COURSE OF STUDY *Master degree: Food Science and Technology (LM70)*
ACADEMIC YEAR *2023-2024*
ACADEMIC SUBJECT *Food microbiology*

General information	
Year of the course	1st year
Academic calendar (starting and ending date)	2nd semester (26/02/2024 – 14/06/2024)
Credits (CFU/ETCS):	6 CFU
SSD	Food Microbiology (AGR/16)
Language	Italian
Mode of attendance	Optional

Professor/ Lecturer	
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Department and address	III floor of the previous Faculty of Agriculture
Virtual room	Microsoft Teams ID: quj7qrr
Office Hours (and modalities: e.g., by appointment, on line, etc.)	Every day from Monday to Friday by appointment

Work schedule			
Hours			
Total	Lectures	Hands-on (laboratory, workshops, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
150	40	14	96
CFU/ETCS			
6	5	1	

Learning Objectives	The course aims to provide knowledge and skills relating to food microbiology with the aid of case-study application in the field of the main industrial problems in terms animal food (dairy products) and vegetables (leavened baked products) characterization, management, and conditioning of sensory, nutritional, and hygienic quality. As additional aim, it introduces general concepts concerning the intestinal microbiota, eubiosis and dysbiosis, as well as how diet, i.e., different dietary regimes, macro and micronutrients, prebiotics, and probiotics, can influence microbiota composition and activity.
Course prerequisites	The course requires knowledge of Biochemistry, General Microbiology, Food Chemistry. Knowledge of the main technologies and food chains. Basic knowledge of mathematics and statistics. The exam does not include prerequisites.

Teaching strategies	The teaching will be provided with the aid of Power Point presentations, including the critical analysis of the case studies that will be analyzed in this course. Classroom and/or laboratory lessons will complete the training path in a complementary way to the topics covered during the course and with particular

	reference to the case studies, or to the applicable methods aimed at solving the main industrial problems.
Expected learning outcomes in terms of	
Knowledge and understanding on:	o Knowledge of selection criteria for natural and commercial microbial starters. o Knowledge of the main advanced microbiological methodologies for the selection and preparation of microbial starters. o Knowledge of the factors contributing to the definition of the composition of the intestinal microbiota activity.
Applying knowledge and understanding on:	o Advanced microbiological techniques aimed at the selection of natural and commercial microbial starters. o Advanced microbiological techniques for the characterization of the intestinal microbiota, metabolic activity, and beneficial effects on the host.

Soft skills	• ***Making informed judgments and choices***
	  o Ability to correctly drive the microbial starter selection process according to process and product variables.
	  o Ability to develop and apply formal models aimed at evaluating the growth of microorganisms in response to specific biotic and abiotic factors.
	  o Ability to provide a key to critical interpretation of the results of microbiological analyzes on foods.
	• ***Communicating knowledge and understanding***
	  o Ability to express the theoretical concepts acquired in oral and written form, using appropriately the specific technical-scientific language of food microbiology.
	  o Ability to describe, by application examples also, the practical aspects and potential effects deriving from microbial fermentations on research and development activities in the food industry.
	• ***Capacities to continue learning***
	  o Ability to update the knowledge with respect to the application of starter microorganisms in the food industry.
	  o Ability to update knowledge regarding the available microbiological analyses potentially applicable in the food-field with the aim of guaranteeing high production standards, i.e., hygienic-sanitary, and sensory of foods.

Syllabus	
Content knowledge	**Dairy products:** • Endogenous enzymes of milk and their pro-technological contribution during the cheesemaking process. • Purification, characterization, and using of microbial enzymes in dairy processes. • Definition and pro-technological contributions of primary and secondary starters and non-starter lactic bacteria during the cheesemaking and ripening of dairy products. • Methodologies for the characterization of dairy products: case studies. **Leavened- bakery foods:** • Definition and classification of sourdough. • Factors influencing the definition of the sourdough microbiota. • Bio-preservation of leavened bakery products: case studies. **Human-intestinal microbiota-diet axis:** • Definition and functions of the intestinal microbiota, definition of homeostasis and dysbiosis.

