

Team name and photography:

Bacterial Infection and antimicrobial therapy (BIAT) group.



Logo del grupo:



Bacterial Infections &
Antimicrobial Therapies

Brief description

Within IBEC, the research activities of the “Bacterial infections: antimicrobial therapies” group (www.ibecbarcelona.eu/bactinf) led by **Dr. Eduard Torrents** (start in 2012), are developed at two different levels: (i) applied science to solve biomedical challenges related to infectious diseases and (ii) basic research to understand the mechanisms of bacterial infections.

Group Members:

Dr. Eduard Torrents

Dr. Núria Blanco Cabra

Dr. Víctor Campo Pérez

Dr. Alba Rubio Canalejas

Joana Admella Pedrico

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Domingo Marchan Del Pino
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Research topics:

Our lab aims to investigate new antimicrobial therapies and strategies to combat bacterial infections with different objectives:

- The use of nanomedicine techniques for the development of novel and specific nanoparticles to deliver existing antibiotics or new identify antimicrobial drugs, significantly when the bacteria are growing in biofilm, close to the physiological conditions of the disease and where the current chemotherapy fails;
- The identification and screening of new molecules for the highly selective inhibition of new antibacterial targets (e.g. ribonucleotide reductases);
- The use of nanomedicine techniques for the development of novel and specific nanoparticles to deliver existing antibiotics or new identify antimicrobial drugs, significantly when the bacteria are growing in biofilm, close to the physiological conditions of the disease and where the current chemotherapy fails;
- To study new methodologies to treat chronic bacterial infections in patients suffering cystic fibrosis;
- To develop a new family of antibacterial vaccines;
- The development of new strategies for bacterial coculture systems;
- To study and develop models for wound healing infections and the search of novel treatments;
- The use of lab-on-a-chip technology to deeply elucidate mechanisms to combat bacterial forming biofilm as well as new approaches to identify multiresistant bacteria to different antibiotics.
- To establish the molecular basis for the regulation of genes involved in DNA synthesis (ribonucleotide reductase genes), their importance in virulence and biofilm formation;

Recent articles:

Selected from 2018-23:

- Alba Rubio-Canalejas, A., Pedraz, L., Torrents, L. (2023). ReViTA: A novel in vitro transcription system to study gene regulation. *New Biotechnology*. 76:41-48.
- Rubio-Canalejas, A., Admella, J., Pedraz, L. and Torrents, E. (2023). *Pseudomonas aeruginosa* nonphosphorylated AlgR induces ribonucleotide reductase expression under oxidative stress infectious conditions. *mSystems*. 8(2):e01005-22.
- Sanmukh, SG., Admella, J., Moya-Andérico, L., Fehér, T., Arévalo-Jaimes, BV., Blanco-Cabra, N and **Torrents, E.** (2023). Accessing the in vivo efficiency of

clinically isolated phages against uropathogenic and invasive biofilm-forming *Escherichia coli* strains for phage therapy. *Cells*. 12:344.

