



DAFTAR PUSTAKA

- Agrawal, T., Ajitkumar, R., Prakash, R., Nandan, G., 2018. Sodium Silicide As A Hydrogen Source For Portable Energy Devices: A Review. *Mater. Today Proc.* 5, 3563–3570. <https://doi.org/10.1016/j.matpr.2017.11.605>
- Aillon, K.L., Xie, Y., El-Gendy, N., Berkland, C.J., Forrest, M.L., 2009. Effects of nanomaterial physicochemical properties on in vivo toxicity. *Adv. Drug Deliv. Rev.* 61, 457–466. <https://doi.org/10.1016/j.addr.2009.03.010>
- Ardhiati, F., Muldarisnur, M., 2019. Pengaruh Konsentrasi Larutan Prekursor Terhadap Morfologi dan Ukuran Kristal Nanopartikel Seng Oksida. *J. Fis. Unand* 8, 133–138.
- Argueta-Figueroa, L., Morales-Luckie, R.A., Scougall-Vilchis, R.J., Olea-Mejía, O.F., 2014. Synthesis, characterization and antibacterial activity of copper, nickel and bimetallic Cu–Ni nanoparticles for potential use in dental materials. *Prog. Nat. Sci. Mater. Int.* 24, 321–328. <https://doi.org/10.1016/j.pnsc.2014.07.002>
- Aronson, J.K. (Ed.), 2016. *Sulfonamides*, in: Meyler's Side Effects of Drugs (Sixteenth Edition). Elsevier, Oxford, pp. 555–569. <https://doi.org/10.1016/B978-0-444-53717-1.01484-0>
- Balouiri, M., Sadiki, M., Ibsouda, S.K., 2016. Methods for in vitro evaluating antimicrobial activity: A review. *J. Pharm. Anal.* 6, 71–79. <https://doi.org/10.1016/j.jpha.2015.11.005>
- Bhangu, S.K., Ashokkumar, M., 2016. Theory of Sonochemistry. *Top. Curr. Chem.* 374, 56. <https://doi.org/10.1007/s41061-016-0054-y>
- Camacho-Flores, B.A., Arenas-Arrocena, Ma.C., Martínez-Alvarez, O., García-Contreras, R., Argueta-Figueroa, L., Fuente-Hernández, J., Ls, A.-T., Cortázar, J., Guanajuato, M., Acosta-Torres, L., 2015. Copper: Synthesis Techniques in Nanoscale and Powerful Application as an Antimicrobial Agent. *J. Nanomater.* 36969, 10. <https://doi.org/10.1155/2015/415238>
- Caron, D.A., Worden, A.Z., Countway, P.D., Demir, E., Heidelberg, K.B., 2009. Protists are microbes too: a perspective. *ISME J.* 3, 4–12. <https://doi.org/10.1038/ismej.2008.101>
- Cavassini, E.D., de Figueiredo, L.F.P., Otoch, J.P., Seckler, M.M., de Oliveira, R.A., Franco, F.F., Marangoni, V.S., Zucolotto, V., Levin, A.S.S., Costa, S.F., 2015. Comparison of methods to detect the in vitro activity of silver nanoparticles (AgNP) against multidrug resistant bacteria. *J. Nanobiotechnology* 13, 64. <https://doi.org/10.1186/s12951-015-0120-6>
- Champion, J.A., Mitragotri, S., 2006. Role of target geometry in phagocytosis. *Proc. Natl. Acad. Sci. U. S. A.* 103, 4930–4934. <https://doi.org/10.1073/pnas.0600997103>
- Chawla, P., Kumar, N., Bains, A., Dhull, S.B., Kumar, M., Kaushik, R., Punia, S., 2020. Gum arabic capped copper nanoparticles: Synthesis, characterization, and applications. *Int. J. Biol. Macromol.* 146, 232–242. <https://doi.org/10.1016/j.ijbiomac.2019.12.260>
- Chen, H., Yang, H., Weir, M.D., Schneider, A., Ren, K., Homayounfar, N., Oates, T.W., Zhang, K., Liu, J., Hu, T., Xu, H.H.K., 2020. An antibacterial and



- injectable calcium phosphate scaffold delivering human periodontal ligament stem cells for bone tissue engineering. *RSC Adv.* 10, 40157–40170. <https://doi.org/10.1039/D0RA06873J>
