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DAFTAR PUSTAKA

Abdel-Aty, A.M., Bassuiny, R.I., Barakat, A.Z., dan Mohamed, S.A., 2019. Upgrading the phenolic content, antioxidant and antimicrobial activities of garden cress seeds using solid-state fermentation by Trichoderma reesei. *Journal of Applied Microbiology*, **127**: 1454–1467.

Abdel-Rhman, S.H., 2019. Role of Pseudomonas aeruginosa lipopolysaccharides in modulation of biofilm and virulence factors of Enterobacteriaceae. *Annals of Microbiology*, **69**: 299–305.

Abdul Manan, M. dan Webb, C., 2018. Estimation of growth in solid state fermentation: A review. *Malaysian Journal of Microbiology*, **14**: 61–66.

Abou-Donia, A.H., Darwish, F.A., Toaima, S.M., Shawky, E., dan Takla, S.S., 2014. A new approach to develop a standardized method for assessment of acetylcholinesterase inhibitory activity of different extracts using HPTLC and image analysis. *Journal of Chromatography B: Analytical Technologies in the Biomedical and Life Sciences*, **955–956**: 50–57.

Afonso, A.C., Oliveira, D., Saavedra, M.J., Borges, A., dan Simões, M., 2021. Biofilms in diabetic foot ulcers: Impact, risk factors and control strategies. *International Journal of Molecular Sciences*, **22**: 1–26.

Ahmad, I., Althubiani, A.S., Dar, M.S., Samreen, Qais, F.A., Abulreesh, H.H., dkk., 2019. Actinomycetes as continued source of new antibacterial leads, dalam: Ahmad, I., Ahmad, S., dan Rumbaugh, K.P. (Editor), *Antibacterial Drug Discovery to Combat MDR: Natural Compounds, Nanotechnology and Novel Synthetic Sources*. Springer Singapore, Singapore, hal. 327–349.

Ahmed, A., Skinley, K., dan Zhang, H., 2023. Column technology for liquid chromatography. *Liquid Chromatography: Fundamentals and Instrumentation: Volume 1, Third Edition*, **1**: 37–60.

Aini, M., 2023. The Effect of Modified Media on The Antibacterial Activity of The Sea Sponge Symbion Fungi, Fusarium solani. *Jurnal Biologi Tropis*, **23**: 546–553.

Al-Kafaween, M.A., Khan, R.S., Hilmi, A.B.M., dan Ariff, T.M., 2019. Characterization of biofilm formation by Escherichia coli: An in vitro study. *Journal of Applied Biology and Biotechnology*, **7**: 17–19.

Alvarez-Rivera, G., Ballesteros-Vivas, D., Parada-Alfonso, F., Ibanez, E., dan Cifuentes, A., 2019. Recent applications of high resolution mass spectrometry for the characterization of plant natural products. *Trends in Analytical Chemistry*, **112**: 87–101.

Alvarez-Segura, T., Ortiz-Bolsico, C., Torres-Lapasió, J.R., dan García-Álvarez-Coque, M.C., 2015. Serial versus parallel columns using isocratic elution: A comparison of multi-column approaches in mono-dimensional liquid chromatography. *Journal of Chromatography A*, **1390**: 95–102.

UNIVERSITAS
GADJAH MADA
Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai Antibiofilm Polimikroba
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Alves, P.M., Al-Badi, E., Withycombe, C., Jones, P.M., Purdy, K.J., dan Maddocks, S.E., 2018. Interaction between Staphylococcus aureus and Pseudomonas aeruginosa is beneficial for colonisation and pathogenicity in a mixed biofilm. *Pathogens and Disease*, **76**.

Alyidrus, R., Wahyuni, W., A, N., dan Kasman, N., 2022. Aktivitas Antibakteri Ekstrak Etanol Batang Laruna (Chromolaena Odorata L.) Terhadap Staphylococcus Aureus Dan Pseudomonas Aeruginosa. *Indonesian Health Journal (Inhealth)*, **1**: 62–70.

Anderson, G.G. dan O'Toole, G.A., 2008. Innate and induced resistance mechanisms of bacterial biofilms. *Current Topics in Microbiology and Immunology*, **322**: 85–105.

Ansari, F.A., Jafri, H., Ahmad, I., dan Abulreesh, H.H., 2017. Factors Affecting Biofilm Formation in in vitro and in the Rhizosphere , dalam: *Biofilms in Plant and Soil Health*. hal. 275–290.

Antia, B.S., Aree, T., Kasettrathat, C., Wiyakrutta, S., Ekpa, O.D., Ekpe, U.J., dkk., 2011. Itaconic acid derivatives and diketopiperazine from the marine-derived fungus Aspergillus aculeatus CRI322-03. *Phytochemistry*, **72**: 816–820.

Armstrong, D.G., Boulton, A.J.M., dan Bus, S.A., 2017. Diabetic Foot Ulcers and Their Recurrence. *New England Journal of Medicine*, **376**: 2367–2375.

Avdić, M., Džuzić, N., Hasanić, O., Spahić, A., Smajlović-Skenderagić, L., Badnjević, A., dkk., 2019. Development of a novel biofilm classification tool and comparative analysis of result interpretation methodologies for the evaluation of biofilm forming capacity of bacteria using tissue culture plate method. *Medicinski Glasnik*, **16**: 7–12.

Ayu, L., Kuspradini, H., dan Ruga, R., 2024. Potential Antibacterial Activity Of Dichloromethane And Methanol Extracts Of The Golden Trumpet Flower (Allamanda cathartica L.) Against Staphylococcus aureus ATCC 25923. *Jurnal Atomik*, **9**: 78–83.

Aziza, M. dan Amrane, A., 2012. Diauxic growth of geotrichum candidum and penicillium camembertii on amino acids and glucose. *Brazilian Journal of Chemical Engineering*, **29**: 203–210.

Bahry, M.S., Radjasa, O.K., dan Trianto, A., 2021. Potential of marine sponge-derived fungi in the aquaculture system. *Biodiversitas*, **22**: 2883–2892.

Bakkiyaraj, D., Sritharadol, R., Padmavathi, A.R., Nakpheng, T., dan Srichana, T., 2017. Anti-biofilm properties of a mupirocin spray formulation against Escherichia coli wound infections. *Biofouling*, **33**: 591–600.

Balasubramanian, S., Skaf, J., Holzgrabe, U., Bharti, R., Förstner, K.U., Ziebuhr, W., dkk., 2018. A new bioactive compound from the marine sponge-derived Streptomyces sp. SBT348 inhibits staphylococcal growth and biofilm formation. *Frontiers in Microbiology*, **9**.

Balouiri, M., Sadiki, M., dan Ibnsouda, S.K., 2016. Methods for in vitro evaluating

Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai
Antibiofilm Polimikroba
Dyan Wigati, 4. Prof. Dr. apt. Erna Prawita Setyowati, M.Si., 5. Dr. Sylvia Utami Tunjung Pratiwi,S.Si.,M.Si, .Si, selaku
Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

antimicrobial activity: A review. *Journal of Pharmaceutical Analysis*, **6**: 71–79.

Baranac-Stojanović, M., 2014. New insight into the anisotropic effects in solution-state NMR spectroscopy. *RSC Advances*, **4**: 308–321.

Basu, S., Bose, C., Ojha, N., Das, N., Das, J., Pal, M., dkk., 2015. Evolution of bacterial and fungal growth media. *Bioinformation*, **11**: 182–184.

Bate, F., Amekan, Y., Pushkin, D.O., Chong, J.P.J., dan Bees, M., 2023. Emergent Lag Phase in Flux-Regulation Models of Bacterial Growth. *Bulletin of Mathematical Biology*, **85**.

Bessa, L.J., Buttachon, S., Dethoup, T., Martins, R., Vasconcelos, V., Kijjoa, A., dkk., 2016. Neofiscalin A and fiscalin C are potential novel indole alkaloid alternatives for the treatment of multidrugresistant Gram-positive bacterial infections. *FEMS Microbiology Letters*, **363**: .

Bheemaraya, Patil, M.., Ramesh, Yenjerappa, S.., Amaresh, Y.., dan Naik, M.K., 2013. Salinity stress tolerance in native Trichoderma isolates. *Environment and Ecology*, **31**: 727–729.

Bie, S., Yuan, H., Shi, C., Li, C., Lu, M., Yao, Z., dkk., 2025. Antibiofilm activity of Plumbagin against Staphylococcus aureus. *Scientific Reports 2025 15:1*, **15**: 1–11.

Blunt, J.W., Carroll, A.R., Copp, B.R., Davis, R.A., Keyzers, R.A., dan Prinsep, M.R., 2018. Marine natural products. *Natural Product Reports*, **35**: 8–53.

Botz, L., 2019. BIOASSAYS | bioautography. *Encyclopedia of Analytical Science*, 253–260.

Brachmann, A.O., Brameyer, S., Kresovic, D., Hitkova, I., Kopp, Y., Manske, C., dkk., 2013. Pyrones as bacterial signaling molecules. *Nature Chemical Biology*, **9**: 573–581.

Breijyeh, Z., Jubeh, B., dan Karaman, R., 2020. Resistance of Gram-Negative Bacteria to Current Antibacterial Agents and Approaches to Resolve It. *Molecules*, **25**: 1340.

Bunyan, I.A., Hadi, O.M., dan Al-Mansoori, H.A.K., 2019. Phenotypic detection and biofilm formation among pseudomonas aeruginosa isolated from different sites of infection. *International Journal of Pharmaceutical Quality Assurance*, **10**: 334–341.

Cai, L., 2014. Thin layer chromatography, dalam: *Current Protocols in Essential Laboratory Techniques*. Blackwell Publishing Inc., hal. 6.3.1-6.3.18.

Campoccia, D., Mirzaei, R., Montanaro, L., dan Arciola, C.R., 2019. Hijacking of immune defences by biofilms: a multifront strategy. *Biofouling*, **35**: 1055–1074.

Cangui-Panchi, S.P., Ñacato-Toapanta, A.L., Enríquez-Martínez, L.J., Salinas-Delgado, G.A., Reyes, J., Garzon-Chavez, D., dkk., 2023. Battle royale:

UNIVERSITAS GADJAH MADA
Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai Antibiofilm Polimikroba
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Immune response on biofilms – host-pathogen interactions. *Current Research in Immunology*, **4**.

Cao, Y., Yang, R., Zheng, F., Meng, X., Zhang, W., dan Liu, W., 2022. Dual Regulatory Role of Chromatin Remodeler ISW1 in Coordinating Cellulase and Secondary Metabolite Biosynthesis in Trichoderma reesei. *mBio*, **13**: 1–20.

