Therapies for infectious diseases

Our environment contains a multitude of microbes, including viruses, bacteria, archaea and unicellular eukaryotic microorganisms interacting with both each other and with their human hosts.

Central to our research pursuits is the comprehensive understanding of the mechanisms through which these microbes interact, proliferate, cause diseases and potentially evade the immune response, and other reprogramming strategies developed by the host. The research carried out at the I2BC is of considerable importance in tackling the crucial public health challenges provoked by endemic infectious diseases, emerging epidemics, pandemics and the increasingly serious problem of antibiotic resistance. By doing so, we open up new horizons for the development of innovative, preventive and therapeutic measures against infections.

Therapies for infectious diseases

Towards the development of novel preventive strategies to combat viral infections

- Discovery of novel viral antigens with potential applicability in vaccine development[1]
- Pioneering the field of virus-based innovation for vaccine design, particularly in the development of a novel vaccination platform based on capsid-like particles derived from bacteriophage T5. These versatile nanoparticles facilitate efficient antigen grafting onto their surface, triggering robust immune responses[2]

Towards new therapeutic strategies against infections

- Harnessing *Streptomyces* genome engineering for the optimization of antibiotic production[3]
- Developing molecular tools to target specific physiological processes in bacterial (*S. aureus, P. aeruginosa, E. coli, S. pneumoniae, C. difficile*) and viral (CMV, HSV-1, EBV, HIV...) pathogens, thereby paving the way for novel therapeutic strategies[4-6]
- Unraveling the intricate steps of bacterial cell wall biosynthesis that can be targeted for the development of novel antibiotics. This involves the identification and engineering of new antibacterial targets within the cell wall biosynthesis process[7,8]
- Taking advantage of genetic engineering and synthetic biology methods to produce bacterial natural products and analogues with potential antiviral, antibacterial and antifungal properties[9,10]

Fields of expertise

- Bacterial genetics and physiology
- Gene expression
- Genome engineering
- Genome evolution dynamics
- Bacterial cell wall
- Combinatorial biosynthesis of antimicrobial products
- General virology
- Antiviral and antimicrobial activities
- Viral antigens and immune response
- Production of virus-like particles

Technical skills

- Genomics approaches (ChIP-seq, HiC…)
- Transcriptomics (RNA-seq, NET-seq, ribosome-seq…)
- Proteomics approaches
- Immuno-monitoring of immune responses (flow cytometry, Elispot)
- Molecule screening and drug binding analysis
- Confocal, super-resolution, electron microscopies (TEM, SEM, cryoEM) and tomography
- Structural prediction and modeling of multimolecular complexes
- Calculation, storage, use of bioinformatics software (development of workflows, data processing), online tools and services

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