Flax and Hemp Advanced Fibre Based Composites

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BACKGROUND

Together, the distribution sector (wholesale and retail), the food and drink industry (processing and manufacturing) and the agricultural sector are the driving forces of the food supply chain and important economic sectors. Development of a competitive and sustainable agriculture will not be possible without providing the tools to valorize its products through novel products and techniques.

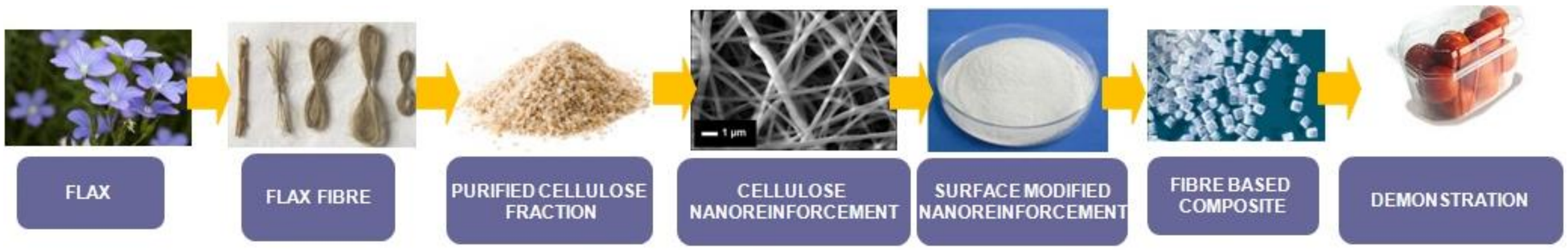
Nowadays, ecological concern has resulted in a renewed interest in materials derived from renewable resources, like natural fibres. Although the demand for natural fibres is growing worldwide and its price is increasing, annual plants such as jute, sisal, kenaf, flax or hemp require further development to provide novel products with improved properties.

Packaging industry has a huge interest in reducing packaging materials and associated wastes, and biodegradable materials have been evaluated for this application. However, the use of biodegradable films for food packaging has been strongly limited because of lower barrier properties and mechanical properties shown by natural polymers, among other factors such as availability and price. A possible strategy to increase its properties is the development of fibre based biocomposites.

OBJECTIVE

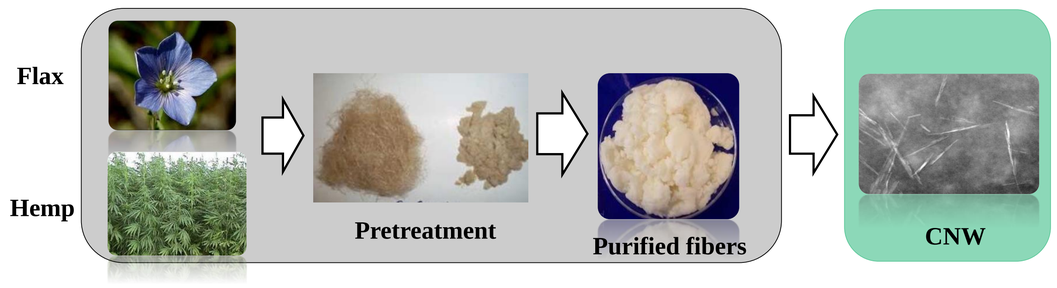
FLHEA project focuses on the chemical modification and upscaling of micro and nanoreinforcements based in hemp and flax, and its subsequent processing to obtain new biodegradable composites with improved properties.

This scope will assure the development of a biodegradable fibre-based composites ready for its application on packaging industry. FLHEA industrial process is being evaluated to provide a high-throughput, environmental, energetic and cost efficient process.