- Chithrani, B.D., Ghazani, A.A., Chan, W.C.W., 2006. Determining the Size and Shape Dependence of Gold Nanoparticle Uptake into Mammalian Cells. *Nano Lett.* 6, 662–668. <https://doi.org/10.1021/nl052396o>
- Choi, H., Chatterjee, P., Lichtfouse, E., Martel, J.A., Hwang, M., Jinadatha, C., Sharma, V.K., 2021. Classical and alternative disinfection strategies to control the COVID-19 virus in healthcare facilities: a review. *Environ. Chem. Lett.* <https://doi.org/10.1007/s10311-021-01180-4>
- Choi, U., Lee, C.-R., 2019. Distinct Roles of Outer Membrane Porins in Antibiotic Resistance and Membrane Integrity in *Escherichia coli*. *Front. Microbiol.* 10. <https://doi.org/10.3389/fmicb.2019.00953>
- Cholewińska, E., Ognik, K., Fotschki, B., Zduńczyk, Z., Juśkiewicz, J., 2018. Comparison of the effect of dietary copper nanoparticles and one copper (II) salt on the copper biodistribution and gastrointestinal and hepatic morphology and function in a rat model. *PLOS ONE* 13, e0197083. <https://doi.org/10.1371/journal.pone.0197083>
- Chong, A., Lee, S., Yang, Y.-A., Song, J., 2017. The Role of Typhoid Toxin in *Salmonella Typhi* Virulence. *Yale J. Biol. Med.* 90, 283–290.
- Cui, S.M., Li, T., Wang, Q., He, K.K., Zheng, Y.M., Liang, H.Y., Song, L.Y., 2020. Antibacterial Effects of *Schisandra chinensis* Extract on *Escherichia coli* and its Applications in Cosmetic. *Curr. Microbiol.* 77, 865–874. <https://doi.org/10.1007/s00284-019-01813-6>
- Danikowski, K.M., Cheng, T., 2018. Alkaline Phosphatase Activity of *Staphylococcus aureus* Grown in Biofilm and Suspension Cultures. *Curr. Microbiol.* 75, 1226–1230. <https://doi.org/10.1007/s00284-018-1514-0>
- De Jong, W.H., Hagens, W.I., Krystek, P., Burger, M.C., Sips, A.J.A.M., Geertsma, R.E., 2008. Particle size-dependent organ distribution of gold nanoparticles after intravenous administration. *Biomaterials* 29, 1912–1919. <https://doi.org/10.1016/j.biomaterials.2007.12.037>
- DeAlba-Montero, I., Guajardo-Pacheco, J., Morales-Sánchez, E., Araujo-Martínez, R., Loredo-Becerra, G.M., Martínez-Castañón, G.-A., Ruiz, F., Compeán Jasso, M.E., 2017. Antimicrobial Properties of Copper Nanoparticles and Amino Acid Chelated Copper Nanoparticles Produced by Using a Soya Extract. *Bioinorg. Chem. Appl.* 2017, 1–6. <https://doi.org/10.1155/2017/1064918>
- Decker, E.M., 2001. The ability of direct fluorescence-based, two-colour assays to detect different physiological states of oral streptococci. *Lett. Appl. Microbiol.* 33, 188–192. <https://doi.org/10.1046/j.1472-765x.2001.00971.x>
- Delano, M.L., Mischler, S.A., Underwood, W.J., 2002. Chapter 14 - *Biology and Diseases of Ruminants*: Sheep, Goats, and Cattle, in: Fox, J.G., Anderson, L.C., Loew, F.M., Quimby, F.W. (Eds.), *Laboratory Animal Medicine* (Second Edition), American College of Laboratory Animal Medicine. Academic Press, Burlington, pp. 519–614. <https://doi.org/10.1016/B978-012263951-7/50017-X>



- Desmarchelier, P., Fegan, N., 2016. *Pathogens in Milk: Escherichia coli*, in: Reference Module in Food Science. Elsevier. <https://doi.org/10.1016/B978-0-08-100596-5.00989-6>
- Desmarchelier, P., Fegan, N., 2002. *ESCHERICHIA COLI*, in: Roginski, H. (Ed.), Encyclopedia of Dairy Sciences. Elsevier, Oxford, pp. 948–954. <https://doi.org/10.1016/B0-12-227235-8/00158-9>
