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DAFTAR PUSTAKA

Abdelgawad, A. M., and S. M Hudson. 2019. Chitosan nanoparticles: polyphosphates cross-linking and protein delivery properties. *International Journal of Biological Macromolecules*. *136*:133-142.

Adefisoye, M. A., and A. O. Olaniran. 2022. Does chlorination promote antimicrobial resistance in waterborne pathogens? Mechanistic insight into co-resistance and its implication for public health. Antibiotics. 11(5):564.

Adlu, F. H. 2022. Aplikasi nanokitosan sebagai sanitizer alami terhadap biofilm Morganella morganii TK7 pada berbagai material alat pengolahan. Doctoral dissertation, Universitas Gadjah Mada.

Agmo Hernández, V. 2023. Tinjauan umum tentang gaya permukaan dan teori DLVO. ChemTexts. 9(4):10.

Akirthasary, D. 2021. Review artikel: enzim l-histidin dekarboksilase dan mekanisme penghambatan. Unesa Journal of Chemistry. 10(2):147-157.

Alauhdin, M., dan N. Widiarti. 2014. Sintesis dan modifikasi lapis tipis kitosan-tripolifosfat. Indonesian Journal of Mathematics and Natural Sciences. 37(1).

Al-kafaween, M. A., A. B. Mohd Hilmi, N. Jaffar, H. A. N. Al-Jamal, and M. K. Zahri. 2019. Determination of optimum incubation time for formation of *Pseudomonas aeruginosa* and *Streptococcus pyogenes* biofilms in microtiter plate. Bulletin of the National Research Centre. 43(1):100.

American Society for Microbiology. 2016. Triple sugar iron agar protocols. American Society for Microbiology. https://asm.org/asm/media/protocol-images/triple-sugar-iron-agar-protocols.pdf. Diakses pada 24 Juni 2026.

Amri, I., F. Ramadani, and R. Adawiyah. 2019. Identification of bacteria variation at Polyclinic of Tadulako General Hospital in 2018. Jurnal Ilmiah Kedokteran. 6(3):38-47.

Arrieta-Mendoza, D., A. A. Hidalgo, A. Neira-Carrillo, ans S. A. Bucarey. 2026. Sulfated chitosan induces membrane disruption, aggregation, and antibiofilm activity in *Piscirickettsia salmonis*: a biomimetic strategy as an antimicrobial alternative in aquaculture. Antibiotics. 15(5):435.

Ashish K., N. Singh, A. Aggarwal, dan M. Khanna. 2012. Pola resistensi antibiotik pada spesies *Citrobacter*: patogen nosokomial yang baru muncul di rumah sakit perawatan tersier. J. Clin. Diagn. Res. 6:642–644.

Attaran, B., and T. Falsafi. 2017. Identification of factors associated with biofilm formation ability in the clinical isolates of *Helicobacter pylori*. Iranian Journal of Biotechnology. 15(1):58.

UNIVERSITAS
GADJAH MADA
**Pengaruh Durasi Perendaman Nanokitosan terhadap Densitas Citrobacter freundii CK01 pada Permukaan
Stainless Steel**
Kintan Rahmasari, Indun Dewi Puspita, S.P., M.Sc., Ph.D.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Babaei-Ghazvini, A., B. Acharya, and D. R. Korber. 2021. Antimicrobial biodegradable food packaging based on chitosan and metal/metal-oxide bio-nanocomposites: A review. Polymer. 13(16):2790.

Bernal-Mercado, A. T., Juarez, J., Valdez, M. A., Ayala-Zavala, J. F., Del-Toro-Sánchez, C. L., & Encinas-Basurto, D. 2022. Hydrophobic chitosan nanoparticles loaded with carvacrol against *Pseudomonas aeruginosa* biofilms. Molecules. 27(3):699.

Berne, B. J., J. D. Weeks, and R. Zhou. 2009. Dewetting and hydrophobic interaction in physical and biological systems. Annual Review of Physical Chemistry. 60:85-103.

Bhagwat, G., W. O'connor, I. Grainge, and T. Palanisami. 2021. Understanding the fundamental basis for biofilm formation on plastic surfaces: role of conditioning films. Frontiers in Microbiology. 12:687118.

Bhattacharjee, S. 2016. DLS and zeta potential–what they are and what they are not?. Journal of Controlled Release. 235:337-351.

Bhumkar, D. R., and V. B. Pokharkar. 2006. Studies on effect of pH on cross-linking of chitosan with sodium tripolyphosphate: a technical note. AAPS PharmSciTech. 7(2):50.

Brar, S. K., and M. Verma. 2011. Measurement of nanoparticles by light-scattering techniques. TrAC Trends in Analytical Chemistry. 30(1):4-17.

Brenner, D. J., O'Hara, C. M., Grimont, P. A., Janda, J. M., Falsen, E., Aldova, E., ... & Steigerwalt, A. G. 1999. Biochemical identification of *Citrobacter* species defined by DNA hybridization and description of *Citrobacter gillenii* sp. nov.(formerly *Citrobacter* genomospecies 10) and *Citrobacter murliniae* sp. nov.(formerly *Citrobacter* genomospecies 11). Journal of Clinical Microbiology. 37(8):2619-2624.