Carmona-Orozco, M.L. dan Echeverri, F., 2024. Induction of biofilm in extended-spectrum beta-lactamase Staphylococcus aureus with drugs commonly used in pharmacotherapy. *Microbial pathogenesis*, **195**.

Carpa, R., Cândea, A., Remizovschi, A., Barbu-Tudoran, L., dan Maior, M.C., 2018. Cellulase production and morphology of Trichoderma reesei in different experimental conditions. *Studia Universitatis Babeş-Bolyai Biologia*, **63**: 115–129.

Catalán, E. dan Sánchez, A., 2020. Solid-State Fermentation (SSF) versus Submerged Fermentation (SmF) for the Recovery of Cellulases from Coffee Husks: A Life Cycle Assessment (LCA) Based Comparison. *Energies 2020, Vol. 13, Page 2685*, **13**: 2685.

Celikel, N. dan Kavas, G., 2008. Antimicrobial properties of some essential oils against some pathogenic microorganisms. *Czech Journal of Food Sciences*, **26**: 174–181.

Chen, L., Wu, G.W., Liu, D., Zhuang, W.Y., dan Yin, W.B., 2019. Trichodermatides E and F from fungus Trichoderma applanatum. *Journal of Asian Natural Products Research*, **21**: 659–665.

Chen, M., Yu, Q., dan Sun, H., 2013. Novel strategies for the prevention and treatment of biofilm related infections. *International Journal of Molecular Sciences*, **14**: 18488–18501.

Chen, S., Liu, D., Zhang, Q., Guo, P., Ding, S., Shen, J., dkk., 2021. A Marine Antibiotic Kills Multidrug-Resistant Bacteria without Detectable High-Level Resistance. *ACS Infectious Diseases*, **7**: 884–893.

Chirathanamettu, T.R. dan Pawar, P.D., 2020. Quorum sensing-induced phenotypic switching as a regulatory nutritional stress response in a competitive two-species biofilm: An individual-based cellular automata model. *Journal of Biosciences*, **45**.

Choma, I. dan Jesionek, W., 2015. TLC-Direct Bioautography as a High Throughput Method for Detection of Antimicrobials in Plants. *Chromatography*, **2**: 225–238.

Choma, I.M. dan Grzelak, E.M., 2011. Bioautography detection in thin-layer chromatography. *Journal of chromatography. A*, **1218**: 2684–2691.

Chu, D. dan Barnes, D.J., 2016. The lag-phase during diauxic growth is a trade-off between fast adaptation and high growth rate. *Scientific Reports*, **6**.

UNIVERSITAS GADJAH MADA
Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai Antibiofilm Polimikroba
Dyan Wigati, 4. Prof. Dr. apt. Erna Prawita Setyowati, M.Si., 5. Dr. Sylvia Utami Tunjung Pratiwi,S.Si.,M.Si, .Si, selaku
Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Colvin, K.M., Irie, Y., Tart, C.S., Urbano, R., Whitney, J.C., Ryder, C., dkk., 2012. The Pel and Psl polysaccharides provide Pseudomonas aeruginosa structural redundancy within the biofilm matrix. *Environmental Microbiology*, **14**: 1913–1928.

Cruz, A., Condinho, M., Carvalho, B., Arraiano, C.M., Pobre, V., dan Pinto, S.N., 2021. The two weapons against bacterial biofilms: Detection and treatment. *Antibiotics*, **10**.

Culotti, A. dan Packman, A.I., 2014. Pseudomonas aeruginosa promotes Escherichia coli biofilm formation in nutrient-limited medium. *PLoS ONE*, **9**.

da Silva, R.A.G., Afonina, I., dan Kline, K.A., 2021. Eradicating biofilm infections: an update on current and prospective approaches. *Current Opinion in Microbiology*, **63**: 117–125.

David, A., Tahrioui, A., Tareau, A.S., Forge, A., Gonzalez, M., Bouffartigues, E., dkk., 2024. Pseudomonas aeruginosa Biofilm Lifecycle: Involvement of Mechanical Constraints and Timeline of Matrix Production. *Antibiotics 2024, Vol. 13, Page 688*, **13**: 688.

Davis, W.W. dan Stout, T.R., 1971. Disc Plate Method of Microbiological Antibiotic Assay: I. Factors Influencing Variability and Error 1. *Applied Microbiology*, **22**: 659.

de Castro, R.J.S. dan Sato, H.H., 2015. Enzyme Production by Solid State Fermentation: General Aspects and an Analysis of the Physicochemical Characteristics of Substrates for Agro-industrial Wastes Valorization. *Waste and Biomass Valorization*, **6**: 1085–1093.

De Filippis, A., Nocera, F.P., Tafuri, S., Ciani, F., Staropoli, A., Comite, E., dkk., 2021. Antimicrobial activity of harzianic acid against Staphylococcus pseudintermedius. *Natural Product Research*, **35**: 5440–5445.

de Sá, J.D.M., Pereira, J.A., Dethoup, T., Cidade, H., Sousa, M.E., Rodrigues, I.C., dkk., 2021. Anthraquinones, diphenyl ethers, and their derivatives from the culture of the marine sponge-associated fungus neosartorya spinosa kufa 1047†. *Marine Drugs*, **19**: 457.

Debrah, P., Kwapong, A.A., dan Fredua-Agyeman, M., 2020. Treatment of Biofilms in Infected Wounds, dalam: *Therapeutic Dressings and Wound Healing Applications*. Wiley Online Library, hal. 115–136.

Deepika, S., Thangam, R., dan Perias, S., 2018. Combined effect of a natural flavonoid rutin from Citrus sinensis and conventional antibiotic gentamicin on Pseudomonas aeruginosa biofilm formation. *Food Control*, **90**.

Del Pozo, J.L., 2018. Biofilm-related disease. *Expert Review of Anti-Infective Therapy*, **16**: 51–65.

Dengler Haunreiter, V., Boumasmoud, M., Häffner, N., Wipfli, D., Leimer, N., Rachmühl, C., dkk., 2019. In-host evolution of Staphylococcus epidermidis in a pacemaker-associated endocarditis resulting in increased antibiotic

Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai
Antibiofilm Polimikroba
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

tolerance. *Nature Communications*, **10**: 1–14.

Derntl, C., Rassinger, A., Srebotnik, E., Mach, R.L., dan Mach-Aigner, A.R., 2016. Identification of the main regulator responsible for synthesis of the typical yellow pigment produced by Trichoderma reesei. *Applied and Environmental Microbiology*, **82**: 6247–6257.

Dewanjee, S., Gangopadhyay, M., Bhattacharya, N., Khanra, R., dan Dua, T.K., 2014. Bioautography and its scope in the field of natural product chemistry. *Journal of Pharmaceutical Analysis*, **5**: 75.

Dewasthale, S., Mani, I., dan Vasdev, K., 2018. Microbial biofilm: current challenges in health care industry. *Journal of Applied Biotechnology & Bioengineering*, **5**: 156–160.

Díez-Aguilar, M., Ekkelenkamp, M., Morosini, M.I., Huertas, N., Del Campo, R., Zamora, J., dkk., 2021. Anti-biofilm activity of murepavadin against cystic fibrosis Pseudomonas aeruginosa isolates. *Journal of Antimicrobial Chemotherapy*, **76**: 2578–2585.

Ding, G., Chen, A.J., Lan, J., Zhang, H., Chen, X., Liu, X., dkk., 2012. Sesquiterpenes and cyclopeptides from the endophytic fungus Trichoderma asperellum Samuels, Lieckf. & Nirenberg. *Chemistry and Biodiversity*, **9**: 1205–1212.

Dirga, D., Khairunnisa, S.M., Akhmad, A.D., Setyawan, I.A., dan Pratama, A., 2021. Evaluasi Penggunaan Antibiotik pada Pasien Rawat Inap di Bangsal Penyakit Dalam RSUD. Dr. H. Abdul Moeloek Provinsi Lampung. *Jurnal Kefarmasian Indonesia*, **11**: 65–75.

Dong, K., Li, W., Xu, Q., Hong, Z., Zhang, S., Zhang, B., dkk., 2023. Exploring the correlation of metabolites changes and microbial succession in solid-state fermentation of Sichuan Sun-dried vinegar. *BMC Microbiology*, **23**: 1–17.

Donlan, R.M., 2002. Biofilms: Microbial life on surfaces. *Emerging Infectious Diseases*, **8**: 881–890.

Ebada, S.S., Linh, M.H., Longeon, A., De Voogd, N.J., Durieu, E., Meijer, L., dkk., 2015. Dispacamide e and other bioactive bromopyrrole alkaloids from two Indonesian marine sponges of the genus Stylissa. *Natural Product Research*, **29**: 231–238.

Ebeshi, B.U., Vaikosen, E.N., dan Temes, K.T., 2015. High performance thin layer chromatographic and ultra-violet spectrophotometric fingerprinting of some beta lactam antibiotics. *Journal of Science and Practice of Pharmacy*, **2**: 64–69.

El-Naggar, H.A., Bashar, M.A.E., Rady, I., El-Wetidy, M.S., Suleiman, W.B., Al-Otibi, F.O., dkk., 2022. Two Red Sea Sponge Extracts (Negombata magnifica and Callyspongia siphonella) Induced Anticancer and Antimicrobial Activity. *Applied Sciences (Switzerland)*, **12**: 1–23.

Elissawy, A.M., Ebada, S.S., Ashour, M.L., Özkaya, F.C., Ebrahim, W., Singab,

Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai
Antibiofilm Polimikroba
Dyan Wigati, 4. Prof. Dr. apt. Erna Prawita Setyowati, M.Si., 5. Dr. Sylvia Utami Tunjung Pratiwi,S.Si.,M.Si, .Si, selaku
Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

A.N.B., dkk., 2017. Spiroarthrinols a and B, two novel meroterpenoids isolated from the sponge- derived fungus Arthrinium sp. *Phytochemistry Letters*, **20**: 246–251.

Elmayanti, Fatmawati, A., Rianto, M.R., dan Basarang, M., 2017. Perbandingan Besaran Partikel Bekatul 0,18 mm, 0,25 mm dan 0,39 mm Terhadap Pertumbuhan Aspergillus sp. *Jurnal Medika: Media Ilmiah Analis Kesehatan*, **2**.

Eloff, J.N., 2004. Quantification the bioactivity of plant extracts during screening and bioassay guided fractionation. *Phytomedicine : international journal of phytotherapy and phytopharmacology*, **11**: 370–371.

Elyashberg, M., 2015. Identification and structure elucidation by NMR spectroscopy. *TrAC Trends in Analytical Chemistry*, **69**: 88–97.

