



Universitat de Lleida

DEGREE CURRICULUM  
**FOOD MICROBIOLOGY AND  
PARASITOLOGY**

Coordination: RAMOS GIRONA, ANTONIO JAVIER

Academic year 2021-22

## Subject's general information

|   |   |               |                  |                  |
|---|---|---------------|------------------|------------------|
| <b>Subject name</b>   | FOOD MICROBIOLOGY AND PARASITOLOGY  |               |                  |                  |
| <b>Code</b>   | 100610  |               |                  |                  |
| <b>Semester</b>   | 2nd Q(SEMESTER) CONTINUED EVALUATION / 1st Q(SEMESTER) CONTINUED EVALUATION   |               |                  |                  |
| <b>Typology</b>   | <b>Degree</b>   | <b>Course</b> | <b>Character</b> | <b>Modality</b>  |
|   | Bachelor's Degree in Human Nutrition and Dietetics  | 2             | COMPULSORY       | Attendance-based |
|   | Double bachelor's degree: Degree Physiotherapy and Degree in Human Nutrition and Dietetics  | 2             | COMPULSORY       | Attendance-based |
| <b>Course number of credits (ECTS)</b>  | 9   |               |                  |                  |
| <b>Type of activity, credits, and groups</b>                                    | <b>Activity type</b>  | PRALAB        | PRAULA           | TEORIA           |
|   | <b>Number of credits</b>  | 4.1           | 0.4              | 4.5              |
|   | <b>Number of groups</b>   | 6             | 2                | 2                |
| <b>Coordination</b>   | RAMOS GIRONA, ANTONIO JAVIER  |               |                  |                  |
| <b>Department</b>   | FOOD TECHNOLOGY   |               |                  |                  |
| <b>Teaching load distribution between lectures and independent student work</b> | <p>The teaching load distribution (90h), will follow the following distribution:<br/> Classroom: 33.33%<br/> Non-classroom class: 66.66%<br/> Independent student work: 135h<br/> If the circumstances derived from the health crisis force to change, this distribution may be modified.</p> |               |                  |                  |
| <b>Important information on data processing</b>                                 | Consult <a href="#">this link</a> for more information.   |               |                  |                  |
| <b>Language</b>   | Spanish and Catalan   |               |                  |                  |
| <b>Distribution of credits</b>  | Credits received by students taught by teachers of the Department of CMB. 4.5<br>Credits received by students taught by teachers of the Department of TECAL. 4.5  |               |                  |                  |

| Teaching staff                 | E-mail addresses               | Credits taught by teacher | Office and hour of attention |
|--------------------------------|--------------------------------|---------------------------|------------------------------|
| ALEGRE VILAS, ISABEL           | isabel.alegre@udl.cat          | 4,5                       |                              |
| BELLÍ MARTÍNEZ, GEMMA          | gemma.belli@udl.cat            | 3,2                       |                              |
| BORRÀS VALLVERDÚ, BERNAT       | bernat.borras@udl.cat          | 2,3                       |                              |
| COLAS MEDA, MARIA DEL PILAR    | pilar.colas@udl.cat            | 1,1                       |                              |
| DE LA TORRE RUIZ, M. ANGELES   | mariaangeles.delatorre@udl.cat | 5,1                       |                              |
| NICOLAU LAPEÑA, IOLANDA        | iolanda.nicolau@udl.cat        | 1,5                       |                              |
| PUJOL CARRION, NURIA           | nuria.pujol@udl.cat            | 8,3                       |                              |
| RAMOS GIRONA, ANTONIO JAVIER   | antonio.ramos@udl.cat          | 4,1                       |                              |
| VIÑAS ALMENAR, M.INMACULADA C. | inmaculada.vinas@udl.cat       | 4,3                       |                              |

## Subject's extra information

This course introduces students into the microbial world (viruses, bacteria, fungi, protozoa and helminths), presenting basics about their structure, physiology, genetics and pathogenicity, and making a special impact on microbiology and parasitology of each food group, addressing issues such as spoilage, pathogens and toxicology, prophylaxis and the effect of the main conservation methods used to control food microorganisms.

## Learning objectives

This course introduces students into the microbial world (viruses, bacteria, fungi, protozoa and helminths), firstly presenting basics about their structure, physiology, genetics and pathogenicity, and then make a special emphasis on microbiology and parasitology of each group of food, with a special interest in the way by which alterations occur, key food pathogens, toxicology, prophylaxis and the effect the main conservation methods used on microorganisms.

