KNOW-HOW IN MOLECULAR MICROBIAL ECOLOGY

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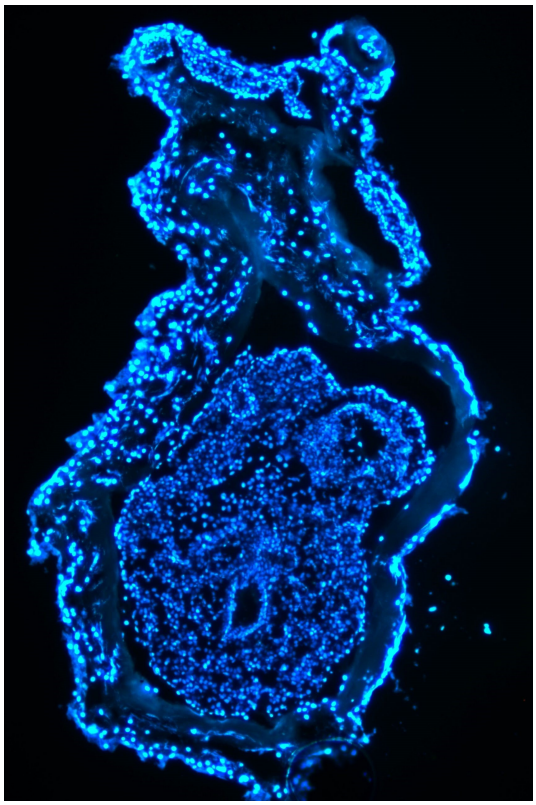
ABSTRACT

The Molecular Microbial Ecology group is devoted to the study of diversity, ecological role and function of microbes –prokaryotes and their viruses and microbial eukaryotes as well- from different environments including hypersaline, marine and other aquatic environments and human or animal microenvironments.

TECHNICAL DESCRIPTION

The Molecular Microbial Ecology group started its trajectory addressing different aspects of the microbial ecology of hypersaline environments and the microbiota of marine invertebrates, by using different culture dependent and independent approaches. The group has grown and diversified in four Principal Investigators laboratories whose research topics, although different, are interconnected.

What joins the different research topics and laboratories of the group is not only their passion to **unveil the `dark microbial matter´** (unculturable microorganisms) **and microbial function** without forgetting the power of culture in microbiology but it pursues their aims **from an ecogenomic holistic view** including multidisciplinary approaches and -omics techniques, from culturomics to metagenomics or single-cell and-virus genomics, imaging techniques and other complementary advanced technologies. Taking this as the axis and compass of the group, the different **on-going research topics** "walks on diverse, but common interconnected paths":



- **Marine environments:**
  - o Diversity and function of microbial marine symbionts
  - o *Vibrio* coral pathogens and their viruses
  - o Marine aquatic microbial ecology and virology
  - *o Micro-diversity of Pelagibacter and their viruses*
  - o Microbial communities of Mar Menor sediments
- **Hypersaline environments:**
  - o Ecology and evolution of microbes from hypersaline environments and their viruses
  - o *Salinibacter* and its viruses as model system
- **Other systems:**
  - o Microbiology and Virology of drinking water wastewater and spread of antibiotic resistance genes by wastewater microbes
  - o Animal and Human Microbiome studies
  - o Biofilms in drinking water systems
- **Virology:**
  - o Viruses of the world: from the Antarctic to other remote environments
  - o Control of virus-host interactions
  - o Microfluidics as a tool in microbial ecology

ADVANTAGES AND INNOVATIVE ASPECTS

MAIN ADVANTAGES OF THE TECHNOLOGY

Microorganisms play an essential role in the biosphere, since they participate in all biogeochemical cycles. They are present in all places where life can exist, in the most diverse environments, even in extreme conditions of temperature, pH or salinity.

By means of the application of molecular techniques, we can study microbiomes and pathobiomes. Said studies allow the identification of changes in bacterial and viral diversity, as well as in microorganism community structures, their interrelation and function. Such changes are useful indicators for assessing the impact that climate change, pollution and other anthropogenic activities have on microbial communities.

INNOVATIVE ASPECTS AND CURRENT STATE OF DEVELOPMENT

Metagenomics allows the identification of microorganisms that are present in samples directly collected from the environment, including unculturable microorganisms. The main advantage of metagenomics over culture-dependent techniques, is that the latter only allow the isolation of microorganisms that may represent barely a small fraction of bacterial and viral inhabitants in natural environments.

However, in microorganism communities made up of closely related strains, the proper identification of microorganisms by means of metagenomics analysis can become a trouble. Furthermore, this technology has limitations in the identification of viral populations. Said challenges can be overcome by means of single-cell genomics techniques, which our group has adapted to viral communities. In this novel technique, single cells or viruses are sorted by flow cytometry, enabling the analysis of their genome and/or proteome individually.

Moreover, the application of microfluidics in molecular techniques has allowed the volumes of samples required for molecular microbial ecology studies to be considerably reduced.

MARKET APPLICATIONS

Our developments have application, among others, in the following sectors:

Environmental sector: Changes in bacterial and viral diversity and in microorganism community structures are useful indicators for assessing the environmental impact of anthropogenic activities, such as fish farming, as well as of the effect of global warming in ecosystems.

Medicine and Health: Gut microbiota has proved to play a key role in the effectiveness of therapies against diseases such as cancer. Therefore, knowledge on human microbiome, e.g., associated to gut, skin or lungs, can be crucial in the development of new therapies. In addition, the development of antibiotic resistance genes by pathogenic microorganisms is a problem of increasing concern. Early identification of these genes and their possible spread, for example through sewage, is of great importance and one of the objectives of the European Union.

Drinking water supply and sewerage: The formation of biofilms in drinking water supply storage and piping systems is a drawback, both from the sanitary and the supply efficiency point of view. The evaluation of biofilm formation and the application of procedures to prevent their formation are of great importance, not only for the drinking water supply sector, but also for other industries that require this type of facilities, such as the **food industry**. In this sector, in addition, the detection of active pathogens in food is also paramount.

Blue economy: Blue biotechnology is considered a suitable opportunity for the European Union's economic recovery. Knowledge of marine biodiversity and its functions can promote the development of new pharmaceuticals, enzymes and other products of high industrial interest that, in addition, are capable of withstanding extreme environmental conditions.

COLLABORATION SOUGHT

We are interested in establishing the following collaborations:

Establishment of R&D&I projects with research organisations (public or private), with the aim of opening new lines of research or implementing novel technological developments.

Conducting technical reports and scientific advice for companies.

Specific training in the area of characterization of microbial communities in extreme environments (marine, hypersaline).

Standardization, calibration, development of national and international technical standards, etc.

Technological support in those techniques that require high training or sophisticated equipment that are not available to the applicant company.

Exchange of personnel for defined periods of time (to learn a technique, etc.).

Rental of the laboratory's equipment to customers who wish to carry out their own tests.

More information: https://mme.scienseed.com/

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Proyecto INNTA1/2020/25
Agente de innovación para potenciar la transferencia de la tecnología generada en la Universidad de Alicante en el campo de la Microbiología al entono empresarial de la Comunidad Valenciana

INTELLECTUAL PROPERTY RIGHTS

The technologies developed and described in this technology offer are protected under the *know-how* of the research group.

MARKET APPLICATION (8)

Agri-food and Fisheries
Biodiversity and Landscape
Biology
Molecular Biology and Biotechnology
Pollution and Environmental Impact
Marine Studies
Pharmacology, Cosmetics and Ophthalmology
Medicine and Health