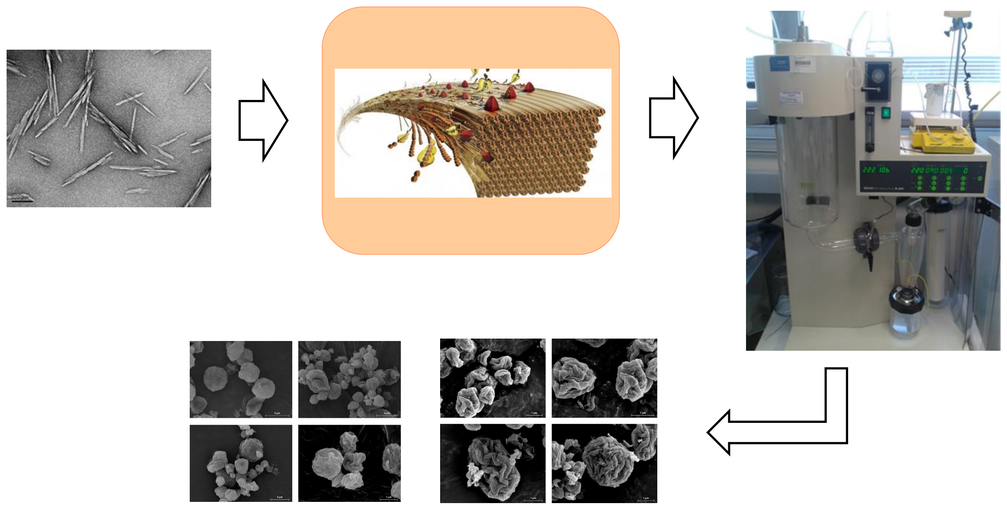
CELLULOSE ISOLATION AND NANOWHISKERS PRODUCTION

- **Fibre pretreatment**: Prior to delignification raw materials were subjected to retting, the initial process of decomposition of the chemical bonds between the fibre and surrounding tissues, thus allowing the bast and hurd to separate with minimal damage.
- **Cellulose isolation**: Removal of non cellulosic fractions were based on the application of conventional pulping methods (alkali treatments), optimizing NaOH concentration, temperature and soaking duration.
- **Cellulose pulp evaluation**: Cellulose fractions were evaluated once separated to establish the cellulosic content and presence of any impurities. Fibre dimensions and morphology were evaluated as well, based on optical microscopy.
- **Cellulose nanowhiskers (CNW) production**: CNW were produced from purified cellulose fibers by acid hydrolysis. The suspensions of nanowhiskers were characterized, determining the average size of nanowhiskers

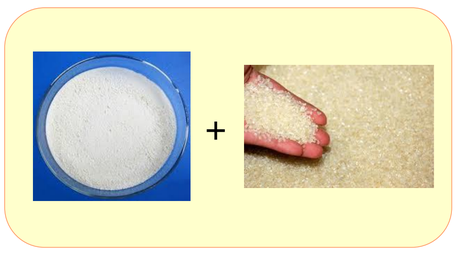


CELLULOSE NANOFIBRE MODIFICATION

- CNW were chemically modified to improve their compatibility with the biopolymer in order to ensure homogeneous dispersion within the matrix.
- Different chemical modifiers were evaluated and the functionalization was studied by spectroscopic techniques.
- Modified-CNW suspensions were dried by spray drying to get a fine and homogeneous powder.



FIBRE COMPOSITE PROCESSING



- Dry modified-CNW were incorporated into the biopolymer by a miniextrusion equipment.
- Different processing parameters such as screw geometry, speed, residence time, temperature profile and CNW loading were studied.
- Mechanical, thermal and barrier properties of CNW composites were evaluated at lab scale.

UPSCALING AND PACKAGING VALIDATION

- Optimized processing parameters and structures will be taken into account for the upscaling of CNW composites to produce extruded films.
- Thermoforming parameters will be optimized: different temperatures, drawing depths and tray sizes will be evaluated at industrial scale.
- Final packaging properties (thermal, mechanical and barrier) including preliminary biodegradability tests will be studied.
- Food safety assessment will be based upon Commission Regulation (EU) Nº 10/2011 on plastic materials and articles intended to come into contact with food.

CONSORTIUM

ACKNOWLEDGEMENTS

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