## Competences

### Basic skills

CB3 That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant social, scientific or ethical issues. Specific skills

### Specific skills

CE13 Knowing the microbiology, parasitology and toxicology of foods.

### General skills

CG4. Communicate effectively, both orally and in writing, with people, health professionals or industry and the media, knowing how to use information and communication technologies, especially those related to nutrition and lifestyle habits.

### Transversal skills:

CT5. To acquire essential notions of scientific thinking.

CT2 Mastering a foreign language

## Subject contents

### PART 1. General Concepts of Microbiology (22 hours)

Unit 1.- The prokaryotic cell. Bacterial morphology and sizes. The plasma membrane. The cell wall of Gram-positive and Gram-negative bacteria. The bacterial chromosome and ribosomes. Bacterial capsule and other external structures. Bacterial movement. Reserve materials. The endospore.

Unit 2. The eukaryotic cell. Differential properties regarding the prokaryotic cell. Endosymbiont theory. The hydrogenosome. Cytoplasmic organelles. The fungal cell. The protozoan cell.

Unit 3. Bacterial genetics. The bacterial chromosome. Mutagenesis. Conjugation. Transformation. Transduction. Plasmids: concept and types. Transposons.

Unit 4. Microbial metabolism. Energy sources. Nutritional requirements. Culture media, types and preparation techniques. Breathing. Fermentations. Growth curve. Regulation of microbial metabolism: enzyme reactions, regulation final product, catabolite repression, metabolic pathways.

Unit 5. Control of microbial growth. Action of physical and chemical agents. Microbial resistance to cold and heat. Action of moisture and microbial needs. Chemicals. Antibiotics. Antifungals. Microbicides. Preservatives.

Unit 6. Virology. General characteristics. Viruses. Viral infections of the digestive tract.

Unit 7. Human Microbiology. Bases of microbial pathogenicity. Microbial flora of the human body. Opportunistic flora. Infection and disease. Invasiveness, pathogenicity and virulence. Virulence factors and pathogenic mechanisms. Exotoxins and endotoxins. Constitutive defense mechanisms.

Unit 8. Immunology. Immunity to microbial infections. Vaccines.

### PART 2. Food Microbiology (14 hours)

#### I. NATURAL SPOILAGE AND GENERAL PRINCIPLES OF FOOD MICROBIAL ALTERATION

Unit 9. Natural food contamination. Origin of microbial contamination of food and food products. The food handler

as a source of contaminación. Microbiological monitoring of the environment.

Unit 10. General principles of food spoilage. Intrinsic factors: water activity ( $a_w$ ), pH, redox potential, nutrients, antimicrobials, structure and composition of food and protective barriers. Extrinsic factors: temperature, humidity, gaseous atmosphere. Technological treatments. Implicit factors. Interaction of factors, synergisms and antagonisms.

## II. MICROBIOLOGY OF DIFFERENT KINDS OF FOOD

Unit 11. Microbiology of drinking water. Native and non-native microbiota. Types of water. Microbiological parameters that determine water quality. Major pathogens: disease and epidemiology. Purification and distribution of water for human consumption.

Unit 12. Microbiology of plant products. Microbiological alteration of: i) cereals, flours and derivatives, ii) fruits, juices, vegetables and derivatives. Major foodborne pathogens.

Unit 13. Microbiology animal products Microbiological alteration of: i) meat and meat products, ii) poultry iii) eggs and egg products, iv) dairy products, v) fish and other foods of aquatic origin. Major foodborne pathogens.

Unit 14. Microbiology of canned foods. Canned foods: definition and types. Classification of canned foods according to their acidity. Biological sterility and commercial sterility. Major pathogens and cause alterations in canned foods. Major alterations and origin. Systematic review of preserves and microbiological analysis.

### PART 3. Food Parasitology (9 hours)

Unit 15. Introduction to Parasitology. Definition. Adaptations to parasitism. Effects of the parasite on the host. Host reaction against the parasite. Parasites and host weakened. Economic significance of contamination by parasites.

