EU circular economy project for leather

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In 2015, the European Commission released its Communication "Closing-the-loop - An EU action plan for the Circular Economy"[1], establishing an ambitious package with the aim of encouraging both European businesses and consumers to make more sustainable use of resources by implementing a circular economy model. Among other measures, this model promotes the re-use of wastes by turning by-products into secondary raw materials, which is expected to also stimulate industrial symbiosis.

During the implementation of this circular economy, one of the industrial sectors which the project focussed on was the tanning industry. Even though this sector is considered to play an important environmental role because it reuses the by-products of the meat industry, processes carried out at the different stages require high amounts of chemicals and natural resources. For this reason, the European tanning sector needs to implement new, greener strategies and solutions to provide a cleaner, more sustainable and more competitive industry.

Also, the meat and fish industries annually produce high amounts of animal by-products (ABPs) that must be managed in compliance with European Regulation (EC) No 1069/2009.

Collaborative project in the leather sector

Since September 2017, chemical company Trumpler Española and the Spanish Footwear and Leather Technological Centre Inescop, along with the meat industry EL Horreo Healthy Food and the ABP-rendering company Pural, have been involved in the development of the byProtVal project, a multisectoral initiative that promotes this Circular Economy model, and which is being funded by the European Union LIFE Programme.

Over three years, this consortium will work on the recovery of protein derivatives from greases generated at ABPs rendering companies and from meat processing wastewater, as well as in their further valorisation as raw materials for the production of chemicals. Besides, in order to approach to the objective "zero waste" in the European Union, remaining non-recovered by-products will be fed to a biogas plant that is available at Pural's premises for the production of renewable energy.

Animal by-products in Europe

According to the European Fats Processing and Renderers Association (EFPRA), 328 million farm animals (mainly cattle,

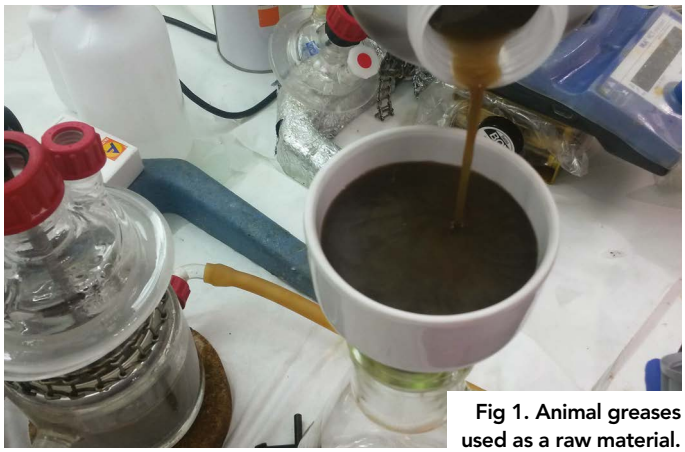

Fig 1. Animal greases used as a raw material.

Fig 2. Enzymatic process at a laboratory scale for the recovery of protein derivatives.

