

RINGKASAN

Infeksi Saluran Pernapasan Akut (ISPA) merupakan penyakit menular yang menyerang saluran pernapasan bagian atas dan bawah. Penyakit ISPA diketahui telah banyak mengakibatkan kematian terhadap bayi dan balita baik di negara berkembang maupun negara maju. Salah satu mikroorganisme penyebab ISPA adalah bakteri. Bakteri penyebab penyakit ISPA diketahui telah banyak mengalami resistensi antibiotik, sehingga dibutuhkan antibiotik baru yang mampu menghambat pertumbuhan bakteri penyebab ISPA. Salah satu sumber antibiotik adalah aktinomisetes endofit yang tumbuh pada tumbuhan di lingkungan ekstrim seperti mangrove. Penelitian aktinomisetes endofit tumbuhan mangrove sebagai sumber antibakteri asal mangrove Kulon Progo belum banyak dilakukan. Sebagian besar penelitian mengenai mikroba endofit hanya dilakukan pada bakteri dan fungi.

Penelitian ini bertujuan untuk memperoleh isolat aktinomisetes endofit asal tumbuhan mangrove *Rhizophora mucronata*, *Sonneratia caseolaris*, dan *Avicennia marina* di lokasi wisata Mangrove Jembatan Api-Api (MJAA) Kulon Progo yang mampu menghambat pertumbuhan bakteri penyebab ISPA *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, dan *Staphylococcus aureus*, mengetahui kemampuan senyawa bioaktif antibakteri yang dihasilkan oleh aktinomisetes endofit dalam menghambat pertumbuhan bakteri penyebab ISPA, dan melakukan karakterisasi dan identifikasi aktinomisetes endofit yang mampu menghambat pertumbuhan bakteri penyebab ISPA dengan metode fenetik.

Penelitian ini dilakukan dengan metode survei eksploratif. Semua data yang diperoleh dianalisis secara deskriptif. Sampel akar dan kulit batang tumbuhan mangrove *R. mucronata*, *S. caseolaris* dan *A. marina* diperoleh dari lokasi wisata MJAA Kulon Progo. Penelitian serta isolat bakteri patogen diperoleh dari Laboratorium Mikrobiologi Fakultas Biologi Universitas Jendral Soedirman. Ekstraksi etil asetat metabolit sekunder dilakukan di Laboratorium Riset Universitas Jendral Soedirman.

Isolasi aktinomisetes endofit dari akar dan kulit batang tumbuhan mangrove *R. mucronata*, *S. caseolaris*, dan *A. marina* diperoleh sebanyak 64 isolat yang

dikarakterisasi berdasarkan perbedaan koloni dan sumber isolat. Sebagian besar isolat memiliki warna putih dan permukaannya bersifat *powdery*. Isolat aktinomisetes terbanyak diperoleh dari kulit batang *S. caseolaris* dan *A. marina*, sedangkan aktinomisetes endofit pada *R. mucronata* paling banyak ditemukan pada akar. Hal ini dapat disebabkan karena jaringan pada kulit batang lebih luas dan terpapar oleh udara.

