

# Alternative strategies for the development of high-nutritional-value products from cereals and pulses

Lorenzo Estivi (lorenzo.estivi@unimi.it)

Tutor: Prof. Alyssa Hidalgo (alyssa.hidalgoval@unimi.it)

Department of Food, Environmental and Nutritional Sciences (DeFENS), University of Milan



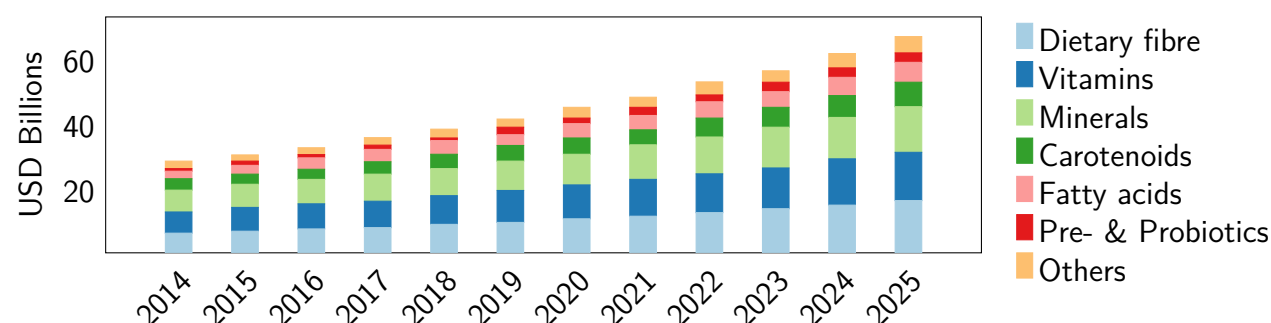
## Abstract

This PhD research project aims to develop cereals and pulses-based ingredients with added nutritional value. Different strategies will be combined: using the natural modifications occurring during germination; exploiting underutilized crops; recovering and valorizing food industry by-products. We intend to pursue a cross-cutting approach reducing water, energy and time wasting, hence an efficient, up-and-coming technology, high-power low-frequency ultrasound (US), will be involved at different stages. Tailored ultrasound treatments will be developed and scaled-up at a pilot plant. A multidisciplinary approach will analyze US-treated materials and derived foods. We expect to support ultrasound technology diffusion at industrial scale.

## State of the Art

The expansion of markets for functional foods and animal product substitutes proves that consumers are increasingly interested in the role of food in maintaining good health and reducing environmental impact. Based on growing number of vegetarians and vegans a transition from animal to plant-based products has started and it will become even more necessary to cope with the oncoming overpopulation [1]. Improving staple foods from cereals and pulses may have a decisive impact: given their high consumption, even small variations in the amount of their health-enhancing compounds imply a relevant positive effect on human health [2].

Functional food market size in USA, by ingredient: a forecast (Grand View Research, 2019)

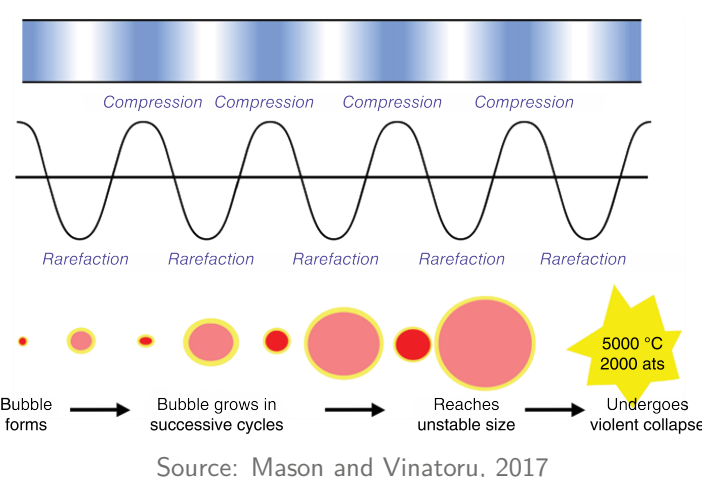


## High-power low-frequency ultrasound technology



Source: Hielscher GmbH

Frequency range	Application field
20 to 100 kHz	high-power US
100 kHz to 2 MHz	sonochemistry
5 to 10 MHz	medical or analytical

