study extraction under different pressure and temperature conditions, different raw materials, and the extracts' composition.

Keywords: Supercritical Fluid Extraction Assisted by Pressing, Supercritical CO_2, Cold pressing extraction.