- Díaz-Visurraga, J., Daza, C., Pozo, C., Becerra, A., von Plessing, C., García, A., 2012. Study on antibacterial alginate-stabilized copper nanoparticles by FT-IR and 2D-IR correlation spectroscopy. *Int. J. Nanomedicine* 7, 3597–3612. <https://doi.org/10.2147/IJN.S32648>
- Din, M.I., Arshad, F., Hussain, Z., Mukhtar, M., 2017. Green Adeptness in the Synthesis and Stabilization of Copper Nanoparticles: Catalytic, Antibacterial, Cytotoxicity, and Antioxidant Activities. *Nanoscale Res. Lett.* 12, 638. <https://doi.org/10.1186/s11671-017-2399-8>
- Dodds, J.A., Rasteiro, M., Scarlett, B., Weichert, R., Williams, R., 2004. From Particle Size Analysis (PSA 1970) to Particulate Systems Analysis (PSA 2003). *Chem. Eng. Res. Des. - CHEM ENG RES DES* 82. <https://doi.org/10.1205/cerd.82.12.1533.58040>
- Dong, X., Ji, X., Jing, J., Li, M., Li, J., Yang, W., 2010. *Synthesis of Triangular Silver Nanoprisms by Stepwise Reduction of Sodium Borohydride and Trisodium Citrate*. <https://doi.org/10.1021/JP909964K>
- Gatoo, M., Naseem, S., Arfat, M., Dar, A., Qasim, K., Zubair, S., 2014. Physicochemical Properties of Nanomaterials: Implication in Associated Toxic Manifestations. *BioMed Res. Int.* 2014, 498420. <https://doi.org/10.1155/2014/498420>
- Guidry, C.A., Mansfield, S.A., Sawyer, R.G., Cook, C.H., 2014. Resistant Pathogens, Fungi, and Viruses. *Surg. Clin. North Am.* 94, 1195–1218. <https://doi.org/10.1016/j.suc.2014.08.010>
- Harti, A.S., 2015. *Mikrobiologi Kesehatan*. CV. Andi Offset, Yogyakarta.
- Haruta, M., 2004. Nanoparticulate Gold Catalysts for Low-Temperature CO Oxidation. *J. New Mater. Electrochem. Syst. J New Mat Electrochem Syst.* 7, 163–172. <https://doi.org/10.1002/chin.200448226>
- Hassellöv, M., Readman, J.W., Ranville, J.F., Tiede, K., 2008. Nanoparticle analysis and characterization methodologies in environmental risk assessment of engineered nanoparticles. *Ecotoxicology* 17, 344–361. <https://doi.org/10.1007/s10646-008-0225-x>
- Hoshino, A., Fujioka, K., Oku, T., Suga, M., Sasaki, Y.F., Ohta, T., Yasuhara, M., Suzuki, K., Yamamoto, K., 2004. Physicochemical Properties and Cellular Toxicity of Nanocrystal Quantum Dots Depend on Their Surface Modification. *Nano Lett.* 4, 2163–2169. <https://doi.org/10.1021/nl048715d>
- Huang, S.-H., Juang, R.-S., 2011. Biochemical and biomedical applications of multifunctional magnetic nanoparticles: a review. *J Nanopart Res* 20.
- Hwang, S.-J., Kim, J.-W., Yoo, S.-J., Jang, J.-H., Cho, E.-A., Lim, T.-H., Pyo, S.-G., Kim, S.-K., 2012. Stabilizer-mediated Synthesis of High Activity PtFe/C Nanocatalysts for Fuel Cell Application. *Bull. Korean Chem. Soc.* 33, 699–702. <https://doi.org/10.5012/bkcs.2012.33.2.699>



- Inkson, B.J., 2016. 2 - *Scanning electron microscopy (SEM) and transmission electron microscopy (TEM) for materials characterization*, in: Hübschen, G., Altpeter, I., Tschuncky, R., Herrmann, H.-G. (Eds.), *Materials Characterization Using Nondestructive Evaluation (NDE) Methods*. Woodhead Publishing, pp. 17–43. <https://doi.org/10.1016/B978-0-08-100040-3.00002-X>
- Ispas, C., Andreeșcu, D., Patel, A., Goia, D.V., Andreeșcu, S., Wallace, K.N., 2009. Toxicity and developmental defects of different sizes and shape nickel nanoparticles in zebrafish. *Environ. Sci. Technol.* 43, 6349–6356.