Buczkowska, M., A. Szczyrba, D. Szajnoga, M. Górski, J. Malinowska-Borowska, J. Domagalska, and P. Rozentryt. 2024. The factors influencing the concentration of histamine in jarred baby foods containing fish, considering evaluation of daily histamine intake. Journal of Food Protection. 87(9):100328.

Buwana, R. O. K., W. Siswomihardjo, dan S. Sunarintyas. 2017. Pengaruh polyethylene fiber pada material resin komposit terhadap jumlah koloni *Candida albicans*. Jurnal Material Kedokteran Gigi. 6(2):38-43.

Cai, L., H. Wang, L. Liang, G. Wang, X. Xu, and H. Wang. 2018. Response of formed-biofilm of *Enterobacter cloacae*, *Klebsiella oxytoca*, and *Citrobacter freundii* to chlorite-based disinfectants. Journal of Food Science. 83(5):1326-1332.

Campana, R., Biondo, F., Mastrotto, F., Baffone, W., & Casettari, L. 2018. Chitosans as new tools against biofilms formation on the surface of silicone urinary catheters. International Journal of Biological Macromolecules. 118:2193-2200.

Pengaruh Durasi Perendaman Nanokitosan terhadap Densitas Citrobacter freundii CK01 pada Permukaan
Stainless Steel
Kintan Rahmasari, Indun Dewi Puspita, S.P., M.Sc., Ph.D.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Carrascosa, C., D. Raheem, F. Ramos, A. Saraiva, and A. Raposo. 2021. Microbial biofilms in the food industry—A comprehensive review. International Journal of Environmental Research and Public Health. 18(4):2014.

Carrasco-Sandoval, J., M. Aranda, K. Henríquez-Aedo, M. Fernández, A. López-Rubio, and M. J. Fabra. 2023. Impact of molecular weight and deacetylation degree of chitosan on the bioaccessibility of quercetin encapsulated in alginate/chitosan-coated zein nanoparticles. International Journal of Biological Macromolecules. 242:124876.

Chandrasekaran, M., Kim, K. D., & Chun, S. C. 2020. Antibacterial activity of chitosan nanoparticles: A review. Processes. 8(9):1173.

Chung, Y. C., Y. P. Su, C. C. Chen, G. Jia, H. L. Wang, J. G. Wu, and J. G. Lin. 2004. Relationship between antibacterial activity of chitosan and surface characteristics of cell wall. Acta Pharmacologica Sinica. 25(7):932-936.

Ciolacu, L., E. Zand, C. Negrau, and H. Jaeger. 2022. Bacterial attachment and biofilm formation on antimicrobial sealants and stainless steel surfaces. Foods. 11(19):3096.

Cortés-Sánchez, A. D. J., M. D. L. P. Salgado-Cruz, M. Diaz-Ramirez, E. Torres-Ochoa, and L. D. Espinosa-Chaurand. 2023. A review on food safety: the case of *Citrobacter* sp., fish and fish products. Applied Sciences. 13(12):6907.

De Beer, D., R. Srinivasan, adn P. S. Stewart. 1994. Direct measurement of chlorine penetration into biofilms during disinfection. Applied and Environmental Microbiology. 60(12):4339-4344.

De Plano, L. M., Caratozzolo, M., Conoci, S., Guglielmino, S. P., & Franco, D. 2024. Impact of nutrient starvation on biofilm formation in *Pseudomonas aeruginosa*: an analysis of growth, adhesion, and spatial distribution. Antibiotics. 13(10):987.

Defoirdt, T. 2018. Quorum-sensing systems as targets for antivirulence therapy. Trends Microbiol. 26:313-328.

Dewangan, A. K., Patel, A. D., & Bhadania, A. G. 2015. Stainless steel for dairy and food industry. Journal of Material Sciences & Engineering. 4(5):191

Dompeipen, E. J. 2017. Isolasi dan identifikasi kitin dan kitosan dari kulit udang Windu (*Penaeus monodon*) dengan spektroskopi inframerah. Majalah Biam. 13(01):31-41.

EHEDG. 2025. Hygienic Equipment Design Criteria, Guideline document 8, European Hygienic Engineering and Design Group. 4th Ed. Amsterdam, Netherlands.

El-Naggar, N. E. A., Eltarahony, M., Hafez, E. E., & Bashir, S. I. 2023. Green fabrication of chitosan nanoparticles using *Lavendula angustifolia*, optimization, characterization and in vitro antibiofilm activity. Scientific Reports. 13(1):11127.

UNIVERSITAS
GADJAH MADA
**Pengaruh Durasi Perendaman Nanokitosan terhadap Densitas Citrobacter freundii CK01 pada Permukaan
Stainless Steel**
Kintan Rahmasari, Indun Dewi Puspita, S.P., M.Sc., Ph.D.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Faille, C., Jullien, C., Fontaine, F., Bellon-Fontaine, M. N., Slomianny, C., & Benezech, T. 2002. Adhesion of *Bacillus* spores and *Escherichia coli* cells to inert surfaces: role of surface hydrophobicity. Canadian Journal of Microbiology. 48(8):728-738.

Febrianto, R. 2025. Pengaruh Gas Pressure dan Laser Power pada Proses Fiber Laser Cutting terhadap Kekasaran Permukaan Material Baja AISI 1040 Ketebalan 6mm. Jurnal Mesin Material Manufaktur dan Energi. 5(2):150-157.

