Diversity, Antimicrobial Capabilities, and Biosynthetic Potential of Mangrove Actinomycetes from Coastal Waters in Pahang, Malaysia

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Abstract

Actinomycetes are biotechnologically important for their unparalleled capability to produce various bioactive secondary metabolites. The diversity and antimicrobial capabilities were investigated for actinomycetes, which were previously isolated from mangrove sediment of the Pahang mangrove forest. The biosynthetic potential using type I polyketide synthase (PKS-I) and nonribosomal peptide synthetase (NRPS) genes and the morphological characteristics of actinomycetes were also determined. Representative isolates were selected from five sampling locations in the Kuantan mangrove forest. Antimicrobial activities of crude ethyl acetate extract of these actinomycetes against five test microorganisms-Bacillus subtilis, Candida albicans, Escherichia coli, Serratia marcescens, and Staphylococcus aureus-were evaluated using the disc diffusion method. Actinomycetes were identified using the 16S rRNA gene sequence, and culture characteristics of selected actinomycetes were determined by inoculating the strains onto a set of agar media, namely, starch-yeast extract agar, inorganic salt-starch agar, starch-casein agar, and nutrient agar. Screening of the biosynthetic potential of these actinomycetes was achieved through polymerase chain reaction amplification of PKS-I and NRPS genes. Most isolates exhibited moderate to good antimicrobial activities toward B. subtilis and S. aureus, and a few inhibited C. albicans and E. coli. Streptomyces sp. K1-01 and Streptomyces sp. K2-03 showed antimicrobial activity against all test organisms, suggesting a broad-spectrum nature of the compounds they produced. Mangrove actinomycetes enumerated in this study demonstrated a high level of diversity, and they were distributed among nine genera. Streptomyces and Micromonospora were the most predominant genera observed, alongside Micrococcus, Gordonia, Nocardia, Dietzia, Pseudonocardia, Saccharopolyspora, and Verrucosispora. However, there is no direct correlation between antimicrobial capability and presence of PKS-I and NRPS in actinomycetes. Cultural characterization of selected actinomycetes revealed two interesting isolates-Micromonospora sp. K3-13, producing blue diffusible pigment, and Streptomyces sp. K2-03, producing purple diffusible pigment. This study demonstrated the potential of mangrove sediment as a new resource for highly diverse actinomycetes with biosynthetic capabilities. Detection of PKS-I and NRPS in these actinomycetes helps to establish a focus group that can be applied for future study of the natural product, particularly in antibiotic production.

Keywords

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