Emilda, E. dan Delfira, N., 2023. Pemanfaatan Silika Gel 70-230 Mesh Bekas Sebagai Pengganti Fase Diam Kromatografi Kolom pada Praktikum Kimia Organik. *Indonesian Journal of Laboratory*, **6**: 45–51.

Famuyide, I.M., Aro, A.O., Fasina, F.O., Eloff, J.N., dan McGaw, L.J., 2019. Antibacterial and antibiofilm activity of acetone leaf extracts of nine under-investigated south African Eugenia and Syzygium (Myrtaceae) species and their selectivity indices. *BMC complementary and alternative medicine*, **19**: .

Ferreira, M., Pinto, M., Aires-da-Silva, F., Bettencourt, A., Gaspar, M.M., dan Aguiar, S.I., 2024. Rifabutin: a repurposed antibiotic with high potential against planktonic and biofilm staphylococcal clinical isolates. *Frontiers in Microbiology*, **15**.

Field, L.D., Sternhell, S., dan Kalman, J.R., 2013. *Organic Structures from Spectra*, 5th ed. John Wiley and Sons Ltd., Sydney.

Filho, J.A.C., 2018. Endophytic microbes as a novel source for producing anticancer compounds as multidrug resistance modulators, dalam: Akhtar, M.S. dan Swamy, M.K. (Editor), *Anticancer Plants: Natural Products and Biotechnological Implements*. Springer, Singapore, hal. 343–381.

Filkins, L.M., Graber, J.A., Olson, D.G., Dolben, E.L., Lynd, L.R., Bhuju, S., dkk., 2015. Coculture of Staphylococcus aureus with Pseudomonas aeruginosa drives S. aureus towards fermentative metabolism and reduced viability in a cystic fibrosis model. *Journal of Bacteriology*, **197**: 2252–2264.

Flemming, H.C. dan Wuertz, S., 2019. Bacteria and archaea on Earth and their abundance in biofilms. *Nature Reviews Microbiology*, **17**: 247–260.

Galinier, A., 2018. Carbon catabolite repression or how bacteria choose their favorite sugars. *Medecine/Sciences*, **34**: 531–539.

Ganesan, A. dan Rengarajan, J., 2024. Green synthesis of chitosan nanoparticles using Cassia fistula leaf extract: evaluation of antimicrobial, antioxidant, antibiofilm, and cytotoxic activities. *3 Biotech*, **14**: .

UNIVERSITAS GADJAH MADA
Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai Antibiofilm Polimikroba
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Garduño, I.R., Smith, M., Baranova, E., dan Kinsley, C., 2024. Hydrogen production in dark fermentation of a brewery sludge pre-treated with white-rot fungi in submerged culture. *Bioresource Technology Reports*, **25**: 101773.

Ghanwate, N.A., Thakare, P. V, Bhise, P.R., dan Tayde, S., 2014. Prevention of Biofilm Formation in Urinary Catheters by Treatment with Antibiofilm Agents. *International Journal*, **3**: 2–5.

Goel, N., Fatima, S.W., Kumar, S., Sinha, R., dan Khare, S.K., 2021. Antimicrobial resistance in biofilms: Exploring marine actinobacteria as a potential source of antibiotics and biofilm inhibitors. *Biotechnology Reports*.

Golus, J., Sawicki, R., Widelski, J., dan Ginalska, G., 2016. The agar microdilution method – a new method for antimicrobial susceptibility testing for essential oils and plant extracts. *Journal of Applied Microbiology*, **121**: 1291–1299.

Gomes, L.C. dan Mergulhão, F.J., 2017. SEM analysis of surface impact on biofilm antibiotic treatment. *Scanning*, **2017**.

Gomes, L.C., Moreira, J.M.R., Araújo, J.D.P., dan Mergulhão, F.J., 2017. Surface conditioning with escherichia coli cell wall components can reduce biofilm formation by decreasing initial adhesion. *AIMS Microbiology*, **3**: 613–628.

Gomes, L.C., Silva, L.N., Simões, M., De Melo, L.F., dan Mergulhão, F.J., 2015. Exploring the antibiotic effects in bacterial biofilms by epifluorescence and scanning electron microscopy. *Springer Proceedings in Physics*, **164**: 241–248.

Greco-Duarte, J., de Almeida, F.P., de Godoy, M.G., Lins, U., Freire, D.M.G., dan Gutarra, M.L.E., 2023. Simultaneous lipase production and immobilization: morphology and physiology study of Penicillium simplicissimum in submerged and solid-state fermentation with polypropylene as an inert support. *Enzyme and Microbial Technology*, **164**: 110173.

Guiard, B.P. dan Gotti, G., 2024. The High-Precision Liquid Chromatography with Electrochemical Detection (HPLC-ECD) for Monoamines Neurotransmitters and Their Metabolites: A Review. *Molecules*, **29**: .

Gupta, M.K. dan Biswas, P.K., 2023. Chromatography: Basic principle, types, and applications. *Basic Biotechniques for Bioprocess and Bioentrepreneurship*, 173–182.

Ha, V.T.N. dan Le, N.T.H., 2022. Extraction of anthocyanins from Clitoria ternatea L. petals in Vietnam and determination of its antioxidant and antimicrobial activities. *Jordan Journal of Pharmaceutical Sciences*, **15**: 145–157.

Hall, C.W. dan Mah, T.F., 2017. Molecular mechanisms of biofilm-based antibiotic resistance and tolerance in pathogenic bacteria. *FEMS Microbiology Reviews*, **41**: 276–301.

Hamzah, H., Hertiani, T., Utami Tunjung Pratiwi, S., dan Nuryastuti, T., 2019. The Inhibition Activity of Tannin on the Formation of Mono-Species and Polymicrobial Biofilm Escherichia coli, Staphylococcus aureus, Pseudomonas

Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

aeruginosa, and Candida albicans. *Majalah Obat Tradisional*, **24**: 110.

Hamzah, H., Hertiani, T., Utami Tunjung Pratiwi, S., Nuryastuti, T., Kalimantan Timur, M., Biologi Farmasi, D., dkk., 2021. Efek Saponin Terhadap Penghambatan Planktonik dan Mono-Spesies Biofilm Candida albicans ATCC 10231 pada Fase Pertengahan, Pematangan dan Degaradasi. *Majalah Farmaseutik*, **17**: 198–205.

Hamzah, H., Pratiwi, S.U.T., dan Hertiani, T., 2022. Efficacy of C-10 massoialactone against-multispecies microbial biofilm. *Biointerface Research in Applied Chemistry*, **12**: 3472–3487.

Hamzah, H., Pratiwi, S.U.T., Nur, A., Nuryastuti, T., Pratama, V.Y., dan Maulana, R., 2024. Antibacterial and Antibiofilm Activities of Ternate Blue Pea (Clitoria ternatea) Flower Extract against Staphylococcus aureus. *Tropical Journal of Natural Product Research*, **8**: 5992–5996.

Hancu, G., Simon, B., Kelemen, H., Rusu, A., Mircia, E., dan Gyéresi, Á., 2013. Thin Layer Chromatographic Analysis of Beta-Lactam Antibiotics. *Advanced Pharmaceutical Bulletin*, **3**: 367.

Hanif, N., Murni, A., Tanaka, C., dan Tanaka, J., 2019. Marine natural products from Indonesian waters. *Marine Drugs*, **17**: 364.

Harborne, J.., 1978. *Metode Fitokimia. Penuntun Cara Modern Menganalisis Tumbuhan. Alih Bahasa Kosasih Padmawinata.*, Bandung : ITB. ITB, Bandung.

Harika, K., Shenoy, V., Narasimhaswamy, N., dan Chawla, K., 2020. Detection of biofilm production and its impact on antibiotic resistance profile of bacterial isolates from chronic wound infections. *Journal of Global Infectious Diseases*, **12**: 129–134.

Hayward, J.J., Mader, L., dan Trant, J.F., 2022. Giving Preparative Thin-Layer Chromatography Some Tender Loving Care. *Synthesis (Germany)*, **54**: 2391–2394.

Healy, A.R., Vinale, F., Lorito, M., dan Westwood, N.J., 2015. Total synthesis and biological evaluation of the tetramic acid based natural product harzianic acid and its stereoisomers. *Organic Letters*, **17**: 692–695.

Hema, T., Seghal Kiran, G., Sajayyan, A., Ravendran, A., Gowtham Raj, G., dan Selvin, J., 2019. Response surface optimization of a glycolipid biosurfactant produced by a sponge associated marine bacterium Planococcus sp. MMD26. *Biocatalysis and Agricultural Biotechnology*, **18**.

Hikmawan, B.D., Wahyuono, S., dan Setyowati, E.P., 2020. Marine sponge compounds with antiplasmodial properties: Focus on in vitro study against Plasmodium falciparum. *Journal of Applied Pharmaceutical Science*, **10**: 142–157.

Horie, T., Kawamata, T., Matsunami, M., dan Ohsumi, Y., 2017. Recycling of iron via autophagy is critical for the transition from glycolytic to respiratory

Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai
Antibiofilm Polimikroba
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

growth. *Journal of Biological Chemistry*, **292**: 8533–8543.

Hossain, T.J., 2024. Methods for screening and evaluation of antimicrobial activity: A review of protocols, advantages, and limitations. *European Journal of Microbiology and Immunology*, **14**: 97–115.

Huang, J., Lu, C., Qian, X., Huang, Y., Zheng, Z., dan Shen, Y., 2011. Effect of salinity on the growth, biological activity and secondary metabolites of some marine fungi. *Acta Oceanologica Sinica*, **30**: 118–123.

Ikram, M., Ali, N., Jan, G., Hamayun, M., Jan, F.G., dan Iqbal, A., 2019. Novel antimicrobial and antioxidative activity by endophytic Penicillium roqueforti and Trichoderma reesei isolated from Solanum surattense. *Acta Physiologiae Plantarum*, **41**: .

Jabila Mary, T.R., Kannan, R.R., Iniyan, A.M., Ramachandran, D., dan Prakash Vincent, S.G., 2021. Cell wall distraction and biofilm inhibition of marine Streptomyces derived angucycline in methicillin resistant Staphylococcus aureus. *Microbial Pathogenesis*, **150**: .

Jagannath, S., Konappa, N., Lokesh, A., Bhuvaneshwari, Dasegowda, T., Udayashankar, A.C., dkk., 2021. Bioactive compounds guided diversity of endophytic fungi from Baliospermum montanum and their potential extracellular enzymes. *Analytical Biochemistry*, **614**: 114024.

Jakovljević, V.D. dan Vrvić, M.M., 2017. The Potential Application of Selected Fungi Strains in Removal of Commercial Detergents and Biotechnology, dalam: *Application and Characterization of Surfactants*. InTech.

