Towards a bio-circular economy: high added value protein recovery and recycling from animal processing by-products

H. Pérez-Aguilar, F. Arán-Ais

INESCOP. Centre of innovation and technology, Elda, Alicante, 03600, Spain
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Presenting author email: aran@inescop.es

Abstract

The use of animal by-products (ABPs) is undoubtedly an immense contribution towards a **bio-circular economy** where these biological resources and their waste streams might be recovered into value-added products due to their abundance of protein and fat, carbohydrate, minerals, vitamins as well as other nutrients.

According to the European Fats Processors and Renderers Association (EFPRA), EU slaughterhouses generate each year a large volume of Category 3 (low risk) animal by-products and derived products not intended for human consumption (ABPs). Besides, a large quantity of fallen stock is annually collected from farms, which if not carrying infectious diseases, can account for almost 2.5 million tonnes of Category 2 ABPs, main objective of **LIFE byProtVal project**. 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[1]. Another source for wastewater with high protein content is the meat processing industry, also addressed by the project.

Such ABPs must be conveniently managed in compliance with European Regulation (EC) No 1069/2009 (ABPR), which allows different applications for these by-products, depending on their risk category. In practice, Category 2 products are mainly derived to energy recovery (last route recommended by the EU's Circular Economy strategy) or disposed of in authorised landfills, while Category 3 products are mainly intended for animal feed.

Nowadays, the recovery of proteins and fats from animal by-products wastes using green emerging approaches is a hot trend and clearly the best alternative to ensure their sustainable production and make these ingredients more popular, although still full of challenging aspects.

LIFE byProtVal project proposes the use of ABPs as secondary raw material for the production of higher added value products, mainly biobased chemicals and amino acid-based fertilizers or biostimulants. The recovery and quality of water, and recovery of proteins that would otherwise turn into sludge waste, are also key issues dealt by LIFE byProtVal project.

In this sense, animal protein hydrolysates as plant biostimulants have currently attracted much interest at European level due to their potential application in sustainable agriculture. They represent an environmentally friendly way to promote plant growth and enhance crop productivity, while reducing the dependency on chemical and/or inorganic fertilizers.

Developing biostimulants from animal processing by-products paves the path to waste recycling and reduction, generating benefits for the rendering industry. Therefore it could mean a new market-niche for this kind of animal by-products, mainly for Category 2 ones whose current use is limited to solid and liquid biofuels.

Generally, protein hydrolysates of animal origin are chemically hydrolyzed by acids and alkalis which increases their salinity[3]. Considered to be more sustainable, LIFE byProtVal proposes an enzymatic process as methological solution that has proven to be suitable for the treatment of non-tanned hides[4,5] and processed animal proteins (PAPs)[6].

As raw material, greaves mainly constituted by previously deffated pig carcasses has been used. Processing conditions have been adapted to the new raw materials and products intended use. The developed process has proved to allow the recovery up to 85% protein present in the treated animal by-products and it has shown itself to be a versatile process easily customisable to different kinds of ABPs.

As a result, a mixture of amino acids and peptides of different lengths with low salinity is obtained depending on the hydrolysis process extension.

They have been characterised in order to assess their compliance with related legislation, in terms of heavy metals content, amino acids profile, chemical properties, etc., as well as the influence of enzymatic process parameters on those properties according to the intended applications.

To conclude, the production of biostimulants from animal by-products by means of enzymatic hydrolysis has proven to be a more resource-efficient process than conventional ones based on chemical hydrolysis. It contributes to energy and water (96% aprox) reduction and minimise wastewater streams, as well as a 35% reduction in CO_2 emissions into the atmosphere.

Finally, LIFE byProtVal philosophy is in line with EU policies on biocircular economy, since it intends to make waste become into raw material for the manufacture of added value products. Besides, the substitution of mineral fertilisers by the organic fertilising products produced in the project will mean a reduction of nitrogen leaching to groundwater and GHG emissions due to agricultural activities. Thus, it will support the implementation of EU policies on organic farming, as well as future Common Agricultural and other policies derived from the European Green Deal. Also, the use of peptides recovered in the project as biobased functional chemicals in the tanning industry will support EU policies regarding sustainable and circular fashion.

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