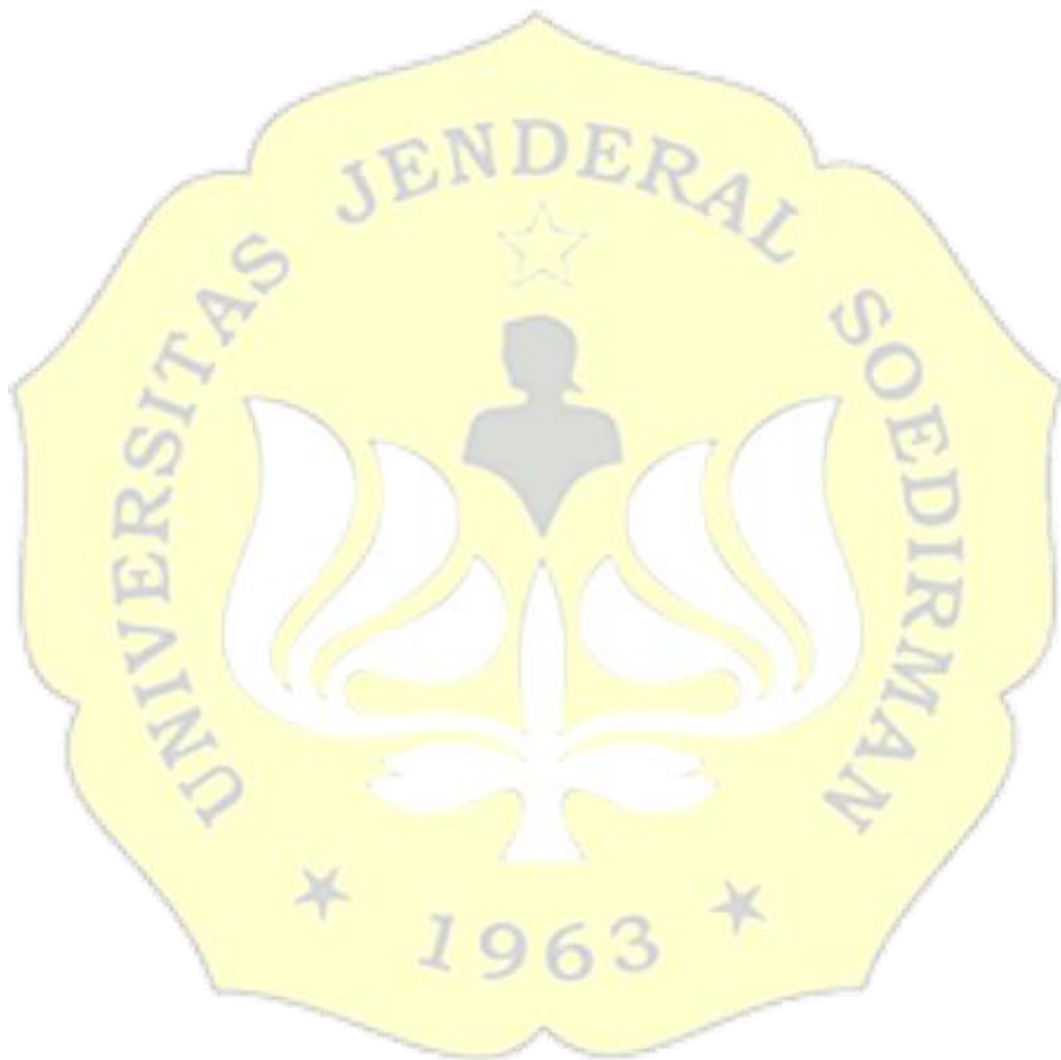
Skrining pertama dengan uji antagonis terhadap bakteri patogen *S. aureus* dan *K. pneumoniae* menghasilkan 17 isolat aktinomisetes endofit yang mampu menghambat pertumbuhan bakteri *S. aureus* dan tiga isolat diantaranya mampu menghambat *K. pneumoniae*. Skrining kedua menggunakan metode Kirby-Bauer terhadap filtrat sel. Sebanyak empat isolat diketahui mampu menghambat *P. aeruginosa*, dua isolat mampu menghambat *K. pneumoniae*, dan tidak ada satu isolat pun yang menghambat *S. aureus*. Berdasarkan hasil skrining, isolat terbaik yang mampu menghambat ketiga bakteri patogen adalah isolat KAM4 D2. Isolat KAM4 D2 digunakan pada tahap selanjutnya yaitu produksi dan ekstraksi senyawa bioaktif antibakteri serta karakterisasi dan identifikasi isolat.

Ekstrak etil asetat senyawa bioaktif isolat KAM4 D2 memiliki diameter zona hambat tertinggi terhadap *P. aeruginosa* dan *S. aureus* pada konsentrasi ekstrak 100%. Diameter zona hambat tertinggi terhadap *P. aeruginosa* adalah 11,5 mm pada medium SCNB umur 14 hari dan SNB mod umur tujuh hari, sedangkan diameter zona hambat tertinggi terhadap *S. aureus* adalah 17 mm pada medium SCNB umur 14 hari. Sementara itu, diameter zona hambat tertinggi terhadap *K. pneumoniae* adalah 9 mm pada medium SNB umur 14 hari dengan konsentrasi ekstrak 25%. Diameter zona hambat terhadap *S. aureus* diketahui telah memenuhi standar diameter zona hambat dari EUCAST 2023 dan CLSI 2020.

Nilai KHM ekstrak etil asetat senyawa bioaktif isolat KAM4 D2 adalah 12,5% untuk *S. aureus* dari medium SCNB dan 6,25% untuk *K. pneumoniae* dari medium SNB. Sementara itu, semua konsentrasi ekstrak mampu menghambat *P. aeruginosa*, sehingga dapat diduga bahwa nilai KHM untuk *P. aeruginosa* dapat lebih rendah atau sama dengan konsentrasi terendah (3,125%) yang telah diujikan.