Jamal, M., Ahmad, W., Andleeb, S., Jalil, F., Imran, M., Nawaz, M.A., dkk., 2018. Bacterial biofilm and associated infections. *Journal of the Chinese Medical Association*, **81**: 7–11.

Jamal, M., Bukhari, S.M.A.U.S., Raza, S., Shah, L., Redaina, R., dan ALi, N., 2021. Microbial Biofilms. Properties, Biodiversity, Conservation and Management, dalam: *Microbial Biofilms. Properties and Applications in the Environment, Agriculture, and Medicine*. hal. 3.

Ji, H., Xu, Y., Lu, H., dan Zhang, Z., 2019. Deep MS/MS-Aided Structural-Similarity Scoring for Unknown Metabolite Identification. *Analytical Chemistry*, **91**: 5629–5637.

Jovcevski, B. dan Pukala, T.L., 2019. Mass Spectrometry and Its Applications. *Biomolecular and Bioanalytical Techniques: Theory, Methodology and Applications*, 219–253.

Jóźwiak, G.W., Majer-Dziedzic, B., Jesionek, W., Zieliński, W., dan Waksmundzka-Hajnos, M., 2016. Thin-layer chromatography: Direct bioautography as a method of examination of antimicrobial activity of selected Potentilla species. *Journal of Liquid Chromatography and Related Technologies*, **39**: 281–285.

Kadhim, K.F. dan Al-Rubayae, I.M., 2023. Alternative Fuel Production From Four

UNIVERSITAS GADJAH MADA
Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai Antibiofilm Polimikroba
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Oleaginous Fungal Species in Basra Using Waste Industrial Media. *AIP Conference Proceedings*, **2845**.

Kale, D.S., Karande, G.S., dan Datkhile, K.D., 2023. Diabetic Foot Ulcer in India: Aetiological Trends and Bacterial Diversity. *Indian Journal of Endocrinology and Metabolism*, **27**: 107–114.

Kang, D. dan Kirienko, N. V., 2018. Interdependence between iron acquisition and biofilm formation in Pseudomonas aeruginosa. *Journal of Microbiology*, **56**: 449–457.

Karami, P., Khaledi, A., Mashoof, R.Y., Yaghoobi, M.H., Karami, M., Dastan, D., dkk., 2020. The correlation between biofilm formation capability and antibiotic resistance pattern in Pseudomonas aeruginosa. *Gene Reports*, **18**.

Kartal, M.O., Ekinci, M.B., dan Poyraz, B., 2021. Biofilm Structure and Prevention. *Akademik Gida*, **19**: 353–363.

Karthikeyan, A., Joseph, A., dan Nair, B.G., 2022. Promising bioactive compounds from the marine environment and their potential effects on various diseases. *Journal of Genetic Engineering and Biotechnology*, **20**.

Kateel, R., Augustine, A.J., Prabhu, S., Ullal, S., Pai, M., dan Adhikari, P., 2018. Clinical and microbiological profile of diabetic foot ulcer patients in a tertiary care hospital. *Diabetes and Metabolic Syndrome: Clinical Research and Reviews*, **12**: 27–30.

Kathiresan, N., Prabu, D., Kasilingam, H., Sangavi, P., Arumugam, V. ravi, dan Kulanthaivel, L., 2024. Anti-quorum sensing mediated anti-infective efficacy of pentadecanoic acid against Staphylococcus aureus infections through in vitro, and in silico analyses. *Biocatalysis and Agricultural Biotechnology*, **62**: 103442.

Kementerian Kesehatan Republik Indonesia, 2020. *Farmakope Indonesia Edisi IV*, IV. ed. Jakarta, Indonesia.

Khadke, S.K., Lee, J.H., Kim, Y.G., Raj, V., dan Lee, J., 2021. Assessment of antibiofilm potencies of nervonic and oleic acid against acinetobacter baumannii using in vitro and computational approaches. *Biomedicines*, **9**: 1133.

Khan, F., Bamunuarachchi, N.I., Pham, D.T.N., Tabassum, N., Khan, M.S.A., dan Kim, Y.M., 2021. Mixed biofilms of pathogenic Candida-bacteria: regulation mechanisms and treatment strategies. *Critical Reviews in Microbiology*, **47**: 699–727.

Khan, M.A.R., Wang, B.W., Chen, Y.Y., Lin, T.H., Lin, H.C., Yang, Y.L., dkk., 2021. Natural polyketide 6-pentyl-2H-pyrone-2-one and its synthetic analogues efficiently prevent marine biofouling. *Biofouling*, .

Khan, N.A., Barthes, N., McCormack, G., O'Gara, J.P., Thomas, O.P., dan Boyd, A., 2023a. Sponge-derived fatty acids inhibit biofilm formation of MRSA and MSSA by down-regulating biofilm-related genes specific to each pathogen.

Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Journal of Applied Microbiology, **134**: 1–13.

Khan, N.A., Barthes, N., McCormack, G., O'Gara, J.P., Thomas, O.P., dan Boyd, A., 2023b. Sponge-derived fatty acids inhibit biofilm formation of MRSA and MSSA by down-regulating biofilm-related genes specific to each pathogen. *Journal of Applied Microbiology*, **134**.

Kim, K.W., Lee, K.H., Ha, W.S., Kim, Y., dan Jang, Y.P., 2025. Isolation of Natural Products Using Preparative TLC. *Methods in molecular biology (Clifton, N.J.)*, **2895**: 259–269.

Kim, Y.G., Lee, J.H., Park, S., Kim, S., dan Lee, J., 2022. Inhibition of polymicrobial biofilm formation by saw palmetto oil, lauric acid and myristic acid. *Microbial Biotechnology*, **15**: 590–602.

Kvich, L., Crone, S., Christensen, M.H., Lima, R., Alhede, Morten, Alhede, Maria, dkk., 2022. Investigation of the Mechanism and Chemistry Underlying Staphylococcus aureus' Ability to Inhibit Pseudomonas aeruginosa Growth In Vitro. *Journal of Bacteriology*, **204**

Kwak, M., Molina, M., Arnold, S., Woodward, A., An, J.Y., Nuckels, E., dkk., 2022. FragView: An Educational Web Server for Visualizing Metabolite Fragmentation. *IMCIC 2022 - 13th International Multi-Conference on Complexity, Informatics and Cybernetics, Proceedings*, **1**: 120–123.

Kwon, O.S., Kim, C.K., Byun, W.S., Oh, J., Lee, Y.J., Lee, H.S., dkk., 2018. Cyclopeptides from the Sponge Stylissa flabelliformis. *Journal of Natural Products*, **81**: 1426–1434.

Latif, P.S.M.A., Noor, N.M.M., Mazlan, S., Razali, N., Ramasamy, K., dan Ariffin, S.A., 2022. Saline Tolerant of Marine Endophytic Fungi from Teluk Kemang Malaysia – A Rich Source of Bioactive Material. *Malaysian Applied Biology*, **51**: 193–200.

Laverty, G., Gorman, S.P., dan Gilmore, B.F., 2014. Biomolecular mechanisms of Pseudomonas aeruginosa and Escherichia coli biofilm formation. *Pathogens*, **3**: 596–632.

Le Goff, G., Lopes, P., Arcile, G., Vlachou, P., Elslande, E. Van, Retailleau, P., dkk., 2019. Impact of the Cultivation Technique on the Production of Secondary Metabolites by Chrysosporium lobatum TM-237-S5, Isolated from the Sponge Acanthella cavernosa. *Marine Drugs*, **17**

Li, C., Yang, Z., He Can Zhang, R., Zhang, D., Chen, S., dan Ma, L., 2013. Effect of pH on cellulase production and morphology of Trichoderma reesei and the application in cellulosic material hydrolysis. *Journal of Biotechnology*, **168**: 470–477.

Li, J., Zhang, S., dan Zhang, Y., 2025. Optimization of mycelial culture conditions of the entomopathogenic fungus Cordyceps blackwelliae in submerged culture. *Mycological Progress*, **24**: 1–10.

Lozano-Sánchez, J., Borrás-Linares, I., Sass-Kiss, A., dan Segura-Carretero, A.,

UNIVERSITAS GADJAH MADA
Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai Antibiofilm Polimikroba
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

2018. Chromatographic Technique: High-Performance Liquid Chromatography (HPLC), dalam: *Modern Techniques for Food Authentication*. Academic Press, hal. 459–526.

Lu, C.J., Tang, Z.Z., Su, Z.W., Li, H.Y., Zhang, G.S., Gao, C.H., dkk., 2023. Secondary Metabolites from Marine-Derived Fungus Aspergillus carneus GXIMD00519. *Records of Natural Products*, **17**: 343–351.

Luo, A., Wang, F., Sun, D., Liu, X., dan Xin, B., 2022. Formation, Development, and Cross-Species Interactions in Biofilms. *Frontiers in Microbiology*, **12**

Luo, X., Jiang, J.H., Liu, S.L., Gao, J.Y., dan Zhou, L.W., 2024. Metabolomics analysis of rice fermented by medicinal fungi providing insights into the preparation of functional food. *Food Chemistry*, **459**

Macias-Valcayo, A., Aguilera-Correa, J.-J., Broncano, A., Parron, R., Auñon, A., Garcia-Cañete, J., dkk., 2022. Comparative In Vitro Study of Biofilm Formation and Antimicrobial Susceptibility in Gram-Negative Bacilli Isolated from Prosthetic Joint Infections . *Microbiology Spectrum*, **10**

Mahapatra, G.P., Raman, S., Nayak, S., Gouda, S., Das, G., dan Patra, J.K., 2020. Metagenomics Approaches in Discovery and Development of New Bioactive Compounds from Marine Actinomycetes. *Current Microbiology*, **77**: 645–656.

Majik, M.S., Gawas, U.B., dan Mandrekar, V.K., 2019. Analytical methods for natural products isolation: Principles and applications, dalam: *Advances in Biological Science Research: A Practical Approach*. Academic Press, hal. 395–409.

Malešević, M., Di Lorenzo, F., Filipić, B., Stanisavljević, N., Novović, K., Senerovic, L., dkk., 2019. Pseudomonas aeruginosa quorum sensing inhibition by clinical isolate Delftia tsuruhatensis 11304: involvement of N-octadecanoylhomoserine lactones. *Scientific Reports*, **9**: 1–13.

Malviya, N. dan Malviya, S., 2017. Bioassay guided fractionation-an emerging technique influence the isolation, identification and characterization of lead phytomolecules. *International Journal of Hospital Pharmacy*, **2**

Marquez, B.L. dan Williamson, R.T., 2019. *Quantitative Applications of NMR Spectroscopy*, Chemical Engineering in the Pharmaceutical Industry. wiley.