Unit 16. Main parasites transmitted by water and plants. Relationship between fecal contamination, water and plant food. *Entamoeba histolytica*, *Giardia*, *Cryptosporidium* sp, *Blastocystis hominis*, *Fasciola hepatica*, *Echinococcus* sp, *Enterobius vermicularis*, *Ascaris lumbricoides*. Taxonomy. Morphology. Life cycle. Symptomatology.

Epidemiology. Routes of contamination of food. Prevention and control. Situation in Spain.

Unit 17. Main parasites transmitted by meat and fish. *Toxoplasma gondii*, *Taenia* sp., *Trichinella spiralis*, *Anisakis* sp. Life cycle. Symptomatology. Epidemiology. Routes of contamination of food. Prevention and control. Situation in Spain.

### Seminars (2 hours)

1. Applications of microbiology in human nutrition and health.
2. Vaccines.

### Laboratory practical lessons (total 41 hours):

#### PART I (19 hours)

Practice 1: Preparation of different culture media. The use and interpretation of differential culture media.

Practice 2: Making a throat swab and isolation of different living organisms. Characterization of different types of microbial colonies. Identification of hemolytic toxin producing bacteria.

Practice 3: Identifying other mechanisms of toxicity carried out by pathogenic bacteria catalase activity.

Practice 4: Identification, to species level, of two different bacteria by biochemical tests (Enterotube gallery).

Practice 5: Test of antibiotic activity.

Practice 6: Analysis of disinfectants.

Practice 7: Immunodetection of a pathogen.

Practice 8: Microbial stains.

Practice 9: Isolation of a plasmid.

Practice 10: Microbial growth curve.

#### PART II (22 hours)

Practice 11: Introduction to a Food Microbiology laboratory and sample preparation

Practice 12: General counting of microorganisms:

Aerobic plate count at 30 ° C.  
 Count of molds and yeasts.  
 Observation and identification of filamentous fungi.  
 Enterobacteriaceae and Kligler test.  
 Anaerobic microorganisms.  
 Coagulase positive staphylococci.  
 Enterococci counts.  
 Interpretation and report of results.  
 Resolution of practical cases.

Practice 13: Observation of food parasites under microscope.

It is MANDATORY that students have the following individual protection teams (EPI) in the course of teaching practices.

Lab coat  
 Safety glasses  
 Gloves for chemical / biological protection

Sanitary masks

The EPI can be purchased at UdL's ÚDELS store

Center for Cultures and Cross-Border Cooperation - Cappont Campus

Carrer de Jaume II, 67. 25001 Lleida

## Methodology

Due to the special circumstances derived from the health crisis caused by COVID-19, this subject will have both face-to-face classes and virtual teaching.

## Development plan

### Bachelor's Degree in Human Nutrition and Dietetics (FIRST SEMESTER-Lleida)

Course 2021-2022

| Day              | Day | Hour   | Kind of activity | Classroom | Teachers |
|------------------|-----|--------|------------------|-----------|----------|
| <b>SEPTEMBER</b> |     |        |                  |           |          |
| Monday           | 13  | 15-17h | Theory           | 0.02      | CMB-MG   |
| Wednesday        | 15  | 17-19h | Theory           | 0.02      | CMB-MG   |
| Thursday         | 16  | 17-19h | Theory           | 0.02      | CMB-MG   |
| Monday           | 20  | 15-17h | Theory           | 0.02      | CMB-MG   |
| Wednesday        | 22  | 15-17h | Theory           | 0.02      | CMB-MG   |
| Thursday         | 23  | 17-19h | Theory           | 0.02      | CMB-MG   |
| Monday           | 27  | 15-17h | Theory           | 0.02      | CMB-MG   |
| Thursday         | 30  | 17-19h | Theory           | 0.02      | CMB-MG   |
| <b>OCTOBER</b>   |     |        |                  |           |          |

