Journal of Applied Microbiology, vol. 122(3): 686-697

Hydrolysis of nitriles by soil bacteria: variation with soil origin

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ABSTRACT:

Aims: The aim of this study was to explore bacterial soil diversity for nitrile biocatalysts, in particular, those for hydrolysis of b-substituted nitriles, to the corresponding carboxamides and acids that may be incorporated into peptidomimetics. To achieve this, we needed to compare the efficiency of isolation methods and determine the influence of land use and geographical origin of the soil sample.

Methods and Results: Nitrile-utilizing bacteria were isolated from various soil environments across a 1000 km long transect of South Africa, including agricultural soil, a gold mine tailing dam and uncultivated soil. The substrate profile of these isolates was determined through element-limited growth studies on seven different aliphatic or aromatic nitriles. A subset of these organisms expressing broad substrate ranges was evaluated for their ability to hydrolyse β-substituted nitriles (3-amino-3-phenylpropionitrile and 3-hydroxy-4-phenoxybutyronitrile) and the active organisms were found to be Rhodococcus erythropolis from uncultivated soil and Rhodococcus rhodochrous from agricultural soils.

Conclusions: The capacity for hydrolysis of b-substituted nitriles appears to reside almost exclusively in Rhodococci. Land use has a much greater effect on the biocatalysis substrate profile than geographical location. Significance and Impact of the Study: Enzymes are typically substrate specific in their catalytic reactions, and this means that a wide diversity of enzymes is required to provide a comprehensive biocatalysis toolbox. This paper shows that the microbial diversity of nitrile hydrolysis activity can be targeted according to land utilization. Nitrile biocatalysis is a green chemical method for the enzymatic production of amides and carboxylic acids that has industrial applications, such as in the synthesis of acrylamide and nicotinamide. The biocatalysts discovered in this study may be applied to the synthesis of peptidomimetics which are an important class of therapeutic compounds.