- Jessop, I.A., Pérez, Y.P., Jachura, A., Nuñez, H., Saldías, C., Isaacs, M., Tundidor-Camba, A., Terraza, C.A., Araya-Durán, I., Camarada, M.B., Cárcamo-Vega, J.J., 2021. New Hybrid Copper Nanoparticles/Conjugated Polyelectrolyte Composite with Antibacterial Activity. *Polymers* 13, 1–14. <https://doi.org/10.3390/polym13030401>
- Jiang, J., Oberdörster, G., Biswas, P., 2009. Characterization of size, surface charge, and agglomeration state of nanoparticle dispersions for toxicological studies. *J. Nanoparticle Res.* 11, 77–89. <https://doi.org/10.1007/s11051-008-9446-4>
- Jørgensen, M.G., van Raaphorst, R., Veening, J.-W., 2013. Chapter 6 - *Noise and Stochasticity in Gene Expression*: A Pathogenic Fate Determinant, in: Harwood, C., Wipat, A. (Eds.), *Methods in Microbiology, Microbial Synthetic Biology*. Academic Press, pp. 157–175. <https://doi.org/10.1016/B978-0-12-417029-2.00006-6>
- Kaminskiene, Ž., Prosycevas, I., Stonkutė, J., Guobiene, A., 2013. Evaluation of Optical Properties of Ag, Cu, and Co Nanoparticles Synthesized in Organic Medium. *Acta Phys. Pol. A* 123, 111. <https://doi.org/10.12693/APhysPolA.123.111>
- Kaper, J.B., Nataro, J.P., Mobley, H.L., 2004. Pathogenic *Escherichia coli*. *Nat. Rev. Microbiol.* 2, 123–140. <https://doi.org/10.1038/nrmicro818>
- Khare, P., Sharma, A., Verma, N., 2014. Synthesis of phenolic precursor-based porous carbon beads in situ dispersed with copper–silver bimetal nanoparticles for antibacterial applications. *J. Colloid Interface Sci.* 418, 216–224. <https://doi.org/10.1016/j.jcis.2013.12.026>
- Khodashenas, B., Ghorbani, H., 2014. ChemInform Abstract: Synthesis of Copper Nanoparticles : An Overview of the Various Methods. *Korean J. Chem. Eng.* 31, 1105–1109. <https://doi.org/10.1007/s11814-014-0127-y>
- Khodashenas, B., Ghorbani, H.R., 2019. Synthesis of silver nanoparticles with different shapes. *Arab. J. Chem.* 12, 1823–1838. <https://doi.org/10.1016/j.arabjc.2014.12.014>
- Koo, H., Gomes, B.P.F.A., Rosalen, P.L., Ambrosano, G.M.B., Park, Y.K., Cury, J.A., 2000. In vitro antimicrobial activity of propolis and Arnica montana against oral pathogens. *Arch. Oral Biol.* 45, 141–148. [https://doi.org/10.1016/S0003-9969\(99\)00117-X](https://doi.org/10.1016/S0003-9969(99)00117-X)
- Kruk, T., Szczepanowicz, K., Stefańska, J., Socha, R.P., Warszyński, P., 2015. Synthesis and antimicrobial activity of monodisperse copper nanoparticles. *Colloids Surf. B Biointerfaces* 128, 17–22.