Karakterisasi isolat KAM4 D2 dilakukan berdasarkan pendekatan fenetik. Beberapa karakter yang diujikan adalah karakter morfologi koloni dan sel, sifat biokimia dan enzimatis, serta sifat fisiologi. Hasil karakterisasi diketahui bahwa isolat KAM4 D2 merupakan bagian dari genus *Streptomyces*.

Kata kunci: aktinomisetes, antibakteri, endofit, ISPA, mangrove



SUMMARY

Acute Respiratory Infection (ARI) is an infectious disease affects the upper and lower respiratory systems. ARI had caused mortality in babies and toddlers around the world, especially from developed countries. One of the microorganisms that caused ARI is bacteria that had developed resistance to antibiotics, so new antibiotics needed to be found. Mangrove soil had been the source of actinomycetes for producing antibiotics. Mangrove has extreme conditions such as high salinity and high organic compounds in the soil. Actinomycetes from soil had been known can produce many antibiotics. Until recently, endophytic actinomycetes from mangrove plants were also studied due to the plant association with soil microbial. Endophytic actinomycetes as antimicrobial source in mangrove tourism area Mangrove Jembatan Api-Api (MJAA) Kulon Progo had not been explored. Most of the studies on endophytic microbial only focused on fungi and bacteria.

This study aimed to obtain endophytic actinomycetes from mangrove plants (*Rhizophora mucronata*, *Sonneratia caseolaris*, and *Avicennia marina*) at MJAA that can inhibit ARI's bacteria. The potential of the bioactive compound from the chosen isolate was also studied as Minimum Inhibitory Concentration (MIC). Then, characterization and identification of the best isolate producing bioactive compound were also done by the phenetic method.

The study was conducted using an exploratory survey method. Every data collected was analyzed descriptively. The roots and bark samples from mangrove plants *R. mucronata*, *S. caseolaris*, and *A. marina* were collected from the tourism mangrove area MJAA Kulon Progo. The isolation and pathogenic bacteria caused ARI were obtained from the Microbiology Laboratory of Biology Faculty of Jendral Soedirman University. Extraction and evaporation of secondary metabolites was carried out at Research Laboratorium of Jendral Soedirman University.

This study recovered 64 isolates of endophytic actinomycetes from the roots and barks of mangrove plants *R. mucronata*, *S. caseolaris*, and *A. marina*. The isolates are differentiated and characterized based on the colony properties and the source. Most isolates have a white colour and powdery surface. Most endophytic

actinomycetes were obtained from the bark of *S. caseolaris* and *A. marina*, while most actinomycetes on *R. mucronata* were obtained from the root. This condition could be caused by the bark tissue being wider than the root, also the bark being exposed to air.

The first screening was done by antagonistic assay, resulting in only 17 isolates having the ability against the growth of *S. aureus* and three of them were able to inhibit against *K. pneumoniae*. Then, a second screening was done by Kirby-Bauer method. A total of four isolates were known to be able to inhibit *P. aeruginosa*, two isolates were able inhibit *K. pneumoniae* and no isolates were able to inhibit *S. aureus* from the filtrate cell. Based on both screening steps, isolate KAM4 D2 was chosen for the next step due to its inhibition ability on the three pathogenic bacteria.

The ethyl acetate extract of the bioactive compound isolate KAM4 D2 had the highest inhibition zone diameter against *P. aeruginosa* and *S. aureus* at 100% of the extract concentration. The diameter of the highest inhibition zone against *P. aeruginosa* was 11.5 mm in SCNB medium at 14 days incubation and SNB mod at seven days incubation, while the diameter of the highest inhibition zone against *S. aureus* was 17 mm in SCNB medium at 14 days incubation. Meanwhile, the diameter of the highest inhibition zone against *K. pneumoniae* was 9 mm in SNB medium at 14 days incubation with 25% of the extract concentration. The diameter of the inhibition zone for *S. aureus* is known to have met the inhibition zone diameter standards from EUCAST 2023 and CLSI 2020.

The Minimum Inhibitory Concentration (MIC) value of the ethyl acetate extract KAM4 D2 isolate on *S. aureus* was 12,5% in SCNB medium and 6,25% on *K. pneumoniae* in SNB medium. Meanwhile, all the extract concentrations were able to inhibit *P. aeruginosa*. Those, it can be assumed that the MIC value for *P. aeruginosa* could be lower or same as the lowest concentration (3.125%) that has been tested.

The characterization of KAM4 D2 isolate was carried out by a phenetic approach. Those resulting on KAM4 D2 isolates belonged to *Streptomyces* genus

based on the colony and cell morphological characters, biochemical and enzymatic properties, and physiological properties.

Key words: actinomycetes, antibacterial, ARI, endophytic, mangrove

