



BEST doctoral program - October 2027-Sept 2029

Co-funded by the European Union (MSCA-COFUND) and the University of Toulouse***New generation of antimicrobials from biomass and CO₂***

Keywords: Innovative antimicrobials, CO₂ valorization, (Photo)catalysis, Biomass, Synthesis, Mechanisms

Supervisors: *Montserrat Gómez*, Laboratory of Fundamental and Applied Heterochemistry (LHFA), University of Toulouse (UT) / CNRS, Toulouse, France;
Jesus Aranda, Department of Genetics and Microbiology, Autonomous University of Barcelona (UAB), Bellaterra, Spain.

The World Health Organization ranks antibiotic resistance among the greatest global health threats, projecting up to 10 million annual deaths by 2050. This project addresses the urgent need for new antibacterial agents with unprecedented mechanisms to combat multi-drug-resistant pathogens like MRSA and VRE.

The multidisciplinary approach of this project combines synthetic chemistry, catalysis, and microbiology to inhibit bacterial growth. The first goal of this project proposes a sustainable and innovative strategy to prepare antibacterial molecules, based on terpene amines. The second goal aims at the integration of these structural scaffolds into molecular architectures of robust materials, such as COFs. With this approach, we envision the generation of new antibacterial materials with a high density of active sites, towards the enhancement of the antibacterial activity. This sustainable CO₂-to-bioactive-molecules pipeline contributes to circular economy principles while advancing antibiotic discovery to combat resistance for human and animal health.

Methodologically, CO₂ will be photocatalytically converted to syngas, followed by terpene carbonylation and multicomponent hydroaminomethylation. Using non-toxic terpenes (limonene, myrcene) and CO₂, this produces homologated terpene aldehydes that react with aromatic amines to generate terpene amines. These will serve as antibacterial agents and multifunctional monomers for bioactive COFs. The CO₂-to-CO photo-transformation enables selective CO production at mild temperatures (25–100 °C) and ambient pressure, avoiding harsh conventional reforming conditions (>800 °C).

For achieving these purposes, two research groups will be involved: one team expert on the development of catalytic systems for synthesis of the University of Toulouse (UT, France) and one team expert in molecular microbiology of the Autonomous University of Barcelona (UAB, Spain).

Context

The LHFA (UMR 5069, CNRS/University of Toulouse) is a chemistry laboratory with six research teams (19 researchers, 40+ PhD/postdocs annually). Research focuses on p-block molecular chemistry, with transversal actions in organometallics, nanomaterials, catalysis, and polymers, together with mechanistic studies and photoactivation. The LHFA-SYMAC team at UT, led by M. Gómez, designs metal-based (nano)catalysts for innovative synthetic processes, including one-pot multi-step (sequential/tandem) reactions and biomass valorization. Recent work includes sustainable catalytic processes via immobilization in liquid media (ionic liquids, glycerol) or functionalized supports to stabilize metal-based nanoparticles and enable recycling. Mechanistic insights are investigated through diverse techniques (ReactIR, NMR, EPR, SAXS...).

The Molecular Microbiology group at UAB, led by Jesus Aranda and Susana Campoy, investigates microbial physiology, pathogenicity, and host-microbe interactions, with a translational focus on developing new antimicrobials. Their research bridges fundamental molecular microbiology with

applied solutions, creating synergies in the framework of this project towards innovative antimicrobial strategies.

Application

This doctoral program is aimed at highly qualified students with an enthusiastic interest in the design and development of sustainable processes, including mechanistic studies and going as far as applications. Students must have solid knowledge in organic and inorganic chemistry, with knowledge of spectroscopic techniques; acquaintance of molecular biology will be appreciated.

Requests must include a cover letter, a detailed Curriculum Vitae and the contact of at least one contact person.

Contacts

Prof. Montserrat Gómez (montserrat.gomez-simon@utoulouse.fr)
<https://lhfa.cnrs.fr/>

Dr. Jesus Aranda (Jesus.Aranda@uab.cat),
<https://portalrecerca.uab.cat/en/organisations/grup-de-recerca-microbiologia-molecular/>

Deadline for candidatures

Applications must be submitted by **November 23rd, 2026 at 12:00 PM CET** through the following link: <https://edd-projets.utoulouse.fr/>

The guide for applicants: <https://doctorat.univ-toulouse.fr/cofund-best>

