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Felix Luman Shanahan, Prof. Dr. Endah Retnaningrum, S.Si., M.Eng.
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Comparative Analysis of 3 Brands of Stirred Yogurt Products in Indonesia for *E. coli* and *Salmonella* spp. Growth Inhibition and Antibiofilm Activity

By

Felix Luman Shanahan
22/496195/BI/10989

Supervisor: Prof. Dr. Endah Retnaningrum, S.Si., M.Eng.

ABSTRACT

The human gut microbiota plays an important role in maintaining gastrointestinal health. However, infections caused by pathogenic bacteria may disrupt microbial balance and lead to dysbiosis. Probiotics found in fermented dairy products such as yogurt are known to possess antimicrobial and antibiofilm properties. Therefore, this study aimed to evaluate the antibacterial, biofilm disruption, and biofilm inhibition activities of commercial yogurt products available in Indonesia against *E. coli* and *Salmonella* spp. This study was conducted using in vitro experimental methods. Antibacterial activity was assessed using the agar well diffusion method, while biofilm disruption and inhibition assays were performed using 96-well microplates followed by crystal violet staining and microplate reader analysis. Three commercial yogurt products (Yogurt X, Y, and Z) were tested alongside chloramphenicol as the positive control and sterile aquadest as the negative control. Statistical analysis was performed using one-way ANOVA followed by Tukey HSD post hoc analysis. The results showed that all yogurt samples exhibited antibacterial activity against both pathogens. Yogurt Y produced the highest inhibition zones against *E. coli* (7.1±0.2 mm) and *Salmonella* spp. (7.43±0.25 mm), although no significant differences were observed among yogurt treatments ($p > 0.05$). In the biofilm disruption assay, all yogurt treatments increased biofilm biomass, while chloramphenicol reduced preformed biofilms by 72.26±1.27% in *E. coli* and 33.07±1.61% in *Salmonella* spp. In contrast, the biofilm inhibition assay showed that yogurt treatments reduced biofilm formation, with Yogurt Y demonstrating the greatest inhibition against *E. coli* (49.48±1.57%) and Yogurt X against *Salmonella* spp. (58.90±1.66%). In conclusion, commercial yogurts sold in Indonesia possess antibacterial and biofilm inhibitory activities against *E. coli* and *Salmonella* spp. However, they were ineffective in disrupting mature biofilms and instead increased biofilm biomass, possibly due to the nutrient content of the yogurt formulations. These findings suggest that commercial yogurts may be more effective in preventing biofilm formation rather than eliminating established biofilms.

Keywords: biofilm, lactic acid bacteria, pathogen growth inhibition, probiotics, yogurt

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Analisis Komparatif 3 Merek Produk Yogurt Aduk di Indonesia untuk Penghambatan Pertumbuhan E. coli dan Salmonella spp. serta Aktivitas Antibiofilm

Oleh

Felix Luman Shanahan
22/496195/BI/10989

Pembimbing: Prof. Dr. Endah Retnaningrum, S.Si., M.Eng.

INTISARI

Mikrobiota usus manusia berperan penting dalam menjaga kesehatan saluran pencernaan. Namun, infeksi yang disebabkan oleh bakteri patogen dapat mengganggu keseimbangan mikroba dan menyebabkan disbiosis. Probiotik yang terdapat pada produk susu fermentasi seperti yogurt diketahui memiliki sifat antimikroba dan antibiofilm. Oleh karena itu, penelitian ini bertujuan untuk mengevaluasi aktivitas antibakteri, kemampuan disrupsi biofilm, dan kemampuan inhibisi biofilm dari produk yogurt komersial yang tersedia di Indonesia terhadap *E. coli* dan *Salmonella* spp. Penelitian ini dilakukan menggunakan metode eksperimental *in vitro*. Aktivitas antibakteri diuji menggunakan metode difusi sumuran agar, sedangkan uji disrupsi dan inhibisi biofilm dilakukan menggunakan mikrotiter plate 96-sumur yang dilanjutkan dengan pewarnaan crystal violet dan analisis menggunakan microplate reader. Tiga produk yogurt komersial (Yogurt X, Y, dan Z) diuji dengan chloramphenicol sebagai kontrol positif dan akuades steril sebagai kontrol negatif. Analisis statistik dilakukan menggunakan one-way ANOVA yang dilanjutkan dengan uji lanjut Tukey HSD. Hasil penelitian menunjukkan bahwa seluruh sampel yogurt memiliki aktivitas antibakteri terhadap kedua bakteri patogen. Yogurt Y menghasilkan zona hambat tertinggi terhadap *E. coli* (7,1±0,2 mm) dan *Salmonella* spp. (7,43±0,25 mm), meskipun tidak terdapat perbedaan signifikan antar perlakuan yogurt ($p > 0,05$). Pada uji disrupsi biofilm, seluruh perlakuan yogurt justru meningkatkan biomassa biofilm, sedangkan chloramphenicol mampu menurunkan biofilm yang telah terbentuk sebesar 72,26±1,27% pada *E. coli* dan 33,07±1,61% pada *Salmonella* spp. Sebaliknya, pada uji inhibisi biofilm, perlakuan yogurt mampu menurunkan pembentukan biofilm, dengan Yogurt Y menunjukkan inhibisi terbesar terhadap *E. coli* (49,48±1,57%) dan Yogurt X terhadap *Salmonella* spp. (58,90±1,66%). Kesimpulannya, yogurt komersial yang dijual di Indonesia memiliki aktivitas antibakteri dan inhibisi biofilm terhadap *E. coli* dan *Salmonella* spp. Namun, yogurt tersebut tidak efektif dalam mendisrupsi biofilm matang dan justru meningkatkan biomassa biofilm, kemungkinan akibat kandungan nutrisi dalam formulasi yogurt. Temuan ini menunjukkan bahwa yogurt komersial berpotensi lebih efektif dalam mencegah pembentukan biofilm dibandingkan mengeliminasi biofilm yang telah terbentuk.

Kata kunci: bakteri asam laktat, biofilm, inhibisi pertumbuhan patogen, probiotik, yogurt