

Groundbreaking advances in sustainable protein production by the ALEHOOP project

Over the past four years, the ALEHOOP project has come to an end making significant strides in the field of sustainable protein innovation. ALEHOOP (Biorefineries for the valorization of macroalgal residual biomass and legume processing by-products) **aims to revolutionize the production of low-cost alternative proteins for high-value food and feed applications**. This initiative addresses the growing market demand for sustainable protein solutions while reducing Europe's reliance on traditional plant-based proteins like soy.

Significant progress has been made in developing processes for extracting and purifying proteins and polysaccharides from macroalgae and legumes. One of the key achievements includes the **development of a prototype for removing mineral contaminants from green seaweeds and scaling up the process for extracting proteins and polysaccharides**. Additionally, **a lab-scale legume protein extraction process has been successfully translated to pilot scale**, incorporating feedback from end-users to adapt the process and include a debittering step for lupin protein extracts.

Development of a protein extraction protocol at lab scale for legume by-products has resulted in high protein content extracts (>80%) with improved solubility via enzymatic hydrolysis. Required standards for biorefineries processing legume by-products and algae residues have been compiled, ensuring compliance with industry standards and developing an inventory of relevant EU food safety regulations.

Advancements have been made in product development and consumer acceptance. Capabilities in evaluating alternative proteins have been expanded, and the smoothfood product concept has been enhanced to include high-caloric products. New product concepts have been positively received by consumers.

A promising lupin protein isolate with suitable techno-functional and sensorial properties for various savory food applications has been developed. Seaweed powder has shown potential as a nutritional fortification and spicing ingredient. Comparative testing of protein structuring technologies led to the development of eight meat analogue applications, achieving a technology readiness level (TRL) of 5-6. Initial consumer tests indicated high acceptance for these plant-based products.

Research highlighted the nutritional profiles of various legume protein concentrates, achieving protein concentrations above 70% with favorable amino acid profiles. Lupin protein concentrate stood out with the lowest levels of anti-nutrients and high nutritional value. In vivo assays with lupin and lentil protein concentrates showed promising results, including lower final body weight in rats while maintaining lean, fat, and mass distribution.

Extensive safety and toxicological testing validated the safety of protein extracts derived from legume by-products and algae for food and feed applications. These evaluations confirmed ALEHOOP proteins as safe and sustainable alternatives for the food industry.

A sustainability analysis using the Life Cycle Assessment (LCA) methodology ensures the environmental, economic, and social sustainability of production processes. Efforts have transitioned from lab-scale analysis to designing industrial-scale production processes to maintain sustainability. Additionally, regulatory standards are being met to ensure all protein samples are safe and free from contaminants, paving the way for market introduction.

Research into animal feed applications has shown promising results. The effects of including *Ulva* macroalgae concentrates in feeds for gilthead sea bream were assessed. Findings indicated no significant differences in



growth performance between experimental and control groups, suggesting metabolic and antioxidant benefits without compromising growth performance.

About ALEHOOP

ALEHOOP is an EU-funded project, which started in June 2020, and which counts on a consortium of 16 partners from 6 different countries: Spain, Germany, Belgium, Norway, Ireland and Czechia. It is an Innovation Action that **received funding from the BBI-JU**. The project will last until February 2025.

About **BBI-JU**: the Bio-Based Industries Joint Undertaking (BBI-JU), now known as **Circular Bio-Based Europe Joint Undertaking (CBE-JU)**, is a **partnership between the European Union and the Bio-Based Industries Consortium (BIC)** to fund projects advancing competitive circular bio-based industries in Europe.

For more information:

ALEHOOP Coordination team: alehoop@contactica.es