28th Workshop on the Developments in the Italian Ph.D research on Food Science, Technology and Biotechnology

Catania, 18-20 September 2024

FOOD PROTEINS FROM ALTERNATIVE SOURCES: FUNCTIONAL CHARACTERIZATION AND STRATEGIES FOR THE DESIGN OF INNOVATIVE FOOD

Francesco Iervese – fiervese@unite.it francesco.iervese@unito.it
National PhD in Food Science, Technology and Biotechnology
Dept. Bioscience and Technology for Food, Agriculture and Environment, University of Teramo, Italy
Tutors: Prof. Carla Di Mattia, Prof. Paola Pittia

AIM OF THE STUDY

To investigate alternative protein sources to evaluate and optimize their technological functionality for the design of innovative foods. Various protein sources and different applications will be investigated through the optimal use of either innovative technologies or food design in order to obtain complex food structures able to meet both consumers and food companies expectations in terms of qualitative properties and sustainability attributes.

STATE OF ART

Proteins are essential macronutrients crucial for the human body and play a significant role in the texture of food products. Currently, animal proteins dominate global consumption, but with the world's population projected to reach 10 billion by 2050, alternative and sustainable protein sources are needed. Pulses like beans, lentils, and peas are gaining attention for their nutritional and functional properties [1], but legume proteins face challenges like low solubility and poor sensory attributes in food applications. To address such issues, various modification strategies, including physical, chemical, and enzymatic treatments, are used [2]. Grass pea (Lathyrus sativus L.), an underutilized pulse, seems to be a promising crop due to its resilience to harsh farming conditions and high protein content which surpasses more commonly used pulses, such as chickpeas and French beans [3]. It is considered a model crop for sustainable agriculture, adaptable to different soils and climates, and suitable for cultivation on marginal lands [4]. This doctoral project aims to explore grass pea's functional properties, particularly in emulsified and gelled food systems, with a focus on formation and optimization microgels particles for food applications. Structural and molecular characterization will also be conducted to understand the mechanisms underlying food structures.

OBJECTIVES AND MILESTONES

A1. Characterization of physicochemical properties of native protein isolates of different origins

If not available on the market, proteins will be extracted from selected matrices (e.g., grass pea). This will result in chemical characterization (e.g., SDS-PAGE; fluorescence spectroscopy) (A1.1) and physical and functional characterization (e.g., solubility) (A1.2) of all isolates under consideration.

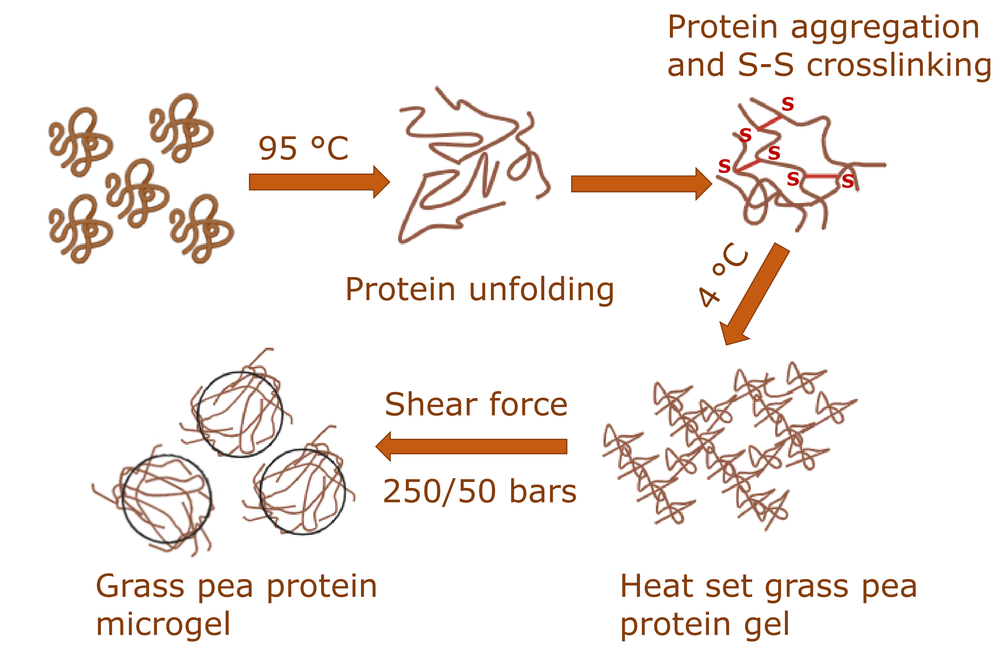
A2. Preparation of microgels using different protein isolates

