Innovative processes for the extraction of rapeseed proteins

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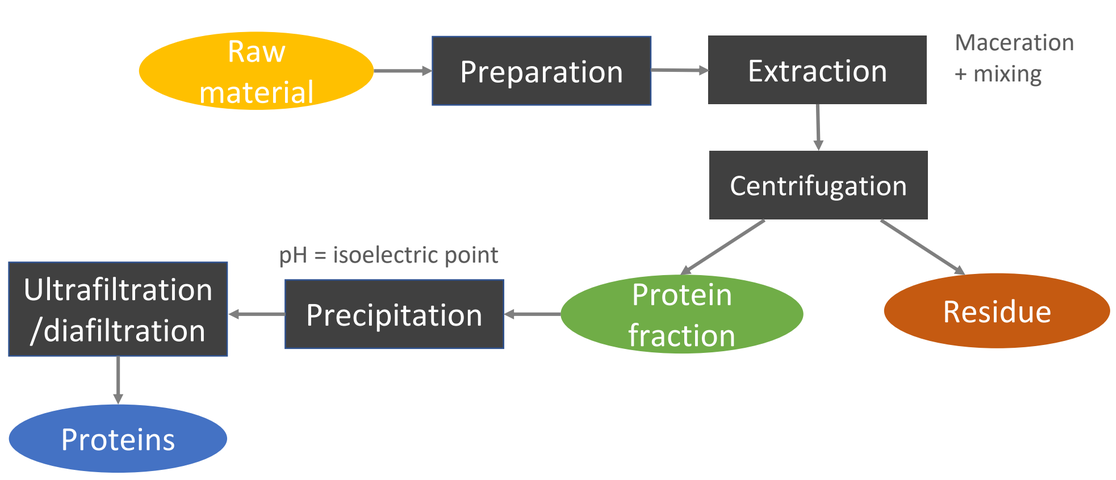
Introduction

Considering global population growth driven by emerging countries and consequently the increase in the nutritional needs of populations, the valorization of the protein fraction of plant resources, particularly proteins from oleaginous seeds like rapeseed, appears to be a major challenge in meeting this demand. The valorization of these proteins uses traditional extraction processes and, increasingly, innovative techniques to preserve the nutritional and functional quality of proteins. Methods of intensification and extraction with alternative solvents are examples of techniques that are likely to develop and which can be considered for the extraction of proteins from rapeseed.

Raw Material

Conventional extraction (production of isolates)

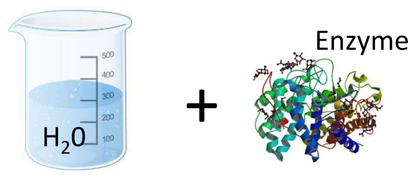


Example	Rapeseed meal
Solvent	Water, Ethanol, Na_2SO_4(0.4%), NaCl (0.1 M)
Temp.	25°C
Time	60 min
ratio S/L	1:5
Yield	30%

Chabanon G, Chevalot I, Framboisier X, et al (2007) Hydrolysis of rapeseed protein isolates: Kinetics, characterization and functional properties of hydrolysates. Process Biochemistry 42:1419–1428.

Intensified extractions

➢ Enzyme assisted extraction



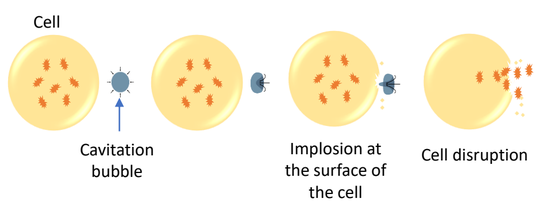
Example	Rapeseed
Enzyme	Alcalase 2.4L
Temp.	60°C
Time	180 min
S/L ratio	1:5
pH	10
Yield	83.3 %

Wang Z. *Journal of The American Oil Chemists Society* **84**:97–105 (2007).