Martzy, R., Mello-de-Sousa, T.M., Mach, R.L., Yaver, D., dan Mach-Aigner, A.R., 2021. The phenomenon of degeneration of industrial Trichoderma reesei strains. *Biotechnology for Biofuels*, **14**.

Maurya, A., Kalani, K., Verma, S.C., Singh, R., dan Srivastava, A., 2018. Vacuum Liquid Chromatography: Simple, Efficient and Versatile Separation Technique for Natural ProductsNo Title. *Organic and Medicinal Chemistry*, **7**

Meng, J., Cheng, W., Heydari, H., Wang, B., Zhu, K., Konuklugil, B., dkk., 2018. Sorbicillinoid-based metabolites from a sponge-derived fungus Trichoderma saturnisporum. *Marine Drugs*, **16**

UNIVERSITAS GADJAH MADA
Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai Antibiofilm Polimikroba
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Michaliski, L.F., Ióca, L.P., Oliveira, L.S., Crnkovic, C.M., Takaki, M., Freire, V.F., dkk., 2023. Improvement of Targeted Fungi Secondary Metabolite Production Using a Systematic Experimental Design and Chemometrics Analysis. *Methods and Protocols*, **6**: 1–18.

Mienda, B.S., Idi, A., dan Umar, A., 2011. Microbiological Features of Solid State Fermentation and its Applications - An overview. *Research in Biotechnology*, **2**: 21–26.

Mirani, Z.A., Fatima, A., Urooj, S., Aziz, M., Khan, M.N., dan Abbas, T., 2018. Relationshipof cell surfacehydrophobicitywithbiofilmformationand growth rate: A study on Pseudomonas aeruginosa, Staphylococcus aureus, and Escherichia coli. *Iranian Journal of Basic Medical Sciences*, **21**: 760–769.

Mironova, A. V., Karimova, A. V., Bogachev, M.I., Kayumov, A.R., dan Trizna, E.Y., 2023. Alterations in Antibiotic Susceptibility of Staphylococcus aureus and Klebsiella pneumoniae in Dual Species Biofilms. *International Journal of Molecular Sciences*, **24**.

Mirzaei, R., Alikhani, M.Y., Arciola, C.R., Sedighi, I., Yousefimashouf, R., dan Bagheri, K.P., 2022. Prevention, inhibition, and degradation effects of melittin alone and in combination with vancomycin and rifampin against strong biofilm producer strains of methicillin-resistant Staphylococcus epidermidis. *Biomedicine & Pharmacotherapy*, **147**: 112670.

Mirzaei, R., Mohammadzadeh, R., Alikhani, M.Y., Shokri Moghadam, M., Karampoor, S., Kazemi, S., dkk., 2020. The biofilm-associated bacterial infections unrelated to indwelling devices. *IUBMB Life*, **72**: 1271–1285.

Mishra, N., Khan, S.S., dan Sundari, S.K., 2016. Native isolate of Trichoderma: a biocontrol agent with unique stress tolerance properties. *World Journal of Microbiology and Biotechnology*, **32**.

Mishra, R.K., Pandey, S., Mishra, M., Singh Rathore, U., dan Singh, B., 2024. Identification and characterization of high salinity tolerant Trichoderma harzianum strain, IIPRTh-3 for mitigating salt stress, wilt incidence and promoting plant growth in pigeonpea. *Archives of Phytopathology and Plant Protection*, **57**: 691–704.

Mohanasrinivasan, V., Dhrisya, P., Dipinsha, K.P., Nnithan, C.M., Viswanath, K.M., dan Devi, C.S., 2009. A comparative study of the lipase yield by solid state and submerged fermentations using fungal species from biopharmaceutical oil waste. *African Journal of Biotechnology*, **8**: 073–076.

Moldoveanu, S.C. dan David, V., 2016. *Selection of the HPLC Method in Chemical Analysis*, Selection of the HPLC Method in Chemical Analysis.

Mordmuang, A., Udomwech, L., dan Karnjana, K., 2021. Influence of contact lens materials and cleaning procedures on bacterial adhesion and biofilm formation. *Clinical Ophthalmology*, **15**: 2391–2402.

Morita, M. dan Schmidt, E.W., 2018. Parallel lives of symbionts and hosts:

Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai
Antibiofilm Polimikroba
Dyan Wigati, 4. Prof. Dr. apt. Erna Prawita Setyowati, M.Si., 5. Dr. Sylvia Utami Tunjung Pratiwi,S.Si.,M.Si, .Si, selaku
Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Chemical mutualism in marine animals. *Natural Product Reports*, **35**: 357–378.

Mottola, C., Mendes, J.J., Cristino, J.M., Cavaco-Silva, P., Tavares, L., dan Oliveira, M., 2016. Polymicrobial biofilms by diabetic foot clinical isolates. *Folia Microbiologica*, **61**: 35–43.

Muras, A., Mallo, N., Otero-Casal, P., Pose-Rodríguez, J.M., dan Otero, A., 2022. Quorum sensing systems as a new target to prevent biofilm-related oral diseases. *Oral Diseases*, **28**: 307–313.

Nascimento, L.D., Lopes, A.C.P., Teixeira, M.M., da Silva, J.M.A., Silva, L.O., de Almeida, J.B., dkk., 2021. Clinical and Microbiological Profile of Diabetic Foot Ulcers Infected With Staphylococcus aureus in a Regional General Hospital in Bahia, Brazil. *International Journal of Lower Extremity Wounds*.

Nicoletti, R. dan Vinale, F., 2018. Bioactive compounds from marine-derived aspergillus, penicillium, talaromyces and trichoderma species. *Marine Drugs*, **16**: 408.

Nielsen, J.C., Prigent, S., Grijseels, S., Workman, M., Ji, B., dan Nielsen, J., 2019. Comparative Transcriptome Analysis Shows Conserved Metabolic Regulation during Production of Secondary Metabolites in Filamentous Fungi. *American Society for Microbiology*, **4**: e00012-19.

Nunes, S. de O., Rosa, H. da S., Canellas, A.L.B., Romanos, M.T.V., dos Santos, K.R.N., Muricy, G., dkk., 2021. High reduction of staphylococcal biofilm by aqueous extract from marine sponge-isolated Enterobacter sp. *Research in Microbiology*, **172**.

Oluah, A., Oputa, A.I., Ndukwe, G.I., dan Fekarurhobo, G.K., 2020. Application of Vacuum Liquid Chromatography to the Separation of Secondary Metabolites of Baphia nitida Lodd. Stem. *Journal of Chemical Society of Nigeria*, **45**: 220–225.

Onofre, S.B., Bonfante, T., Santos, Z.M.Q. dos, Moura, M.C. de, Cardoso, A.F., Onofre, S.B., dkk., 2014. Cellulase Production by Endophytic Strains of Trichoderma reesei from Baccharis dracunculifolia D. C. (Asteraceae). *Advances in Microbiology*, **4**: 275–283.

Oyardi, Ö., Hacioğlu, M., Özdemir, E., Erbay, M.Ş., Kültür, Ş., dan Bozkurt Güzel, Ç., 2024. Screening of Antimicrobial, Antibiofilm, and Cytotoxic Activities of Some Medicinal Plants from Balıkesir Province, Türkiye: Potential Effects of Allium paniculatum Flower. *Turkish Journal of Pharmaceutical Sciences*, **21**: 252–258.

Özkaya, F.C., Ebrahim, W., El-Neketi, M., Tansel Tanrıkul, T., Kalscheuer, R., Müller, W.E.G., dkk., 2018. Induction of new metabolites from sponge-associated fungus Aspergillus carneus by OSMAC approach. *Fitoterapia*, **131**: 9–14.

Pang, Z., Raudonis, R., Glick, B.R., Lin, T.J., dan Cheng, Z., 2019. Antibiotic

UNIVERSITAS GADJAH MADA
Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai Antibiofilm Polimikroba
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

resistance in Pseudomonas aeruginosa: mechanisms and alternative therapeutic strategies. *Biotechnology Advances*, **37**: 177–192.

Papaianni, M., Ricciardelli, A., Fulgione, A., D'errico, G., Zoina, A., Lorito, M., dkk., 2020. Antibiofilm activity of a trichoderma metabolite against xanthomonas campestris pv. Campestris, alone and in association with a phage. *Microorganisms*, **8**.

Parsa, H. dan Samani, S., 2015. Microbiological Features and Risk Factors in Patients with Diabetic Foot Ulcers. *Wounds*, **27**: 308–312.

Patel, N.B., Hinojosa, J.A., Zhu, M., dan Robertson, D.M., 2018. Acceleration of the formation of biofilms on contact lens surfaces in the presence of neutrophil-derived cellular debris is conserved across multiple genera. *Molecular Vision*, **24**: 94–104.

Paul, J.S., Tiwari, K.L., dan Jadhav, S.K., 2015. Long term preservation of commercial important fungi in glycerol at 4°C. *International Journal of Biological Chemistry*, **9**: 79–85.

Peralta-Rodríguez, R.D., Guerrero-Hernández, L.A., Alfonso-Sánchez, E., Meléndez-Ortiz, H.I., Betancourt-Galindo, R., Espinosa-Neira, R., dkk., 2025. Synthesis, characterization, and cytotoxic evaluation of dianionic bicephalous surfactants derived from fatty acids: A theoretical and experimental approach. *Journal of Molecular Structure*, **1336**: 142098.

Picoli, T., Peter, C.M., Zani, J.L., Waller, S.B., Lopes, M.G.K.N.B., Vargas, G. dAvila, dkk., 2017. Melittin and its potential in the destruction and inhibition of the biofilm formation by Staphylococcus aureus, Escherichia coli and Pseudomonas aeruginosa isolated from bovine milk. *Microbial Pathogenesis*, **112**: 57–62.

Pierce, C.G., Uppuluri, P., Tummala, S., dan Lopez-Ribot, J.L., 2010. A 96 Well Microtiter Plate-based Method for Monitoring Formation and Antifungal Susceptibility Testing of Candida albicans Biofilms. *Journal of Visualized Experiments: JoVe*, .

Ponnambalam, A.S., Ghosh, A.R., dan Prabu, L. V., 2014. Solid state production of baterial cellulase using Agave sisalana as substrate. *Journal of Chemical and Pharmaceutical Sciences*, 86–88.

Pouget, C., Dunyach-Remy, C., Pantel, A., Schuldiner, S., Sotto, A., dan Lavigne, J.P., 2020. Biofilms in diabetic foot ulcers: Significance and clinical relevance. *Microorganisms*, **8**: 1–15.

