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Application of Natural Deep Eutectic Solvents for the Extraction of Bioactive Compounds from Rapeseed Meal

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Rapeseed meal, an abundant by-product of the oil industry, is a promising source of natural antioxidant compounds. This study investigated ultrasound-assisted extraction using choline chloride-based deep eutectic solvents as a greener alternative to conventional organic solvents for recovering valuable bioactive constituents from rapeseed meal. Different solvent formulations were examined, and the choline chloride/urea system showed the greatest extraction effectiveness. To further improve the process, response surface methodology with a Box–Behnken design was used to evaluate the influence of extraction temperature, time, and solvent to DES ratio on extract quality. The recovered extracts were assessed for their overall antioxidant potential and total phenolic content. Under optimized conditions, the extraction process yielded extracts with strong antioxidant properties, and the experimental findings closely matched the model predictions. In comparison with conventional methanolic extraction, the deep eutectic solvent-based ultrasound approach proved to be both efficient and more environmentally sustainable for the recovery of antioxidant compounds from rapeseed meal. These results underline the potential of deep eutectic solvents as green extraction media for the valorization of oilseed processing by-products.