Filipe, V., Hawe, A., and Jiskoot, W. 2010. Critical evaluation of Nanoparticle Tracking Analysis (NTA) by NanoSight for the measurement of nanoparticles and protein aggregates. Pharmaceutical Research. 27(5):796-810.

Fitrah, M. A., M. Taufiq, dan H. H. Utami. 2024. Pengenalan teknologi tepat guna: pemilihan bahan stainless steel dalam pembuatan alat pangan untuk meningkatkan keamanan dan kualitas produk. 2(2):130-135.

Flemming, H. C., dan J. Wingender. 2010. The biofilm matrix. Nature Reviews Microbiology. 8(9):623-633.

Flemming, H.-C., E. D. Van Hullebusch, T. R. Neu, P. H. Nielsen, T. Seviour, P. Stoodley, J. Wingender, and S. Wuertz. 2023. The biofilm matrix: multitasking in a shared space. Nature Reviews Microbiology. 21(2):70–86.

Galante, R., Rediguieri, C. F., Kikuchi, I. S., Vasquez, P. A., Colaço, R., Serro, A. P., & Pinto, T. J. 2016. About the sterilization of chitosan hydrogel nanoparticles. PLoS One. 11(12):e0168862.

Gan, Q., Wang, T., Cochrane, C., & McCarron, P. 2005. Modulation of surface charge, particle size and morphological properties of chitosan–STPP nanoparticles intended for gene delivery. Colloids and Surfaces B: Biointerfaces. 44(2-3):65-73.

Geesey, G. G., Gillis, R. J., Avci, R., Daly, D., Hamilton, M., Shope, P., & Harkin, G. 1996. The influence of surface features on bacterial colonization and subsequent substratum chemical changes of 316L stainless steel. Corrosion Science. 38(1):73-95.

Ghadi, A., Mahjoub, S., Tabandeh, F., & Talebnia, F. 2014. Synthesis and optimization of chitosan nanoparticles: Potential applications in nanomedicine and biomedical engineering. Caspian Journal of Internal Medicine. 5(3):156.

Goh, S. Y., Khan, S. A., Tee, K. K., Abu Kasim, N. H., Yin, W. F., & Chan, K. G. 2016. Quorum sensing activity of *Citrobacter amalonaticus* L8A, a bacterium isolated from dental plaque. Scientific Reports. 6(1):20702.

Gunduz, G. T., & Tuncel, G. 2006. Biofilm formation in an ice cream plant. Antonie Van Leeuwenhoek. 89(3):329-336.

Pengaruh Durasi Perendaman Nanokitosan terhadap Densitas Citrobacter freundii CK01 pada Permukaan
Stainless Steel
Kintan Rahmasari, Indun Dewi Puspita, S.P., M.Sc., Ph.D.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Gupta, A., Landis, R. F., & Rotello, V. M. 2016. Nanoparticle-based antimicrobials: surface functionality is critical. F1000Research. 5:F1000-Faculty.

Handayani, L., Syahputra, F., & Astuti, Y. 2018. Utilization and characterization of oyster shell as chitosan and nanochitosan. Jurnal Kimia Sains dan Aplikasi. 21(4):224-231.

Haniastuti, T. 2016. Penurunan hidrofobisitas permukaan sel bakteri plak gigi setelah dipapar rebusan daun sirih merah konsentrasi 10%. Dentika: Dental Journal. 19(1):38-41.

Hariyadi, R. D. dan Cynthia. 2014. Inaktivasi Bakteri Patogen Planktonik dan Biofilm oleh Sanitaiser Komersial. Jurnal Mutu Pangan. 1(2):110-117.

Hashim, M. H., & Alkhafaji, M. H. 2018. Isolation and identification of *Citrobacter freundii* from chicken meat samples using cultural and molecular techniques. Iraqi Journal of Science. 59(3A):1216-1224.

Hawaldar R., Sadhna S. 2019. Prevalensi dan pola resistensi obat *Citrobacter* sps – Sebuah studi retrospektif. Indian J. Microbiol. Res. 6:142–145.

Hidayat, F. R., Warmi, Y., Amalia, S., & Rachman, A. Y. D. 2025. Analisis Hidrofobisitas dan Estimasi Kekuatan Dielektrik Isolator Keramik 150kV dengan Pelapisan RTV-SiR+ SiO_2 untuk Peningkatan Keandalan Sistem Transmisi Listrik. ELECTRON Jurnal Ilmiah Teknik Elektro. 6(2):163-174.

Hidayati, A. N., dan C. C. Liuwan. 2019. Peran biofilm terhadap infeksi saluran genital yang disebabkan oleh vaginosis bakterial. Berkala Ilmu Kesehatan Kulit dan Kelamin. 31(2):150-158.

Hilbert, L. R., Bagge-Ravn, D., Kold, J., & Gram, L. 2003. Influence of surface roughness of stainless steel on microbial adhesion and corrosion resistance. International Biodeterioration & Biodegradation. 52(3):175-185.

Hočevar, M., M. Jenko, M. Godec, and D. Drobne. 2014. An overview of the influence of stainless-steel surface properties on bacterial adhesion. Materiali in Tehnologije. 48(5):609–617.

