

DOTTORATO DI RICERCA IN BIOLOGIA CELLULARE E DELLO SVILUPPO

41° Cycle

Project proposal for a PhD scholarship

Title of the research: Biotechnological applications of carbonic anhydrase for carbon capture and drug delivery

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Summary

In a call to find microbial strategies that can be developed to cope with global warming, bacterial enzymes and metabolic activities have emerged as promising solutions. Recently, the pressing issue of carbon dioxide emissions have stimulated the exploration of Microbially Induced Calcium Carbonate Precipitation (MICP), and the corresponding bacterial enzymes, for biotechnological applications. There is an increasing interest in the utilization of carbonic anhydrases, ubiquitous metallo-enzymes which catalyze the reversible hydration of carbon dioxide in bicarbonate ions and protons, in CO₂ capture and storage processes. However, since this use is greatly limited by the harsh conditions required in these processes, a biotechnological study of these enzymes is necessary. This proposal is based on two parallel research, both based on a collection of carbonatogenic bacterial strains.

The first is specifically based on the selection of the best carbonatogenic bacterial strains to study their carbonatogenic metabolisms and their carbonic anhydrase enzymes, while the second is based on the use of calcium carbonate produced by bacteria for drug delivery.

Pertinent Publications of the proponent (last 5 years)

1. Sabellico G., Baggetta A., Sandrucci E., Zanellato G., Martinelli A., Montanari A. and Bianchi M.M. "Oxidative deterioration of polypropylene by redox mediators and yeast expressing a fungal recombinant laccase" INT. BIODETER. BIODEGR. (doi: 10.1016/j.ibiod.2024.105947) (**2024**).
2. Caraba B., Stirpe M., Palermo V., Vaccher U., Bianchi M.M., Falcone C. and Mazzoni C. "Yeast lsm pro-apoptotic mutants show defects in autophagy induction" INT. J. MOL. SCI. (doi: 10.3390/ijms241813708) 24, 13708 (**2023**).
3. Camponeschi I., Montanari A., Mazzoni C. and Bianchi M.M. "Light stress in yeasts: signaling and responses in creatures of the night" INT. J. MOL. SCI. (doi: 10.3390/ijms24086929) 24, 6929 (**2023**).
4. Pompa L., Montanari A., Tomassini A., Bianchi M.M., Aureli W., Miccheli A., Uccelletti D. and Schifano E. "In vitro probiotic properties and in vivo anti-ageing effects on *Caenorhabditis elegans* of *Lactobacillus plantarum* PFA2018AU strain isolated from carrots" MICROORGANISMS (doi: 10.3390/microorganisms11041087) 11, 1087 (**2023**).
5. Camponeschi I., Damasco A., Uversky V.N., Giuliani A. and Bianchi M.M. "Phenotypic suppression caused by resonance with light-dark cycles indicates the presence of a 24-hours oscillator in yeast and suggests a new role of intrinsically disordered protein regions as internal mediators" J. BIOMOL. STRUCTURE & DYNAMICS. (doi:10.1080/07391102.2020.1749133) 39, 2490–2501 (**2021**).

6. Camponeschi I., Montanari A., Beccaccioli M., Reverberi M., Mazzoni C. and Bianchi M.M. "Light-stress response mediated by the transcription factor KIMga2 in the yeast *Kluyveromyces lactis*" FRONT. MICROBIOL. doi: 10.3389/fmicb.2021.705012 (**2021**).
7. Palermo V., Stirpe M., Bianchi M.M., Rinaldi T., Cirigliano A., Ragnini-Wilson A., Falcone C. and Mazzoni C. "The C-terminal region of yeast Ubiquitin-protein ligase Not4 mediates its cellular localization and stress response" FEMS MICROBIOL. LETT. (doi: 10.1093/femsle/fnab097) 368, fnab097 (**2021**).
8. Cirigliano A., Amelina A., Biferali B., Macone A., Mozzetta C., Bianchi M.M., Mori M., Botta B., Pick E., Negri R. and Rinaldi T. "Statins interfere with the attachment of *S. cerevisiae* mtDNA to the inner mitochondrial membrane" J. ENZYME INHIB. MED. CHEM. (doi: 10.1080/14756366.2019.1687461) 35, 129-137 (**2020**).
9. Aguirre-López B., Escalera-Fanjul X., Hersch-González J., Rojas-Ortega E., El-Hafidi M., Lezama M., González J., Bianchi M.M., López G., Márquez D., Scazzocchio C., Riego-Ruiz L. and González A. "In *Kluyveromyces lactis* a pair of paralogous isozymes catalyze the first committed step of leucine biosynthesis in either the mitochondria or the cytosol" FRONT. MICROBIOL. (doi: 10.3389/FMICB.2020.01843) 11, 1843 (**2020**).