Syllabus

Course Description

Course Title	Starter and functional microbes for innovation, authenticity and healthy status
Course Code	44761
Course Title Additional	
Scientific-Disciplinary Sector	
Language	English
Degree Course	Master in Food Sciences for Innovation and Authenticity
Other Degree Courses (Loaned)	
Lecturers	Prof. Marco Gobbetti, Marco.Gobbetti@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/32209 Prof. Andrea Polo, Andrea.Polo@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/36646 Prof. Raffaella Di Cagno, Raffaella.DiCagno@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/37608 dr. Olga Nikoloudaki, Olga.Nikoloudaki@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/38535
Teaching Assistant	
Semester	Second semester
Course Year/s	1st
CP	12
Teaching Hours	72
Lab Hours	48

Individual Study Hours	180
Planned Office Hours	42
Contents Summary	The natural microbial starters for innovation and authenticity: criteria and tools for selecting and use microbial starters in food fermentations; examples of spontaneous fermentation and drivers affecting the fermentation; type of natural and commercial starters; examples of uses of selected microbial starters in cheeses, baked goods, fermented fruits/vegetables and functional foods. Computational analysis in food microbiomes: the module provides an introduction to the use of sequencing and data integration to study microbial ecosystems in food fermentations. The course covers the principles of 16S rRNA gene sequencing and shotgun metagenomics, alongside physicochemical measurements such as pH, acidity, and metabolite content. Using accessible platforms like MicrobiomeAnalyst, students will gain hands-on experience in microbiome profiling, diversity analysis, functional annotation, and integration of multi-source data. By the end of the course, they will be able to interpret and communicate results linking microbial communities to fermentation quality and functionality. The food: human axis for driving the gut microbiome: principles on the digestive system; gut microbiota composition and functionality; omics for investigating the gut microbiota/microbiome; observational and intervention studies on the effect of diet, fibres, polyphenols and food intolerances on the gut microbiota composition and functionality; gut-brain axis and cases of study on autism; how to carry out an intervention study on the gut microbiota/microbiome.
Course Topics	The topics of the modules are described in the section of each module
Keywords	The keywords of the modules are listed in the section of each module
Recommended Prerequisites	
Propaedeutic Courses	None
Teaching Format	Traditional teaching in classroom; discussion and analyses of cases of study (scientific articles). Lab exercises will be in didactic

	laboratories and include the use of advanced analytical methods, and group activities among participants with collaborative solving of experimental questions.
Mandatory Attendance	No
Specific Educational Objectives and Learning Outcomes	Knowledge and understanding: Knowledge of analytical methods for determining the authenticity, functionality, and microbiological safety of food products, as well as the related methodological tools for risk assessment. These knowledge areas will be developed through an educational program that integrates theoretical teaching activities with practical activities, such as laboratory exercises, computer simulations, simulations of food processes using pilot plants, and company visits. Ability to apply knowledge and understanding: Ability to manage the technological, microbiological, biochemical, chemical, and physical processes that drive food transformation and the main issues related to the stability and shelf life of food products. Ability to plan and develop analytical techniques, innovative products, and processes using a multidisciplinary approach, with particular attention to local food productions. Making judgements: Independent judgement is developed through a training programme designed to stimulate critical analysis in students. This includes the use of case studies, simulations using spreadsheets and videos, the reading and critical discussion of scientific articles, as well as specialist seminars held by experts in the food sector. The assessment of the independent judgement acquired by students is entrusted to the individual teachers responsible for the training activities, who will assess it through oral and/or written reports on specific topics and/or through exams. Communication skills: Use of the English language, both written and spoken, at a B2 level, with a command of technical and scientific vocabulary related to food science. Structure and draft scientific and technical documentation

	describing project activities. Learning skills: The degree course provides graduates with the cognitive skills, logical tools and familiarity with new information technologies necessary to ensure continuous updating of knowledge, both in their specific professional field and in the field of scientific research.
Specific Educational Objectives and Learning Outcomes (additional info.)	
Assessment	The assessment of the student preparation is through an oral exam. The oral assessment includes questions to assess the knowledge and understanding of the course topics and questions designed to assess the ability to transfer these skills to case studies and practical applications. Questions on practical applications also assess the ability of the student to apply the knowledge and understanding of the course topics, the ability to make judgments and finally, the student communication skills.
Evaluation Criteria	The evaluation criteria are described in the section of each module
Required Readings	The required readings are indicated in the section of each module
Supplementary Readings	
Further Information	
Sustainable Development Goals (SDGs)	Good health and well-being, Responsible consumption and production, Industry, innovation and infrastructure

Course Module

Course Constituent Title	The natural microbial starters for innovation and authenticity
Course Code	44761A
Scientific-Disciplinary Sector	AGRI-08/A
Language	English
Lecturers	Prof. Raffaella Di Cagno, Raffaella.DiCagno@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/37608

