

BIODEGRADATION OF PHENANTHRENE
BY A BACTERIUM ISOLATED FROM PORT DICKSON
COASTAL WATERS

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AKHIR PROJEK

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coastal waters

Dengan ini disahkan bahawa saya telah menyemak laporan akhir projek ini dan

- (i) semua pembetulan yang disarankan oleh pemeriksa-pemeriksa telah dibuat, dan
- (ii) laporan ini telah mengikut format yang diberikan dalam Panduan PSF 499 - Projek dan Seminar, 1991. Fakulti Perikanan dan Sains Samudra, Universiti Pertanian Malaysia.

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*To my beloved parents
for all their love and sacrifice*

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ABSTRACT

A phenanthrene utilizing bacterium was isolated from Port Dickson coastal waters, and we named it as AR3-1 for this study. AR3-1 was capable to utilize 48.3 ppm of phenanthrene with the presence of 20 mg/l yeast extract. The rate of phenanthrene degradation by AR3-1 was 1.6×10^{-5} $\mu\text{g/day/cell}$ with an initial cell population of 1.25×10^6 cells/ml.

The effects of amino acids on biodegradation of phenanthrene were also conducted, and the growth could be easily detected by visual inspection (turbidity). The results showed that glutamic acid, arginine, histidine and phenylalanine individually might be the growth promoting substrates for phenanthrene biodegradation by AR3-1. Incorporation of two or three types of these essential amino acids did not support a better growth.

The analysis of ESSO Tapis A blended crude oil by using Liquid chromatography column indicated that ESSO Tapis A blended crude oil consist 61.51% saturated fraction, 26.30% aromatic hydrocarbons, 4.30% asphaltenes and 9.10% residue.

AR3-1 was capable of degrading 392.3 ppm saturated fraction after 12 days incubation without addition of yeast extract. Incorporation of 20 mg/l yeast extract, resulted in the degradation of 50.9 ppm of aromatic fraction. Asphaltenes

was persistent to microbial degradation. The biodegradation rate of aromatic and saturated fraction were 1.7×10^{-5} $\mu\text{g/day/cell}$ and 1.3×10^{-4} $\mu\text{g/day/cell}$ respectively.

Phosphate and ammonium enhanced the biodegradation of phenanthrene by natural population of microorganisms in Port Dickson coastal waters and ammonium seemed to be the limiting factor in this study.

ABSTRAK

Bakteria yang berupaya mendegradasikan fenantrena dipencilkan dari kawasan perairan Port Dickson. Bakteria ini dinamakan sebagai AR3-1 dalam kajian ini. AR3-1 dapat mendegradasikan 48.3 ppm fenantrena dengan penambahan 20 mg/l ekstrak yis. Kadar degradasi adalah 1.6×10^{-5} $\mu\text{g}/\text{hari}/\text{sel}$. Populasi sel asal untuk eksperimen ini adalah 1.25×10^6 sel/ml.

Kesan asid amino ke atas biodegradasi fenantrena juga dijalankan, pertumbuhan sel boleh dikesan dengan kekeruhan medium kultur. Keputusan eksperimen ini menunjukkan asid glutamik, arginin, histidin dan fenilalanin secara individual dapat bertindak sebagai substrak galakan pertumbuhan sel dalam biodegradasi fenantrena. Percampuran 2 atau tiga jenis asid amino tidak dapat menunjukkan keputusan pertumbuhan sel yang lebih pesat.

Analysis mengenai minyak mentah ESSO Tapis A dengan menggunakan kolumn kromatografi cecair mendapati minyak mentah ini mengandungi 61.51% bahagian tepu, 26.30% aromatic, 4.30% asphaltene and 9.10% sisa.

AR3-1 boleh mendegradasikan sebanyak 392.3 ppm bahagian tepu minyak mentah dalam masa 12 hari dengan tanpa penambahan ekstrak yis. Sebanyak 50.9 ppm aromatik boleh didegradasikan

dengan penambahan 20 mg/l ekstrak yis ditambah. Asphaltene tidak dapat didegradasikan oleh AR3-1. Kadar biodegradasi bagi aromatik dan bahagian tepu minyak mentah adalah 1.7×10^5 $\mu\text{g}/\text{hari}/\text{sel}$ dan 1.3×10^{-4} $\mu\text{g}/\text{hari}/\text{sel}$.

Fosfat dan amonium boleh mempengaruhi biodegradasi fenantrena oleh populasi semulajadi mikro-organisma dari perairan Port Dickson. Amonium adalah faktor penghad dalam kajian ini.