Honary, S., & Zahir, F. 2013. Effect of zeta potential on the properties of nano-drug delivery systems-a review (Part 2). Tropical Journal of Pharmaceutical Research. 12(2):265-273.

Huang, C., S. Tao, J. Yuan, and X. Li. 2022. Effect of sodium hypochlorite on biofilm of *Klebsiella pneumoniae* with different drug resistance. American Journal of Infection Control. 50(9):1005–1010.

Huang, M., Khor, E., & Lim, L. Y. 2004. Uptake and cytotoxicity of chitosan molecules and nanoparticles: effects of molecular weight and degree of deacetylation. Pharmaceutical Research. 21(2):344-353.

UNIVERSITAS
GADJAH MADA
**Pengaruh Durasi Perendaman Nanokitosan terhadap Densitas Citrobacter freundii CK01 pada Permukaan
Stainless Steel**
Kintan Rahmasari, Indun Dewi Puspita, S.P., M.Sc., Ph.D.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Ibrahim, H. M., M. K. El-Bisi, G. M. Taha, and E. A. El-Alfy. 2015. Chitosan nanoparticles loaded antibiotics as drug delivery biomaterial. Journal of Applied Pharmaceutical Science. 5(10):085-090.

Jacobs, H. M., O'Neal, L., Lopatto, E., Wozniak, D. J., Bjarnsholt, T., & Parsek, M. R. 2022. Mucoid *Pseudomonas aeruginosa* can produce calcium-gelled biofilms independent of the matrix components Psl and CdrA. Journal of Bacteriology. 204(5):e00568-21.

Jha, R., and R. A. Mayanovic. 2023. A review of the preparation, characterization, and applications of chitosan nanoparticles in nanomedicine. Nanomaterials. 13(8):1302.

Jia, K., N. Yang, X. Zhang, R. Cai, Y. Zhang, J. Tian, S. H. A. Raza, Y. Kang, A. Qian, and Y. Li. 2020. Genomic, Morphological and Functional Characterization of Virulent Bacteriophage IME-JL8 Targeting *Citrobacter freundii*. Frontiers in Microbiology. 11.

Jiang, T., Wang, Y., Yu, Z., & Du, L. 2024. Synthesis, characterization of chitosan/tripolyphosphate nanoparticles loaded with 4-chloro-2-methylphenoxyacetate sodium salt and its herbicidal activity against *Bidens pilosa* L. Scientific Reports. 14(1):18754.

Jiménez-Pichardo, R., Hernández-Martínez, I., Regalado-González, C., Santos-Cruz, J., Meas-Vong, Y., Wacher-Rodarte, M. D. C., ... & García-Almendárez, B. E. 2021. Innovative control of biofilms on stainless steel surfaces using electrolyzed water in the dairy industry. Foods. 10(1):103.

Jonassen, H., Kjøniksen, A. L., & Hiorth, M. 2012. Stability of chitosan nanoparticles cross-linked with tripolyphosphate. Biomacromolecules. 13(11):3747-3756.

Kabeel, A. E., Abou El Maaty, T., & El Samadony, Y. 2013. The effect of using nano-particles on corrugated plate heat exchanger performance. Applied Thermal Engineering. 52(1):221-229.

Kakade, M., Sharma, S., Pandey, T., & Rao, V. 2025. Performance of chitosan nanoparticle-loaded irrigants on biofilm disruption. Bioinformation. 21(10):3823.

Kaloti, M., & Bohidar, H. B. 2010. Kinetics of coacervation transition versus nanoparticle formation in chitosan–sodium tripolyphosphate solutions. Colloids and Surfaces B: Biointerfaces. 81(1):165-173.

Khan, F., D. T. N. Pham, S. F. Oloketuyi, P. Manivasagan, J. Oh, and Y. Kim. 2020. Chitosan and their derivatives: Antibiofilm drugs against pathogenic bacteria. Colloids and Surfaces B: Biointerfaces. 185:110627.

Khelissa, S. O., Jama, C., Abdallah, M., Boukherroub, R., Faille, C., & Chihib, N. E. 2017. Effect of incubation duration, growth temperature, and abiotic surface type on cell surface properties, adhesion and pathogenicity of biofilm-detached *Staphylococcus aureus* cells. AMB Express. 7(1):191.

UNIVERSITAS GADJAH MADA
Pengaruh Durasi Perendaman Nanokitosan terhadap Densitas Citrobacter freundii CK01 pada Permukaan Stainless Steel
Kintan Rahmasari, Indun Dewi Puspita, S.P., M.Sc., Ph.D.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Khodabandeh, H., Tajbakhsh, E., Khamesipour, F., Momtaz, H., & Momeni Shahraki, M. 2025. Unraveling genetic diversity and antibiotic resistance mechanisms in *Citrobacter freundii* isolates from meat products: implications for food safety and public health. Veterinary Medicine and Science. 11(6):e70493.

Kilic, T. 2025. Factors affecting biofilm formation and the effects of these factors on bacteria. In Exploring Bacterial Biofilms. IntechOpen.

Konecsni, K., Low, N. H., & Nickerson, M. T. 2012. Chitosan–tripolyphosphate submicron particles as the carrier of entrapped rutin. Food Chemistry. 134(4):1775-1779.

