



# GreenChem-26

## ABSTRACTS E-BOOK

**7<sup>th</sup>** International Conference on  
**Green Chemistry and  
Sustainable Engineering**

 Gran Canaria,  
Canary Islands, Spain

 22–24 July 2026



Organized by



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## Characterization and in vitro bioaccessibility of rapeseed protein isolates: a comparison of alkaline and DES extraction

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**1. Introduction** – The global shift towards sustainable protein sources has intensified interest in valorising edible oil by products as food grade ingredients. Rapeseed proteins are nutritionally attractive due to their well-balanced essential amino acid (EAA) profile [1]. Conventional alkaline extraction (pH 9–12) offers high recovery, yet it may promote cruciferin denaturation, napin losses, and colour deterioration driven by phenolic oxidation [2]. Green alternatives, such as deep eutectic solvents (DES), have emerged as promising media due to their low toxicity and the ease with which their properties can be tailored through chemical composition [3]. The main aim of this study was to compare the nutritional quality and in vitro digestibility of rapeseed protein isolates obtained by conventional alkaline extraction (AE-12) and by a choline chloride:urea DES system (DES-ChCl:U).

**2. Experimental** - Protein isolates were obtained from defatted rapeseed cake by alkaline extraction at pH 12 (AE-12) and with choline chloride:urea DES (1:2, 10% water; pH 7.60 at 60 °C). Amino acid composition was determined by ion-exchange chromatography, while in vitro digestibility and molecular-weight distribution before and after digestion were evaluated using the INFOGEST protocol and lab-on-a-chip capillary electrophoresis, respectively.

**3. Results and Discussion** - The nutritional value of the obtained isolates was assessed through analysis of their amino acid (AA) composition and their susceptibility to enzymatic hydrolysis. A particularly notable finding was the high content of sulfur-containing amino acids (methionine and cystine) in the DES1 isolate, exceeding 3%, which fully meets the FAO/WHO nutritional requirements for adults [2]. Among the essential amino acids (EAA), leucine was highest in DES-ChCl:U (6.39 g/100 g), whereas lysine reached its maximum in AE-12 (5.09 g/100 g).

This high proportion of essential amino acids, with an EAA/NEAA ratio of 0.59, makes the isolate nutritionally superior to many other plant sources, such as legumes [1]. The high nutritional potential was further confirmed by in vitro digestion performed according to the INFOGEST protocol. Although both isolates showed high digestibility, DES-ChCl:U exhibited a distinct digestion profile, indicating a more extensive conversion of proteins into smaller, absorbable components. By the end of the intestinal phase, the proportion of fractions below 10 kDa in the DES-ChCl:U isolate reached 89.77%, suggesting an almost complete conversion of proteins into bioavailable peptides and free amino acids. This digestion efficiency is directly linked to the excellent solubility of the DES-ChCl:U isolate across a wide pH range (gastric and intestinal conditions), enabling proteolytic enzymes to access peptide bonds more readily. In contrast to the AE-12 isolate, which shows signs of structural fragmentation due to extreme pH, the DES-ChCl:U system preserves more native cruciferin oligomers (145 kDa) prior to digestion, which are then efficiently broken down during digestion. Overall, these findings confirm that the use of choline based DES systems not only preserves the nutritional integrity of rapeseed proteins but also ensures their maximal utilization in the body.

**4. Conclusions** - The DES-ChCl:U system represents a sustainable and efficient alternative to alkaline extraction. Although it offers a lower yield, the resulting isolate is of superior purity and nutritional quality, with a well-balanced amino acid profile and excellent digestibility. These characteristics make DES-ChCl:U extracted rapeseed proteins highly suitable for the development of functional food products.

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