\+ Targeted action, precise conditions

\- Enzyme costs and retreatment

➢ Ultrasound (US) assisted extraction



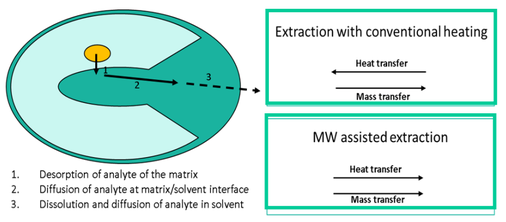
Example	Rapeseed meal
Device	US Bath
P	450 W
Temp.	35°C
Time	84min
S/L ratio	1:24
pH	8.5
Yield	71.3 %

Dong X.-Y., Guo L.-L., Wei F., *et al J Sci Food Agric* **91**:1488–1498 (2011).

\+ Destruction of cell walls, improving mass transfers

\- Possible degradation of equipments and extracts

➢ Microwave assisted extraction



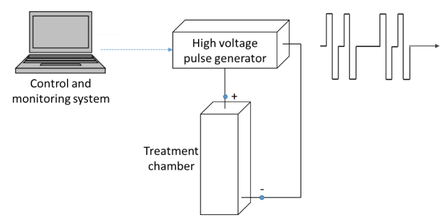
Example	Rapeseed
Solvent	H_2O + NaOH
Temp.	35°C
P	73 W
Time	8 min
S/L ratio	1:28
pH	11.5
Yield	38.8 %

Choi, I., Choi, S. J., Chun, J. K. & Moon, T. W *J. Food Process. Preserv.* **30**, 407-419 (2006).

\+ Destruction of cell walls, improving mass transfers

\- Heating homogeneity, hot spots

➢ Extraction with pulsed electric fields



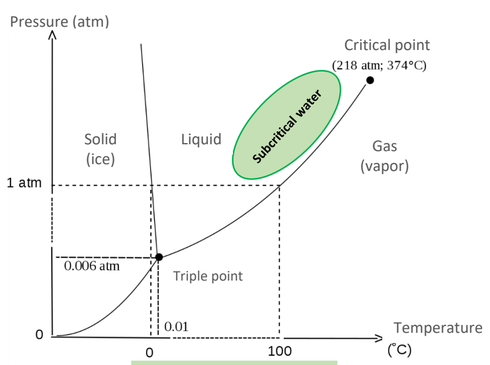
Example	Rapeseed
E	8 kV/cm
Temp.	20°C
Time	2 ms
S/L ratio	1:2
Yield	64.1 %

Yu X., Gouyo T., Grimi N., *et al. Bioresour Technol* 199:194–201 (2016).

\+ Electroporation of cell walls, improving mass transfers

\- Difficult ease of operation

Extraction with subcritical water



Example	Rapeseed cake
Pressure	30 bar
Temp.	215°C
Time	36 min
S/L ratio	1:5
Yield	48.9 %

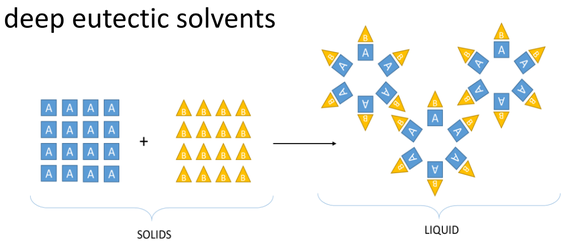
Pińkowska H., Wolak P., Oliveros E. *Biomass and Bioenergy* **64**:50–61 (2014)

\+ Mass transfer improved

\- Hydrolysis or Maillard reaction

To be developped…

➢ Extraction with deep eutectic solvents



Deep eutectic solvents (DESs) are known as a new class of promising ionic solvents with a broad range of potential applications. DESs are systems characterized by their ability to form an eutectic mixture, meaning that their melting point is much lower than those of the individual components. They are generally regarded as "green" because they are composed of ammonium salts and H-bond donors (HBDs) which are considered to be eco-friendly. DESs have already been used for the extraction of proteins (bovine serum albumin, trypsin) with an aqueous two-phase system. However, it can also be extrapolated to the extraction of rapeseed proteins.

Conclusion

Innovative and intensification techniques provide promising solutions for preserving the quality and functionality of proteins as well as for reducing the environmental impacts of extraction processes.

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