Prasath, K.G., Sethupathy, S., dan Pandian, S.K., 2019. Proteomic analysis uncovers the modulation of ergosterol, sphingolipid and oxidative stress pathway by myristic acid impeding biofilm and virulence in Candida albicans. *Journal of Proteomics*, **208**: 103503.

Pratiwi, S.U.T., 2023a. *Dasar Dasar Mikrobiologi Jilid 2*, 2nd ed, Dasar dasar Mikrobiologi. Erlangga, Jakarta, Indonesia.

Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Pratiwi, S.U.T., 2023b. *Dasar Dasar Mikrobiologi Jilid 1*, 1st ed. Erlangga, Jakarta, Indonesia.

Pratiwi, S.U.T. dan Hamzah, H., 2020. Inhibition and degradation activity of (Sapindus rarak seeds) ethanol extract against polymicrobial biofilm. *Research Journal of Pharmacy and Technology.* **13:**11

Pratiwi, S.U.T. dan Hertiani, T., 2017. Efficacy of Massoia Oil in Combination With Some Indonesian Medicinal Plants Oils As Anti-Biofilm Agent Towards *Candida Albicans*. *International Journal of Pharmaceutical Sciences and Research*, **8**: 2013–2025.

Pratiwi, S.U.T., Lagendijk, E., Weert, S. de, Idroes, R., Hertiani, T., dan Hondel, C. van den, 2015. Effect of Cinnamomum burmannii Nees ex Bl. and Massoia aromatica Becc. Essential Oils on Planktonic Growth and Biofilm formation of Pseudomonas aeruginosa and Staphylococcus aureus In Vitro. *International Journal of Applied Research in Natural Products*, **8**: 1–13.

Praveen, A.S., Vinitha, S., Vinayalekshmi, V.S., Ramya, P., dan Vanavil, B., 2023. Seaweed Metabolites for Targeting Pel Polysaccharide Biosynthesis in Pseudomonas aeruginosa– A Novel Strategy for Biofilm Control. *Current Trends in Biotechnology and Pharmacy*, **17**: 1316–1326.

Quintin, T.J., 2010. Chromatography: Types, techniques and methods. *Chromatography: Types, Techniques and Methods*, 1–551.

Rabin, N., Zheng, Y., Opoku-Temeng, C., Du, Y., Bonsu, E., dan Sintim, H.O., 2015. Biofilm formation mechanisms and targets for developing antibiofilm agents. *Future Medicinal Chemistry*, 493–512.

Rajesh, R.W., Rahul, M.S., dan Ambalal, N.S., 2016. Trichoderma: A significant fungus for agriculture and environment. *African Journal of Agricultural Research*, **11**: 1952–1965.

Rajitha, P.B. dan Naik, P., 2021. Optimization of growth medium and physicochemical parameters for high-yield biomass production and active metabolites from aspergillus terreus. *Research Journal of Pharmacy and Technology*, **14**: 2924–2930.

Raouf, M., Essa, S., El Achy, S., Essawy, M., Rafik, S., dan Baddour, M., 2021. Evaluation of Combined Ciprofloxacin and azithromycin free and nano formulations to control biofilm producing Pseudomonas aeruginosa isolated from burn wounds. *Indian Journal of Medical Microbiology*, **39**: 81–87.

Rashiya, N., Padmini, N., Ajilda, A.A.K., Prabakaran, P., Durgadevi, R., Veera Ravi, A., dkk., 2021a. Inhibition of biofilm formation and quorum sensing mediated virulence in Pseudomonas aeruginosa by marine sponge symbiont Brevibacterium casei strain Alu 1. *Microbial Pathogenesis*, **150**: 104693.

Rashiya, N., Padmini, N., Ajilda, A.A.K., Prabakaran, P., Durgadevi, R., Veera Ravi, A., dkk., 2021b. Inhibition of biofilm formation and quorum sensing mediated virulence in Pseudomonas aeruginosa by marine sponge symbiont

UNIVERSITAS GADJAH MADA
Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai Antibiofilm Polimikroba
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Brevibacterium casei strain Alu 1. *Microbial Pathogenesis*, **150**.

Ratnaweera, P.B., Madhushika, D.P.H., Jayasundara, J.M.N.M., Williams, D.E., de Silva, E.D., dan Andersen, R.J., 2022. Antifeedant properties and contact toxicities of the trichocellins A-I and B-II from a Trichoderma reesei against Plutella xylostella larvae. *International Journal of Tropical Insect Science*, **42**: 845–854.

Rawat, N., Sheoran, S., Khan, J., Khan, R., Alzobaidi, N., dan Alhalmi, A., 2025. Different aspects of Pseudomonas aeruginosa biofilm: an in-depth analysis from formation to detection. *Naunyn-Schmiedeberg's Archives of Pharmacology*, .

Ray, H., Weis, C., Nwaeze, C., Zhou, V., Basu, P., dan Mitra, A., 2025. Development and Control of Biofilms in Diabetic Foot Infections: A Narrative Review. *Acta Microbiologica Hellenica (Switzerland)*, **70**.

Rehman, S.U., Wu, J.S., Yang, L.J., Ting, S., Shao, C.L., dan Wang, C.Y., 2020a. One New Terphenyl Glycoside From a Sponge-Derived Fungus Trichoderma reesei (HN-2016-018). *Natural Product Communications*, **15**: 1–5.

Rehman, S.U., Yang, L.J., Zhang, Y.H., Wu, J.S., Shi, T., Haider, W., dkk., 2020b. Sorbicillinoid Derivatives From Sponge-Derived Fungus Trichoderma reesei (HN-2016-018). *Frontiers in Microbiology*, **11**: 1334.

Rodríguez-Rodríguez, N., Martínez-Jiménez, I., García-Ojalvo, A., Mendoza-Mari, Y., Guillén-Nieto, G., Armstrong, D.G., dkk., 2022. Wound Chronicity, Impaired Immunity and Infection in Diabetic Patients. *MEDICC Review*, **24**: 44–58.

Rohatgi, A. dan Gupta, P., 2021. Natural and synthetic plant compounds as anti-biofilm agents against Escherichia coli O157:H7 biofilm. *Infection, Genetics and Evolution*, .

Rozman, N.A.S., Tong, W.Y., Leong, C.R., Tan, W.N., dan Ab Rashid, S., 2020. Diabetic wound infection: A review on microbial population and infection control. *Asia-Pacific Journal of Molecular Biology and Biotechnology*, **28**: 36–43.

Rubio-Clemente, A., Chica, E.L., dan Peñuela, G.A., 2018. High-performance liquid chromatography and chemometric techniques for analytical method development. *High-Performance Liquid Chromatography: Types, Parameters and Applications*, 121–144.

Ruhal, R. dan Kataria, R., 2021. Biofilm patterns in gram-positive and gram-negative bacteria. *Microbiological research*, **251**

Rusmalina, S., Mahfur, M., Hasanah, N., Wiyono, M.A., Ekayanti, N.N., dan Nathania, J.C., 2024. The Optimation of Fermentation Time, Antibacterial Activity and Profiling Secondary Metabolite of Symbiont Fungi from Sponge Gelliodes fibulata. *Pharmaciana*, **14**: 242–250.

Sahal, G., Woerdenbag, H.J., Hinrichs, W.L.J., Visser, A., Tepper, P.G., Quax,

UNIVERSITAS GADJAH MADA
Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai Antibiofilm Polimikroba
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

W.J., dkk., 2020. Antifungal and biofilm inhibitory effect of Cymbopogon citratus (lemongrass) essential oil on biofilm forming by Candida tropicalis isolates; an in vitro study. *Journal of ethnopharmacology*, **246**: .

Saini, H., Chhibber, S., dan Harjai, K., 2015. Azithromycin and ciprofloxacin: A possible synergistic combination against Pseudomonas aeruginosa biofilm-associated urinary tract infections. *International Journal of Antimicrobial Agents*, **45**: 359–367.

Samirana, P.O., Murti, Y.B., Jenie, R.I., dan Setyowati, E.P., 2021. Antibacterial and cytotoxic activities of supernatant and mycelium extracts from fermentation of fungal symbiont Trichoderma reesei TV221. *Journal of Applied Pharmaceutical Science*, **11**: 090–099.

Samirana, P.O., Murti, Y.B., Jenie, R.I., dan Setyowati, E.P., 2023. GC-MS metabolomic approach to study antimicrobial activity of the marine sponge-derived fungi Trichoderma reesei TV221. *Journal of Applied Pharmaceutical Science*, **13,**: 159–173.

Sánchez-Montesinos, B., Diánez, F., Moreno-Gavira, A., Gea, F.J., dan Santos, M., 2019. Plant growth promotion and biocontrol of Pythium ultimum by saline tolerant trichoderma isolates under salinity stress. *International Journal of Environmental Research and Public Health*, **16**: 2053.

Santos, S.S., Augusto, D.G., Casaes Alves, P.A., Pereira, J.S., Duarte, L.M.B., Melo, P.C., dkk., 2018. Trichoderma asperelloides ethanolic extracts efficiently inhibit Staphylococcus growth and biofilm formation. *PLoS ONE*, **13**: 1–12.

Sarhan, O.M., 2025. Tackling Biofilm Resistance of Gram-Positive and Gram-Negative Bacteria Against Levofloxacin via Nanotechnology and Essential Oils. *Journal of Pharmaceutical Innovation*, **20**: 1–12.

Sauer, K., Stoodley, P., Goeres, D.M., Hall-Stoodley, L., Burmølle, M., Stewart, P.S., dkk., 2022. The biofilm life cycle– expanding the conceptual model of biofilm formation. *Nature reviews. Microbiology*, **20**: 608.

Saxena, A., Mukhopadhyay, A.K., dan Nandi, S.P., 2020. Antibacterial activity of selected plants extract against pathogenic bacteria and detection of phytochemicals y. *Journal of Environmental Biology*, **41**: 1486–1492.

Scheiner, S., 2016. Assessment of the Presence and Strength of H-Bonds by Means of Corrected NMR. *Molecules 2016, Vol. 21, Page 1426*, **21**: 1426.

Scoffield, J. dan Wu, H., 2019. Microbial biofilms. *Encyclopedia of Microbiology*, 110–114.

Scopel, M., Abraham, W.R., Henriques, A.T., dan MacEdo, A.J., 2013. Dipeptide cis-cyclo(Leucyl-Tyrosyl) produced by sponge associated Penicillium sp. F37 inhibits biofilm formation of the pathogenic Staphylococcus epidermidis. *Bioorganic and Medicinal Chemistry Letters*, **23**: 624–626.