- Martínez, A., Torrents, E. (2022). Terapia antimicrobiana con fagos ¿realidad o ficción?. Per a vèncer. Revista de la associació catalana de Fibrosis Quística. Vol. 76:36-38-42. https://fibrosiquistica.org/wp-content/uploads/2023/02/fq76_definitiva.pdf.
- Rubio-Canalejas, A., Herbera, S., Baelo, A., Blanco-Cabra, N., Vukomanovic, M., **Torrents, E.** (2022). 3D spatial organization and improved antibiotic treatment of a *Pseudomonas aeruginosa* - *Staphylococcus aureus* wound biofilm by nanoparticle enzyme delivery. *Frontiers in Microbiology*. 13: 959156.
- Vukomanovic, M., Gazvoda, L., Kurtjak, M., Hrescak, J., Jaklic, B., Moya-Andérico, L., Cendra, MdM., **Torrents, E.** (2022). Development of a ternary cyclodextrin–arginine–ciprofloxacin complex with enhanced stability. *Communications Biology*. 5:1234.
- Blanco-Cabra, N., Movellan, J., Marradi, M., Gracia, R., Salvador, C., Dupin, D., Loinaz, I., **Torrents, E.** (2022). Dextran-based single-chain nanoparticles improve the tobramycin and DNase I activity against mature biofilms by interacting with the extracellular matrix. *npj Biofilms and Microbiomes*. 8:52.
- Vukomanovic, M., Cendra, MdM., Baelo, A. and **Torrents, E.** (2021). Nano-engineering stable contact-based antimicrobials: chemistry at the interface between nano-gold and bacteria. *Colloids and Surfaces B: Biointerfaces*. 208: 112083.
- Blanco-Cabra, N., López-Martínez, MJ., Arévalo-Jaimes, BV., Martín-Gómez, MT., Samitier, J. and **Torrents, E.** (2021). A new BiofilmChip device as a personalized solution for testing biofilm antibiotic resistance. *npj Biofilms and Microbiomes* 7:62.
- Vilela, D., Blanco-Cabra, N., Eguskiza, A., Hortelao, AC., **Torrents, E.** and Sánchez, S. (2021). Drug-free Enzyme-based bactericidal nanomotors against pathogenic bacteria. *ACS Applied Materials and Interfaces*. 13:14964-14973.
- Cendra, MdM and **Torrents, E.** (2021). *Pseudomonas aeruginosa* 's biofilms and their partners in crime. *Biotechnology Advance*. 46:107734.
- Abdelrahman, F., Easwaran, M., Daramola, OI., Ragab, S., Lynch, S., Oduselu, TJ., Khan, FM., Ayobami, A., Adnan, F., **Torrents, E.**, Sanmukh, S., and El-Shibiny, A. (2021). Phage-encoded endolysins. *Antibiotics*. 10(2):124.
- Moya-Andérico, L., Vukomanovic, M., Cendra, MdM., Segura-Feliu, M., Gil, V., del Río, J.A., **Torrents, E.** (2021). Utility of *Galleria mellonella* larva for evaluating nanoparticle toxicology. *Chemosphere*. 266: 129235.
- Cendra, MdM. And **Torrents, E.** (2020). Differential adaptability between reference strains and clinical isolates of *Pseudomonas aeruginosa* into the lung epithelium intracellular lifestyle. *Virulence*. 11(1):862-876.
- Pedraz, L., Blanco, N., **Torrents, E.** (2020). Gradual adaptation of facultative anaerobic pathogens to microaerobic and anaerobic conditions. *FASEB Journal*. 34: 2912-2928.
- Blanco-Cabra, N., Vega-Granados, K., Moya-Andérico, L., Vukomanovic, M., Parra, A., de Cienfuegos, LA., **Torrents, E.** (2019). Novel oleanolic and maslinic acids derivatives as a promising treatment against bacterial biofilms in nosocomial infections: as in vitro and in vivo study. *ACS Infectious Diseases*. 5 (9):1581-1589.

- Vukomanovic, M and **Torrents, E.** (2019). High time resolution and high signal-to-noise monitoring of the bacterial growth kinetics in the presence of plasmonic nanoparticles. *Journal of Nanobiotechnology*. 17(1):21.
- Crespo, A., Blanco-Cabra, N. and **Torrents, E.** (2018). Aerobic vitamin B₁₂ biosynthesis is essential for *Pseudomonas aeruginosa* class II ribonucleotide reductase activity during planktonic and biofilm growth. *Frontiers in Microbiology*. 9: 986. **Q1 (IF: 4.259)**.
- Basas, J., Palau, M., Ratia, C., del Pozo, J.L., Martín, M.T., Gomis, X., **Torrents, E.**, Almirante, B. and Gavaldà, J. (2018). High-dose daptomycin is effective as an antibiotic-lock therapy in rabbit model of *Staphylococcus epidermidis* catheter-related infection. *Antimicrobial Agents and Chemotherapy*. 62(2): e01777-17.