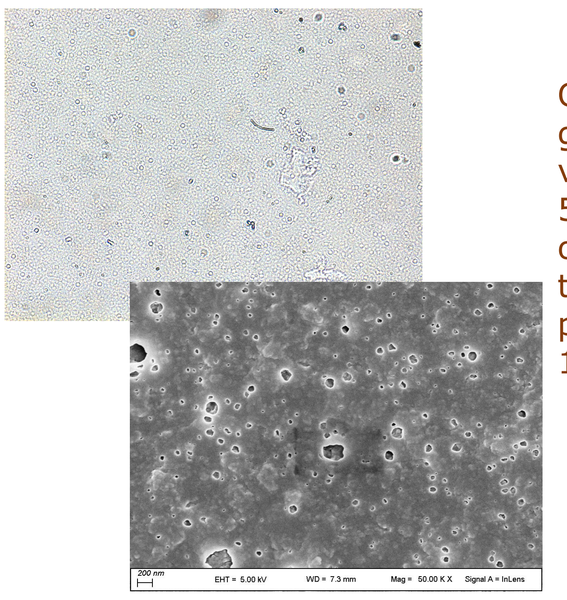
Protein isolates will be used for the preparation of microgels in solution, which will be evaluated through rheological (A2.1), tribological (A2.2), and microstructural analysis (A2.3).

A3. Application of innovative technology to improve functionality of selected isolates for microgels production

Based on the performance obtained from the characterization of native isolates and the corresponding microgels, some selected isolates will undergo physico-mechanical treatments (i.e. high dynamic/hydrostatic pressure) to enhance/modulate their functionality, specifically their gelling properties. Three main activities will be involved: (A3.1) Optimization of treatment parameters; (A3.2) Characterization of the treated isolates; (A3.3) Preparation of microgels with the improved isolates and comparison with previous results. (A3.4) Application of microgels for food matrices formulation (suspensions, emulsions, gels).

A.4 Writing and Editing of the PhD thesis, scientific papers and oral and/or poster communications





Optical and SEM image of grass pea microgel with a volume fraction (ϕ) of 51.5%. The microgel was obtained starting from a thermal induced gel of grass pea with a concentration of 16% w/w

	ACTIVITIES	MONTHS																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	Bibliografich research																								
A1	**A1: Characterization of physicochemical properties of native protein isolates of different origins**																								
	A1.1: Chemical characterization																								
	A1.2: Physical characterization																								
A2	**A2: Preparation of microgels using different protein isolates**																								
	A2.1: Rheology																								
	A2.2: Tribology																								
	A2.3: Microstructure and particle size analysis																								
A3	**A3: Application of innovative technology to improve functionality of selected isolates for microgels production**																								
	A3.1: Optimization of process parameters																								
	A3.2: Characterization of treated isolates																								
	A3.3: Preparationof microgels with improved isolates and comparison with prevoius results																								
	A3.4: Application of microgels for food matrices formulation																								
A4	**A4: Writing and editing of the PhD thesis, scientific papers and oral and/or poster communications**																								

SELECTED REFERENCES

[1] Diaz-Bustamante, M. L., Keppler, J. K., Reyes, L. H., & Alvarez Solano, O. A. (2023). Trends and prospects in dairy protein replacement in yogurt and cheese. Heliyon, 9(6). https://doi.org/10.1016/j.heliyon.2023.e16974
[2] Tarahi, M., & Ahmed, J. (2023). Recent advances in legume protein-based colloidal systems. In Legume Science. John Wiley and Sons Inc. https://doi.org/10.1002/leg3.185
[3] Ghobadi, M., Varidi, M. J., Koocheki, A., & Varidi, M. (2021). Effect of heat treatment on the structure and stability of Grass pea (Lathyrus sativus) protein isolate/Alyssum homolocarpum seed gum nanoparticles. International Journal of Biological Macromolecules, 182, 26–36. https://doi.org/10.1016/j.ijbiomac.2021.03.170
[4] Gonçalves, L.; Rubiales, D.; Bronze, M.R.; Vaz Patto, M.C. Grass Pea (Lathyrus sativus L.)—A Sustainable and Resilient Answer to Climate Challenges. Agronomy 2022, 12, 1324. https://doi.org/10.3390/ agronomy12061324