

COURSE: Dairy microbiology

ACADEMIC YEAR: 2019-2020

TYPE OF EDUCATIONAL ACTIVITY: (Basic, Characteristic, Affine, Free choice, Other) Free choice

LECTURER: Prof. Eugenio Parente

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mobile (optional):

Language: Italian

ECTS: 6 (5 Lectures + 1 practicals)

n. of hours: 40 h lectures + 16 h practicals

Campus: Potenza
Dept./School: School of Agriculture, Forest, Food and Environmental Sciences
Program: MSc in Food Science and Technology

Semester: 1

EDUCATIONAL GOALS AND EXPECTED LEARNING OUTCOMES

This is an advanced course in Dairy microbiology and its purpose is to provide MSc students in Food Science and Technology with the ability to plan and control processes for the management of beneficial, spoilage and pathogenic microorganisms in fermented and non-fermented dairy products. The knowledge and abilities will be applied to existing products and processes and to the development of new processes and products. The course activities will be planned together with the lecturers for other optional courses in dairy science and technology.

- **knowledge and understanding:** Knowledge of the role of microorganisms in dairy products. Knowledge of the taxonomy, the ecology and physiology of the main groups of microorganisms which affect the quality of dairy products. Knowledge of the metabolism and genetics of lactic acid bacteria, with emphasis on the species used as starters, adjuncts and probiotics in dairy foods. Knowledge of the technology of dairy starters and of the principles and techniques for the control of bacteriophage infections. Knowledge of the microbiology and biochemistry of the main groups of dairy products (milk, butter and cream, fermented milks, cheese).
- **applying knowledge and understanding:** Ability to identify the factors that control microbial contamination, growth and survival in a specific food product and to identify the means for the control of the most relevant spoilage and pathogenic microorganisms. Ability to identify the starter cultures which are appropriate for a given fermentation process and to identify and control the factors which affect their performance. Ability to develop HACCP plans and microbiological quality assurance programs for dairy products.
- **making judgements:** Ability to identify the most effective tools for microbial quality assurance in the development of new products and processes and in the improvement of existing ones.
- **communication skills:** Ability to communicate the impact of microorganisms on food quality and safety to both non-technical and technical audiences. Risk communication skills. Ability to interact and communicate with food business operators in the development and implementation of microbial quality assurance tools and solutions. Ability to communicate with representative of food safety agencies, official control agencies and quality certification agencies in all the steps needed for the registration and approval of a food production/distribution plant and during food quality and safety audits.
- **learning skills:** Ability to access sources of statistical data relevant to quality assurance of dairy foods (epidemiological databases, surveillance databases, Rapid Alert System for Foods and Feeds), to understand and summarize the data. Ability to access documentation and information sources on quality and safety of dairy foods using technical and scientific literature.

PRE-REQUIREMENTS

To understand the material presented in this course the following knowledge and skills are needed (note that these are usually provided in BSc courses in Food Science and Technology):

- general microbiology (≥6 ECTS credits: structure and physiology of microorganisms, microbial growth, genetics, microbial taxonomy),
- food microbiology and food safety (>12 cfu: food microbial ecology; effect of intrinsic, extrinsic and implicit factors on the growth, survival and death of food spoilage and pathogenic microorganisms, microorganisms

in foodborne infections, knowledge of food hygiene legislation, knowledge of approaches for microbiological quality assurance, quality assurance systems and HACCP)

- food unit operations and food technology (≥ 12 ECTS credits): knowledge and understanding of the most important unit operations which affect contamination, growth and survival of microorganisms (thermal treatments, drying, refrigeration, freezing, etc.) and of the processes and technologies used in the production of the main categories of fresh and minimally processed foods
 - basic knowledge in mathematics and statistics: knowledge and understanding of analysis and calculus, basic concepts in statistics (characterization of samples and populations, hypothesis testing, experimental design, regression methods)
 - English language skills ($\geq B1$) and basic skills in information technology
 - basic concepts in general and organic chemistry, biochemistry and food chemistry
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SYLLABUS

The course is divided in 7 teaching blocks, 4 of which are introductory and 3 pertain to the microbiology of specific products. Introductory blocks will provide material on general subjects (milk composition, microorganisms in dairy products, technology of starter cultures). For each of the blocks for specific categories of products the microbiota of raw materials, starter cultures and their functions, the evolution of microbial communities during manufacture and storage and the techniques for controlling microbiological quality will be described.

Block 1. Introduction, microorganisms and dairy products (8 h, lectures)

The economic importance of dairy products. Milk and dairy products as substrates for microbial growth. The main groups of microorganisms in dairy products: taxonomy, ecology, physiology, role in the quality of dairy products.

Block 2. Metabolism and genetics. (8 h, lectures).