- <https://doi.org/10.1016/j.colsurfb.2015.02.009>
- Kuo, J. (Ed.), 2014. *Electron Microscopy: Methods and Protocols*, 3rd ed, Methods in Molecular Biology. Humana Press. <https://doi.org/10.1007/978-1-62703-776-1>
- Lansdown, A.B.G., 2002. Silver. I: Its antibacterial properties and mechanism of action. *J. Wound Care* 11, 125–130. <https://doi.org/10.12968/jowc.2002.11.4.26389>
- Lee, M.-K., Lim, S.-J., Kim, C.-K., 2007. Preparation, characterization and in vitro cytotoxicity of paclitaxel-loaded sterically stabilized solid lipid nanoparticles. *Biomaterials* 28, 2137–46. <https://doi.org/10.1016/j.biomaterials.2007.01.014>
- Lherm, C., Müller, R.H., Puisieux, F., Couvreur, P., 1992. Alkylcyanoacrylate drug carriers: II. Cytotoxicity of cyanoacrylate nanoparticles with different alkyl chain length. *Int. J. Pharm.* 84, 13–22. [https://doi.org/10.1016/0378-5173\(92\)90210-S](https://doi.org/10.1016/0378-5173(92)90210-S)
- Li, P., Liang, J., Su, D., Huang, Y., Pan, J., Peng, M., Li, G., Shan, Y., 2020. Green and efficient biosynthesis of pectin-based copper nanoparticles and their antimicrobial activities. *Bioprocess Biosyst. Eng.* 43, 2017–2026. <https://doi.org/10.1007/s00449-020-02390-w>
- Liang, H., He, K., Li, T., Cui, S., Tang, M., Kang, S., Ma, W., Song, L., 2020. Mechanism and antibacterial activity of vine tea extract and dihydromyricetin against *Staphylococcus aureus*. *Sci. Rep.* 10, 21416. <https://doi.org/10.1038/s41598-020-78379-y>
- Liu, X., Liu, W., Wang, C., Zheng, Z., 2016. Optimization and modeling for one-step synthesis process of Ag–Cu nano-particles using DOE methodology. *J. Mater. Sci. Mater. Electron.* 27, 4265–4274. <https://doi.org/10.1007/s10854-016-4292-0>
- Liu, X., Xia, W., Jiang, Q., Xu, Y., Yu, P., 2015. Effect of kojic acid-grafted-chitosan oligosaccharides as a novel antibacterial agent on cell membrane of gram-positive and gram-negative bacteria. *J. Biosci. Bioeng.* 120, 335–339. <https://doi.org/10.1016/j.jbiosc.2015.01.010>
- MacGowan, A., Macnaughton, E., 2017. Antibiotic resistance. *Medicine (Baltimore)* 45, 622–628. <https://doi.org/10.1016/j.mpmed.2017.07.006>
- Madigan, M.T., Brock, T., Martinko, J., Clark, D.P., Dunlap, P., 2009. *Brock Biology of Microorganisms*. Pearson/Benjamin Cummings.
- Madl, A.K., Plummer, L.E., Carosino, C., Pinkerton, K.E., 2014. Nanoparticles, Lung Injury, and the Role of Oxidant Stress. *Annu. Rev. Physiol.* 76, 447–465. <https://doi.org/10.1146/annurev-physiol-030212-183735>
- Mahdieh, M.H., Fattahi, B., 2015. Effects of water depth and laser pulse numbers on size properties of colloidal nanoparticles prepared by nanosecond pulsed laser ablation in liquid. *Opt. Laser Technol.* 75, 188–196. <https://doi.org/10.1016/j.optlastec.2015.07.006>
- Makvandi, P., Gu, J.T., Zare, E.N., Ashtari, B., Moeini, A., Tay, F.R., Niu, L.-N., 2020. Polymeric and inorganic nanoscopical antimicrobial fillers in dentistry. *Acta Biomater.* 101, 69–101. <https://doi.org/10.1016/j.actbio.2019.09.025>



- Martin, I., Sawatzky, P., Liu, G., Mulvey, M.R., 2015. Antimicrobial resistance to *Neisseria gonorrhoeae* in Canada: 2009–2013. *Can. Commun. Dis. Rep. Relevé Mal. Transm. Au Can.* 41, 35–41. <https://doi.org/10.14745/ccdr.v41i02a04>
- Matei, A., Vasilica, T., Marian, P., Cosmin, R., Bogdan, B., Ileana, C., 2018. *Synthesis and characterization of various surfactants for stabilized CuO powder*, in: Materials Research Proceedings. Presented at the Powder Metallurgy and Advanced Materials, pp. 52–60. <https://doi.org/10.21741/9781945291999-6>
