

Module's syllabus

Title: Food waste valorisation in food product design

General information	
Course	Food waste valorisation in food product design
Scope	Sustainability, Food waste, design thinking, food formulation, techno-functional properties
Language	English
Evaluation	Case studies/ multiple choice questions
Holders	Paola Pittia
Length	One day course
Didactic method	Lectures with activity-based content
Location	Online, or in class, or hybrid

Learning objectives
<ol style="list-style-type: none"> 1. Understand the concepts of food waste recovery, technological functionality of waste biomolecules and their potential for valorisation along with the technological aspects 2. Understand the role of food waste recovery within circular economy and the bioeconomy models and the link between the circular economy and social impact. 3. Identify potential food waste and side-streams for food ingredients and products development, based on technological functionality and technologies available. 4. Apply biorefinery and food technology concepts for food ingredients and products design.

Required skills
<p>Learners need a multidisciplinary skill set, including unit food chemistry, food unit operations and processes, sustainability principles (circular economy, resource optimization, and waste-to-value systems), and the ability to valorise the techno-functional, nutritional and health properties in food product design.</p> <p>Additionally, learners should develop process and product design along with innovation skills. The ability to integrate technofunctionality, sustainability, and cost in decision-making is critical, as is the capacity to analyze case studies, interpret process efficiency data, and ensure compliance with food safety and environmental regulations.</p> <p>Strong communication and interdisciplinary collaboration skills and awareness of emerging trends in green technologies, sustainable processing, and biorefinery are essential. Basic knowledge of experimental design approaches, response surface methodology and statistical methods in food waste bioactives process optimisation and food product design is also beneficial.</p>

Subjects
<p>Challeng based lecture: Food waste: from what, what, what for and how: current and future sustainable strategies for valorisation.</p> <p>Teaching session 1 : Technological functionalities of food waste for green ingredients design</p> <p>Teaching session 2: Biorefinery approaches and innovative technologies for food ingredients</p> <p>Case-study 1: Identify a specific food value chain and related waste and side-streams to be valorised for innovative food ingredients and products based on their technological functionalities. E.g. From waste to value: the case of chocolate</p> <p>Case-study 2: Propose/describe a technological solution to develop/produce a food ingredient/product from holistic perspective (applications, environmental impact, raw materials, cost etc.). E.g. the case of mushrooms processing chain.</p> <p>Teaching session 3: Circular economy, industrial sustainability and social impact</p>

Teaching methods

Lectures, case studies

Verification of learning

The achievement of the training objectives of the Food waste valorisation in food product design will be assessed through interactive methods, including multiple-choice questions and case study analyses. These assessments will evaluate the learners' ability to understand and apply the new knowledge on technological functionality of biomolecules, the potential of food waste as new second raw material for new products development, analyze and synthesize information, and make informed decisions in scenarios that mirror real-world conditions in food waste valorisation.

Multiple-choice questions will test foundational knowledge, while case studies will challenge learners to solve problems related to process selection and optimization, scalability, and environmental impact. Practical exercises, such as real case studies and data interpretation, will measure their ability to effectively apply theoretical knowledge to operational contexts. These methods ensure a comprehensive evaluation of both conceptual understanding and practical skills.

Indicative resources

1. EC: Food waster (frameworks, standards for food waste): [website link](#)
2. Review: Makiso-Uruso et al., A comprehensive review of current approaches on food waste reduction strategies [\[Link 1\]](#)
3. Review: Springmann et al 2018. Options for keeping the food system within environmental limits [\[Link 2\]](#)
4. Review: Wang et al 2025. Food waste used as a resource can reduce climate and resource burdens in agrifood systems [\[Link 3\]](#)
5. Review: Galanakis C. 2012. Recovery of high added-value components from food wastes: Conventional, emerging technologies and commercialized applications [\[Link 4\]](#)
6. Book Chapter: Pittia & Gharsallaoui, Food waste recovery [\[Link 5\]](#)
7. Review: Patel et al., 2024. Innovative biorefinery approaches for upcycling of post-consumer food waste in a circular bioeconomy context [\[Link 6\]](#)
8. Review: Fazole-Rabbi & Bin Amin, 2024. Circular economy and sustainable practices in the food industry: A comprehensive bibliometric analysis [\[Link 7\]](#)