Kreve, S., & Dos Reis, A. C. 2021. Bacterial adhesion to biomaterials: What regulates this attachment? A review. Japanese Dental Science Review. 57:85-96.

Kumar, C. G., & Anand, S. K. 1998. Significance of microbial biofilms in food industry: a review. International Journal of Food Microbiology. 42(1-2):9-27.

Kusumawati, N., and A. K. Wardani. 2023. Bacteriophages for biocontrol of biofilms in food system. Tropical Microbiome. 1(1):47-72.

Law, K. Y. 2014. Definitions for hydrophilicity, hydrophobicity, and superhydrophobicity: getting the basics right. The Journal of Physical Chemistry Letters. 5(4):686-688.

Lekkerkerker, H. N., Tuinier, R., & Vis, M. 2024. Colloids and the Depletion Interaction (p. 24). Springer Nature.

Lewis, K. 2007. Persister cells, dormancy and infectious disease. Nature Reviews Microbiology. 5(1):48-56.

Li, X. F., Feng, X. Q., Yang, S., Fu, G. Q., Wang, T. P., & Su, Z. X. 2010. Chitosan kills *Escherichia coli* through damage to be of cell membrane mechanism. Carbohydrate Polymers. 79(3):493-499.

Liang, R., Li, J., Tang, H., Sima, W., Tang, J., Wu, L., & Lin, C. 2023. Influence of extracellular polymeric substances on electrochemical behaviours of stainless steels in circulating cooling water. Materials Chemistry and Physics. 293:126892.

Lieber, E. R., & Taylor, S. L. 1978. Thin-layer chromatographic screening methods for histamine in tuna fish. Journal of Chromatography A. 153(1):143-152.

Liu, L., Lan, R., Liu, L., Wang, Y., Zhang, Y., Wang, Y., & Xu, J. 2017. Antimicrobial resistance and cytotoxicity of *Citrobacter* spp. in Maanshan Anhui Province, China. Frontiers in Microbiology. 8:1357.

Luhurningtyas, F. P., Damayanti, P. N., Astyamalia, S., Kemila, M. A., & Novitasari, E. 2024. Formulasi dan Karakterisasi Nanopartikel Ekstrak Biji Carica (*Carica pubescens*) dengan Variasi Konsentrasi Kitosan menggunakan Metode Gelasi Ionik. Pharmaceutical and Biomedical Sciences Journal (PBSJ). 6(2):144-151.

UNIVERSITAS
GADJAH MADA
**Pengaruh Durasi Perendaman Nanokitosan terhadap Densitas Citrobacter freundii CK01 pada Permukaan
Stainless Steel**
Kintan Rahmasari, Indun Dewi Puspita, S.P., M.Sc., Ph.D.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Luo, A., Wang, F., Sun, D., Liu, X., & Xin, B. 2022. Formation, development, and cross-species interactions in biofilms. Frontiers in Microbiology. 12:757327.

Luu, P., Chhetri, V. S., Janes, M. E., King, J. M., & Adhikari, A. 2020. Effectiveness of aqueous chlorine dioxide in minimizing food safety risk associated with *Salmonella*, *E. coli* O157:H7, and *Listeria monocytogenes* on sweet potatoes. Foods. 9(9):1259.

Ma, Z., Bumunang, E. W., Stanford, K., Bie, X., Niu, Y. D., & McAllister, T. A. 2019. Biofilm formation by Shiga toxin-producing *Escherichia coli* on stainless steel coupons as affected by temperature and incubation time. Microorganisms. 7(4):95

Maraki S., Vardakas KZ, Mavromanolaki VE, Kyriakidou M., Spais G., Kofteridis DP, dkk. 2017. Fenotipe kerentanan dan resistensi in vitro pada isolat *Citrobacter* kontemporer di Rumah Sakit Universitas di Kreta, Yunani. Infect. Dis. (Auckl). 49:532–539

Mardy, D. C., S. Sudjari, dan S. I. Rahayu. 2015. Perbandingan efektivitas kitosan (2-Acetamido-2-Deoxy-D-Glucopyranose) dan nano kitosan terhadap pertumbuhan bakteri *Enterococcus faecalis* secara in vitro. Majalah Kesehatan. 2(4):229-240.

Margareta, G., Ratnawati, S. E., & Puspita, I. D. 2020. Growth Rate and Histamine Production of *Citrobacter freundii* CK01 in Various Incubation Temperatures. In E3S Web of Conferences (Vol. 147, p. 03018). EDP Sciences.

Matysik, A., & Kline, K. A. 2019. *Streptococcus pyogenes* capsule promotes microcolony-independent biofilm formation. Journal of Bacteriology. 201(18):10-1128.

McGaffey, M., Zur Linden, A., Bachynski, N., Oblak, M., James, F., & Weese, J. S. 2019. Manual polishing of 3D printed metals produced by laser powder bed fusion reduces biofilm formation. PLoS One. 14(2):e0212995.

Mirbagheri, V. S., A. Alishahi, G. Ahmadian, S. H. H. Petroudi, S. M. Ojagh, and G. Romanazzi. 2024. Toward understanding the antibacterial mechanism of chitosan: Experimental approach and in silico analysis. Food Hydrocolloids. 147:109382.

Moradali, M. F., and B. H. Rehm. 2020. Bacterial biopolymers: from pathogenesis to advanced materials. Nature Reviews Microbiology. 18(4):195-210.

