



## Programas de Internacionalización Study Abroad 2021

**Course title:** Microorganisms, Biotechnology and Sustainability. The power of the Unseen

**Teaching period:** July 5 to July 30, 2020

**Teaching hours:** 80

**Academic coordinators:** María José López López y Francisca Suárez Estrella

**Knowledge area:** Biotechnology/Microbiology/Environmental Science

### 1. INTRODUCTION *[around 300 words]*

The importance of microorganisms is undeniable. They are the origin of life on Earth, in fact, they constitute the bulk of their biomass, and carry out chemical reactions necessary for higher organisms, to the point that without them they could not exist, since they also take care of recycling of the fundamental nutrients and the degradation of organic matter.

On the other hand, the field of Biotechnology is closely linked to Microbiology, since the first processes of production of substances of interest to humans (currently encompassed in studies with a biotechnological approach) were developed thanks to prior knowledge about the microbial world. In short, microorganisms play a leading role in this applied branch of science and, especially, in the so-called White Biotechnology, in which microorganisms or products derived by them, like enzymes, are used for their subsequent application in different industries.

As if this were not enough, the term Biotechnology is attributed to an agronomist, Károly Ereki, who coined it for the first time in a book dedicated to agri-food production. The fact that the well-known father of biotechnology is an engineer specialized in the field of agriculture is not random, since, together with other basic and applied sciences, agronomic engineering and food technology represent two of the pillars in which biotechnology is based.

Bearing in mind that the University of Almeria is a world-renowned reference in the development of technologies associated to agriculture and the environment. And the research groups that make up this institution, among which we are, are specialized in the application of biotechnological tools for the solution and improvement of environmental and agricultural problems, always from a sustainable point of view. This course, eminently practical, is successfully integrated as a supplement for the knowledge of different areas such as agricultural engineering, environmental microbiology, ecology, biotechnology and environmental and natural sciences, among others.

### 2. OBJECTIVES

1. To study global climate change and the increase of greenhouse effect, caused by



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anthropogenic action, through the observation of variations suffered by microbial populations.

2. To study different techniques for the exploitation, reduction and recovery of waste through the use of environmental microorganisms, especially composting because it is a sustainable technique, economically and ecologically.

3. To study the biotechnological potential of environmental microorganisms, in particular, those isolated from composting piles, as potential producers of antibiotics and substances with an interest on agriculture.

4. To study the obtaining of microbial products and by-products related to the agri-food industry.

### 3. CONTENT

Modules	Description
<b>MODULE A</b> <i>Environmental microorganisms: allochthonous and autochthonous microorganisms</i>	<ul style="list-style-type: none"> <li>• Introduction to microbial biotechnology.</li> <li>• Impact of anthropogenic activity on the environment from the microbiological point of view.</li> <li>• Study of the microorganisms involved in the biogeochemical cycles: global climate change and greenhouse effect.</li> <li>• Microorganisms as indicators of environmental pollution: environmental and hygienic-sanitary implications.</li> </ul>
<b>MODULE B</b> <i>Microbial utilization for treatment of contaminated environmental samples and organic waste</i>	<ul style="list-style-type: none"> <li>• Problems associated to Organic waste: environmental impact and European regulations.</li> <li>• Study of the different techniques and processes for the use of organic waste: biomethanization, silage, composting, biofuels, MFC, etc.</li> <li>• Composting: from tradition to applied biotechnology. Definition, historical context, development of the fundamental stages and the importance of microorganisms in the process.</li> </ul>
<b>MODULE C</b> <i>Biotechnological potential of microorganisms isolated from</i>	<ul style="list-style-type: none"> <li>• Importance of environmental microorganisms in applied biotechnology.</li> <li>• Searching for new antibiotic producers in environmental samples.</li> <li>• Microorganisms with interest in agriculture and the food industry.</li> </ul>



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<i>composting</i>	
<b>MODULE D</b> <i>Application of microorganisms in obtaining food or by-products</i>	<ul style="list-style-type: none"> <li>• Food microbiology: history and new products.</li> <li>• Products and by-products of the agri-food industry made from microorganisms.</li> <li>• Conservation techniques applied to microorganisms and with feeding origin (lyophilization, cryogenization and alginate).</li> </ul>

#### 4. METHODOLOGY [200-250 words]

All the thematic lines described in the previous section, will be carried out from a practical point of view. Each session will consist of an explanation with a theoretical basis, necessary for the understanding of the contents, after which a series of practical procedures related to the subject taught will be applied.

Taking into account the possible different profiles of the students, the first session will consist of a general approach about the peculiarities of working in a microbiology laboratory: work in aseptic conditions, sterilization and disinfection techniques, preparation of culture media, techniques of pure cultivation, etc. The rest of the work of that first week would try to characterize the autochthonous microorganisms from an specific environment, making tests that relate them to the cycles of the fundamental elements (C, S, P and N) and allochthonous, that is, those that do not belong to that environment and verify the existence of polluting residues (bio-indicators of fecal contamination). During the next module, composting piles at laboratory scale will build up, which will serve as a source of microorganisms. That is, we will use that microhabitat to isolate the strains with which we will later undergo a series of biochemical tests that will allow us to characterize them as possible producers of substances of biotechnological interest. With those strains that show the best results, an *in planta* test will be carried out. Finally, in the last week, *in vitro* elaboration of foods and other products used in the agri-food industry processed from microorganisms (beer, bread, yogurt, xanthan and SCP) will take place.

