VNIVERSITAT DE VALÈNCIA

Course Guide
33948 Food Microbiology

COURSE DATA

Data Subject	
Code	33948
Name	Food Microbiology
Cycle	Grade
ECTS Credits	6.0
Academic year	2020 - 2021

Study (s)

Degree	Center	Acad. year	Period
1205 - Degree in Human Nutrition and Dietetics	Faculty of Pharmacy and Food Sciences	1	Second term

Subject-matter

Degree	Subject-matter	Character
1205 - Degree in Human Nutrition and Dietetics	14 - Food microbiology	Obligatory

Coordination

Name	Department
RICO VIDAL, HORTENSIA	275 - Microbiology and Ecology

SUMMARY

The course is structured around two core themes. The first part provides the student with an overview of the microbial world, their diversity and importance as well as an outlook of microbiology as a multidisciplinary basic and applied science. It explores the various aspects of the biology of microorganisms: taxonomy, microbial anatomy, structure/function relationship, metabolism and physiology, growth and its control, genetics, genomics, molecular biology and genetic engineering.

The second module, introduces students to the relationship between the human species and the microbial world, with special emphasis on the significance of microorganisms on health, nutrition and feeding of human beings. With this goal in mind, it addresses the basics of immunology and microbial pathogenesis, and explores the role of microorganisms as food producers, as responsible of food spoilage and as causative agents of foodborne infections and intoxications.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

In order to successfully address this Course, the student must master the fundamentals of subjects such as Biochemistry and Cell Biology

OUTCOMES

1205 - Degree in Human Nutrition and Dietetics

- Gain basic knowledge of the different types of microorganisms.
- Know and understand the criteria for the classification and identification of microorganisms, in particular, the differential physiological and biochemical characteristics of microorganisms of food significance.
- Differentiate between antibiotics and synthetic and semisynthetic chemotherapeutic agents and understand the importance and the genetic basis of microbial resistance to chemotherapeutic agents.
- Isolate pure cultures of microorganisms, evaluate microbial growth and work bearing in mind the aseptic technique and the concept of sterility.
- Master the techniques of cultivation, isolation and identification of microorganisms in food.
- Apply preventive measures against the transmission of foodborne microbial diseases.
- Conocer y manejar las fuentes de información básica relacionadas con la Microbiología.
- Understand the growth of microorganisms, their requirements and the methods for controlling them.
- Understand the basic mechanisms of microbial pathogenicity.
- Understand microbial genetics and the basic applications of genetic engineering in the area of food.
- Know the main sources of microbial contamination of food.
- Know about foodborne pathogenic microorganisms.
- Know and understand the epidemiology of foodborne microbial diseases.
- Know the symptoms and treatment of major diseases caused by eating food contaminated with microorganisms.

LEARNING OUTCOMES

The result of the acquisition of skills described above will be reflected in a range of abilities, competences and skills that will make the student self-reliant to:

- Develop a rationale as well as theoretical and practical arguments about the role of microorganisms in food production, in food spoilage and as source of foodborne infections and food poisoning.

- Design and carry out experiments for detection, isolation and identification of microorganisms in food.

- Understand future advancements and developments that will be occurring in the field of food microbiology.

DESCRIPTION OF CONTENTS

1. BASIC PRINCIPLES OF MICROBIOLOGY

Chapter 1.- Introduction to Microbiology.
The microbial world. Concept of microbe. The science of Microbiology. The historical evolution of Microbiology

Chapter 2.- Microbial Evolution and Diversity.
Origin of life on Earth. Microbial evolution and diversification. Phylogenetic relationships. Types of microorganismes

Chapter 3.- Structure and function of the prokaryotic cell: I- The Cell Envelope.
Morphology and cell size. Cytoplasmic membrane: structure, function and differences between prokaryotic domains. Cell wall architecture in the domain Bacteria: Gram positive, Gram-negative. Cell wall architecture in the domain Archaea. Capsules and mucosal layers. Pili and fimbriae. Flagellum of prokaryotes: structure and mobility. Chemotaxis. Protein secretion.

Chapter 4.- Structure and function of the prokaryotic cell: II Cytoplasmic Inclusions and the cellular matrix.
The cytoplasmic matrix: inclusion bodies, gas vesicles, nucleoid, ribosomes, plasmids. Cellular microcompartments. Bacterial endospores: structure, formation and germination. Comparison between prokaryotic and eukaryotic cells.

2. BASIC PRINCIPLES OF MICROBIOLOGY

Chapter 5.- Nutrition and culture of microorganisms.
Nutritional requirements of microorganisms. Nutritional types. Culture Media: classes and preparation. Aseptic technique and isolation of pure cultures. Cellular uptake of nutrients: Transport and transport systems of the cell membrane.