Navarro Llorens, J. M., Tormo, A., & Martínez-García, E. 2010. Stationary phase in Gram-negative bacteria. FEMS Microbiology Reviews. 34(4):476-495.

Nugraha, G. R., H. Abdillah, dan B. Irawan. 2024. Analisis penggunaan stainless steel 304 pada mesin heating tank di PT Pachira Distrinusa. Innovative: Journal of Social Science Research. 4(6):7823-7830.

Pengaruh Durasi Perendaman Nanokitosan terhadap Densitas Citrobacter freundii CK01 pada Permukaan
Stainless Steel
Kintan Rahmasari, Indun Dewi Puspita, S.P., M.Sc., Ph.D.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Nugraheni, P.S., A. H. Soeriyadi, Ustadi, W.B. Sediawan, and W. Budhijanto. 2019. Comparison of formulation methods to produce nanochitosan as inhibitor agent for bacteria growth. J. Eng. Technol. Sci. 51(3):430-441.

Nurmala, N., I. G. N. Virgiandhy, A. Andriani, dan D. F. Liana. 2015. Resistensi dan sensitivitas bakteri terhadap antibiotik di RSU dr. Soedarso Pontianak tahun 2011-2013. EJournal Kedokteran Indonesia. 3(1):60551.

Oktariani, A. F., Ramona, Y., Sudaryatma, P. E., Dewi, I. A. M. M., & Shetty, K. 2022. Role of marine bacterial contaminants in histamine formation in seafood products: A review. Microorganisms. 10(6):1197.

Pamp, S. J., & Tolker-Nielsen, T. 2007. Multiple roles of biosurfactants in structural biofilm development by *Pseudomonas aeruginosa*. Journal of Bacteriology. 189(6):2531-2539.

Peivasteh-Roudsari, L., Rahmani, A., Shariatifar, N., Tajdar-Oranj, B., Mazaheri, M., Sadighara, P., & Khaneghah, A. M. 2020. Occurrence of histamine in canned fish samples (Tuna, Sardine, Kilka, and Mackerel) from markets in Tehran. Journal of Food Protection. 83(1):136-141.

Price, L. B., Hungate, B. A., Koch, B. J., Davis, G. S., & Liu, C. M. 2017. Colonizing opportunistic pathogens (COPs): the beasts in all of us. PLoS Pathogens. 13(8):e1006369.

Putri, A. I., Sundaryono, A., & Candra, I. N. 2018. Karakterisasi nanopartikel kitosan ekstrak daun ubijalar (*Ipomoea batatas* L.) menggunakan metode gelasi ionik. Jurnal Pendidikan dan Ilmu Kimia. 2(2):203-207.

Qurashi, M. T., Blair, H. S., & Allen, S. J. 1992. Studies on modified chitosan membranes. I. Preparation and characterization. Journal of Applied Polymer Science. 46(2):255-261.

Rabin, N., Zheng, Y., Opoku-Temeng, C., Du, Y., Bonsu, E., & Sintim, H. O. 2015. Biofilm formation mechanisms and targets for developing antibiofilm agents. Future Medicinal Chemistry. 7(4):493-512.

Rachfa, M. A. F., Putri, D. K. T., & Dewi, R. K. 2021. Uji kitosan sisik ikan haruan (*Channa striata*) terhadap aktivitas enzim glukosiltransferase *Streptococcus mutans*. Dentin. 5(2).

Räisänen K., Sarvikivi E., Arifulla D., Pietikäinen R., Forsblom-Helander B., Tarkka E., dkk. 2021. Tiga kelompok *Citrobacter freundii* penghasil karbapenemase di Finlandia 2016-20. J. Antimikroba. Ibu Kemoterapi. 76:2697–2701

Razatos, A., Ong, Y. L., Sharma, M. M., & Georgiou, G. 1998. Molecular determinants of bacterial adhesion monitored by atomic force microscopy. Proceedings of the National Academy of Sciences. 95(19):11059-11064.

UNIVERSITAS
GADJAH MADA
**Pengaruh Durasi Perendaman Nanokitosan terhadap Densitas Citrobacter freundii CK01 pada Permukaan
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Rodriguez, A., Autio, W. R., & Mclandsborough, L. A. 2008. Effect of surface roughness and stainless steel finish on *Listeria monocytogenes* attachment and biofilm formation. Journal of Food Protection. 71(1):170-175.

Rodriguez-Loya, J., Lerma, M., & Gardea-Torresdey, JL. 2023. Hamburan cahaya dinamis dan aplikasinya untuk mengontrol agregasi nanopartikel dalam sistem koloid: sebuah tinjauan. Mikromesin. 15(1):24.

Roiska, R. 2022. Pembentukan biofilm single dan dual-species bakteri pembentuk histamin pada permukaan polypropylene dan ketahanannya terhadap agen sanitasi. Doctoral dissertation, Universitas Gadjah Mada.

Romadona, R. B. 2022. Pembentukan biofilm *Citrobacter freundii* CK01 dan *Raoultella ornithinolytica* TK01 pada berbagai permukaan kontak makanan. Skripsi, Faperta UGM.

Rossi, S., Leso, S. M., & Calovi, M. 2024. Study of the corrosion behavior of stainless steel in food industry. Materials. 17(7):1617.