|                 |    |        |                 |                     |                  |
|-----------------|----|--------|-----------------|---------------------|------------------|
| Monday          | 4  | 15-17h | Theory          | 0.02                | CMB-MG           |
| Thursday        | 7  | 17-19h | Theory          | 0.02                | CMB-MG           |
| Monday          | 11 | 15-17h | Theory          | 0.02                | CMB-MG           |
| Thursday        | 14 | 15-17h | Theory          | 0.02                | MA-I.Viñas       |
| Monday          | 18 | 17-19h | EXAM            |                     |                  |
| Monday          | 25 | 8-12h  | Practs. group A | 0.03/2.05/2.10/2.06 | CMB-MG           |
| Tuesday         | 26 | 8-12h  | Practs. group A | 0.03/2.05/2.10/2.06 | CMB-MG           |
| Wednesday       | 27 | 8-12h  | Practs. group A | 0.03/2.05/2.10/2.06 | CMB-MG           |
| Thursday        | 28 | 12-14h | Practs. group A | 2.05/2.06/2.10      | CMB-MG           |
|                 |    | 17-19h | Theory          | 0.02                | MA-I.Viñas       |
| Friday          | 29 | 12-14h | Practs. group A | 2.05/2.06/2.10      | CMB-MG           |
| <b>NOVEMBER</b> |    |        |                 |                     |                  |
| Thursday        | 4  | 15-17h | Theory          | 0.02                | MA-I.Viñas       |
| Friday          | 5  | 15-17h | Seminari        | 0.02                | CMB-MG           |
|                 |    | 17-19h | Seminari        | 0.02                | CMB-MG           |
| Monday          | 8  | 9-13h  | Practs. group B | 0.03/2.05/2.10/2.06 | CMB-MG           |
|                 |    | 15-17h | Theory          | 0.02                | MA-I.Viñas       |
| Tuesday         | 9  | 9-13h  | Practs. group B | 0.03/2.05/2.10/2.06 | CMB-MG           |
|                 |    | 15-17h | Theory          | 0.02                | MA-I.Viñas       |
| Wednesday       | 10 | 9-13h  | Practs. group B | 0.03/2.05/2.10/2.06 | CMB-MG           |
| Thursday        | 11 | 9-13h  | Practs. group B | 0.03/2.05/2.10/2.06 | CMB-MG           |
|                 |    | 17-19h | Theory          | 0.02                | MA-I.Viñas       |
| Friday          | 12 | 9-13h  | Practs. group B | 0.03/2.05/2.10/2.06 | CMB-MG           |
| Monday          | 22 | 17-19h | EXAM            |                     |                  |
| <b>DECEMBER</b> |    |        |                 |                     |                  |
| Friday          | 10 | 15-16h | Theory          | 0.02                | PA-AJ. Ramos     |
|                 |    | 16-17h | Theory          | 0.02                | MA-I.Viñas       |
| Monday          | 20 | 15-17h | Theory          | 0.02                | PA-AJ. Ramos     |
| <b>JANUARY</b>  |    |        |                 |                     |                  |
| Monday          | 10 | 15-17h | Theory          | 0.02                | PA-AJ. Ramos     |
| Monday          | 17 | 15-20h | Practs. Group A | ETSEA               | I.Viñas/AJ.Ramos |
| Tuesday         | 18 | 15-20h | Practs. Group A | ETSEA               | I.Viñas/AJ.Ramos |
| Wednesday       | 19 | 15-20h | Practs. Group A | ETSEA               | I.Viñas/AJ.Ramos |
| Thursday        | 20 | 15-20h | Practs. Group A | ETSEA               | I.Viñas/AJ.Ramos |
| Friday          | 21 | 15-20h | Practs. Group A | ETSEA               | I.Viñas/AJ.Ramos |
| Monday          | 24 | 9-14h  | Practs. Group B | ETSEA               | I.Viñas/AJ.Ramos |
|                 |    | 15-17h | Theory          | 0.02                | PA-AJ. Ramos     |

|                |    |        |                 |       |                  |
|----------------|----|--------|-----------------|-------|------------------|
| Tuesday        | 25 | 9-14h  | Practs. Group B | ETSEA | I.Viñas/AJ.Ramos |
| Wednesday      | 26 | 9-14h  | Practs. Group B | ETSEA | I.Viñas/AJ.Ramos |
|                |    | 15-17h | Theory          | 0.02  | PA-AJ. Ramos     |
| Thursday       | 27 | 9-14h  | Practs. Group B | ETSEA | I.Viñas/AJ.Ramos |
| Friday         | 28 | 9-14h  | Practs. Group B | ETSEA | I.Viñas/AJ.Ramos |
| Monday         | 31 | 17-19h | EXAM            |       |                  |
| <b>FEBRERO</b> |    |        |                 |       |                  |
|                |    |        |                 |       |                  |

**Note:** CMB: teaching assigned to the Dept. of Basic Medical Sciences. I. Viñas & AJ Ramos: teachers assigned to the Dept. of Food Technology

