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Perspective

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Enhanced Propolis Extraction through Central Composite Design and Natural Deep Eutectic Solvents

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DESCRIPTION

Propolis, a resinous substance collected by bees from various plant sources, has gained considerable attention due to its potential health benefits and versatile applications in the food, pharmaceutical, and cosmetic industries. Extracting bioactive compounds from propolis efficiently and sustainably is crucial for maximizing its value. Natural Deep Eutectic Solvents (NADES) are emerging as eco-friendly alternatives to conventional organic solvents for the extraction of bioactive compounds. NADES are mixtures of two or more natural compounds that form a eutectic system with a lower melting point than any of the individual components. They are considered green solvents due to their natural origin, biodegradability, and low toxicity.

NADES have shown great potential in extracting bioactive compounds from various natural sources, including propolis. Common components of NADES include organic acids, amino acids, and sugars. The extraction of bioactive compounds from propolis typically involves dissolving it in a solvent, followed by filtration and concentration. NADES offer an attractive alternative to traditional organic solvents due to their environmental and health benefits. To optimize the extraction process, we employ Central Composite Design (CCD), a statistical method that efficiently explores the influence of multiple variables on the extraction yield. CCD is a Response Surface Methodology (RSM) that combines both factorial and axial points to design experiments for optimization. It allows for the evaluation of multiple variables and their interactions while minimizing the number of experiments required. CCD comprises three key components: the factorial design, the axial design, and the center point design.

The key parameters for propolis extraction using NADES include NADES composition, extraction temperature, extraction time, and the solid-to-liquid ratio. These factors are selected as independent variables for the CCD. A CCD is created with a predetermined number of experimental runs based on the selected factors. The design includes factorial points at high and low levels of each variable, axial points at intermediate levels, and center points for replicates. This design ensures a comprehensive exploration of the parameter space. Propolis samples are subjected to extraction under different combinations of the selected variables, as per the CCD design matrix.

The extraction yield, representing the amount of bioactive compounds extracted from propolis, is recorded as the response variable. The data obtained from the CCD experiments are used to construct a response surface model. This mathematical model describes the relationship between the independent variables and the response (extraction yield). The model allows for the prediction of optimal extraction conditions. The response surface model is utilized to identify the optimal conditions for propolis extraction using NADES. The optimization aims to maximize the extraction yield while minimizing resource consumption and process time. CCD enables the simultaneous investigation of multiple extraction parameters and their interactions in a systematic and efficient manner. By determining the optimal conditions, CCD helps reduce the consumption of propolis and NADES, contributing to sustainability. Optimized conditions often result in higher extraction yields and the preservation of bioactive compounds, enhancing the quality of the extracted propolis.

The optimization of propolis extraction using Natural Deep Eutectic Solvents (NADES) through Central Composite Design (CCD) represents an effective and sustainable approach to maximize the yield of bioactive compounds from this valuable natural resource. NADES, as green solvents, offer environmental and health benefits, while CCD provides a statistically robust method for exploring the complex interactions of extraction parameters. The resulting response surface model guides the selection of optimal conditions, ensuring efficient resource utilization and improved product quality. This approach has the potential to enhance the utilization of propolis in various industries, promoting sustainability and eco-friendliness in the extraction process.