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The influence of particle size on oil extraction yield: Kinetic study and assessment of physicochemical properties of cherry pit oil for biodiesel production

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Alternative feedstocks and agro-industrial by-products are low-cost resources for sustainable biodiesel production. Fruit processing generates millions of tons of by-products suitable for energy recovery. Fruit kernels are recognised as exceptional sources of high-quality oil; however, utilisation of the whole fruit pit and simplification of the extraction process can further improve biomass valorisation. The pits remaining after sour cherry processing (Oblačinska variety, *Prunus cerasus* L.), with an oil content of approximately 22% (wb), were used as a substrate for oil recovery using solvent extraction (hexane; S/L 1:10; 65 °C) and the Soxhlet method. Oil yield was examined using three particle size fractions: $d < 450$ µm, $d < 900$ µm and $d > 900$ µm. The obtained oils were analysed for fatty acid composition and key physicochemical properties.

The kinetics of oil extraction was studied under optimal conditions and the best mathematical model was selected to fit the data. The results showed that cherry pit particle size significantly affected oil yield. The highest yield was obtained with the fraction $d < 450$ µm using both, solvent and Soxhlet extraction. Particle sizes above 450 µm significantly reduced oil yield. The oil extraction kinetics was described by a first-order kinetic model, showing good agreement between predicted and experimental values, revealing that diffusion was the main limiting factor in the oil extraction. The obtained oils showed a high degree of unsaturated fatty acids, with oleic and linoleic acids being the dominant ones. Acid number, saponification and peroxide values demonstrated that the obtained oils are stable and suitable for biodiesel production.

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