- Matuła, K., Richter, Ł., Adamkiewicz, W., Åkerström, B., Paczesny, J., Hołyst, R., 2016. Influence of nanomechanical stress induced by ZnO nanoparticles of different shapes on the viability of cells. *Soft Matter* 12, 4162–4169. <https://doi.org/10.1039/c6sm00336b>
- Mazurek, W., Kennedy, B.J., Murray, K.S., O'Connor, M.J., Rodgers, J.R., Snow, M.R., Wedd, A.G., Zwack, P., 1985. Magnetic interactions in metal complexes of binucleating ligands. 2. Synthesis and properties of binuclear copper(II) compounds containing exogenous ligands that bridge through two atoms. Crystal and molecular structure of a binuclear .mu.-pyrazolato-N,N'-bridged dicopper(II) complex of 1,3-bis(salicylideneamino)propan-2-ol. *Inorg. Chem.* 24, 3258–3264. <https://doi.org/10.1021/ic00214a033>
- McQuillan, J.S., Infante, H.G., Stokes, E., Shaw, A.M., 2012. Silver nanoparticle enhanced silver ion stress response in *Escherichia coli* K12. *Nanotoxicology* 6, 857–866. <https://doi.org/10.3109/17435390.2011.626532>
- Meghana, S., Kabra, P., Chakraborty, S., Padmavathy, N., 2015. Understanding the pathway of antibacterial activity of copper oxide nanoparticles. *RSC Adv.* 5, 12293–12299. <https://doi.org/10.1039/C4RA12163E>
- Mileyeva-Biebesheimer, O.N., Zaky, A., Gruden, C.L., 2010. Assessing the Impact of Titanium Dioxide and Zinc Oxide Nanoparticles on Bacteria Using a Fluorescent-Based Cell Membrane Integrity Assay. *Environ. Eng. Sci.* 27, 329–335. <https://doi.org/10.1089/ees.2009.0332>
- Millán, J.L., 2006. Alkaline Phosphatases. *Purinergic Signal.* 2, 335–341. <https://doi.org/10.1007/s11302-005-5435-6>
- Miloš, H., 1996. *Reductions in Organic Chemistry*. American Chemical Society., Washington, D.C.
- Mohamed, M.A., Jaafar, J., Ismail, A. F., Othman, M.H.D., Rahman, M.A., 2017. Chapter 1 - *Fourier Transform Infrared (FTIR) Spectroscopy*, in: Hilal, N., Ismail, Ahmad Fauzi, Matsuura, T., Oatley-Radcliffe, D. (Eds.), *Membrane Characterization*. Elsevier, pp. 3–29. <https://doi.org/10.1016/B978-0-444-63776-5.00001-2>
- Monaco, R.R., 2010. Capture of a Transition State Using Molecular Dynamics: Creation of an Intercalation Site in dsDNA with Ethidium Cation. *J. Nucleic Acids* 2010, e702317. <https://doi.org/10.4061/2010/702317>
- Mu, H., Tang, J.-J., Liu, Q., Sun, C., Wang, T., Duan, J., 2016. Potent Antibacterial Nanoparticles against Biofilm and Intracellular Bacteria. *Sci. Rep.* 6, 18877. <https://doi.org/10.1038/srep18877>



- Narmani, A., Teponno, R.B., Arzanlou, M., Surup, F., Helaly, S.E., Wittstein, K., Praditya, D.F., Babai-Ahari, A., Steinmann, E., Stadler, M., 2019. Cytotoxic, antimicrobial and antiviral secondary metabolites produced by the plant pathogenic fungus *Cytospora* sp. CCTU A309. *Fitoterapia* 134, 314–322. <https://doi.org/10.1016/j.fitote.2019.02.015>
- Naveed, M., Chaudhry, Z., Bukhari, S.A., Meer, B., Ashraf, H., 2020. Chapter 19 - *Antibiotics resistance mechanism*, in: Hashmi, M.Z. (Ed.), *Antibiotics and Antimicrobial Resistance Genes in the Environment, Advances in Environmental Pollution Research Series*. Elsevier, pp. 292–312. <https://doi.org/10.1016/B978-0-12-818882-8.00019-X>
- Olmsted, J., Kearns, D.R., 1977. Mechanism of ethidium bromide fluorescence enhancement on binding to nucleic acids. *Biochemistry* 16, 3647–3654. <https://doi.org/10.1021/bi00635a022>
- Ostaeva, G.Yu., Selishcheva, E.D., Pautov, V.D., Papisov, I.M., 2008. Pseudotemplate synthesis of copper nanoparticles in solutions of poly(acrylic acid)-pluronic blends. *Polym. Sci. Ser. B* 50, 147–149. <https://doi.org/10.1134/S1560090408050102>
- Pawley, J., Schatten, H. (Eds.), 2008. *Biological Low-Voltage Scanning Electron Microscopy*. Springer-Verlag, New York. <https://doi.org/10.1007/978-0-387-72972-5>
