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Sustainable Development of Cross-Linked Films from Rapeseed Meal

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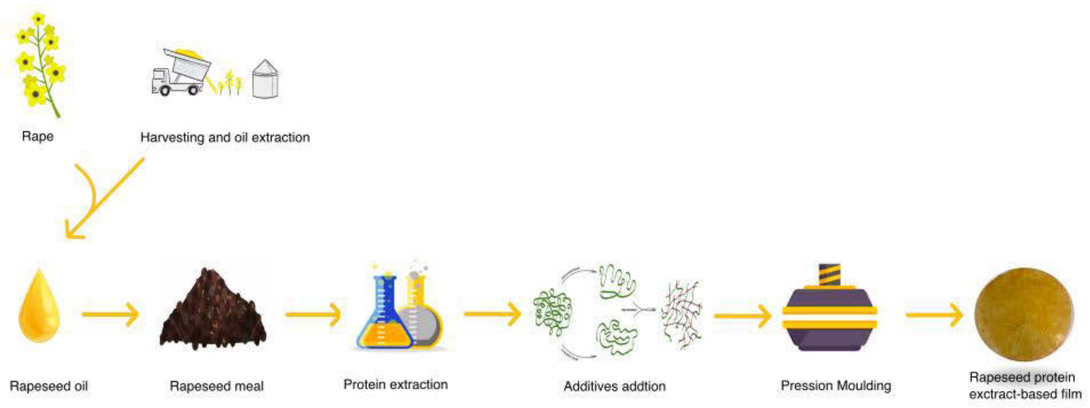
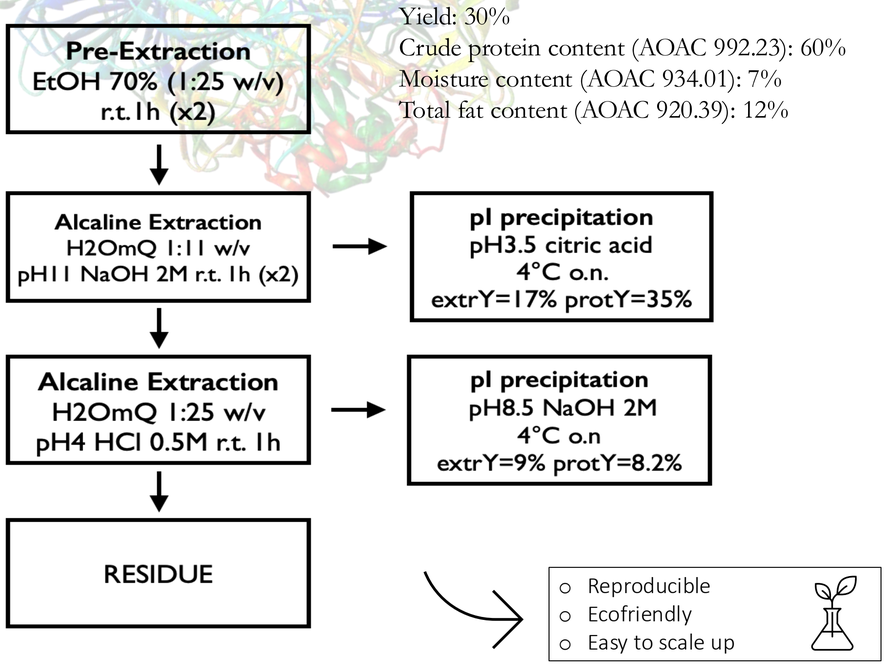
The availability of proteins from agricultural by-products and their favourable properties fostered a renewed interest in protein-based materials, fuelling research on innovative technologies for the preparation of bioplastics.[1] Proteins from rapeseed meal have been chosen as first candidates for our bio-plastics main ingredient due their low cost and biodegradability.[2] Herein, we present our preliminary results toward the development of biocompatible and renewable protein-based film.



