Module's syllabus
Title: Optimized fermentation

General information	
Course	Optimized fermentation
Scope	Sustainability, design thinking, food biotechnology
Language	English
Evaluation	Case studies/ multiple choice questions
Holders	Dan Cristian Vodnar
Length	One day course
Didactic method	Lectures with activity-based content
Location	Online or in class or hybrid

Learning objectives
1. Understand the fundamental principles of optimised fermentation, including the selection of microorganisms in producing specific food ingredients and bioreactor parameters 2. Differentiate between optimised fermentation and traditional fermentation methods/products, highlighting the technological optimization involved. 3. Knowledge on the regulatory landscape surrounding optimised fermentation products. 4.Develop innovative and sustainable optimised fermentation processes.

Required skills
Learners need a multidisciplinary skill set, including a foundational understanding of fermentation processes (types of fermentation, microbial growth, and bioreactor operations), sustainability principles (circular economy, resource optimization, and waste-to-value systems), and the ability to assess environmental impacts (life cycle analysis, carbon footprint, and resource efficiency). Proficiency in microbiology and biotechnology is essential, particularly microbial strain selection for optimized production. Additionally, learners should develop process design and innovation skills, including computer bioreactor monitoring, scalability considerations, and real-time data analysis. The ability to integrate functionality, 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.

Strong communication and interdisciplinary collaboration skills and awareness of emerging trends in green technologies, sustainable bioprocessing, and microbiology are essential. Basic knowledge of statistical methods for analyzing process efficiency and environmental impacts is also beneficial.

Subjects

Challenge-based lecture/discussion: How can we explore optimized fermentation processes to produce sustainable, nutritious, and affordable food ingredients while addressing potential challenges in resource efficiency, consumer acceptance, regulatory compliance, and environmental impact?
Teaching session 1: Fundamental principles of traditional and optimized fermentation and safe & sustainable production practices
Teaching session 2: Safety and risk assessment of optimized fermentation products
Case study 1: Identify alternative microbial-derived protein sources (biomass fermentation) to conventional ones. e.g., mycoproteins/single cell proteins to vegetal/animal origin proteins.
Teaching session 3: Existing optimized fermentation products: Pros and Cons
Case study 2: Proposing an innovative solution for controlled fermentation-derived products - a holistic perspective on applications, environmental impact, raw materials, and cost

Teaching methods

Lectures, case studies

Verification of learning

The achievement of the training objectives for Optimized Fermentation 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 fermentation concepts, analyze and synthesize information, and make informed decisions in scenarios that mirror real-world conditions in fermentation-based processes.
Specifically, multiple-choice questions will test foundational knowledge, while case studies will challenge learners to solve problems related to process optimization, scalability, and environmental impact. Practical exercises, such as fermentation process simulations or 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
- FOOD FERMENTATION EUROPE; EFSA; GOOD FOOD INSTITUTE / Understanding optimized fermentation / Link 1 - European Commission, Eur-Lex, European Union Law / Key Principles of Safe & Sustainable by Design (SSbD) in Optimised Fermentation / Link 2 - European Commission; EU's Novel Foods Regulation (EU Regulation 2015/2283) / Frameworks and standards for responsible production / Link 3 - European Food Safety Authority (EFSA) / Understanding safety protocols in optimized fermentation process / Link 4 - EFSA's risk assessment procedures/EFSA's scientific publications / Risk Assessment Methodologies / Link 5 - Novel foods regulation / Consumer safety and public perception / Link 6 - Quorn mycoprotein / Microbial derived protein / Link 7 - Isomerase / Microbial natural products/ Link 8

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