Roy, P. K., Ha, A. J. W., Mizan, M. F. R., Hossain, M. I., Ashrafudoulla, M., Toushik, S. H., ... & Ha, S. D. 2021. Effects of environmental conditions (temperature, pH, and glucose) on biofilm formation of *Salmonella enterica* serotype Kentucky and virulence gene expression. Poultry Science. 100(7):101209.

Russo, B., Piacentini, E., Bazzarelli, F., Calderoni, G., Vacca, P., Figoli, A., & Giorno, L. 2023. Scalable production of chitosan sub-micron particles by membrane ionotropic gelation process. Carbohydrate Polymers. 318:121125.

Safara, A. S. 2020. Sintesis Nanokitosan Menggunakan Metode Gelasi Ionik Dengan Variasi Konsentrasi Asam Formiat Dan Natrium Tripolifosfat. Skripsi.

Safitri, I. 2020. Skrining dan uji formasi biofilm bakteri pembentuk histamin pada kupon stainless steel dan polypropylene. Skripsi, Faperta UGM.

Sameni, J., Krigstin, S., Jaffer, S. A., & Sain, M. 2018. Preparation and characterization of biobased microspheres from lignin sources. Industrial Crops and Products. 117:58-65.

Samudra, A., G., N. Ramadhani, F. Sani, G. Lestari, B. H. Nugroho. 2021. Formulasi nanopartikel kitosan ekstrak metanol alga laut coklat (*Sargassum hystrix*) dengan metode gelasi ionik. Jurnal Ilmiah Manuntung. 7(1):92-99.

Sato, N., N. Yamane, and T. Kawamura. 1982. Systemic *Citrobacter freundii* infection among sunfish *Mola mola* in Matsushima Aquarium. Bulletin of the Japanese Society of Scientific Fisheries. 48:1551–57.

Sharan, M., Vijay, D., Dhaka, P., Bedi, J., & Gill, J. P. S. 2022. Biofilms as a microbial hazard in the food industry: A scoping review. Journal of Applied Microbiology. 133(4):2210–2234.

UNIVERSITAS GADJAH MADA
Pengaruh Durasi Perendaman Nanokitosan terhadap Densitas Citrobacter freundii CK01 pada Permukaan Stainless Steel
Kintan Rahmasari, Indun Dewi Puspita, S.P., M.Sc., Ph.D.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Shi, J. 2002. Steric stabilization. The Ohio State University:5-13.

Shinu, P. 2022. Antimicrobial resistance, phenotypic characteristics, and biofilm production in *Citrobacter freundii* isolates obtained from urinary tract infections. Journal of Pharmacology and Pharmacotherapeutics. 13(4):375-381.

Sihotang, W. F., Restuati, M., & Silitonga, M. 2025. Uji Aktivitas Antibakteri Ekstrak Etanol Daun Sirih Cina (*Peperomia pellucida*) terhadap Bakteri Penyebab Jerawat (*Propionibacterium acnes*). Biocaster: Jurnal Kajian Biologi. 5(4):824-835.

Sillankorva, S., Neubauer, P., & Azaredo, J. 2011. Use of bacteriophages to control biofilms. LAP Lambert Academic Publishing.

Stevenson, K., McVey, A. F., Clark, I. B., Swain, P. S., & Pilizota, T. 2016. General calibration of microbial growth in microplate readers. Scientific Reports. 6(1):38828.

Stewart, P. S., Rayner, J., Roe, F., & Rees, W. M. 2001. Biofilm penetration and disinfection efficacy of alkaline hypochlorite and chlorosulfamates. Journal of Applied Microbiology. 91(3):525-532.

Sumarji, S. 2011. Studi perbandingan ketahanan korosi stainless steel tipe SS 304 dan SS 201 menggunakan metode U-bend test secara siklik dengan variasi suhu dan Ph. ROTOR. 4(1):1-8.

Tadros, T. 2007. General principles of colloid stability and the role of surface forces. Colloid Stability. 1:1-22.

Tan, X., Han, Y., Xiao, H., & Zhou, Z. 2017. *Pediococcus acidilactici* inhibit biofilm formation of food-borne pathogens on abiotic surfaces. Trans. Tianjin Univ. 23:70-77.

Tang, L., Pillai, S., Revsbech, N. P., Schramm, A., Bischoff, C., & Meyer, R. L. 2011. Biofilm retention on surfaces with variable roughness and hydrophobicity. Biofouling. 27(1):111-121.

Tavares, L., Flores, E. E. E., Rodrigues, R. C., Hertz, P. F., & Noreña, C. P. Z. 2020. Effect of deacetylation degree of chitosan on rheological properties and physical chemical characteristics of genipin-crosslinked chitosan beads. Food Hydrocolloids. 106:105876.

Thoke, G. M., Pitchai, A., Duraisamy, R., Ganapathy, D., & Ramasamy, P. 2025. Fabrication of nanochitosan from *Sepia kobiensis* (Hoyle, 1885) cuttlebone and its anti-blood clotting efficacy. Comparative Immunology Reports:200246.

Tortorella, V., Masciari, P., Pezzi, M., Mola, A., Tiburzi, S. P., Zinzi, M. C., ... & Verre, M. 2014. Histamine poisoning from ingestion of fish or scombroid syndrome. Case Reports in Emergency Medicine. 2014(1):482531.

