Instituto de Medicina Molecular João Lobo Antunes

Master Project Proposal

Title: Harnessing the biotechnological potential of microbial pigments to develop antimicrobial solutions against multidrug resistant human pathogens

Synopsis:

Microbial pigments are colored secondary metabolites of diverse chemical classes (e.g., carotenoids, pyrroles, phenazines, flavonoids, melanins), which play important roles in the physiology and competitiveness of microbial cells and populations, by being involved in iron uptake and growth inhibition of other microbial species, protection against UV radiation and oxidative damage, signaling cascades modulating gene expression, and in microbial pathogenesis [1]. In particular, the pigments violacein and prodigiosin have been extensively studied by their versatile biomedical potential, including antimicrobial activity against a broad range of Gram-negative and Gram-positive bacteria, yeasts, fungal and viral human pathogens [2].

The urgent global need to develop groundbreaking antimicrobial solutions has also prompted the biotechnological prospection of the microbial biomolecular catalogue as a source of novel bioactive compounds, against pathogens associated to the multidrug resistant trait (e.g., strains of *Pseudomonas aeruginosa, Enterobacter* spp., *Klebsiella* spp*., Staphylococcus aureus, Streptococcus* spp., *Candida* spp.) [3]. The combination of microbial pigments with drug delivery systems, such as metal nanoparticles (MNPs), may be fundamental for their clinical implementation [4,5], although their development and characterization has not been systematically explored. Furthermore, the functionalization of MNPs (e.g., silver nanoparticles) can be modulated to improve the stability of the conjugant-MNP complex, low toxicity/immunogenicity and affinity for the target, resulting in efficient antimicrobial agents, which implicates reduced health-care costs [6].

Our group at iMM has a solid record studying the molecular mechanism of action of antimicrobial compounds (e.g., peptides and peptide-based nanosystems), against bacterial, fungal and viral pathogens, and in the development of bio- and nano-based antimicrobial solutions for biomedical application. Moreover, we hold a library of pigment-producing bacterial and fungal strains, which are being characterized regarding the pigment production process and the respective biotechnological potential.

The work plan will be carried out at iMM, in the scope of ongoing projects of the group, mainly focused on the biomedical properties of violacein and prodigiosin, envisaging:

(i) the production of the bacterial pigments in liquid cultures and evaluation of the effect of abiotic factors in the production yield (e.g., type of carbon and nitrogen sources, temperature, pH, micronutrients);

(ii) the extraction, purification and quantification of the bacterial pigments produced in the optimized culture conditions;

(iii) characterization of the purified pigments by spectroscopic methodologies and relevant biochemical methods;

(iv) evaluation of the antimicrobial properties of the pigments, as purified fractions and in MNP-pigment conjugants, against major human pathogens;

(v) revision of the state-of-art regarding the application of the studied bacterial pigments and thesis writing.

Students who are interested in the proposal must meet with both supervisors before selecting this Masters project. The work plan may be further shaped (as much as possible) to the applicant's profile.

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Bibliography:

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