

**EKSPLORASI POTENSI ANTIMIKROBA PADA ISOLAT *BACILLUS*
ASAL TANAH MANGROVE MELALUI KEBERADAAN GEN
BIOSINTETIK PKS DAN NRPS**

TESIS



**SEKOLAH PASCASARJANA
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EKSPLORASI POTENSI ANTIMIKROBA PADA ISOLAT *BACILLUS* ASAL TANAH MANGROVE MELALUI KEBERADAAN GEN BIOSINTETIK PKS DAN NRPS

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ABSTRAK

Resistensi bakteri patogen terhadap antibiotik yang terus meningkat, mendorong eksplorasi sumber antimikroba baru, termasuk mikroorganisme asal ekosistem mangrove. Penelitian ini bertujuan untuk mengisolasi dan mengkarakterisasi isolat *Bacillus* dari tanah mangrove di Kawasan Mandeh, mendeteksi keberadaan gen biosintetik *polyketide synthase* (PKS) dan *non-ribosomal peptide synthetase* (NRPS) melalui PCR multiplex, menguji potensi antimikroba isolat terhadap *E. coli* ATCC, *S. aureus* MRSA, dan *C. acnes* dengan metode difusi cakram, serta identifikasi molekuler isolat potensial berdasarkan gen 16S rRNA. Hasil penelitian didapatkan 12 isolat *Bacillus*, dengan empat isolat memiliki aktivitas antimikroba terhadap ketiga patogen uji, yaitu BMT1.2, BMT1.3, BMT2.4, dan BMT3.2, serta terdeteksi membawa gen PKS dan NRPS yang berperan dalam biosintesis metabolit sekunder antimikroba. Isolat BMT1.3 menunjukkan aktivitas antimikroba tertinggi dengan diameter zona hambat masing-masing sebesar $27,46 \pm 0,05$ mm terhadap *E. coli* ATCC, $19,03 \pm 0,25$ mm terhadap *S. aureus* MRSA, dan $16,92 \pm 0,32$ mm terhadap *C. acnes*. Hasil PCR multiplex menunjukkan adanya pita DNA target gen PKS (± 800 bp) dan NRPS (± 1400 bp). Berdasarkan analisis filogenetik, BMT1.3 berkerabat dekat dengan *Bacillus tequilensis* (99%). Isolat BMT1.3 berpotensi dikembangkan lebih lanjut sebagai kandidat penghasil senyawa antimikroba berbasis sumber daya hayati mangrove.

Kata kunci: PKS, NRPS, 16S rRNA, PCR multiplex.

EXPLORATION OF THE ANTIMICROBIAL POTENTIAL OF BACILLUS ISOLATES FROM MANGROVE SOIL CONTAINING THE PKS AND NRPS BIOSYNTHETIC GENES

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ABSTRACT

The increasing resistance of pathogenic bacteria to antibiotics has driven the exploration of new antimicrobial sources, including microorganisms from mangrove ecosystems. This study aimed to isolate and characterize *Bacillus* isolates from mangrove soil in the Mandeh area, detect the presence of polyketide synthase (PKS) and *non-ribosomal peptide synthetase* (NRPS) biosynthetic genes using multiplex PCR, evaluate the antimicrobial activity of the isolates against *E. coli* ATCC, *S. aureus* MRSA, and *C. acnes* using the disc diffusion method, and perform molecular identification of potential isolates based on the 16S rRNA gene. A total of 12 *Bacillus* isolates were obtained, with four isolates BMT1.2, BMT1.3, BMT2.4, and BMT3.2 showing antimicrobial activity against all tested pathogens, and were detected to carry PKS and NRPS genes involved in antimicrobial secondary metabolite biosynthesis. Isolate BMT1.3 exhibited the highest antimicrobial activity, with inhibition zone diameters of 27.46 ± 0.05 mm against *E. coli* ATCC, 19.03 ± 0.25 mm against *S. aureus* MRSA, and 16.92 ± 0.32 mm against *C. acnes*. Multiplex PCR results showed the presence of DNA bands corresponding to PKS (± 800 bp) and NRPS (± 1400 bp) genes. Based on phylogenetic analysis, BMT1.3 is closely related to *Bacillus tequilensis* (99%). Isolate BMT1.3 has strong potential for further development as a candidate producer of antimicrobial compounds derived from mangrove biological resources.

Keywords: PKS, NRPS, 16S rRNA, multiplex PCR