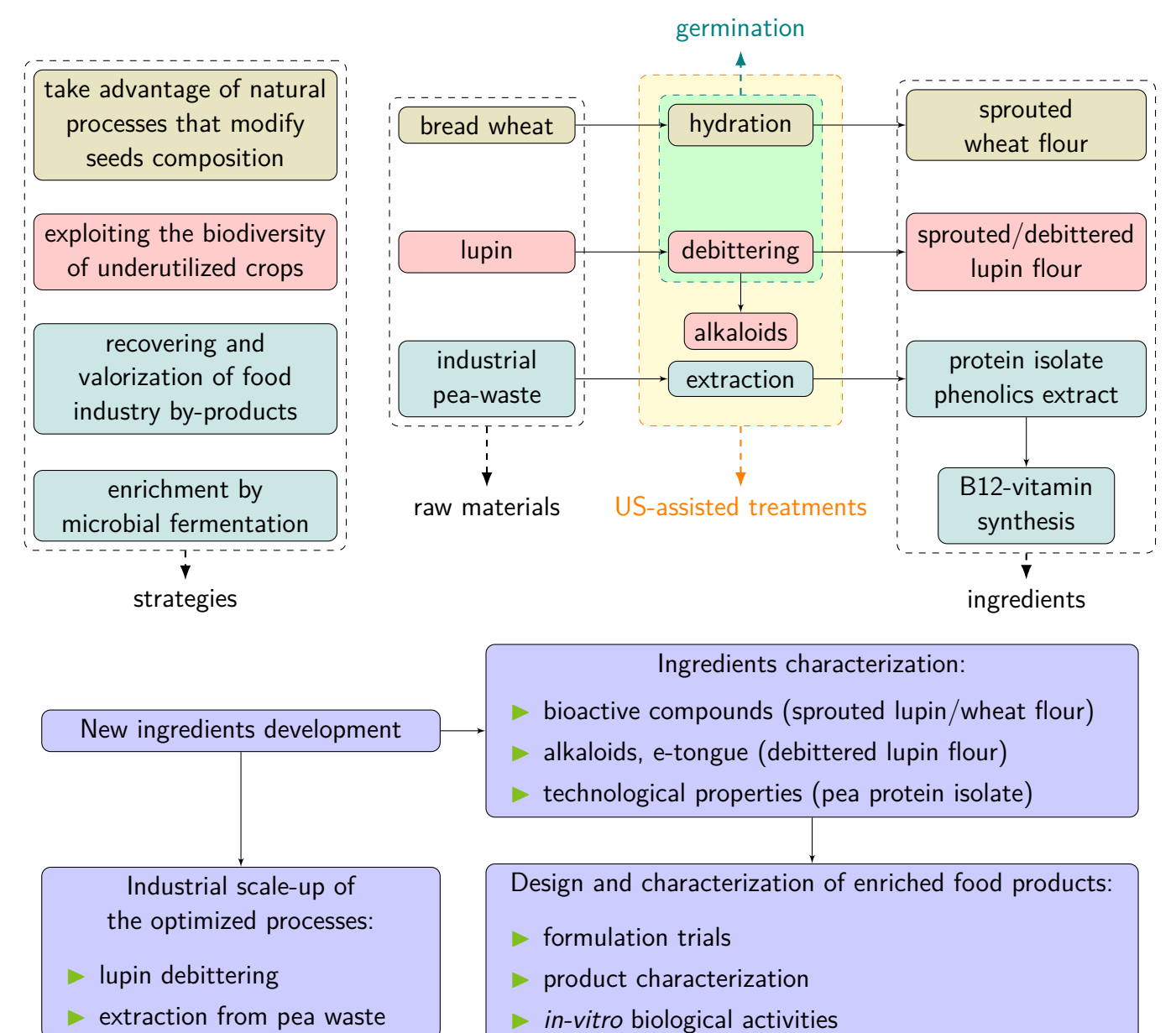


## PhD Thesis Objectives and Milestones

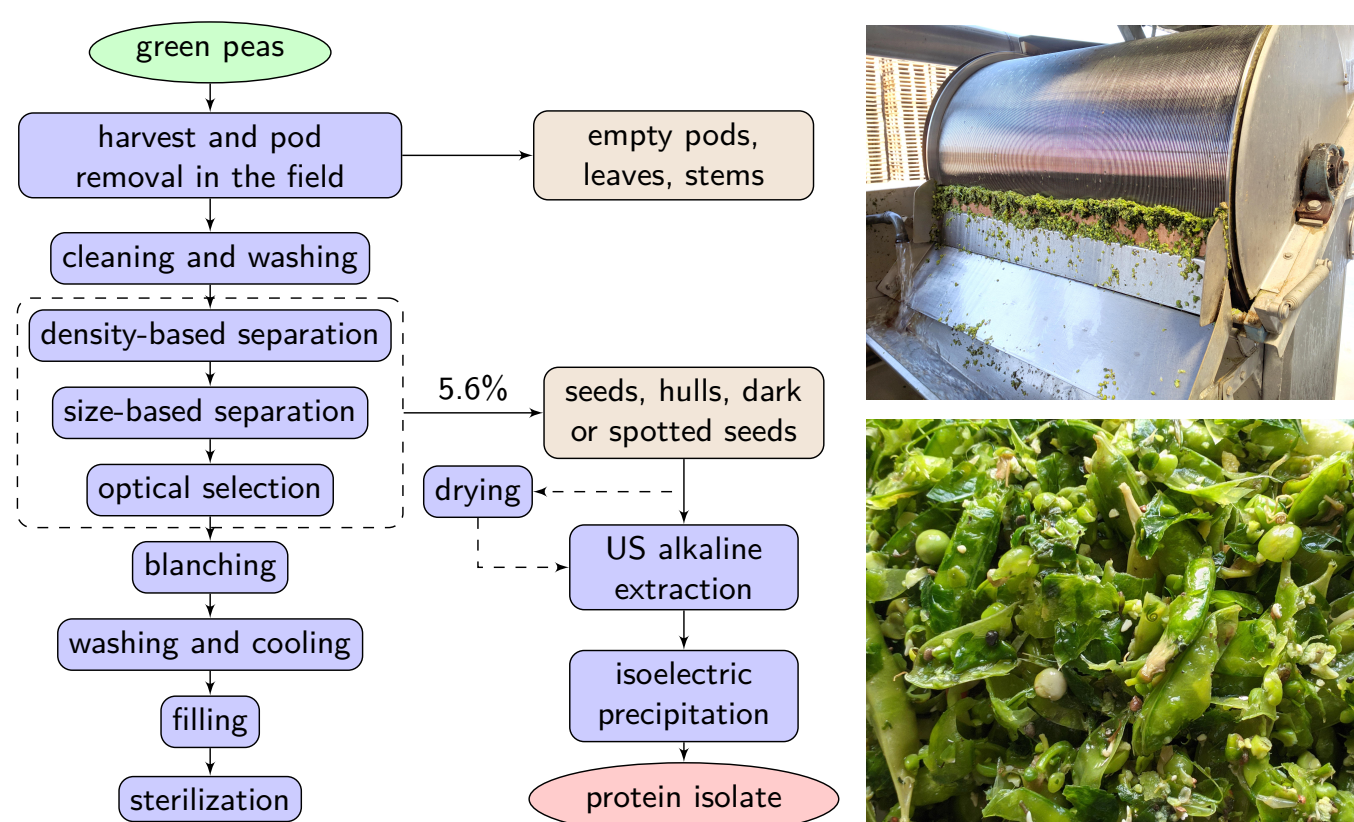
To develop, by different approaches, cereals and pulses-based ingredients with added nutritional value

