Diversity and Biosynthetic Potential of Filamentous Actinomycetes Isolated from Acidic Soil in China

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Abstract:

Acidophilic actinomycetes are potential sources of antifungal antibiotics and acid-stable enzymes. The aim of this study is to explore the diversity and biosynthetic potential of acidophilic filamentous actinomycetes inhabit acidic soil in Jiangxi Province China, where most areas are covered by acidic arid red soil. Four pretreatments and five selective media were used for isolation, and the best combination involved dispersion and differential centrifugation pretreatment and modified GTV medium. 370 isolates were obtained, and were assigned to 11 morphotype groups. A test of pH growth range indicated that 6.6% of the isolates were strictly acidophilic actinomycetes, 72.4% were neutrotolerant acidophilic actinomycetes, and 21.0% were acidotolerant ones. 16S rRNA gene analysis of representative strains from each group showed that the isolates belonged to 12 genera, i.e. Actinomadura, Amycolatopsis, Catenulispora, Kribbella, Lentzea, Microbispora, Micromonospora, Nocardia, Nonomuraea, Planotetraspora, Streptacidiphilus and Streptomyces, of which the Streptomyces isolates formed 12 evolutionary groups in the Streptomyces 16S rRNA gene tree. Antimicrobial assay and functional gene screening were applied to examine physiological and genetic potentials of the isolates for secondary metabolite biosynthesis. The results showed that 29.2% of the isolates produced activities against drug-resistant bacteria, Candida albicans and/or pathogenic fungi, with outstanding activities against multidrug-resistant Pseudomonas aeruginosa and Aspergillus fumigatus. 50.5%, 48.9% and 62.6% of the isolates contained PKS I, PKS II and NRPS genes respectively. Moreover, the detection rates of two tailoring enzyme genes, flavin adenine dinucleotide-dependent halogenase gene (37.4%) and polyether epoxidase gene (9.6%), were notably higher in the acidophilic isolates than in actinomycetes from other sources. Phylogenetic analysis demonstrated large sequence diversity and novelty of these two tailoring enzymes in the isolates. Further chemical analysis indicated a strong correlation between the tailoring enzymes and corresponding structures of products. All these results demonstrate that acidophilic filamentous actinomycetes from acidic soil contain a high taxonomic diversity and can serve as a promising source of polyether ionophores and halogenated metabolites.

Key words: biosynthetic potential, acidic soil, acidophilic actinomycetes, diversity, gene screening