Teaching Assistant	
Semester	Second semester
CP	3
Responsible Lecturer	
Teaching Hours	18
Lab Hours	12
Individual Study Hours	45
Planned Office Hours	9
Contents Summary	The natural microbial starters for innovation and authenticity: criteria and tools for selecting and use microbial starters in food fermentations; examples of spontaneous fermentation and drivers affecting the fermentation; type of natural and commercial starters; examples of uses of selected microbial starters in cheeses, baked goods, fermented fruits/vegetables and functional foods.
Course Topics	The course will cover the following topics: - General criteria for starter selection and tools for selecting microbial starters (e.g., phenomics) - Spontaneous fermentation (sauerkrauts): advantages and limits - Natural starter (milk kefir), commercial and autochthonous starters - Case studies dealing with the use of starters in cheeses, fermented vegetables, functional foods, probiotics, and recycling of food by-products
Teaching Format	Traditional teaching in classroom; discussion and analysis of cases of study (scientific articles); lab activities and one external visit. Lab exercises will be in didactic laboratories and include the use of advanced analytical methods, and group activities among participants with collaborative solving of experimental questions.
Required Readings	Slides of lesson provided by the lecturer and scientific articles
Supplementary Readings	

Course Module

Course Constituent Title	Computational analysis in food microbiomes
Course Code	44761B

Scientific-Disciplinary Sector	AGRI-08/A
Language	English
Lecturers	dr. Olga Nikoloudaki, Olga.Nikoloudaki@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/38535
Teaching Assistant	
Semester	Second semester
CP	3
Responsible Lecturer	
Teaching Hours	18
Lab Hours	12
Individual Study Hours	45
Planned Office Hours	9
Contents Summary	Computational analysis in food microbiomes: the module provides an introduction to the use of sequencing and data integration to study microbial ecosystems in food fermentations. The course covers the principles of 16S rRNA gene sequencing and shotgun metagenomics, alongside physicochemical measurements such as pH, acidity, and metabolite content. Using accessible platforms like MicrobiomeAnalyst, students will gain hands-on experience in microbiome profiling, diversity analysis, functional annotation, and integration of multi-source data. By the end of the course, they will be able to interpret and communicate results linking microbial communities to fermentation quality and functionality.
Course Topics	Introduction to fermented food microbiomes and microbial ecology Fundamentals of DNA sequencing: 16S rRNA amplicon vs. shotgun metagenomics (theoretical overview) Experimental design and sampling strategies in food microbiome studies 16S rRNA data processing workflow (quality control, ASVs, taxonomic assignment) Alpha and beta diversity analysis and ecological interpretation

	Statistical analysis and differential abundance testing Functional prediction from 16S data and limitations Integration of microbiome data with physicochemical parameters Data visualization, interpretation, and common analytical pitfalls
Teaching Format	Traditional teaching in classroom; discussion and analyses of cases of study (scientific articles). Laboratory sessions will consist of group-based bioinformatic analyses designed to address scientific questions concerning food microbiomes.
Required Readings	Introduction to Bioinformatics in Microbiology Henrik Christensen (https://link.springer.com/content/pdf/10.1007/978-3-319-99280-8.pdf) **Bioinformatics: An Introduction** Jeremy Ramsden (Ramsden, J. (2023). Bioinformatics: an introduction. Springer Nature.)
Supplementary Readings	Callahan, B., McMurdie, P., Rosen, M. *et al.* DADA2: High-resolution sample inference from Illumina amplicon data. *Nat Methods* **13**, 581–583 (2016). https://doi.org/10.1038/nmeth.3869

Course Module

Course Constituent Title	The food - human axis for driving the gut microbiome
Course Code	44761C
Scientific-Disciplinary Sector	AGRI-08/A
Language	English
Lecturers	Prof. Marco Gobbetti, Marco.Gobbetti@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/32209 Prof. Andrea Polo, Andrea.Polo@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/36646
Teaching Assistant	

Semester	Second semester
CP	6
Responsible Lecturer	
Teaching Hours	36
Lab Hours	24
Individual Study Hours	90
Planned Office Hours	24
Contents Summary	The Food – Human Axis for Driving the Gut Microbiome: principles on the digestive system; gut microbiota composition and functionality; omics for investigating the gut microbiota/microbiome; observational and intervention studies on the effect of diet, fibres, polyphenols and food intolerances on the gut microbiota composition and functionality; gut-brain axis and cases of study on autism; how to carry out an intervention study on the gut microbiota/microbiome.
Course Topics	Use of omics techniques and most advanced methods for investigating the gut microbiota composition and functionality; observational and intervention cases of study (publications) to modulate the gut microbiota composition and functionality; food intolerances; effects of fibers and polyphenols on the gut microbiota; gut-brain axis as mediated by the the diet and other factors; cases of study dealing with the autism; how to restore transient and permanent dysbiosis; how to carry out an intervention study on the gut microbiota/microbiome.
Teaching Format	Traditional teaching in classroom; discussion and analyses of cases of study (scientific articles). Lab exercises will be in didactic laboratories and include the use of advanced analytical methods, and group activities among participants with collaborative solving of experimental questions.
Required Readings	Scientific articles and slides of lesson provided by the lecturers.
Supplementary Readings	