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

Catania, 18-20 September 2024

Valorization of polysaccharides and oligosaccharides from food waste

Francesca Trevisiol – francesca.trevisiol@spes.uniud.it

Dept. of Agricultural, Food, Environmental and Animal Sciences, University of Udine, Udine, Italy
Tutor: Prof. Prof. Nadia Innocente
Co-tutors: Prof. Sonia Calligaris, Prof. Clara Comuzzi

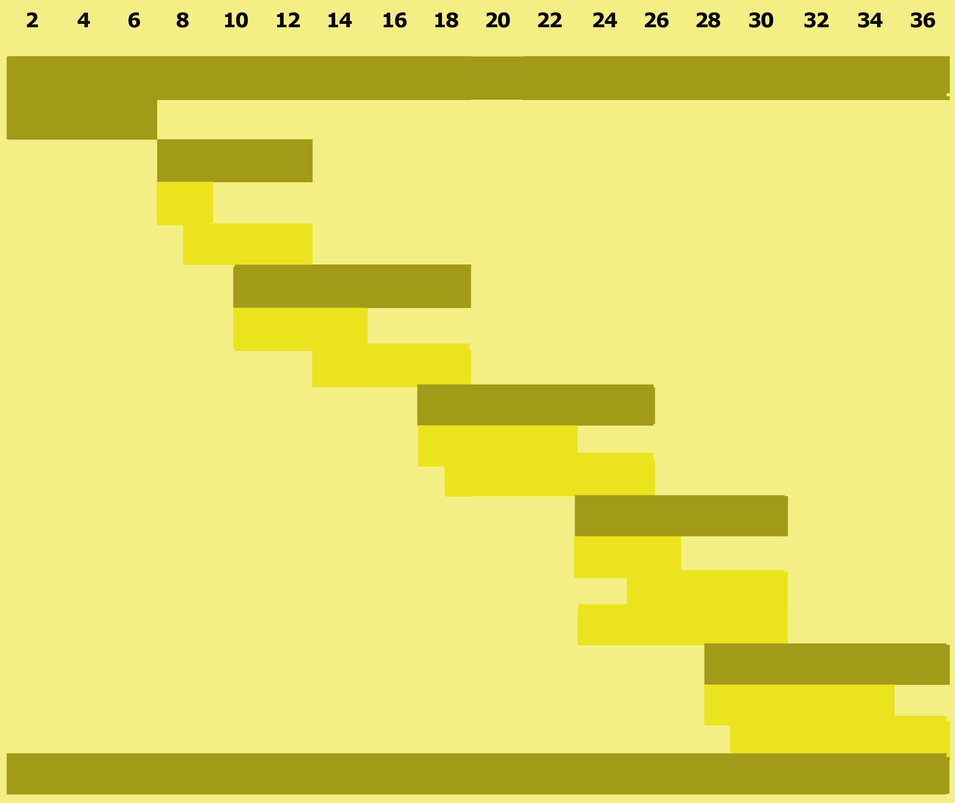
BACKGROUND

The recovery and valorization of polysaccharides and oligosaccharides from plant and animal food waste are rapidly expanding research areas with significant environmental and health implications[1]. From plant waste, such as fruit and vegetable peels and stones, cellulose and hemicellulose can be recovered. These dietary fibers offer health benefits, including improved gut health and reduced risk of obesity, diabetes, and other diseases[2]. These polymers can also be converted into oligosaccharides, which have various technological and biological properties, such as prebiotic and anti-inflammatory effects[3]. Additionally, animal waste, like whey from cheesemaking, can be a valuable source of oligosaccharides, opening new opportunities for industrial and functional food applications[4]. Designing strategies to valorize food waste is a crucial step towards sustainable diets that not only reduce environmental impact but also promote food and nutritional security, thereby fostering a healthy lifestyle for present and future generations[5].

AIM

The present PhD project aims to valorize polysaccharides and oligosaccharides food industry wastes and use them as innovative and beneficial ingredients in food products.

TIMELINE OF ACTIVITIES



PhD APPROACH

Food waste

Polysaccharides and oligosaccharides recovery

Food application

FIRST-YEAR RESULTS

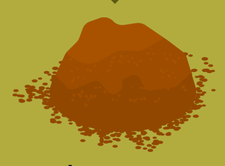
Composition	
Moisture	9.80 ± 0.14
Lipid	0.40 ± 0.03
Fiber	89.16 ± 0.05
Insoluble	88.67 ± 0.05
Soluble	0.49 ± 0.03
Protein	0.77 ± 0.01
Ashes	0.14 ± 0.06

Technological properties		
Imagine		
aw		0.25 ± 0.00
Apparent density (g/mL)		0.73 ± 0.04
OHC (g_{oil}/g_{powder})		1.60 ± 0.20
WHC (g_{H2O}/g_{powder})		1.70 ± 0.10
Color	**L***	79.34 ± 1.18
	a*	5.26 ± 0.22
	b*	22.68 ± 0.40

FIRST-YEAR APPROACH

Olive stones from mill waste

Characterization



Olive stone powder

Extraction eventually assisted by innovative technologies

Water extraction Solvent extraction

Recovery of the extracts and characterization of the technological and healthy properties

Hemicellulose obtained form olive stone powder by solvent assisted extraction

SECOND-YEAR ACTIVITIES

The activities will focus on the application of innovative technologies (e.g. US, PEF) to enhance the extraction of fibers and other compounds of interest. The extracted compounds will be characterized for their technological and health functionalities.
Furthermore, they will be subjected to chemical and enzymatic hydrolysis to obtain oligosaccharides.

Part of the activities were done in the framework of the project VALOStones financed by Prima Foundation

[1] Narisetty V, Parhi P, Mohan B, Hazeena SH, Kumar AN, Gullón B, Srivastava A, Nair LM, Alphy MP, Sindhu R, Kumar V, Castro E, Awasthi MK, Binod, P (2022) Valorization of renewable resources to functional oligosaccharides: recent trends and future prospective. *Bioresour. Technol*. **346**: 126590.
[2] He Y, Wang B, Wen L, Wang F, Yu H, Chen D, Su X, Zhang C (2022) Effects of dietary fiber on human health. *Food Sci. Hum. Wellness*. **11**: 1–10.
[3] Chen Y, Sui X, Wang Y, Zhao Z, Han T, Liu Y, Zhang J, Zhou P, Yang K, Ye Z (2024) Preparation, structural characterization, biological activity, and nutritional applications of oligosaccharides. *Food Chem*. X **22**: 101289.
Fischer C, Kleinschmidt T (2018) Synthesis of galactooligosaccharides in milk and whey: a review. *CRFSFS* **17**: 678–697.
[4] Sadhukhan J, Dugmore TIJ, Matharu A, Martinez-Hernandez E, Aburto J, Rahman PKSM, Lynch J (2020) Perspectives on "game changer" global challenges for sustainable 21st century: plant-based diet, unavoidable food
[5] waste biorefining, and circular economy. *Sustainability*. **12**: 1976.