

ANALISIS EKSPRESI GEN, AKTIVITAS DAN KARAKTER BAKTERI NITRIFIKASI DARI AIR TAMBAK UDANG VANAME (*Penaeus vannamei*)

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Intisari

Amonia merupakan limbah beracun bagi budidaya udang vaname (*Penaeus vannamei*) yang berasal dari proses dekomposisi tidak sempurna protein pada sisa pakan dan feces udang. Pada kondisi tambak yang baik, limbah amonia secara alami teroksidasi oleh bakteri melalui jalur nitrifikasi sehingga proses ini mendukung keberlanjutan budidaya udang. Tujuan penelitian ini adalah menganalisis aktivitas nitrifikasi, ekspresi gen ammonia monooxygenase (*amoA*) dan hydroxylamine oxydoreductase (*hao*) bakteri dari air tambak, serta isolasi dan karakterisasi bakteri nitrifikasi sebagai kandidat bioremediator air. Filter dan *retentate* penyaringan air tambak (diameter saringan: 0,2 μ m, volume sampel: 150 ml) diinokulasi pada medium nitrifikasi cair dan diinkubasi pada suhu ruangan selama tujuh hari, kemudian dilakukan analisis kadar amonia pada medium dan ekspresi gen *amoA* dan *hao*. Isolasi bakteri nitrifikasi dilakukan dengan metode *streak-plate*. Isolat murni diseleksi berdasarkan aktivitas nitrifikasi, kemudian dikarakterisasi dan identifikasi berdasarkan sifat biokimia dan fisiologi, serta identifikasi molekuler berdasarkan sekuen gen 16S rRNA. Potensi bakteri sebagai probiotik diuji berdasarkan kemampuan pembentukan biofilm, protease, dan uji keamanan pada post-larva udang vaname. Hasil uji menunjukkan ekspresi gen amonium monooxygenase A (*amoA*) (2×10^6 dan $< 2 \times 10^2$ salinan per mililiter medium), dan ekspresi gen hydroxylamine oxydoreductase (*hao*) ($1,2 \times 10^7$ dan $3,9 \times 10^7$ salinan per mililiter medium) untuk sampel Kulonprogo dan Kebumen. Sebanyak empat bakteri berhasil diisolasi dan memiliki kemampuan penguraian amonia berkisar 49-55%. Isolat-isolat tersebut menunjukkan karakteristik bakteri heterotrof yang teridentifikasi secara molekuler sebagai *Pantoea dispersa* (WEP 1), *Klebsiella aerogenes* (WEP 2), *Enterobacter cloacae* (WEP 4) and *Serratia marcescens* (WEB 2). Seleksi potensi bioremediator mendapatkan isolat terpilih *Pantoea dispersa* WEP 1 dan *Klebsiella aerogenes* WEP2 untuk digunakan pada budidaya udang.

Kata kunci : *Pantoea*, *Klebsiella*, bioremediator, udang, tambak.

ANALYSIS OF GENE EXPRESSION, ACTIVITY, AND CHARACTER OF NITRIFYING BACTERIA FROM WHITE LEG SHRIMP (*Penaeus vannamei*) PONDS

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Abstract

Ammonia is a hazardous byproduct in the cultivation of white leg shrimp (*Penaeus vannamei*), resulting from incomplete protein degradation in leftover feed and shrimp feces. Under optimal pond conditions, bacteria spontaneously reduce ammonia waste via the nitrification pathway, facilitating the sustainability of shrimp cultivation. This study aims to examine nitrification activity, the expression of ammonia monooxygenase (*amoA*) and hydroxylamine oxidoreductase (*hao*) genes in bacteria from white leg shrimp pond water, and isolate nitrifying bacteria as potential bioremediators. The retentate of water (sieve diameter: 0.2 μm , volume: 150 mL) and 5 mg of sediment were added to a liquid nitrification medium and cultured at ambient temperature for 7 days. Afterward, ammonia concentrations and the expression of *amoA* and *hao* genes in the medium were assessed. The streak-plate approach was employed for the isolation of nitrifying bacteria. Pure isolates were selected based on their nitrification activity, examined for their biochemical and physiological features, and identified molecularly using the 16S rRNA gene. The result shows the expression of a ammonium monooxygenase A (*amoA*) at (2×10^6 and $< 2 \times 10^2$ copy/mL medium) and hydroxylamine oxidoreductase (*hao*) expressed at ($1,2 \times 10^7$ and $3,9 \times 10^7$ copy/mL medium) for both Kulonporogo and Kebumen samples. Four bacteria with ammonia degradation capabilities of 49 - 55% were successfully isolated and exhibited probiotic characteristics. The isolates were molecularly identified as *Pantoea dispersa* (WEP 1), *Klebsiella aerogenes* (WEP 2), *Enterobacter cloacae* (WEP 4), and *Serratia marcescens* (WEB 2). Bioremediator properties screening identified *Pantoea dispersa* WEP 1 and *Klebsiella aerogenes* WEP 2 as the most promising water bioremediator candidates for shrimp farming.

Keywords: *Pantoea*, *Klebsiella*, bioremediator, shrimp, ponds.