Semenov, V.A. dan Krivdin, L.B., 2021. Simple and Versatile Scheme for the

UNIVERSITAS GADJAH MADA
Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai Antibiofilm Polimikroba
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Stereochemical Identification of Natural Products and Diverse Organic Compounds with Multiple Asymmetric Centers. *Journal of Physical Chemistry A*, **125**: 10359–10372.

Serra, R., Grande, R., Butrico, L., Rossi, A., Settimio, U.F., Caroleo, B., dkk., 2015. Chronic wound infections: The role of Pseudomonas aeruginosa and Staphylococcus aureus. *Expert Review of Anti-Infective Therapy*, **13**: 605–613.

Setyowati, E.P., 2004. Uji sitotoksisitas dan uji antimikroba senyawa bioaktif spons S tylissa labelliformis Cytotoxicity and antimicrobial test of the bioactive **15**: 50–56.

Setyowati, E.P., Pratiwi, S.U.T., Hertiani, T., dan Samara, O., 2017. Bioactivity of fungi Trichoderma reesei associated with sponges Stylissa flabelliformis collected from National Park West Bali, Indonesia. *Journal of Biological Sciences*, **17**: 362–368.

Setyowati, E.P., Pratiwi, S.U.T., Purwantiningsih, dan Purwantini, I., 2018. In-vitro cytotoxicity and apoptosis mechanism of ethyl acetate extract from Trichoderma reesei strain TV221 associated with marine sponge: Stylissa flabelliformis. *Journal of Applied Pharmaceutical Science*, **8**: 151–157.

Setyowati, E.P., Pratiwi, S.U.T., Purwantiningsih, dan Samirana, P.O., 2018. Antimicrobial activity and Identification of fungus associated Stylissa flabelliformis sponge collected from Menjangan Island West Bali National Park, Indonesia. *Indonesian Journal of Pharmacy*, **29**: 66–73.

Setyowati, E.P., Purwantiningsih, Erawan, F.M.Y., Rahmanti, S., Hanum, N.R., dan Devi, N.C.M., 2021. Cytotoxic and antimicrobial activities of ethyl acetate extract from fungus Trichoderma reesei strain jcm 2267, Aspergillus flavus strain mc-10-l, Penicillium sp, and Aspergillus fumigatus associated with marine sponge Stylissa flabelliformis. *Research Journal of Pharmacy and Technology*, **14**: 5126–5132.

Setyowati, E.P., Sudarsono, S., dan Wahyuono, S., 2005. Jaspamide: Identifikasi struktur senyawa sitotoksik dan fungisid dari spons Stylissa flabelliformis. *Majalah Farmasi Indonesia*, **16**: 12–19.

Shafikova, T.N., Omelichkina, Y. V., Enikeev, A.G., Boyarkina, S. V., Gvildis, D.E., dan Semenov, A.A., 2018. Ortho-Phthalic Acid Esters Suppress the Phytopathogen Capability for Biofilm Formation. *Doklady Biological Sciences*, **480**: 107–109.

Sharma, G., Sharma, S., Sharma, P., Chandola, D., Dang, S., Gupta, S., dkk., 2016b. Escherichia coli biofilm: development and therapeutic strategies. *Journal of Applied Microbiology*, **121**: 309–319.

Sharma, S., Sisodiya, M., Gautam, R.K., dan Goyal, S., 2020. Columns in pharmaceuticals: For primers. *Indian Journal of Pharmaceutical Education and Research*, **54**: S423–S432.

Shukla, S., 2015. Studying antimicrobial-induced morphostructural damage of

UNIVERSITAS GADJAH MADA
Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai Antibiofilm Polimikroba
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

bacteria by scanning electron microscope. *Bangladesh Journal of Pharmacology*, **10**: 870–874.

Sibero, M.T., Radjasa, O.K., Sabdono, A., Trianto, A., Triningsih, D.W., dan Hutagaol, I.D., 2018. Antibacterial activity of indonesian sponge associated fungi against clinical pathogenic multidrug resistant bacteria. *Journal of Applied Pharmaceutical Science*, **8**: 088–094.

Sibero, M.T., Sabdaningsih, A., Cristianawati, O., Nuryadi, H., Radjasa, O.K., Sabdono, A., dkk., 2017. Isolation, Identification and Screening Antibacterial Activity from Marine Sponge-Associated Fungi Against Multidrug-Resistant (MDR) Escherichia coli. *IOP Conference Series: Earth and Environmental Science*, **55**: 012028.

Silva-Santana, G., Baêta Júnior, E.S., Silva Conceição, G.M., Aguiar-Alves, F., Lima Brandão, M.L., Lopes-Torres, E.J., dkk., 2025. Intervention of Corynebacterium striatum in the sessile lifestyle of Staphylococcus aureus wild-type and mutants for ica genes in polymicrobial biofilms. *Microbial Pathogenesis*, **204**: 107577.

Silva, V., Capelo, J.L., Igrejas, G., dan Poeta, P., 2022. Molecular Mechanisms of Antimicrobial Resistance in Staphylococcus aureus Biofilms. *Emerging Modalities in Mitigation of Antimicrobial Resistance*, 291–314.

Singh, A., Prakash, P., Achra, A., Singh, G., Das, A., dan Singh, R., 2017. Standardization and classification of in vitro biofilm formation by clinical isolates of Staphylococcus aureus. *Journal of Global Infectious Diseases*, **9**: 93–101.

Singh, D., Shukla, L., Kamil, D., Singh, S.K., dan Kumar, A., 2025. Evaluating a Fungal Consortium for Efficient Rice Stubble Degradation. *Journal of Pure and Applied Microbiology*, **19**: 401–418.

Singh, R. dan Tandon, V., 2023. Antibiotics: Past, Present, Future, and Clinical Pipeline. *Recent Advances in Pharmaceutical Innovation and Research*, 583–619.

Singhania, R.R., Sukumaran, R.K., Patel, A.K., Larroche, C., dan Pandey, A., 2010. Advancement and comparative profiles in the production technologies using solid-state and submerged fermentation for microbial cellulases. *Enzyme and Microbial Technology*, **46**: 541–549.

Smithee, S., Tracy, S., Drescher, K.M., Pitz, L.A., dan McDonald, T., 2014. A novel, broadly applicable approach to isolation of fungi in diverse growth media. *Journal of Microbiological Methods*, **105**: 155–161.

Soesanto, L., Mugiastuti, E., dan Manan, A., 2021. The use of alternative liquid media for propagation of pathogenic fungi and their effect on weeds. *Biodiversitas*, **22**: 719–725.

Song, T., Zhang, Z., Jin, Q., Feng, W., Shen, Y., Fan, L., dkk., 2021. Nutrient profiles, functional compositions, and antioxidant activities of seven types of

Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai
Antibiofilm Polimikroba
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

grain fermented with Sanghuangporus sanghuang fungus. *Journal of Food Science and Technology*, **58**: 4091–4101.

Soto, S.M., 2014. Importance of Biofilms in Urinary Tract Infections: New Therapeutic Approaches. *Advances in Biology*, **2014**: 543974.

Sotto, A., Laurent, F., Schuldiner, S., Vouillarmet, J., Corvec, S., Bemer, P., dkk., 2021. Evaluation of the use of antibiofilmogram technology in the clinical evolution of foot ulcers infected by staphylococcus aureus in persons living with diabetes: A pilot study. *Journal of Clinical Medicine*, **10**: 1–11.

Su, Y., Yrastorza, J.T., Matis, M., Cusick, J., Zhao, S., Wang, G., dkk., 2022. Biofilms: Formation, Research Models, Potential Targets, and Methods for Prevention and Treatment. *Advanced Science*, **9**: 2203291.

Sun, J., Wu, J., An, B., De Voogd, N.J., Cheng, W., dan Lin, W., 2018. Bromopyrrole alkaloids with the inhibitory effects against the biofilm formation of gram negative bacteria. *Marine Drugs*, **16**: 9.

Sun, Y., Tian, L., Huang, J., Ma, H.Y., Zheng, Z., Lv, A.L., dkk., 2008. Trichodermatides A-D, novel polyketides from the marine-derived fungus Trichoderma reesei. *Organic Letters*, **10**: 393–396.

Sunarwidhi, A.L., Rosyantari, A., Prasedya, E.S., Ardiana, N., Ilhami, B.T.K., Abidin, A.S., dkk., 2021. The correlation between total protein content and antioxidant activity of collagen isolated from a marine sponge Stylissa flabelliformis collected from North Lombok Indonesia coast. *IOP Conference Series: Earth and Environmental Science*, **913**.

Syafrullah, H., Oktari, A., Supriatin, Y., dan Husni, M., 2019. Growth analysis of Microsporum canis using husk rice (Oryza Sativa L. CV. Ciherang) as a replacement for media Sabouroud Dextrose Agar (SDA). *Journal of Physics: Conference Series*, **1280**.

Szmolka, A. dan Nagy, B., 2013. Multidrug resistant commensal Escherichia coli in animals and its impact for public health. *Frontiers in Microbiology*, **4**: 258.

Takayanagi, M., Kanematsu, H., Miura, H., Kogo, T., Kawai, R., Ogawa, A., dkk., 2022. Biofilms formed on metallic materials by E. coli and S. epidermidis and their evaluation by crystal violet staining and its reflection. *Transactions of the Institute of Metal Finishing*, **100**: 200–207.

Takimoto, Y., Miwa, T., dan Hatamoto, M., 2023. Initiation and progression of Early-Stage microbial-driven membrane fouling in membrane bioreactors: a review. *Biofouling*, **39**: 459–472.

Tasia, W., Lei, C., Cao, Y., Ye, Q., He, Y., dan Xu, C., 2020. Enhanced eradication of bacterial biofilms with DNase I-loaded silver-doped mesoporous silica nanoparticles. *Nanoscale*, **12**: 2328–2332.

Tasse, J., Trouillet-Assant, S., Josse, J., Martins-Simões, P., Valour, F., Langlois-Jacques, C., dkk., 2018. Association between biofilm formation phenotype and clonal lineage in Staphylococcus aureus strains from bone and joint infections.

Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai
Antibiofilm Polimikroba
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

PLoS ONE, **13**.

Tauran, P.M., Djaharuddin, I., Bahrun, U., Nurulita, A., Katu, S., Muchtar, F., dkk., 2022. Excess mortality attributable to antimicrobial-resistant bacterial bloodstream infection at a tertiary-care hospital in Indonesia. *PLOS Global Public Health*, **2**: e0000830.