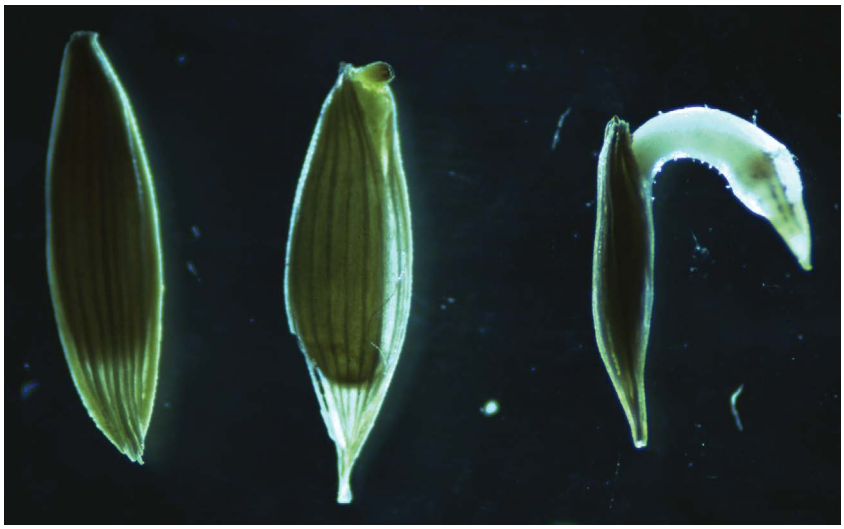

Fig 3. Germination stages of seeds of lettuce (Lactuca sativa). From left to right: Hydrated seed, Radicle emergence and Radicle growth.

sheep, goat) and six billion poultry birds are slaughtered in the EU each year, generating a large volume of Category 3 (low risk) animal by-products and derived products not intended for human consumption (ABPs). Besides this, a large quantity of fallen stock is collected annually from farms, which if not carrying infectious diseases, can account for almost 2.5 million tonnes of Category 2 ABPs. In total, 17 million tonnes of ABPs are yearly processed, producing more than 3.5 million tonnes of animal protein and generating wastewater with high protein content[2]. Another source for wastewater with high protein content is also the meat processing industry itself.

Current ABP regulations allow different applications for these by-products, depending on their risk category. However, in practice, Category 2 products are mostly used for energy production (which is the last resort recommended by the EU's Circular Economy strategy) or are disposed of in authorised landfills, while Category 3 products are mainly intended for the manufacturing of animal feed.

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Turning waste into raw materials

Conversely, the LIFE byProtVal project proposes the use of these by-products as secondary raw materials for the production of two higher added value products: retanning agents and amino acid-based fertilisers or biostimulants.

As a result of the development of this project, a demonstration plant will be constructed and set-up, with an expected capacity to recover 100 tonnes protein derivatives per year.

To date, technicians from Inescop have been working in close cooperation with their project partners in order to establish best procedures at a laboratory scale for the recovery of protein derivatives.

An enzymatic process has been proposed; such a process having proved to be suitable for the treatment of non-tanned hides and skins[3, 4] and of processed animal proteins (PAPs)[5]. Processing conditions are being adapted having in mind particularities of the new raw materials, as well as the intended use of the product.

The type of ABP (provided by Pural and El Horreo), the defatting process, type, concentration and mixtures of enzymes (provided by Trumpler), processing time, temperature and use of a preservative are some of the parameters that have been analysed in order to achieve the desired properties. Raw materials and products have been characterised in terms of their amino-acid profile, hydrolysis degree, free amino-acids content and stability during storage, among others.

Work performed so far at a laboratory scale has allowed the recovery of up to 85% of protein. Besides, different hydrolysis degrees have been obtained, depending on the enzymes used. Last but not least, the use of preservatives allows the product being stored at room temperature for at least 60 days.

Biobased products for the tanning industry

During the process of transforming animal skins into leather, a tanning process takes place where collagen fibres are stabilised. In general, and mainly in the case of mineral or chrome-tanned leathers, a retanning process may be necessary in order to improve leather properties such as touch, embossability and resistance-to-break, as well as to provide a tight and uniform grain surface for leather finishing. Several retanning agents are commonly used, including vegetable tannins and syntans, acrylic polymers, resins, chrome salts and proteins, among others.

Previous studies made by Inescop on the use of collagen hydrolysates recovered from PAPs as retanning agent proved that they improved the mechanical properties of the leather. In addition, these biopolymers showed a good compatibility with other chemicals used in the retanning process, such as dyes, dispersants, acids and fatliquors. [5]

Over the coming months, Trumpler Española will be in charge of validating the suitability of the protein derivatives that are produced within the LIFE byProtVal project for their use as chemicals for the tanning industry and as a source of amino acid and peptide-based fertilisers.

Acknowledgements

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