Research projects: (from 2022-)

- 2022-27 Research grant from the Agència de Gestió d'Ajuts Universitaris I de Recerca (Grups Recerca Qualitat). Group: "Nanobioengineering and Bioelectronics (SIC-BIO)". 2021SGR01545. Collaborator. PI. Prof. Josep Samitier.
- 2022-27 Research grant project from the Ministerio de Ciencia e Innovación – Strategic Lines. MCIN/AEI/10.13039/501100011033 and "ERDF A way of making Europe". "Disruptive nanotherapy to fight AMR through biofilm disaggregation – DISnanoAMR". PLEC2022-009356. **Co-P.I. Dr. Eduard Torrents**.
- 2022-24 Research grant project from the Ministerio de Ciencia e Innovación Proof of Concept. MCIN/AEI/10.13039/501100011033 and "ERDF A way of making Europe". "Development of a new device for personalized diagnostic in biofilm-related infections -IVD-Biofilm". PDC2022-133577-I00. **P.I. Dr. Eduard Torrents**.
- 2022-25 Research grant project from the Ministerio de Ciencia e Innovación MCIN/AEI/10.13039/501100011033 and "ERDF A way of making Europe". "Understanding DNA metabolism and new insights in polymicrobial biofilms: development of more efficient therapies to tackle bacterial infections. (InfectTreat)". PID2021- 125801OB-I00. **P.I. Dr. Eduard Torrents**.

Doctoral Thesis:

- July 9th 2023 Entendiendo la síntesis de ADN en patógenos bacterianos: nuevas estrategias para el tratamiento de enfermedades infecciosas. Dr. Alba Rubio Canalejas. Programa de Biotecnología. Universidad de Barcelona. FPI grant (PRE2018-083709).
- Mar 30th 2023 Interacción de micobacterias no tuberculosas con microorganismos patógenos. Características fisiológicas y modulación de la respuesta inmune en modelos *in vitro* e *in vivo*. Codirecció amb la Dr. Esther Julián. Dr. Víctor Campo Pérez. Universitat Autònoma de Barcelona. FI grant (2019FI-B-00320).

- Abr 16th 2021 Noves metodologies pel tractament de bacteris creixent en forma de biofilms.
Dr. Nuria Blanco Cabra. University of Barcelona.
- Abr 26th 2021 Deciphering the utility of *Galleria mellonella* as an infection and toxicity *in vivo* model.
Dr. Laura Moya Andérico. University of Barcelona. Grant 2017FI_B2 00830.
- Jan 28th-2021 Novel antimicrobial strategies against bacterial infections.
Dr. Aida Baelo Álvarez. University of Barcelona. Grant FPU AP2013-06083.
- Jan 13th-2020 Regulation of ribonucleotide reduction in facultative anaerobic pathogens and its influence in bacterial fitness, virulence and biofilm formation.
Dr. Lucas Pedraz López. Biology Faculty. University of Barcelona. Grant 2017FI_B2 00031.
- Abr 27th-2017 Estudi transcripcional i funcional de les ribonucleotíde reductases de *Pseudomonas aeruginosa*.
Dr. Anna Crespo Puig. Pharmacy Faculty. University of Barcelona.
- Nov 6th-2013 Estudio de la expresión y función de las ribonucleotíde reductasas de *Escherichia coli*.
Dr. Maria del Mar Cendra Gascón. Biology Faculty. University of Barcelona.
- Jun 18th-2007 Towards an Understanding of Ribonucleotide Reduction in Bacteria: a comprehensive study in *Streptococcus pyogenes* and *Escherichia coli*.
Dr. Ignasi Roca Subirà. Science Faculty. Autonomous University of Barcelona.

Web site

www.torrentslab.eu

<https://ibecbarcelona.eu/bactinf>