

FORMATION AND ESTABLISHMENT OF  
BIOFILM BY ANTARCTICAL BACTERIUM  
*Pseudoalteromonas haloplanktis* (TAC125) AND  
BENTHIC MARINE DIATOM  
*Amphora coffeaeformis* (C. Agardh)

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MASTER OF SCIENCE

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**Chairperson :**

**Member :**

**Institute of Marine Biotechnology**

The use of artificial substrates has been proposed as a way to increase aquaculture production, has gained popularity in recent years. Submersed substrates provide sites for the development of a microbial community comprised of autotrophic and heterotrophic microorganisms which can serve as food source for the reared animals and improve the water quality. Mathematical modeling of biofilm formation is a field of steadily increasing academic and industrial importance with an enormous future potential. In this study, we investigate the possibilities formation of biofilm by taking into account the electrostatic interaction energy, Lewis acid-base interaction free energy and Lifshitz-van der Waals interaction energy on a glass substrate introduced into a bioreactor. The contact angle results show all three experiments involving single culture of *Amphora coffeaeformis* and *Pseudoalteromonas haloplanktis* and a mixture of both which were 15.4°, 19.7° and 38.3° respectively suggest that both bacteria and microalgae were in the state of hydrophilic which favors the adhesion and formation of biofilm. From the calculation of the proposed equation, the value of interaction energy of  $\Delta G_{131}^{Total}$  which were 30.91, 30.55 and 45.26 for all three experiments were greater than  $\Delta G_{132}^{Total}$  which valued at 22.20, 22.47 and 23.78 respectively. With the value of  $\Delta G_{131}^{Total}$  greater than  $\Delta G_{132}^{Total}$ , this support the theories of adhesion and formation of biofilm on the substrate proposed. This was further convinced by the images and direct observation of biofilm formed on glass substrate using Scanning Electron Microscope and Confocal Microscopy with the highest aggregate of 153.65 micro meters formed by single species *Amphora coffeaeformis*.

**Keyword:** Mathematical modeling, Biofilm formation, Energy interaction, *Pseudoalteromonas haloplanktis*, *Amphora coffeaeformis*

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**PEMBENTUKAN DAN PENGWUJUDAN LAPISAN *BIOFILM* OLEH  
BAKTERIA *Pseudoalteromonas haloplanktis* (TAC125) DAN DIATOM  
MARIN BENTIK *Amphora coffeaeformis*(C. Agardh)**

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Penggunaan substrat tiruan telah meraih populariti sejak kebelakangan ini sebagai salah satu cara untuk meningkatkan produktiviti akuakultur. *Biofilm* menyediakan tapak untuk pembangunan komuniti mikrob yang terdiri daripada kumpulan mikroorganisma *autotrophic* dan *heterotrophic* yang berfungsi sebagai sumber makanan larva dan memperbaiki kualiti air. Pemodelan matematik pembentukan *biofilm* yang merupakan satu bidang yang mempunyai potensi besar di dalam industri akuakultur dan bidang akademik. Dalam kajian ini, kita menyiasat kemungkinan pembentukan *biofilm* dengan mengambil kira tenaga interaksi elektrostatik, Lewis interaksi tenaga bebas asid-bes dan Lifshitz-van der Waals interaksi tenaga atas substrat kaca yang diperkenalkan ke dalam bioreaktor. Keputusan sudut sentuh menunjukkan ketiga-tiga eksperimen yang melibatkan spesies tunggal *Amphora coffeaeformis* dan *Pseudoalteromonas haloplanktis* dan campuran kedua-dua yang masing-masing berdarjah  $15.4^\circ$ ,  $19.7^\circ$  dan  $38.3^\circ$  mencadangkan bahawa kedua-dua bakteria dan mikroalga dalam keadaan hidrofilik yang menyenangkan lekatan dan pembentukan *biofilm*. Daripada pengiraan yang dicadangkan oleh persamaan yang diterbitkan, nilai tenaga interaksi  $\Delta G_{131}^{Total}$  adalah 30.91, 30.55 dan 45.26 untuk semua ketiga-tiga eksperimen adalah lebih besar daripada  $\Delta G_{132}^{Total}$  masing-masing yang bernilai 22.20, 22.47 dan 23.78. Dengan nilai  $\Delta G_{131}^{Total}$  lebih besar daripada  $\Delta G_{132}^{Total}$ , ia menyokong teori lekatan dan pembentukan lapisan biofilm di atas substrat yang dicadangkan. Teori ini disahkan dengan imej dan pemerhatian langsung biofilm yang terbentuk di atas substrat kaca menggunakan Pengimbasan Elektron Mikroskop dan Mikroskopi Confocal dengan agregat tertinggi 153.65

mikro meter yang dibentuk oleh spesies tunggal *Coffeaeformis Amphora*(*C. Agardh*).

Kata kunci: Pemodelan Matematik, pembentukan lapisan biofilm, interaksi Tenaga, *Pseudoalteromonas haloplanktis*, *Amphora Coeffeaeformis*