Metabolism and genetics of dairy microorganisms with emphasis on lactic acid bacteria. Metabolism of carbohydrates and organic acids, metabolism of protein and amino acids, lipolysis. Genetics of lactic acid bacteria: genomes, gene transfer, regulation of gene expression, genetic engineering of traits relevant to dairy science. Probiotic microorganisms.

Block 3. Technology of starter cultures. (6 h, lectures).

Classification of starter cultures. Factors affecting the growth of starter cultures. Propagation, storage and distribution of starter cultures. Bacteriophages of lactic acid bacteria (classification, biology, genetics) and their control.

Block 4. Laboratory techniques in dairy microbiology (8 h, laboratory)

Use of selective and differential media in dairy microbiology. Isolation, characterization and identification of lactic acid bacteria. Enumeration and isolation of bacteriophages.

Block 5. Milk, fermented milk products, cream, butter. (6 h, lectures)

Microbiology of UHT milk and reduced moisture products. Microbiology of cream and butter. Yoghurt and other fermented milks. Probiotic and prebiotic fermented milks.

Block 6. Cheese microbiology (12 h, lectures)

Cheese classification and general information on the cheese-making process. Cheese microbiology: sources of contamination, sources of beneficial microbes and management of starter cultures, role of the microorganisms during the production of curd and ripening. Microbiology of specific products: soft and fresh cheeses (stracchino, Cottage, mozzarella), cheese with bacterial surface ripening (Taleggio, Limburger etc.), mould ripened cheeses (Camembert, Brie, Gorgonzola, Roquefort), semi-hard and hard cheeses with internal bacterial ripening (Swiss type cheeses, washed curd cheeses, Cheddar), long ripened hard cheeses (Parmigiano Reggiano/Grana, Provolone/Caciocavallo).

Block 7. Visit to dairy plants, laboratory. (16 h, laboratory)

TEACHING METHODS

The course includes 40 h lectures and 16 h laboratory and visits to dairy plants. Besides attending lectures the students are required to develop their skills by participating to several exercises (writing of short articles/essays, planning of production processes for dairy foods).

EVALUATION METHODS

The students attending the course need to pass two written (mid term, end of course) examinations (multiple choice, true/false, short text, short essay), in addition to 10 min mini-tests (T/F and multiple choice questions) delivered biweekly. Mini-tests and written examinations contribute to up to 85% of the final evaluation and are designed to evaluate knowledge and understanding rather than abilities/capabilities. A variety of exercises, carried out by students working in groups, will be used to assess the ability to applying knowledge and understanding, making judgements and communication skills (short journal articles, blog posts, short presentations, predictive microbiology exercises). To obtain top grades (>27) the students, working in groups, must complete a project on the development of a production process for a fermented product such as cheese or fermented milk (15% of the total grade points; honors will be awarded only to students successfully competing the project).

As an alternative the student will have to sit for an oral examination and an exercise on the development/control of a process for the production of a dairy product (without the latter the maximum grade is 24/30).

TEXTBOOKS AND ON-LINE EDUCATIONAL MATERIAL

Course material and handouts will be provided in electronic format during the course and temporarily stored on a document cloud which will be made accessible to the student.

The students are also encouraged to widen their knowledge using textbooks available in the library:

- Mucchetti G, Neviani E (2006). Microbiologia e tecnologia lattiero-casearia. Tecniche nuove

Further readings:

- Marth E H, Steele, JL (2001). Applied dairy microbiology. Marcel Dekker
 - Fox P et al. (2017) Cheese: chemistry, physics, microbiology (2 vol.), Elsevier
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INTERACTION WITH STUDENTS

During the first lecture, the student's knowledge, skills and pre-requisites will be evaluated with a short written examination, and the structure and organization of the course and the evaluation procedure will be presented. The teaching material (slide print-outs, exercises, further hand outs) will be made available to students using a cloud storage system (Dropbox or Google Drive) or made available on a pen drive. The outcome of written examinations will be made available by E-mail.

The lecturer will be available for receiving students at least 4 h a week (on Tuesdays and Wednesdays). The students can also communicate with the lecturer via E-mail.

EXAMINATION SESSIONS (TENTATIVE)¹

13/2/2019, 14/3/2019, 17/4/2019, 15/5/2019, 12/6/2019, 24/7/2019, 18/9/2019, 16/10/2019, 13/11/2019, 11/12/2019, 15/1/2020.

EVALUATION COMMITTEE

Prof. Eugenio Parente (president), Prof. Annamaria Ricciardi (member), Prof. Patrizia Romano (replacement member), Prof. Angela Capece (replacement member)

SEMINARS BY EXTERNAL EXPERTS YES X NO

FURTHER INFORMATION

¹ Subject to possible changes: check the web site of the Teacher or the Department/School for updates.