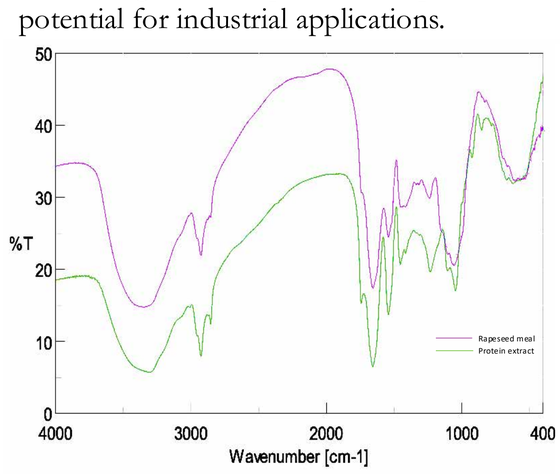
A novel protein extraction method was set up, yielding a protein-enriched extract with high efficiency, showing its potential for industrial application. Utilizing this protein extract, films were fabricated through pression moulding. Blends incorporating the protein extract, glycerol, cross-linker, and protein-based compatibilizer (RM) were formulated. The addition of sodium sulfite (Na_2SO_3) and different denaturants (SDS, urea, guanidine) aimed to induce protein denaturation during thermal processing. Enzymatic proteolysis of the protein-enriched extract with selected proteases lead to hydrolysates that will be employed as additives in the rapeseed protein-based film.

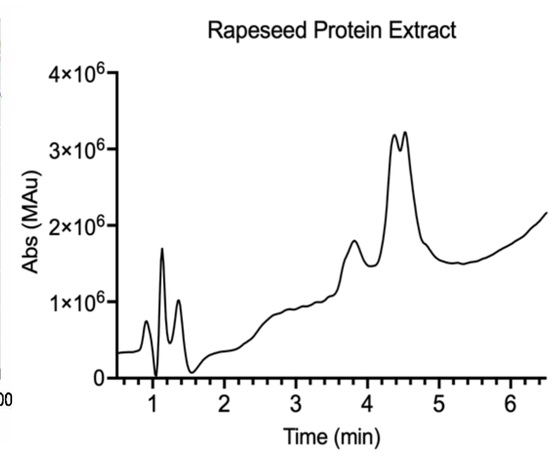
RAPESEED PROTEIN EXTRACTION AND CHARACTERIZATION

The main rapeseed protein component is cruciferin, representing about 60% of the total protein content. Cruciferin is a globular protein with a molecular mass of 300-360 kDa.[3]

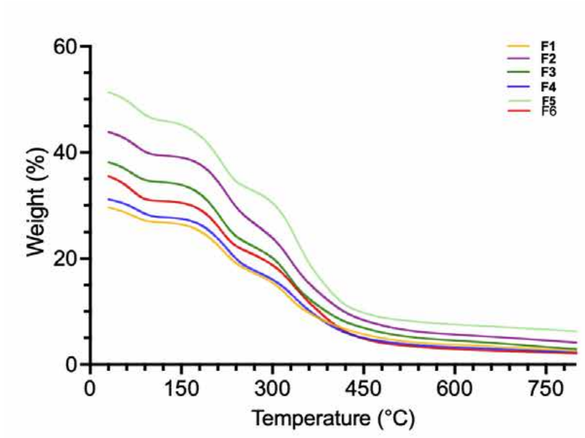


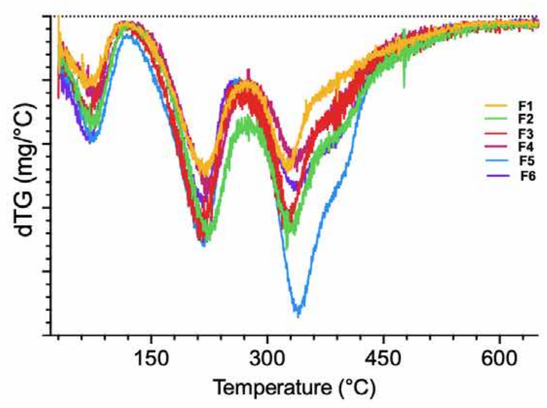
A protein-rich extract was obtained as shown by the IR spectra and RP-HPLC chromatogram. The process is reproducible, scalable, and eco-friendly, demonstrating its potential for industrial applications.

