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Actinobacteria isolated from subterranean and cultural heritage: implications for biotechnology

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Due to their extraordinary properties, Actinobacteria can thrive in extreme environments, such as limestone caves, lava tubes and stone monuments. They grow forming microbial mats and speleothems on the walls and ceilings of caves, ranging from extensive coatings to small colonies (Riquelme et al. 2015). Their colour includes yellow, tan, orange, grey, pink and white. Recently, we have found abundant yellow and white-coloured bacterial mats coating the cave walls and secondary mineral deposits (speleothems) of lava tubes from La Palma Island, Canary Islands, Spain (Gonzalez-Pimentel et al. 2018) and Mount Etna in Catania (Sicily, Italy). Field Emission Scanning Electron Microscopy (FESEM) of the coloured microbial mats revealed abundant Actinobacteria-like cells, including a variety of filaments and spore structures with smooth surface ornamentation or profuse surface appendages. The DNA-/RNA-based analyses confirmed that these microbial mats are mainly composed of metabolically active Actinobacteria (Gonzalez-Pimentel et al. 2018).
It is well known that Actinobacteria, mainly isolated from marine and soil ecosystems, are an important source of bioactive compounds, with Streptomyces ranking first with a huge number of bioactive secondary metabolites (Guo et al. 2015). These compounds, not only produced by Streptomyces but also by Bacillus, are very important to the industrial sector, such as pharmacology, biofuel and food industries, as well as to the conservation of stone cultural heritage, due to their antimicrobial properties (Silva et al. 2017). In the last decades, these sectors have intensified demands for exploring novel eco-friendly bioactive compounds, which stresses the need to investigate new groups of Actinobacteria from underexplored habitats. Yet, Actinobacteria from caves have not been the target of intensive screening for bioactive secondary metabolites.
Hence, Actinobacterial-like microbial mats were collected and isolated from lava tubes in La Palma and Mount Etna to investigate their biotechnological potential. The screening of antimicrobial activity was based both on culture-dependent techniques using the agar diffusion assay and on metagenomics. Our study has showed that the strain Streptomyces sp. MZ0467C isolated from La Palma lava tube has antimicrobial activity against Microbacterium sp., Rhodococcus sp., Arthrobacter sp., Kocuria sp., Sphingomonas sp. and Paenibacillus sp. due to its ingenious adaptations and metabolic strategies to survive under extreme environmental conditions. This demonstrates that Actinobacteria from subterranean environments are promising sources of antibacterial compounds with interest for cultural heritage conservation.

References:
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