MG: General Microbiology; MA (Food Microbiology); PA (Food Parasitology)

### **Bachelor's Degree in Human Nutrition and Dietetics (SECOND SEMESTER- IGUALADA)**

| MONTH    | DAY                 | HOUR                   | SUM OF HOURS | CLASS               | NOTES         |
|----------|---------------------|------------------------|--------------|---------------------|---------------|
| FEBRUARY | 10                  | 9-11 h y 11.30-13.20 h | 4 T          | THEORY              | CMB-MG (4H)   |
|          | 17                  | 9-11 h y 11.30-13.20 h | 8 T          | THEORY              | CMB-MG (4H)   |
|          | 24                  | 9-11 h y 11.30-13.20 h | 12 T         | THEORY              | CMB-MG (4H)   |
|          | 28 february-4 march | 15.00-19.30h (20h)*    | 20 P         | MG PRACTICES        | CMB-MG        |
| MARCH    | 3                   | 9-11 h y 11.30-13.20 h | 16 T         | THEORY              | CMB-MG (4H)   |
|          | 10                  | 9-11 h y 11.30-13.20 h | 20 T         | THEORY              | CMB-MG (4H)   |
|          | 17                  | 9-11 h y 11.30-13.20 h | 4 S          | CLASSROOM PRACTICES | CMB-MG (4H)   |
|          | 24                  | 9-11                   | 22 T         | THEORY              | CMB-MG (2H)   |
|          | 31                  | 9-11 h y 11.30-13.20 h | 26 T         | THEORY              | TECAL-MA (4H) |
| APRIL    | 7                   | 9-11 h                 | --           | FIRST EXAM (MG)     | CMB-MG        |
|          | 7                   | 11.30-13.20 h          | 28 T         | THEORY              | TECAL-MA (2H) |
|          | 21                  | 9-11 h y 11.30-13.20 h | 32 T         | THEORY              | TECAL-MA (4H) |



|      |              |                        |      |                       |                |
|------|--------------|------------------------|------|-----------------------|----------------|
|      | 28           | 9-11 h y 11.30-13.20 h | 36 T | THEORY                | TECAL-MA (4H)  |
| MAY  | 5            | 9-11 h                 | --   | SECOND EXAM (MA)      | TECAL-MA (4H)  |
|      | 5            | 11.30-13.20 h          | 38 T | THEORY                | TACAL-PA (2H)  |
|      | 12           | 9-11 h y 11.30-13.20 h | 42 T | THEORY                | TECAL-PA (4H)  |
|      | 19           | 9-11 h y 11.30-13.20 h | 46 T | THEORY                | TECAL-PA (4H)  |
|      | To determine | 15.00-19.30h (16 h)*   | 36 P | TECAL PRACTICES (MA)  | TECAL-MA       |
|      | 26           | 9-11 h y 11.30-13.20 h | 40 P | TECAL PRACTICES (PA)  | TECAL-PA       |
| JUNE | 6            |                        | --   | THIRD EXAM (PA+pràct) | TECAL-PA       |
|      | 22           |                        | --   | RECOVERY EXAM         | ALL (MG/MA/PA) |

**Note:** CMB: teaching assigned to the Dept. of Basic Medical Sciences. TECAL: teaching assigned to the Dept. of Food Technology

MG (General Microbiology); MA (Food Microbiology); PA (Food Parasitology)

T: theory, P: practices; S: classroom practices

\*Included half hour of rest

### **Exams:**

**First exam, part CMB: April 7.**

**Second exam, part MA: May 5.**

**Third exam, part PA+pràctiques: June 6.**

**Complete subject recovery: June 22.**

## Evaluation

### **Theory and practice:**

The topic is evaluated continuously. To do this, 4 exams throughout the semester are made. Usually exams follow the same pattern: a test of theory and a set of short questions. The evaluation of practical lessons may include large questions and/or test questions.

Each exam has the following value:

Exam 1: group work and collective public presentation, through videoconference, of the theory of General Microbiology..Value: 25% of the course.

Exam 2: questions of practice of General Microbiology. Value: 15% of the course.

Exam 3: questions of theory of Food Microbiology. Value: 15% of the course.

Exam 4: questions of theory of Food Parasitology + questions of practices of Food Microb. and Parasitology. Value 25% of the course.