Chapter 6.- Microbial metabolism.
General concepts, thermodynamic basis and framework of microbial metabolism. Catabolic diversity of the prokaryotic world. Catabolism of chemoorganotrophic heterotrophic microorganisms. Fermentation: concept and characteristics. Alcoholic fermentation. Lactic acid fermentation. Propionic acid fermentation. Fermentation in enteric bacteria. Fermentation in Clostridium spp. Anaerobic respiration: general concepts. Aerobic chemoorganotrophic processes: metabolism of sugars, organic acids, amino

acids and lipids.

Chapter 7.- Microbial growth.
Bacterial cell division. Growth of bacterial populations: the growth curve. Formulation of exponential growth. Continuous culture: the chemostat. Methods of measurement of microbial growth. Influence of environmental factors on growth: temperature, pH, osmotic pressure, oxygen concentration, radiation, pressure. Microbial growth in natural environments. Biofilms.

Chapter8.- Control of microbial growth.
Definition of frequently used terms. Methods of microbial control. Kinetics of microbial death. Variables affecting the efficacy of antimicrobial agents. Physical methods of control: heat, low temperatures, radiation, filtration. Antimicrobial chemicals for external use. Evaluation of antimicrobial efficacy. Antimicrobial chemotherapeutic agents, antibiotics and synthetic antimicrobials. Origin, mechanisms and transmission of antimicrobial drug resistance. Antifungal drugs. Antiviral drugs. Search for new antimicrobials.

3. BACTERIAL GENETICS

Chapter 9.- Fundamentals of bacterial genetics: Genetic organization and mutation
Main characteristics of the processes of DNA replication, transcription and translation in prokaryotes. Mutations: molecular basis, types, effects, mutagens, isolation of mutants. The Ames test.

Chapter 10.- Bacterial genetic recombination
Genetic exchange in prokaryotes: transformation, transduction and conjugation. Plasmids: Concept and types.

4. BASIS OF IMMUNOLOGY AND MICROBIAL PATHOGENESIS

Chapter 11.- Microbial interactions with humans.
Beneficial interactions with humans. Harmful interactions with humans: Pathogenesis of bacterial and viral infections. Virulence. Toxins: exotoxins and endotoxins. Host defenses against infection. Microbial mechanisms to evade host defenses.

Chapter 12.- Basis of immunology.
Cells and organs of the immune system. Innate immunity. Adaptive immunity. Natural immunity. Artificial immunity. Diseases of the immune response. Immunology and clinical diagnostics.

5. MICROBIAL ROLE IN FOOD PRODUCTION, FOOD PRESERVATION, FOOD SPOILAGE AND FOODBORNE DISEASES

Chapter 13.- Introduction to food microbiology.
Influence of human activity Microbiology. Microbiology and food. Food impairment produced by microorganisms. Foodborne illness: food poisoning. Microorganisms and food involved. Mechanisms of action of intestinal pathogens.

Chapter 14.- Factors affecting growth and survival of microorganisms in food.
Intrinsic factors: nutrients, water activity, redox potential, antimicrobial constituents, biological structures. Extrinsic factors: relative humidity, temperature, gaseous atmosphere. Technological treatments. Factors involved.

Chapter 15.- General methods of microbiological analysis of foods.
Principle of food analysis. Sampling and microbiological analysis: general. Microorganisms indicators and indices. Total count of microorganisms: plate count, most probable number, reduced dyes. Microbiological examination of surfaces.

Chapter 16.- Foodborne microorganisms: Gram-positive cocci: Staphylococcus aureus.

Chapter 17.- Foodborne Microorganisms: Cocos and Gram positive spore-forming Bacillus cereus, Clostridium botulinum

Chapter 18- Bacillus Gram positive non-spore, average: Listeria monocytogenes

Chapter 19.- Gram negative aerobic / microaerophilic mobile helical vibroides: Campylobacter

Chapter 20.- Facultative anaerobic gram-negative bacilli. Enterobacteriaceae: Escherichia, Salmonella, Shigella, Yersinia, Enterobacter

Chapter 21.- Facultative anaerobic gram-negative bacilli. Vibrionáceas: Vibrio

Chapter 22.- Virus. Norovirus: Norwalk Virus, Rotavirus, Enetrovirus, Virus, Hepatitis A, Hepatitis E Virus prions

Chapter 23.- Fungi: mycotoxins

6. Practicals

Session 1
- Aseptic technique for inoculation
- Simple staining
- Negative staining
- Study the influence of incubation temperature on bacterial growth
- Study of the skin flora: Demonstration of the presence of mixed populations in nature.
- Preliminary test for the detection of Escherichia coli

