UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Food, Microbes and Human Health

2627-1-F7603Q025-F7603Q02501

Aims

This module provides students with an integrated understanding of the relationships between microorganisms, food systems and human health within a One Health and sustainability framework. The module addresses the role of microorganisms in food production, food preservation and food waste reduction, as well as the safety and regulatory aspects of microbial-based products and applications. Specific attention is given to foodborne diseases, antimicrobial resistance, probiotics, microbial-based nutraceuticals and biome depletion theory, with the aim of linking food microbiology to public health and sustainable food systems.

Knowledge and understanding
Students will acquire knowledge concerning:

- the role of microorganisms in food systems and their relevance for human health;
- the basic principles of food fermentation and the use of microbial starters;
- the contribution of microorganisms to food preservation and food waste reduction;
- the main safety and regulatory issues related to microbial applications in food;
- the concepts of probiotics, prebiotics and microbial-based nutraceuticals;
- the relevance of foodborne diseases, antimicrobial resistance and biome depletion theory in a One Health perspective.

Applying knowledge and understanding
Students will develop the ability to apply basic microbiological concepts to the analysis of food systems and food-related health issues. They will be able to evaluate microbial applications in food production, preservation and waste reduction, considering their potential contribution to sustainability, food safety and public health. Students will also learn to interpret examples and case studies concerning microbial-based products and processes, with attention to their scientific rationale, safety implications and regulatory context.

Making judgements
Students will acquire the ability to critically assess the opportunities and limitations associated with the use of microorganisms in food systems. They will be able to evaluate, at a basic but scientifically grounded level, the

potential benefits and risks of microbial applications in food production and human health, including fermented foods, probiotics and other microbial-based products. They will also develop the capacity to frame microbiological issues within broader sustainability and One Health challenges, including antimicrobial resistance, foodborne diseases and changes in human-associated microbial ecosystems.

Communication skills
Students will be able to communicate the main concepts of food microbiology and microbial applications for sustainability and health using appropriate scientific language. They will develop the ability to explain microbiological topics to audiences with different disciplinary backgrounds, with particular attention to the connection between food systems, public health, environmental sustainability and One Health.

Learning skills
Students will acquire the basic conceptual and methodological tools needed to further explore topics related to food microbiology, sustainable food systems and microbial contributions to human health. They will be able to consult teaching materials, scientific literature, institutional documents and regulatory sources in order to update and integrate their knowledge in an interdisciplinary context.

Contents

• Food microbiology in the One Health framework.
• Fundamentals of food fermentation and microbial applications in food systems.
• Microbial starters and their applications in food production.
• Role of microorganisms in food preservation and food waste reduction strategies.
• Safety and regulatory aspects of microbial applications in food.
• Microorganisms, food and public health: probiotics, antimicrobial resistance, foodborne diseases and biome depletion theory.

Detailed program

Food microbiology in the One Health framework
• Role of microorganisms at the interface between food systems, human health, animal health and the environment.
• Food-associated microorganisms as beneficial, technological, spoilage or pathogenic agents.
• Microbial contributions to sustainable food systems, food safety and public health.
• The One Health approach applied to food microbiology and microbial risks.

Fundamentals of food fermentation and microbial applications in food systems
• Origins and significance of food fermentation.
• Definition of fermented foods.
• Spontaneous and inoculated fermentations.
• Main categories of fermented foods and their relevance for preservation, nutritional quality and sustainability.

Microbial starters and their applications in food production
• Evolution, definition and classification of starter cultures.
• Technological functions of microbial starters in food production.
• Starter cultures as tools to standardize food processes, improve safety and reduce food losses.
• Microbial starters and public health: regulatory context, QPS status and emerging safety concerns.

Role of microorganisms in food preservation and food waste reduction strategies

• Role of microorganisms in food preservation.
• Microbial strategies to control spoilage and improve food shelf-life.
• Contribution of microbial processes to the prevention, reduction and valorization of food waste.
• Examples of microbial applications for the reuse or transformation of food by-products.

Safety and regulatory aspects of microbial applications in food
• Main safety issues related to the intentional use of microorganisms in foods.
• Regulatory concepts relevant to microbial applications in food systems.
• Safety assessment of microbial cultures and microbial-based products.
• Scientific rationale and critical evaluation of claims related to microbial products for human health.

Microorganisms, food and public health: probiotics, antimicrobial resistance, foodborne diseases and biome depletion theory
• Scientific and legal definitions of probiotics.
• Prebiotics and other microbial-related products.
• Foodborne diseases: main types, routes of transmission and socio-economic impact.
• Strategies for the prevention and containment of foodborne diseases.
• Spread of antimicrobial resistance genes through food, animals, humans and the environment.
• Strategies to reduce antibiotic use and antimicrobial resistance from a One Health perspective.
• Biome depletion theory and its possible relationship with non-communicable diseases in industrialized societies.

Prerequisites

• Basic knowledge of biology.
• Basic knowledge of chemistry.
• Basic understanding of ecology and sustainability concepts is useful but not mandatory.

Teaching form

Teaching form

The module includes 4 CFUs, corresponding to 40 hours of in-person teaching activities.

Teaching activities include 30 hours of expository teaching (DE), delivered in person (LEL), dedicated to the presentation of the scientific and conceptual foundations of the module. These activities will introduce the main concepts related to food microbiology, microbial applications in food systems, food safety, public health and sustainability.

The module also includes 10 hours of interactive teaching (DI), delivered in person (LEL). Interactive activities will include guided discussion of case studies, analysis of examples from the scientific literature, problem-solving activities, short debates and group-based exercises focused on microbial applications in food systems, food preservation, food waste reduction, foodborne diseases, antimicrobial resistance and One Health.

Virtual laboratories may be used as optional supporting activities, depending on the availability of suitable tools and their coherence with the learning objectives of the module. They are not planned as compulsory teaching activities.

Textbook and teaching resource

Lecture slides and additional teaching materials will be made available on the e-learning platform of the course. Additional materials may include scientific articles, institutional reports, regulatory documents and other resources related to the topics covered during the module.

No compulsory textbook is required.

Semester

Second semester.

Assessment method

The assessment of the module is based primarily on an individual written test covering the key topics addressed during the module. The test is part of the overall assessment of the integrated laboratory course and contributes to the final grade according to the rules defined in the syllabus of the entire course.

The written test includes open-ended questions aimed at assessing the achievement of the expected learning outcomes. Questions may require students to describe key concepts, connect different topics, interpret case studies or examples, and critically discuss the role of microorganisms in food systems, food safety, public health, sustainability and the One Health framework.

An optional oral examination may be held at the request of the student or the lecturer. The oral examination may be used to integrate the written test, to discuss its outcomes, or, where appropriate, to replace the written test. In all cases, the oral examination will assess the same learning outcomes as the written test, with particular attention to the student’s ability to argue critically, connect different topics and use appropriate scientific terminology.

The module assessment will contribute to the final grade of the integrated laboratory course, expressed on a 30-point scale, from 18/30 to 30/30 cum laude. The assessment will take into account the following criteria:
• knowledge and understanding of the topics covered in the module;
• ability to apply microbiological concepts to food systems, sustainability and public health issues;
• ability to connect different concepts within a One Health perspective;
• autonomy of analysis and judgement in the interpretation of case studies and examples;
• clarity, coherence and accuracy of the answers;
• appropriate use of scientific terminology.

Office hours

By appointment, either in person or online, upon request by e-mail.

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING | QUALITY EDUCATION | RESPONSIBLE CONSUMPTION AND PRODUCTION