- ▶ To Improve the knowledge of natural processes able to increase the nutritional quality of wheat and lupin seeds
- ▶ To fine-tune ultrasound (US) processes for efficient resource utilization
- ▶ To formulate food products and to characterize their technological properties, nutritional value and *in-vitro* biological activity
- ▶ To scale-up the optimized US processes

## Planned activities

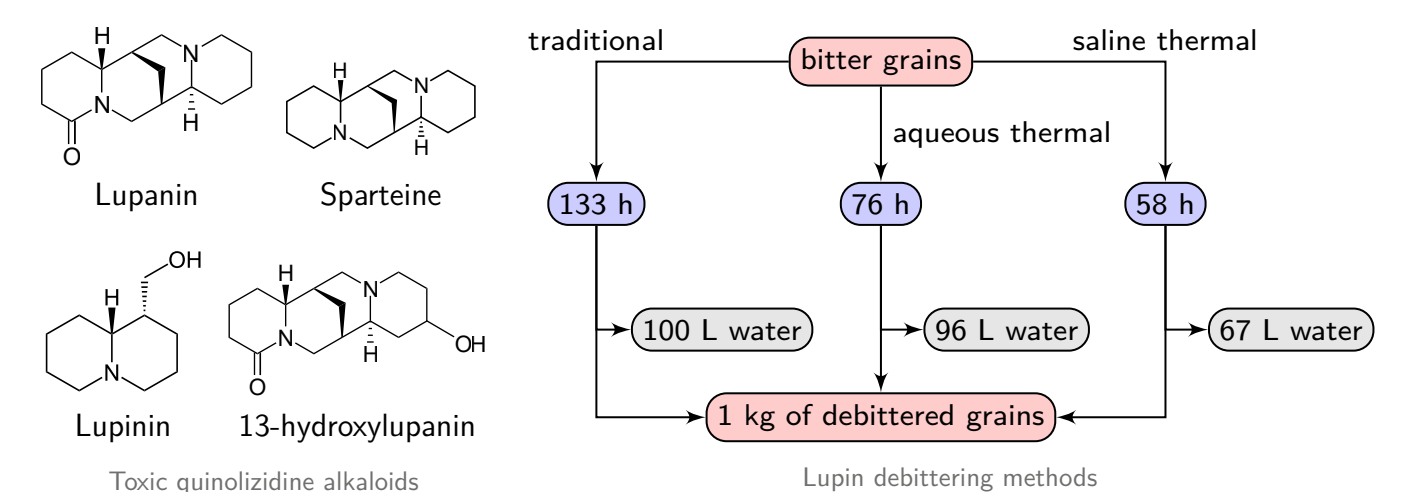


## Pea waste valorization



## Lupin debittering

An underutilized, thrifty crop, rich in protein (29-40%) and tocopherols (103-295 mg/kg DM) [3], whose integration in diet is limited by its toxic alkaloids.



## References

- [1] Willett, W. et al. Food in the anthropocene: the eat-lancet commission on healthy diets from sustainable food systems. In: *Lancet* 393 (2019), 447–492.
- [2] Hidalgo, A. et al. Antioxidant properties and heat damage of water biscuits enriched with sprouted wheat and barley. In: *LWT* 114 (2019), 108423.
- [3] Berru, L. B. et al. Chemical composition, tocopherol and carotenoid content of seeds from different andean lupin (*Lupinus mutabilis*). In: *Plant Foods Hum Nutr* 76 (2021), 98–104.