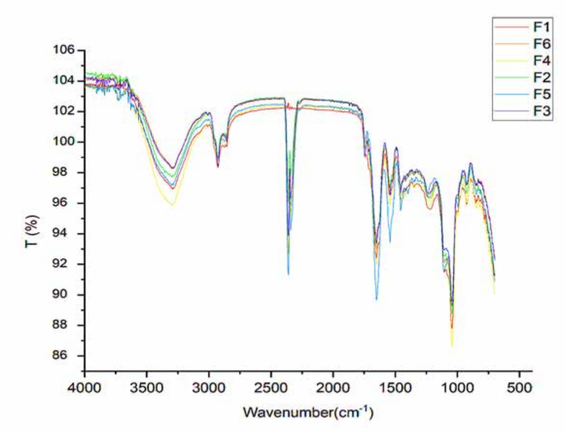




PRELIMINARY STUDIES

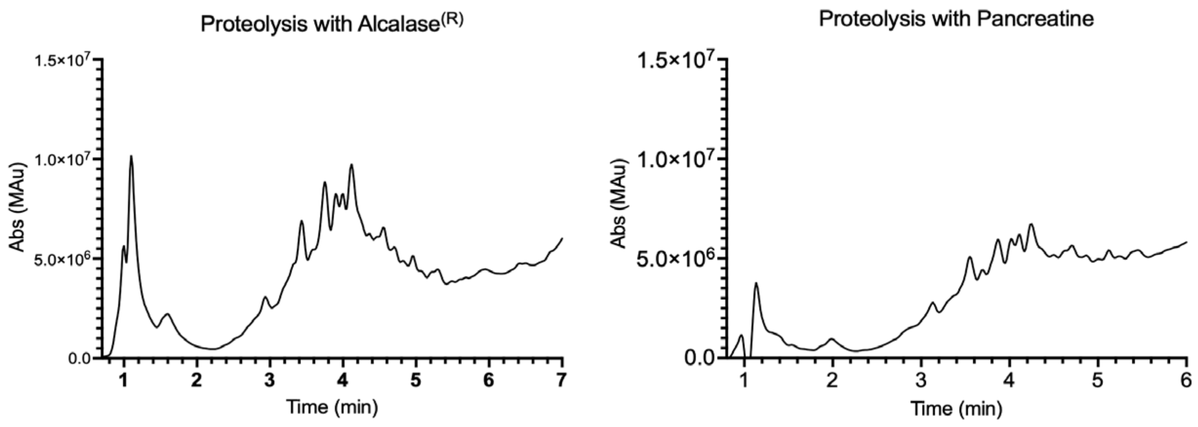






Change in shape in the range of 1600-1625 cm^{-1} were observed in the IR spectrum due to changes in the secondary structure of the protein. TGA indicates an enhanced thermal stability for the material containing both the reducing and the denaturing agent (*F6*).

ENZYMATIC PROTEOLYSIS



Formation of hydrophilic peptides has been showed by RP-HPLC.

CONCLUSIONS AND FUTURE PROSPECTIVES

Rapeseed protein extract has a high potential for its use in the production of sustainable films. First studies on the thermal stability and on the protein structural changes have been done, showing an enhanced thermal stability when both reducing and the denaturing agents (*F6*) are used. The study is certainly innovative and informative but the mechanical properties not industrially competitive. However, our study suggests a promising pathway to develop a protein-rich material for industrial application.

The conditions for proteolysis have been optimized, and ongoing tests are being conducted to assess their impact on the rapeseed protein-based film properties. Purification and characterization of the most promising peptides will be performed in order to understand the relationship between the peptide structures and their influence on the features of the film.

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2. DeFrates, K. G. et al. Nanomaterials 2018, 8 (7), 457.
3. Newson, W. R. Industrial Oil Crops 2012, 59.

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