The course will be taught in Spanish and/or English (depending on the demand).

#### 5. PROFESSIONAL VISITS AND COMPLEMENTARY ACADEMIC ACTIVITIES

There will be two visits related to the topics taught in the course, specifically, to an organic waste treatment plant (Ejido Medioambiente) where some of the technologies that will be explained during module 2 are carried out, specifically composting treatments; and a biological control company (Koppert), related to the thematic lines explained in module 3. Likewise, two



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talks will be held by two experts related to the aforementioned business sectors.

### 6. ASSESSMENT

At the end of the course, students will summarize their work including the results obtained in the laboratory, with the advice of the teaching staff, so they will acquire the capacity to interpret and discuss results based on the scientific bibliography related to the studied topics.

### 7. LECTURERS

**María José López López** is Professor of Microbiology at the University of Almeria since 2002, with teaching in many subjects related to Microbiology to both undergraduate and postgraduate students. She is the author of two books and almost 70 articles published in international journals. She has directed more than 30 final degree projects and 4 Doctoral Theses. Principal Investigator of 3 national research projects, 3 European and 1 with the United States. She is a member of the Spanish Composting Network (REC).

**Francisca Suárez Estrella** teaches at the University of Almeria (UAL) since 1998. PhD in Biology since 2001 and currently hired under the title of Associate Professor in the area of Microbiology at UAL. Her research activity within the BIO-175 Group focuses on the study of microorganisms isolated from composting processes with agricultural applications such as biopesticides and biostimulants. She has co-authored 40 scientific articles of international journals, 11 chapters of scientific books and 2 patents. She has co-directed various research projects and contracts, and 3 Doctoral Theses, one of which is still in the implementation phase.

**Juan Antonio López González** holds a Ph.D. in Agricultural Engineering from the University of Almeria with a Master in Research in Treatment, Management and Valorization of Organic Waste at the Miguel Hernández University. He is currently an Assistant Professor of Microbiology at the University of Almería. He has participated in eight research projects, such as contracted research staff, interns or postdoctoral researcher. The twenty one articles in which he has worked as an author or co-author have been published in prestigious international journals. The presentation of almost seventy communications to congresses, fifteen of them of an international nature, deserves a special mention.

**Macarena del Mar Jurado Rodríguez** is a PhD in Agronomy Engineering since 2015 and with links to the BIO-175 Group of the University of Almería (UAL) since 2010, with which she has participated as a contracted staff in charge of ten research projects, 2 national and 8 European. Currently, with the contractual figure of Assistant Professor, teaches classes in



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different subjects of the Microbiology Area of the UAL. She has participated as author and co-author in 18 scientific articles, published in international impact journals, as well as in some 50 communications to national and international congresses. She also has participated in several scientific divulgation activities such as Pint of Science or Researcher's Night.

**María José Estrella González** is a PhD in Biochemistry since October of 2020. In the last three years, she had been links to the BIO-175 Group of the University of Almería (UAL) with a FPI contract associated to the project AGL2015-64512-R. Nowadays, she has a POP contract for six months and she teaches classes in different subjects of the Microbiology Area of the UAL. She has participated as author and co-author in 6 scientific articles, published in international impact journals, as well as in some 15 communications to national and international congresses. In addition, she has organized scientific dissemination events such as Pint of Science and scientific dissemination activities associated with the projects of the research group.

**Ana Belén Siles Castellano** has a Degree in Chemistry from the University of Almería, with a master's degree in Pesticide Residues, Contaminants and Food and Environmental Control. She has worked in companies dedicated to the quality control of different types of samples. At present she is doing her PhD in Biotechnology and Industrial Processes, in the Group BIO-175 of the University of Almería, where she has participated as hired personnel in 2 European projects. She has participated as author and co-author in 6 scientific articles, published in journals of international impact, as well as in 12 communications to national and international conferences.

**María Rosa Martínez Gallardo** is a PhD student in Biotechnology and Industrial Bioprocess since 2018 and with links to the BIO-175 Group of the University of Almería (UAL) since 2019, with which she has participated as a contracted staff in charge of three international research projects financed with European funds. Currently, with the contractual figure of researcher collaborating in the running of Recover project at the Microbiology Area of the UAL. She has participated as author and co-author in 3 scientific articles, published in international impact journals, as well as in some 20 communications to national and international congresses.

**Ana J. Toribio Gallardo** has a degree in Biochemistry. She was awarded a pre-doctoral scholarship to train research staff of the Ministry in the Department of Applied Biology, Area of Genetics, where she obtained the Diploma of Advanced Studies (D.E.A.) in the field of Biotechnology and taught as a trainee teacher during that period. Hired by companies in the Almerian agro-food sector Savia Biotech S.A. and Coexphal as research staff participating in I+D projects for the development of Molecular Diagnostic Methods and control of microbial rot during post-harvest handling, in the Department of Plant Pathology and Microbiology. Since 2018, she has been linked to the BIO-175 Group of the University of Almería (UAL), with which she has participated as contract personnel in two research projects and is currently working on her Doctoral Thesis in the research line "Antagonism and suppression of



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phytopathogenic microorganisms, especially focused on the search for biological control agents from natural substrates.

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