Session 2
- Gram stain
- Detection and count of sulphite-reducing Clostridium
- Study the effect of UV light on bacterial growth
- Study of the growth of microorganisms: Media selective, differential and enriched
- Confirmative test for the detection of E. coli

Session 3
- Catalase test
- Oxidase test
- Complementary test for the detection of E. coli
- Counting of viable organisms. Plate count technique
- Inoculation of a miniaturised system for identification of bacteria

Session 4
- Spore staining

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	38,00	100
Laboratory practices	15,00	100
Seminars	2,00	100
Tutorials	2,00	100
Development of group work	9,00	0
Study and independent work	70,00	0
Readings supplementary material	6,00	0
Preparation of practical classes and problem	5,00	0
TOTAL	**147,00**	

TEACHING METHODOLOGY

Theory (4.56 ECTS, 114 hours):

Lectures aimed at providing the student with basic knowledge. Attendance: 38 hours; Preparation and study: 76 hours

Practical Classroom (workshops, problems) (0.44 ECTS, 11 hours):

There will be two seminars on topics provided by the teacher and related to the module. The seminars will be submitted in writing and orally presented by students. Following the oral presentation the work will be opened for discussion among students, and moderated by the teacher. Attendance is mandatory. Attendance: 2 hours; Preparation and study: 9 hours

Laboratory and Computer Sessions (0.8 ECTS, 20 hours):

They will be conducted in small groups and attendance is mandatory. Attendance: 15 hours; Preparation and study: 5 hours

Tutorial Sessions (0.08 ECTS, 2h):

They will be structured in small groups and attendance is mandatory. Students will have the opportunity to ask questions about the course, and provide answers to short questions given beforehand. Attendance: 2 hours

Examinations (0.12 ECTS, 3 hours):

Attendance: 3 hours

TOTAL: 150 hours: 60 hours of attendance, 90 hours out of class

EVALUATION

Students will be assessed on their theoretical knowledge through a test / exam representing 80% of the final grade. The minimum grade to pass the course will be 5 out of 10. **In addition, the exam must be balanced and not present serious deficiencies in concepts or important parts of the course.**

The assessment of laboratory sessions will contribute to the final grade by 10% and it is required at least to obtain a score of 5 out of 10 to pass the course. The mark for laboratory sessions will include a test / exam and the mandatory attendance.

If the student does not pass the theoretical part of the course but has passed the practical part will save the note for the next two academic years

Conducting and attendance the seminars is compulsory and its assessment will contribute to the final grade by 10%.

REFERENCES

Basic

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- Fundamental Food Microbiology. B. Ray & A. Bhunia. (2007) 4th edition. CRC Press, Taylor & Francis Group, Boca Raton. ISBN: 978-0-8493-7529-3

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Additional

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ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

1. Content

The contents initially included in the teaching guide are unchanged.

2. Workload and temporary education planning

The workload for the student, derived from the number of credits, remain unchanged as well. However, the methodology of the activities changes along with the conventional teaching guide as a result of the current situation, which made it necessary to adopt a hybrid model of teaching.

3. Teaching methodology

• Theoretical teaching: will be carried out through synchronous sessions (videoconferences synchronized on BBC, or other technology indicated by the Centre) and face-to-face teaching. The students will be distributed into two groups, 50% of the total number of students in each one. While one group learns in the classroom of the Faculty, the other will connect online, alternating their attendance every week. The classes will always be held following the schedule (date and time) approved by the Center Board.

• Tutoring: All sessions will be held face-to-face according to the dates set by the course calendar.

• Coordinated or uncoordinated seminars: All sessions will be held face-to-face according to the dates set by the course calendar.

• Practical classes: All sessions held face-to-face and according to the calendar of the course, but with the appropriate modifications to comply with the safety regulations against CoVid19. These regulations include:

- Limiting the capacity of laboratories to 50% by setting shifts for each group.

- Use of audiovisual descriptions that serve as a pre-practice introduction (virtual classroom).

- Reducing the time spent on sample processing times by showing the student the result that would be obtained if standard incubation times (24 hours) had elapsed, etc.

If a state of total confinement were to be reached, all face-to-face teaching would be done online.

4. Evaluation

If the evolution of the current pandemic allows it, it will be face-to-face and in the terms indicated in the teaching guide.

Only in case this is not possible, the evaluation will be carried out through the virtual classroom with tasks or online questionnaires with single or multiple choice questions, which can be complemented with short questions and / or on certain occasions through an oral exam through video conferencing. The relative weight of theory, practices and seminars is maintained as indicated in the teaching guide