# Refining of plant proteins from food processing side streams using Natural Deep Eutectic Solvents

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**Objective**
The objective of this study was to extract off-taste and off-flavor components of plant proteins using a novel class of food grade solvents, Natural Deep Eutectic Solvents (NADES) instead of standard aqueous extraction for plant protein refining. This study was conducted to identify processing windows for protein refining from food processing side streams, pea protein concentrate (PPC) and rapeseed press cake (RPC).
**Methods**
NADES consist of food grade chemicals, a ternary amine (e.g., choline chloride, betaine, betaine chloride) as hydrogen bond acceptor (HBA) and a polyol (e.g., 1,2-propanediol, glycerin, urea, DL-lactic acid, and ethanol) as hydrogen bond donor (HBD). In this study, processing windows were defined based on a minimal solubilization of protein and maximization of the solubility of polyphenols using a custom factorial design approach. In addition, physico-chemical properties which are most relevant for the extraction efficiency (viscosity, water activity, pH, density, refractive index, surface tension, dielectric properties) of selected NADES were determined. A Folin Ciocâlteu test kit was used to determine the amount of extracted total polyphenols and a BCA assay was used to determine soluble protein.
**Results**
The stoichiometric HBA:HDB ratio of and the water content significantly ($p < 0.05$) affected all NADES physicochemical properties regardless of NADES temperature. In turn, NADES physico-chemical properties significantly ($p < 0.05$) affected the extraction efficiency of polyphenols and phytochemicals from PPC and RPC. The custom factorial design revealed that optimal solubilization of phytochemicals while minimizing the solubilization of proteins was achieved at low water content of NADES in the range of 5-10%. A correlation of NADES composition and physico-chemical properties and the results for the solubilization of proteins and polyphenols in NADES could be established.
**Conclusions**
This study explored the differential solubility of proteins and phytochemicals in NADES. Further aqueous extraction of proteins and recycling of NADES after NADES refining needs to be explored. A circular process needs to be established to use this ‘green chemistry’ approach to yield functional, plain tasting, and colorless plant protein that can be applied in a broad range of foods and a substitute for animal protein.