

General information	
Academic subject	Starters selection and predictive microbiology
Degree course	<i>Master degree: Food Science and Technology (LM70)</i>
Academic Year	<i>First</i>
European Credit Transfer and Accumulation System (ECTS)	6 ECTS
Language	<i>Italian</i>
Academic calendar (starting and ending date)	<i>Second semester (February 27th – June 23rd, 2023)</i>
Attendance	<i>No Compulsory</i>

Professor/ Lecturer	
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Virtual headquarters	<i>Microsoft teams</i>
Tutoring (time and day)	<i>Monday to Friday 9.00 a.m. – 17.30 p.m. by appointment only.</i>

Syllabus	
Learning Objectives	<i>The student will acquire knowledge and skills on the criteria for selecting natural and commercial microbial starters for the food industry and how to prepare and use them in relation to the main industrial needs, as well as in relation to the main sensory, hygienic and nutritional properties of food products. The course also covers the main mathematical models for predicting microbial development in food both for the prevention of contamination by spoilage and pathogenic microorganisms and for the study of microbial interactions in complex matrices.</i>
Course prerequisites	<i>Knowledge of Biochemistry, General Microbiology, Food Chemistry. Knowledge of the main food technologies and food supply chains. Basic knowledge of Mathematics and Statistics.</i>
Contents	<ul style="list-style-type: none"> • <i>Microbial starters for the agro-food productions: dairy products, leavened baked products, fermented meat-based products, fermented beverages, wine, fermented pickles, and functional foods. Illustrative case studies.</i> • <i>Criteria for microbial starters selection.</i> • <i>Microbial starters production.</i> • <i>Scopes and development of predictive microbiology.</i> • <i>Mathematical models and microbial growth.</i> • <i>Microbiological risk and predictive models.</i> • <i>Primary models: microbial growth curves. Gompertz equation, Baranyi and Roberts model, Weibull model.</i> • <i>Secondary models: experimental drawings for the evaluation of multiple effects on microbial growth, Ratkowsky model.</i> • <i>Tertiary models: tools for modeling and databases.</i>
Books and bibliography	<ul style="list-style-type: none"> • <i>Cocolin L., Gobbetti M., Neviani E. "Microbiologia alimentare applicata". Casa Editrice Ambrosiana. Distribuzione Zanichelli. 2022.</i>
Additional materials	<i>The recommended book is intended to supplement the lecture notes and lecture materials provided during the course.</i>

Work schedule	

Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/Self-study hours
Hours			
150	40	14	96
ECTS			
6	5	1	
Teaching strategy		<i>Lectures will be presented through digital tools (PowerPoint presentation, video). Laboratory classes will be performed. Lecture notes and educational supplies will be provided by means of online platforms</i>	
Expected learning outcomes		The expected learning outcomes, in terms of both knowledge and skills, are provided in Annex A of the Academic Regulations of the Degree in Food Science and Technology (expressed through the European Descriptors of the qualification)	
Knowledge and understanding on:		<ul style="list-style-type: none"> ○ Knowledge of the criteria for selection of natural and commercial microbial starter for the food industry; ○ Knowledge of the main advanced microbiological methods for selection and production of microbial starter; ○ Knowledge of the main models available for predictive microbiology applied to the food sector. 	
Applying knowledge and understanding on:		<ul style="list-style-type: none"> ○ Mastership of advanced microbiological techniques for the selection and preparation of natural and commercial microbial starter for the food industry ○ Mastership of mathematical modelling techniques able to describe the microbial evolution in food products, depending on known and measurable environmental conditions 	
Soft skills		<ul style="list-style-type: none"> ● <i>Making informed judgments and choices</i> <ul style="list-style-type: none"> ○ Ability to manage the selection process of microbial starter according to the process and product variables. ○ Ability to develop and apply models and to predict the growth of microorganisms in certain environmental conditions ○ Ability to provide a critical interpretation of the results of microbiological analyses on food, aimed at the prediction of microbial growth, the evaluation of the effects of sanitization treatments (thermal and non-thermal), the evaluation of the commercial shelf-life of foods and food safety. ● <i>Communicating knowledge and understanding</i> <ul style="list-style-type: none"> ○ Ability to communicate the acquired theoretical concepts in oral and written form, using appropriately the scientific language and the specific lexicon of predictive microbiology ○ Ability to describe, also through applicative cases, the practical aspects and potential effects of this discipline on the research and development and quality control activities in food industry. ● <i>Capacities to continue learning</i> <ul style="list-style-type: none"> ○ Ability to deepen and update knowledge regarding the application of starter microorganisms in the food industry, and the criteria for their selection ○ Ability to deepen and update knowledge regarding mathematical modelling techniques and predictive microbiology applied to the food industry. 	
The expected learning outcomes, in terms of both knowledge and skills, are provided in Annex A of the Academic Regulations of the Degree in Food Science and Technology (expressed through the European Descriptors of the qualification).			