Teteneva, N.A., Mart'yanov, S. V., Esteban-López, M., Kahnt, J., Glatter, T., Netrusov, A.I., dkk., 2020. Multiple Drug-Induced Stress Responses Inhibit Formation of Escherichia coli Biofilms. *Applied and Environmental Microbiology*, **86**: 1–15.

Teuber, K., Riemer, T., dan Schiller, J., 2010. Thin-layer chromatography combined with MALDI-TOF-MS and 31P-NMR to study possible selective bindings of phospholipids to silica gel. *Analytical and Bioanalytical Chemistry*, **398**: 2833–2842.

Thomas, L., Larroche, C., dan Pandey, A., 2013. Current developments in solid-state fermentation. *Biochemical Engineering Journal*, **81**: 146–161.

Tola, J.D., Orellana, P.P., Andrade, C.F., Torracchi, J.E., Delgado, D.A., Pavón, A.C., dkk., 2024. Molecular analysis of the ica adhesion gene in Staphylococcus aureus strains, isolated from inert surfaces in clinical and hospital areas. *Genetics and Molecular Research* , **23**.

Tonkin, M., Khan, S., Wani, M.Y., dan Ahmad, A., 2020. Quorum Sensing - A Stratagem for Conquering Multi-Drug Resistant Pathogens. *Current Pharmaceutical Design*, **27**: 2835–2847.

Torres, M., Dessaux, Y., dan Llamas, I., 2019. Saline environments as a source of potential quorum sensing disruptors to control bacterial infections: A review. *Marine Drugs*, **17**.

Trianto, A., Sabdono, A., Radjasa, O.K., Pramesti, R., Putrajaya, N.T.S., Bahry, M.S., dkk., 2019. Optimization Production of Antifungal Substance from a Sponge-associated Trichoderma harzianum cultivated in the Tofu Dregs and Rice Bran. *Research Journal of Biotechnology*, **14**: 68–73.

Usman, Y., Bakari, A.G., Abdullahi, I.N., Ahmad, A.E.F., Sani-Bello, F., Sagay, A.S., dkk., 2021. Phenotypic profile and antibiogram of biofilm-producing bacteria isolates from diabetic foot ulcers in Zaria, Nigeria. *The Nigerian postgraduate medical journal*, **28**: 233–239.

Va, S., Orm, P., Lean, S., Vorn, S., Phuy, M., Ung, H., dkk., 2018. Phytochemical and Thin Layer Chromatography Analyses of Lophopetalum wallichii Kurz Barks Native to Cambodia. *Asian Journal Of Pharmacognosy*, **2**: 25–34.

Vasavi, H.S., Arun, A.B., dan Rekha, P.D., 2016. Anti-quorum sensing activity of flavonoid-rich fraction from Centella asiatica L. against Pseudomonas aeruginosa PAO1. *Journal of microbiology, immunology, and infection = Wei mian yu gan ran za zhi*, **49**: 8–15.

Venkatachalam, M., Gérard, L., Milhau, C., Vinale, F., Dufossé, L., dan Fouillaud,

Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

M., 2019. Salinity and temperature influence growth and pigment production in the marine-derived fungal strain talaromyces albobiverticillius 30548. *Microorganisms*, **7**.

Verderosa, A.D., Totsika, M., dan Fairfull-Smith, K.E., 2019. Bacterial Biofilm Eradication Agents: A Current Review. *Frontiers in Chemistry*, **7**: 1–17.

Verma, S.K., Lal, M., dan Debnath Das, M., 2017. Optimization of process parameters for production of antimicrobial metabolites by an endophytic fungus Aspergillus sp. CPR5 isolated from calotropis Procera root. *Asian Journal of Pharmaceutical and Clinical Research*, **10**: 225–230.

Větrovský, T., Morais, D., Kohout, P., Lepinay, C., Algora, C., Awokunle Hollá, S., dkk., 2020. GlobalFungi, a global database of fungal occurrences from high-throughput-sequencing metabarcoding studies. *Scientific Data*, **7**: 1–14.

Voicu, G., Grumezescu, V., Andronescu, E., Grumezescu, A.M., Ficai, A., Ficai, D., dkk., 2013. Caprolactam-silica network, a strong potentiator of the antimicrobial activity of kanamycin against Gram-positive and Gram-negative bacterial strains. *International Journal of Pharmaceutics*, **446**: 63–69.

Wahyudi, D. dan Soetarto, E.S., 2021. Pembentukan Biofilm Pseudomonas aeruginosa pada Beberapa Media Cair. *Journal of Pharmacy*, **10**: 35–40.

Wang, J., Atolia, E., Hua, B., Savir, Y., Escalante-Chong, R., dan Springer, M., 2014. Natural Variation in Preparation for Nutrient Depletion Reveals a Cost-Benefit Tradeoff. *bioRxiv*, 011148.

Wang, Q.Y., Chen, H.P., dan Liu, J.K., 2021. Isopimarane diterpenes from the rice fermentation of the fungicolous fungus Xylaria longipes HFG1018. *Phytochemistry Letters*, **45**: 100–104.

Wang, W., Liu, J.-S., Zhou, J.-W., dan Jia, A.-Q., 2023. Synergistic effect of kanamycin and amikacin with setomimycin on biofilm formation inhibition of Listeria monocytogenes. *Microbial Pathogenesis*, **185**: 106447.

Wang, X., Mou, Y., Hu, J., Wang, N., Zhao, L., Liu, L., dkk., 2014. Cytotoxic polyphenols from a sponge-associated fungus Aspergillus versicolor Hmp-48. *Chemistry & biodiversity*, **11**: 133–139.

Wang, X., Xia, K., Yang, X., dan Tang, C., 2019. Growth strategy of microbes on mixed carbon sources. *Nature Communications*, **10**.

Wang, Y.Q., Bao, L., Yang, X.L., Dai, H.Q., Guo, H., Yao, X.S., dkk., 2012. Four new cuparene-type sesquiterpenes from Flammulina velutipes. *Helvetica Chimica Acta*, **95**: 261–267.

Wei, G. dan Yang, J.Q., 2023. Impacts of hydrodynamic conditions and microscale surface roughness on the critical shear stress to develop and thickness of early-stage Pseudomonas putida biofilms. *Biotechnology and Bioengineering*, **120**: 1797–1808.

Weller, M.G., 2012. A unifying review of bioassay-guided fractionation, effect-

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Penelusuran Senyawa Jamur Trichoderma reesei JCM 2267 Asosiasi Spons Stylissa flabelliformis sebagai Antibiofilm Polimikroba
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

directed analysis and related techniques. *Sensors (Switzerland)*, **12**: 9181–9209.

Weng, W., Li, R., Zhang, Y., Pan, X., Jiang, S., Sun, C., dkk., 2022. Polyketides isolated from an endophyte Penicillium oxalicum 2021CDF-3 inhibit pancreatic tumor growth. *Frontiers in Microbiology*, **13**: 3847.

Wigati, D., Setyowati, E.P., Pratiwi, S.U.T., dan Nugraha, A.S., 2024. Trichoderma reesei JCM 2267, fungi-associated sponge Stylissa flabelliformis: Effects of applied different fermentation methods on their antibacterial activity. *Journal of Advanced Pharmaceutical Technology & Research*, **15**: 243–247.

Wong, K.C., 2014. *Review of NMR Spectroscopy: Basic Principles, Concepts and Applications in Chemistry* , Journal of Chemical Education. American Chemical Society (ACS).

Wu, W.S., Chen, C.C., Chuang, Y.C., Su, B.A., Chiu, Y.H., Hsu, H.J., dkk., 2013. Efficacy of combination oral antimicrobial agents against biofilm-embedded methicillin-resistant Staphylococcus aureus. *Journal of Microbiology, Immunology and Infection*, **46**: 89–95.

Xue, M., Kitahara, R., Yoshimura, Y., dan Mulder, F.A.A., 2016. Aberrant increase of NMR signal in hydrogen exchange experiments. Observation and explanation. *Biochemical and Biophysical Research Communications*, **478**: 1185–1188.

Yadav, M.K., Song, J.J., Singh, B.P., dan Vidal, J.E., 2019. Microbial biofilms and human disease: A concise review. *New and Future Developments in Microbial Biotechnology and Bioengineering: Microbial Biofilms Current Research and Future Trends in Microbial Biofilms*, 1–13.

Yin, R., Cheng, J., Wang, J., Li, P., dan Lin, J., 2022. Treatment of Pseudomonas aeruginosa infectious biofilms: Challenges and strategies. *Frontiers in Microbiology*, **13**.

Yu, Z.Q., Ren, H., Guo, X.W., Yang, G.G., Wu, J., Xi, J.M., dkk., 2024. Targeted isolation, identification, and antioxidant evaluation of aromatic polyketides from a plant-derived fungus Ophiobolus cirsii LZU-1509. *Fitoterapia*, **175**: 105884.

Zahiruddin, S., Parveen, A., Khan, W., Parveen, R., dan Ahmad, S., 2021. TLC-Based Metabolite Profiling and Bioactivity-Based Scientific Validation for Use of Water Extracts in AYUSH Formulations. *Evidence-based Complementary and Alternative Medicine : eCAM*, **2021**: 2847440.

Zhang, K., Huang, Y., Jiang, Y., Liu, T., Kong, J., Cai, S., dkk., 2025. Effect of Candida albicans' supernatant on biofilm formation and virulence factors of Pseudomonas aeruginosa through las/rhl System. *BMC microbiology*, **25**: 60.

Zhang, P., Deng, Y., Lin, X., Chen, B., Li, J., Liu, H., dkk., 2019. Anti-inflammatory Mono- and Dimeric Sorbicillinoids from the Marine-Derived Fungus Trichoderma reesei 4670. *Journal of Natural Products*, **82**: 947–957.

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Dyan Wigati, 4. Prof. Dr. apt. Erna Prawita Setyowati, M.Si., 5. Dr. Sylvia Utami Tunjung Pratiwi,S.Si.,M.Si, .Si, selaku
Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Zhang, Q., Chen, S., Liu, X., Lin, W., dan Zhu, K., 2021. Equisetin Restores Colistin Sensitivity against Multi-Drug Resistant Gram-Negative Bacteria. *Antibiotics (Basel, Switzerland)*, **10**.

Zhang, S., Song, W., Nothias, L.F., Couvillion, S.P., Webster, N., dan Thomas, T., 2022. Comparative metabolomic analysis reveals shared and unique chemical interactions in sponge holobionts. *Microbiome*, **10**: 1–14.

Zhu, Q., Zang, Y., Luo, J., Hou, W., Lei, L., Huang, J., dkk., 2022. A new meroterpenoid and a new polyketide from Penicillium expansum GY618 Fungus. *Phytochemistry Letters*, **51**: 1874–3900.