	• Influence of diet, prebiotics and probiotics on the composition and functionality of the intestinal microbiota. • Influence of specific dietary regimes (gluten free and very low protein diet) on the intestinal microbiota of celiac disease and nephropathy patients: case studies.
Texts and readings	• L. Cocolin, M. Gobbetti, E. Neviani. Microbiologia alimentare applicata, Casa Editrice Ambrosiana. (2022). • G. Mucchetti, E. Neviani. Tecnologia casearia: dall'empirismo all'industria. Casa Editrice Ambrosiana. (2022). • M. Gobbetti, A. Corsetti. Biotecnologia dei prodotti lievitati da forno. Casa Editrice Ambrosiana. (2010). • D. Biswas, S.O. Rahaman. Gut Microbiome and Its Impact on Health and Diseases. Springer Cham. (2020).
Notes, additional materials	A copy of the paper material is available to students and is available at the Food Microbiology library.
Repository	All the digital teaching material used during the course will be available to students through web sharing platforms (Teams class, code: quj7qrr).

Assessment	
Assessment methods	The final exam consists of an oral discussion about topics learned during the frontal teaching hours as well as to topics covered during the practical activities (laboratory and educational visits). For students belonging to the year of the course in which the teaching is carried out, an intermediate exam is foreseen, i.e., a written test organized into 1 open-answer question/track aimed at assessing the ability to solve technical-scientific questions and 2 multiple-choice questions about dairy products, i.e., corresponding to one-third of the teaching program. They will be processed by the date set for carrying out the mid-term evaluation. The intermediate test will be evaluated out of 30. The open-question will be evaluated up to a maximum of 24/30 to which, by correctly answering both closed/multiple-answer questions, a further 6/30, or 3/30 each, will be added. The intermediate test grade will be communicated by publication on the student's electronic register and will contribute to the final grade by means of arithmetic calculation as detailed at the bottom of this sheet (see Final exam and grading criteria). Upon acceptance of the exemption grade by the student, during the final oral exam the interview will focus on the remaining two-thirds of the contents of this course. The profit exam for foreign students can be carried out in English according to the methods described above.

Assessment criteria	• ***Knowledge and understanding***
	  o Knowledge of the selection criteria of natural and/or commercial microbial starters for the making of dairy products.
	  o Knowledge of the criteria for choosing sourdoughs according to company production needs.
	  o Knowledge of the mechanisms underlying the modulation of the intestinal microbiota through diet in a manner dependent on the expected purposes deriving from the application of different dietary/nutritional regimes.
	• ***Applying knowledge and understanding***
	  o Selection and application of natural and/or commercial microbial starters for the dairy product making.

- o Choice and application of sourdoughs based on company production needs.
  - o Choice and application of different dietary regimens enriched in specific components (e.g., fibers, probiotics, polyphenols) aimed at achieving a status of intestinal eubiosis.
- *Autonomy of judgment*
  - o Develop and apply feasible application models aimed at guaranteeing the performance of the metabolic activities for which the microorganisms are responsible, i.e., predicting microbial growth in response to specific biotic and abiotic factors characterizing the food/substrate/environment matrix.
  - o Provide a key to critical interpretation of the results deriving from microbiological analyzes on food, for the evaluation of the commercial shelf-life of food, their hygienic-sanitary safety, and the sensory quality of the food.
- *Communicating knowledge and understanding*
  - o Express theoretical concepts using appropriately the technical-scientific language as well as the specific terminology of the microbiological field.
- *Communication skills*
  - o Describe, using application examples also, the practical aspects and the potential effects deriving from the use of certain microorganisms, microbial consortia or different microbiota on the production, quality, and wholesomeness of food, or on research and development activities in the field of microbial biotechnology applied to foods.
- *Capacities to continue learning*
  - o Knowing which precautions are known to adopt in the circumstance in which it is necessary to organize an operational-experimental-innovative approach aimed at the characterization and subsequent selection of microbial starters, pro-technological microorganisms and/or probiotics.

Final exam and grading criteria	The verification of learning takes place through the application of pre-established criteria in accordance with what is reported in the Teaching Regulations of the master's degree course in Food Science and Technology (art. 4). The final grade is given out of 30. Upon acceptance by the student of the outcome of the exemption, it contributes to the arithmetic mean of the final grade to the extent of one-third. The remaining two-thirds of the final grade will consider the evaluation results of two thirds of the program of this course. If the student intends, for whatever reason, to renounce the assessment of the exemption, or if the exemption was completed before the last 12 months, the part of the program relating to the exemption will be simultaneously re-evaluated orally. The exam is considered passed if the final grade is greater than or equal to 18. With the unanimity of the members, the Commission can grant *lode*, in cases where the final score is equal to 30.
Further information	