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Assessment and feedback	
Methods of assessment	<p>The exam consists of an oral dissertation on the topics developed during the theoretical and theoretical-practical lectures in the classroom and in the laboratory/production plants, as reported in the Academic Regulations for the Master Degree in Food Science and Technology (article 9) and in the study plan (Annex A).</p> <p>Students attending at the lectures may have a middle-term preliminary exam, consisting of a written test, relative to the first part of the program, which will concur to the final evaluation and will be considered valid for a year.</p> <p>The evaluation of the preparation of the student occurs on the basis of established criteria, as detailed in Annex B of the Academic Regulations for the Master Degree in Food Science and Technology.</p> <p>Non-Italian students may be examined in English language, according to the aforesaid procedures.</p>
Evaluation criteria	<ul style="list-style-type: none"> • <i>Knowledge and understanding</i> <ul style="list-style-type: none"> ○ Describing the criteria for selection of natural and commercial microbial starter for the food industry; ○ Describing the main advanced microbiological methods for the selection and preparation of microbial starter; ○ Describing the main models available for predictive microbiology applied to the food sector. • <i>Applying knowledge and understanding</i> <ul style="list-style-type: none"> ○ Applying advanced microbiological techniques to the selection and preparation of natural and commercial microbial starter for the food industry; ○ Applying mathematical modelling aimed to describe microbial evolution in food products, depending on known and measurable environmental conditions. • <i>Autonomy of judgment</i> <ul style="list-style-type: none"> ○ Managing the selection process of the microbial starter according to the process and product variables. ○ Developing and applying formal models to predict the growth response of microorganisms in specific environmental conditions ○ Providing a critical interpretation of the results of microbiological analyses of food, aimed at the prediction of microbial growth, the evaluation of the effects of sanitization treatments (thermal and non-thermal), the evaluation of the commercial shelf-life of foods and food safety. • <i>Communicating knowledge and understanding</i> <ul style="list-style-type: none"> ○ Describing, also through applicative cases, the practical aspects and potential consequences of this discipline on the research and development and quality control activities in food industry. • <i>Communication skills</i> <ul style="list-style-type: none"> ○ Communicating the theoretical acquired concepts using the appropriate scientific language and the specific lexicon of predictive microbiology; • <i>Capacities to continue learning</i> <ul style="list-style-type: none"> ○ Design a practical approach for the selection of microbial starter according to specific process and product variables. ○ Making hypothesis on the application of mathematical modeling for the interpretation of the results of microbiological analysis carried out on

	food, the effects of sanitizing treatments, commercial shelf-life and food safety.
Criteria for assessment and attribution of the final mark	The evaluation criteria that contribute to the attribution of the final mark will be: knowledge and understanding, the ability to apply knowledge, autonomy of judgment, i.e. the ability to criticize and formulate judgments, communication skills
Additional information	