In any case, to pass the subject, **each of the 4 exams must obtain at least 4.0** (out of 10) so that the grades obtained in the 4 exams can be averaged and the final grade of the subject can be calculated, together with the rest of the evaluation elements.

For the evaluation of the seminars, students must carry out group work and present the results publicly through the Virtual Campus videoconference tool. Attendance control will be carried out, and the public presentation and a written summary of the seminar will be evaluated (10% of the final grade).

The students must submit a memory of the practices carried out in the Microbiology and Food Parasitology part, individually or in pairs (and exceptionally in trios, with previous approval of the teacher), in which the exercises performed are recorded, as well as the critical discussion of the results. For the realization of this memory, the criteria explained in the document "Check-list y rúbrica memoria de prácticas", available in the "Resources" section of the subject space in the Virtual Campus, must be taken into account. The value of each element that forms the memory is indicated. This document must be submitted signed by the authors together with the report. In the memory it is necessary to obtain a minimum of 40 points over 100 so that the grade can be averaged with the grades obtained in the rest of the evaluation elements of the subject. Memory value: 10% of the subject.

Practices and seminars are of **compulsory attendance**. In the case of the practices, only a percentage of absences of 10% of the total hours for this concept will be allowed, provided that it is for a justified reason (in case of illness, medical evidence must be delivered).

In the event that, due to the circumstances derived from the health crisis, laboratory practices could not be carried out, they will be replaced by works on microbiological analysis methods whose weight in the evaluation will be equivalent.

According to the indications received from the Degree Coordination, students who fail the course may, in the following courses:

A) If they have approved the sections of seminars and practices, the student will have to decide within 1 week after the start of the course between:

- Present only to the theoretical evaluations included in the academic calendar of the corresponding course, being your final grade for that course the grade obtained in the theoretical evaluations according to the criteria of each subject. If you fail these theoretical evaluations, you may have the possibility of recovering the subject with a single evaluation (2nd call) where the grade obtained in this exam will correspond to the final grade for the course, or

- Carry out the complete evaluation, including seminars, practicals, theoretical exams, etc., which must be attended and evaluated.

B) If a student fails the subject and does not justify a minimum attendance (90%) and a minimum grade (4.0 out of 10) in the sections of seminars and practices, they must pass these sections during the following course, and the criteria will be those applied if you are completing the subject for the first time.

## Bibliography

### A) BASIC BIBLIOGRAPHY

- Frazier, W.C. y D.C. Westhoff. (1993). Microbiología de los alimentos. Acribia, Zaragoza.
- I.C.M.S.F. (1983). Ecología microbiana de los alimentos. Vol I.: Factores que afectan a la supervivencia de los microorganismos en los alimentos. Acribia, Zaragoza.
- I.C.M.S.F. (2001). Microorganismos de los alimentos 6. Ecología microbiana de los productos alimentarios. Acribia, Zaragoza.
- MADIGAN, M., MARTINKO, J. y PARKER, J. (2003). Brock Biología de los Microorganismos. 10ª Edición. Ed. Prentice-Hall. Madrid.
- MARKELL, E.K., VOGEL, M. y JOHN, D.T. (1990). Parasitología Médica. Editorial Interamericana×McGraw-Hill.
- PRESCOTT, L.M, HARLEY, J.P y KLEIN, D.A (2004). Microbiología. McGraw-Hill Interamericana, Madrid.

#### B) COMPLEMENTARY BIBLIOGRAPHY

- ACHA, P.N. y SZYFRES, B. (1989). Zoonosis y enfermedades transmisibles comunes al hombre y a los animales. Organización Panamericana de la Salud.
- ALLAERT, C. y ESCOLÀ, M. (2002). Métodos de análisis microbiológicos de los alimentos. Díaz de Santos, Madrid.
- Jay, J.M. (2002). Microbiología moderna de los alimentos. Acribia, Zaragoza.
- MOSSEL, D.A.A., J.E.L. CORRY, C.B. STRUIJK *et al.* (1995). Essentials of the microbiology of foods. A textbook for advanced studies. John Wiley & Sons, Chichester.
- Mossel, D.A.A. y B. Moreno. (1985). Microbiología de los alimentos: fundamentos ecológicos para garantizar y comprobar la inocuidad de los alimentos. Acribia, Zaragoza.