Instituto de Medicina Molecular João Lobo Antunes

Master Project Proposal

Title: Optimizing the production of natural microbial pigments for the sustainable dyeing of textile materials

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]. Having in mind these diverse roles, several microbial pigments have been extensively studied as novel bioactive molecules, towards biomedical (e.g., with antimicrobial, antioxidant and anticancer activities) as well as industrial applications (e.g., natural food additives and textile colorants) [2]. Pigment-producing microorganisms are mostly preferred over plant-based pigment sources, due to their fast and cheap cultivation processes, simple pigment extraction protocols associated to higher yields, easier genetic manipulation, among other advantages [1].

The textile industry is the 2nd most polluting industry worldwide, and accounts for 20% of the chemical pollution of water resources, mainly derived from the textile dyeing processes. The study of microbial pigments as ecological substitutes of the conventional synthetic dyes is thus an emerging and promising field of research [3,4]. Our group is a member of the BIOCOLOUR consortium, which aims at the sustainable dyeing of textiles based on microbial pigments. In the scope of this project, we hold a library of bacterial and fungal strains producing different pigments, which are being characterized regarding the production process and their respective biotechnological potential.

The work plan will be carried out at iMM, mainly envisaging:

(i) the systematic characterization of the pigment production process 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), by using molecular, biochemical and phenotypic approaches;

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

(iii) the characterization of the purified pigments by spectroscopic methodologies and relevant biochemical methods, towards their application for dyeing textile fibers.

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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[2] Narsing Rao et al. 2017. Fungal and bacterial pigments: secondary metabolites with wide applications. Frontiers in microbiology, 8, 1113. doi: 10.3389/fmicb.2017.01113

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[4] Panesar, R., Kaur, S., & Panesar, P. S. (2015). Production of microbial pigments utilizing agro-industrial waste: a review. Current Opinion in Food Science, 1, 70-76. doi: 10.1016/j.cofs.2014.12.002