UNIVERSITAS GADJAH MADA
Pengaruh Durasi Perendaman Nanokitosan terhadap Densitas Citrobacter freundii CK01 pada Permukaan Stainless Steel
Kintan Rahmasari, Indun Dewi Puspita, S.P., M.Sc., Ph.D.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

U.S. Environmental Protection Agency. 2020. Sodium Hypochlorite 10: EPA registration number 1258-1094. https://www.epa.gov/

Vallejo-Domínguez, D., Rubio-Rosas, E., Aguila-Almanza, E., Hernández-Cocoletzi, H., Ramos-Cassellis, M. E., Luna-Guevara, M. L., & Show, P. L. 2021. Ultrasound in the deproteinization process for chitin and chitosan production. Ultrasonics Sonochemistry. 72:105417.

Von Borell, E.H. 2001. The Biology of Stress and Its Application to Livestock Housing and Transportation Assessment. J. Anim. Sci. 79:E260-E267.

Wahyuni, W., Ridhay, A., & Nurakhirawati, N. 2016. Pengaruh Waktu Proses Deasetilasi Kitin Dari Cangkang Bekicot (*Achatina fulica*) Terhadap Derajat Deasetilasi. Kovalen. 2(1):144860.

Wang, H., Qi, J., Dong, Y., Li, Y., Xu, X., & Zhou, G. 2017. Characterization of attachment and biofilm formation by meat-borne Enterobacteriaceae strains associated with spoilage. LWT. 86:399-407.

Wang, X., He, M., Wang, X., Liu, S., Luo, L., Zeng, Q., & Jia, R. 2024. Emerging nanochitosan for sustainable agriculture. International Journal of Molecular Sciences. 25(22):12261.

Wang, X., Liu, M., Yu, C., Li, J., & Zhou, X. 2023. Biofilm formation: mechanistic insights and therapeutic targets. Molecular Biomedicine. 4(1):49.

Wang, Y., S. M. Lee, and G. Dykes. 2014. The physicochemical process of bacterial attachment to abiotic surfaces: Challenges for mechanistic studies, predictability and the development of control strategies. Crit. Rev. Microbiol. 1–13.

Wear, S. S., Sande, C., Ovchinnikova, O. G., Preston, A., & Whitfield, C. 2022. Investigation of core machinery for biosynthesis of Vi antigen capsular polysaccharides in Gram-negative bacteria. Journal of Biological Chemistry. 298(1):101486.

Widdel, F. 2007. Theory and measurement of bacterial growth. Di dalam Grundpraktikum Mikrobiologie. 4(11):1-11.

Widiastuti, D., Karima, I. F., & Setiyani, E. 2019. Efek Antibakteri Sodium Hypochlorite terhadap *Staphylococcus aureus*. Jurnal Ilmiah Kesehatan Masyarakat: Media Komunikasi Komunitas Kesehatan Masyarakat. 11(4):302-307.

Winkelströter, L. K., & Martinis, E. C. D. 2015. Different methods to quantify *Listeria monocytogenes* biofilms cells showed different profile in their viability. Brazilian Journal of Microbiology. 46(1):231-235.

Wiranata, D. P. 2020. Isolasi dan identifikasi bakteri pembentuk histamin pada ikan tuna mata besar, cakalang, dan tongkol yang didaratkan di pelabuhan perikanan pantai sadeng, gunung kidul. Skripsi, Faperta UGM.

UNIVERSITAS
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Kintan Rahmasari, Indun Dewi Puspita, S.P., M.Sc., Ph.D.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Xu, Lc., and B. E. Logan. 2005. Gaya interaksi antara koloid dan permukaan berlapis protein diukur menggunakan mikroskop gaya atom. Environ. Sci. Technol. 39:3592-3600.

Yanat, M., & Schroën, K. 2021. Preparation methods and applications of chitosan nanoparticles; with an outlook toward reinforcement of biodegradable packaging. Reactive and Functional Polymers. 161:104849.

Yoda, I., Koseki, H., Tomita, M., Shida, T., Horiuchi, H., Sakoda, H., & Osaki, M. 2014. Effect of surface roughness of biomaterials on *Staphylococcus epidermidis* adhesion. BMC Microbiology. 14(1):234.

Younes, I., & Rinaudo, M. 2015. Chitin and chitosan preparation from marine sources. Structure, properties and applications. Marine Drugs. 13(3):1133-1174.

Yuan, Y., Chesnutt, B.M., Haggard, W.O., & Bumgardner, J.D. 2011. Deacetylation of Chitosan: Material Characterization and in vitro Evaluation via Albumin Adsorption and Pre-Osteoblastic Cell Cultures. Materials. 4(8):1399–1416.

Zhao, X., Zhao, F., Wang, J., & Zhong, N. 2017. Biofilm formation and control strategies of foodborne pathogens: food safety perspectives. RSC Advances. 7(58):36670-36683.

Zheng, S., Bawazir, M., Dhall, A., Kim, H. E., He, L., Heo, J., & Hwang, G. 2021. Implication of surface properties, bacterial motility, and hydrodynamic conditions on bacterial surface sensing and their initial adhesion. Frontiers in Bioengineering and Biotechnology. 9:643722.