

PhD: Food Science

Title: Production of peptides and proteins with cosmetic and biomedical application in plant organisms

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Objectives of the research project and interdisciplinary collaborations:

This research project aims to create recombinant proteins and peptides from specialized plant organs using the natural infection processes of *Agrobacterium* bacteria. By utilizing two species of *Agrobacterium*, *tumefaciens* and *rhizogenes*, we can introduce new genetic material into leaf and root cells, turning them into tools for producing recombinant molecules. This method presents a viable alternative to using animal cell cultures. However, the purification and isolation of proteins from plant tissues and secondary metabolites have been challenging, which has hindered companies' widespread adoption of this technology. Plants such as *Nicotiana benthamiana* and *Nicotiana tabacum*, which are used for producing recombinant proteins, require the removal of harmful metabolites like nicotine. In this proposed project, we plan to adapt the technique to plant species without harmful metabolites, focusing on plants with large leaf surfaces that are suitable for human consumption. Additionally, using roots could aid in protein purification through the rhizosecretion pathway, which transfers the target protein from the cellular environment to the culture medium. We will select proteins with potential applications in the cosmetic and nutraceutical/biomedical sectors as targets of interest. These include human collagen, known for its anti-aging properties, and the protease neprosin, which is useful for individuals with celiac disease due to its affinity for gliadin, the main cause of gluten intolerance. The project will involve collaboration with Arterra Bioscience, a company with expertise in developing products and technologies for various industrial sectors, including cosmetics, nutraceuticals, and agri-food.

Innovation and originality of the project in relation to the state of the art:

Currently, the majority of recombinant molecules intended for human use are produced using animal cell cultures. Although these provide several advantages such as correct processing and high production levels, the high production costs associated with sterile conditions, long processing periods, and difficulties in scaling up the process are limiting factors for many companies. In contrast, plant systems offer several advantages, including the absence of human pathogens, low growth costs, the speed of the transient expression system, the high scalability of the process, and the biodegradability of the unused material. With advancements in experimental techniques and the possibility of modifying a single molecule of plasmid DNA to obtain different peptides and proteins, during the project, it will be possible to produce recombinant proteins with a wider range of applications across various industrial sectors.

Grant availability: Private company, Arterra Bioscience SpA

Collaborations with foreign institutions: Wageningen University & Research, The Netherlands

Collaborations with industry: Arterra Bioscience SpA