Disclaimer:

This deliverable has been submitted to the European Commission and is currently under review. The final version after the approval may differ.

Title of the practice abstract

PROTEIN4IMPACT

New sources of proteins for a changing World

Developing viable protein alternatives from non-conventional sources including agro-industrial waste, fungi, insects, and algae to reduce environmental impact while ensuring nutritional quality and economic feasibility.

Summary for practitioners on the main finding(s)/innovative solution(s)

Objective(s): With global protein demand expected to nearly double by 2050, there is an increasing demand for viable alternatives that maintain nutritional quality while reducing greenhouse gas emissions, water consumption, and waste production. The PROTEIN4IMPACT project will develop new protein sources from agro-industrial by-products, assuring viability in relation to sustainability, industrial production, and societal impact.

Results: The project develops innovative protein extraction and purification processes from agro-industrial by products, that would otherwise be waste, using two approaches: 1) developing processes for protein extraction from agro-food and fishing industries, and 2) producing proteins from the by-products using fungi, insects, micro-algae, and macro-algae. Advanced physico-chemical, biochemical, and biotransformation processes are used to extract and improve the functionality of proteins. Digital twin technology simulates industrial-scale production to demonstrate commercial viability.

Practical implications/recommendations: Practitioners can implement these solutions to create new revenue streams from agricultural waste, reduce disposal costs, and develop marketable protein products. The technologies enable food manufacturers to diversify protein sources, potentially reducing costs compared to traditional animal proteins while meeting consumer demand for sustainable alternatives. Aquaculture operations can benefit from alternative fish feed proteins, reducing environmental impact. The comprehensive assessment approach (including Life Cycle Analysis, economic analysis, and consumer acceptance studies) provides practitioners with reliable data for business decisions and market positioning.

Additional dissemination and exploitation material(s)

Project website: www.protein4impact.eu

LinkedIn: https://www.linkedin.com/company/protein4impact/about/

Technical publications and case studies will be made available through the EU CAP Network database

Industrial simulation tools and digital twin technologies for scaling assessment

Additional information

Facilitating elements: Strong consortium of 18 partners across 13 EU countries provides diverse expertise and market access. Integration with EU Green Deal and Farm-to-Fork strategy objectives

supports policy alignment. Comprehensive evaluation approach addresses safety, environmental, economic, and social acceptance factors simultaneously.

Obstacles: Consumer acceptance of novel protein sources may require extensive education and marketing efforts. Regulatory approval processes for novel foods can be lengthy and complex. Initial investment costs for new processing technologies may be substantial for small-scale operations.

Future actions: Continued research on optimization of extraction processes, development of specific applications for different protein fractions, and scaling studies for commercial implementation. Collaboration with food manufacturers for product development and market testing recommended.

Messages to end-users: These protein alternatives offer genuine opportunities to reduce environmental footprint while maintaining nutritional quality. Success requires careful attention to processing quality, consumer education, and gradual market introduction. Economic viability improves significantly when integrated with existing agricultural and food processing operations through circular economy approaches.

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Why proteins?

Proteins are essential nutrients for our body, participating in many missions. But their importance goes further: proteins provide important properties and functions to foods, which are important in our sensorial evaluation.

Summary for practitioners on the main finding(s)/innovative solution(s)

Proteins are often referred as the building blocks of life, essential for hormone regulation, enzyme function, muscle repair and immunity. They are, therefore, essential nutrients for humans. However, their importance goes further.

Proteins contribute to structure, stability and quality of the foods and beverages we consume on daily basis, enhancing their sensory attributes. For example, in ice cream, milk proteins emulsify fat droplets and stabilize air bubbles during freezing, resulting in its characteristic creamy texture. Similarly, in yogurt, proteins provide gelation properties by interacting with water, which gives it its characteristic thickness.

The functional properties of proteins are not just limited to animal derived proteins. Recently, there is a significant rise in the meat and dairy alternatives in the market, utilizing the functional properties plant proteins. For example, soy proteins provide excellent emulsification and textural properties comparable to animal proteins. On the other hand, pea proteins are used in dairy alternative beverages due to their emulsification and stabilizing properties. Texturized vegetable proteins present meat-like chewiness and texture, while in plant-based beverages, proteins provide a desirable creamier mouthfeel. Moreover, the functionality of the plant proteins can be tunable for the specific applications, as the properties vary significantly depending on the source of protein and the extraction method.

While we often consider proteins from the nutritional aspect, their application in food and beverages is extensive. Proteins significantly contribute to the structure, enhance the texture and mouthfeel, playing a major role in creating desirable sensory experiences. Regardless of whether the protein is derived from animals, plants or microorganisms, they provide a wide range of functional properties that are essential in developing stable and appealing products.

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Future actions: Continued research on optimization of extraction processes, development of specific applications for different protein fractions, and scaling studies for commercial implementation. Collaboration with food manufacturers for product development and market testing recommended.

Messages to end-users: These protein alternatives offer genuine opportunities to reduce environmental footprint while maintaining nutritional quality. Success requires careful attention to processing quality, consumer education, and gradual market introduction. Economic viability improves significantly when integrated with existing agricultural and food processing operations through circular economy approaches.

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Agro-industrial byproducts as protein sources

Agro-industrial byproducts are unconventional sources of protein. Innovative technologies and processing approaches can extract those proteins. However, the efficiency and their properties are still challenges.

Summary for practitioners on the main finding(s)/innovative solution(s)

According to the United Nations, the world's population will increase to 8.7 billion by 2030, making food insecurity a major challenge as feeding this growing population becomes increasingly difficult. One of the difficult challenges will be the supply of protein, which is a macronutrient essential for health. Most of our dietary proteins come from animal sources like meat, dairy, and eggs. But these sources are resource intensive and contribute to the greenhouse gas emissions. New protein sources, therefore, are needed.

Plant based proteins such as soy, peas, lentils and wheat are already being used in meat analogues, dairy substitutes, and baked products. However, these proteins have problems with taste, digestibility, and solubility, which limit their applications.

At the same time, a significant amount of food and agricultural waste is generated every year. For example, postharvest losses, spent grain after beer manufacturing, fish and seafood waste. These sources are often rich in proteins and other bioactive compounds. By utilizing these “wastes” as protein sources, we can address food insecurity while delivering environmental benefits. However, there are few challenges in obtaining the proteins from these sources as they are over processed or bound to other components, that lowers the quality of the protein.

Therefore, this project explores innovative technologies to extract viable and functional proteins from a variety of unconventional sources. The aim is to improve the extraction efficiency and enhance the functionality of the proteins for various applications. To be viable, the developed processes must be efficient in relation to protein recovery, energy and water needs, cost and environmental impact. The obtained proteins are not only useful as nutrient source, but also enhance the sensory qualities of the food and beverage products by offering functional properties – such as modifying texture, incorporating air or fat, retaining water, etc.

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