- Percival, S.L., Williams, D.W., 2014. Chapter Six - *Escherichia coli*, in: Percival, S.L., Yates, M.V., Williams, D.W., Chalmers, R.M., Gray, N.F. (Eds.), *Microbiology of Waterborne Diseases* (Second Edition). Academic Press, London, pp. 89–117. <https://doi.org/10.1016/B978-0-12-415846-7.00006-8>
- Phiwdang, K., Suphankij, S., Mekprasart, W., Pecharapa, W., 2013. Synthesis of CuO Nanoparticles by Precipitation Method Using Different Precursors. *Energy Procedia*, 10th Eco-Energy and Materials Science and Engineering Symposium 34, 740–745. <https://doi.org/10.1016/j.egypro.2013.06.808>
- Pierson, L.S., Maier, R.M., Pepper, I.L., 2015. Chapter 20 - *Microbial Communication: Bacteria/Bacteria and Bacteria/Host*, in: Pepper, I.L., Gerba, C.P., Gentry, T.J. (Eds.), *Environmental Microbiology* (Third Edition). Academic Press, San Diego, pp. 461–481. <https://doi.org/10.1016/B978-0-12-394626-3.00020-X>
- Pigłowski, M., 2019. Pathogenic and Non-Pathogenic Microorganisms in the Rapid Alert System for Food and Feed. *Int. J. Environ. Res. Public. Health* 16. <https://doi.org/10.3390/ijerph16030477>
- Powers, K., Palazuelos, M., Moudgil, B., Roberts, S., 2009. Characterization of the size, shape, and state of dispersion of nanoparticles for toxicological studies. *Nanotoxicology* 1, 42–51. <https://doi.org/10.1080/17435390701314902>
- Prucek, R., Kvítek, L., Panáček, A., Vančurová, L., Soukupová, J., Jančík, D., Zbořil, R., 2009. Polyacrylate-assisted synthesis of stable copper nanoparticles and copper(I) oxide nanocubes with high catalytic efficiency. *J. Mater. Chem.* 19, 8463–8469.



<https://doi.org/10.1039/B913561H>

- Raja, M., Subha, J., Ali, F.B., Ryu, S.H., 2008. Synthesis of Copper Nanoparticles by Electroreduction Process. *Mater. Manuf. Process.* 23, 782–785. <https://doi.org/10.1080/10426910802382080>
- Rana, S., Philip, J., Raj, B., 2010. Micelle based synthesis of cobalt ferrite nanoparticles and its characterization using Fourier Transform Infrared Transmission Spectrometry and Thermogravimetry. *Mater. Chem. Phys.* 124, 264–269. <https://doi.org/10.1016/j.matchemphys.2010.06.029>
- Ratledge, C., Dover, L.G., 2000. Iron Metabolism in Pathogenic Bacteria. *Annu. Rev. Microbiol.* 54, 881–941. <https://doi.org/10.1146/annurev.micro.54.1.881>
- Rehman, K., Fiayyaz, F., Khurshid, M., Sabir, S., Akash, M.S.H., 2020. Chapter 2 - *Antibiotics and antimicrobial resistance: temporal and global trends in the environment*, in: Hashmi, M.Z. (Ed.), *Antibiotics and Antimicrobial Resistance Genes in the Environment, Advances in Environmental Pollution Research Series*. Elsevier, pp. 7–27. <https://doi.org/10.1016/B978-0-12-818882-8.00002-4>
- Rojas-Lopez, M., Monterio, R., Pizza, M., Desvaux, M., Rosini, R., 2018. Intestinal Pathogenic *Escherichia coli*: Insights for Vaccine Development. *Front. Microbiol.* 9. <https://doi.org/10.3389/fmicb.2018.00440>
- Roth, B.L., Poot, M., Yue, S.T., Millard, P.J., 1997. Bacterial viability and antibiotic susceptibility testing with SYTOX green nucleic acid stain. *Appl. Environ. Microbiol.* 63, 2421–2431. <https://doi.org/10.1128/aem.63.6.2421-2431.1997>
- Ruparelia, J.P., Chatterjee, A.K., Duttagupta, S.P., Mukherji, S., 2008. Strain specificity in antimicrobial activity of silver and copper nanoparticles. *Acta Biomater.* 4, 707–716. <https://doi.org/10.1016/j.actbio.2007.11.006>
- Sahoo, M., Ceballos-Olvera, I., del Barrio, L., Re, F., 2011. Role of the Inflammasome, IL-1 β , and IL-18 in Bacterial Infections. *Sci. World J.* 11, 2037–2050. <https://doi.org/10.1100/2011/212680>
- Salzemann, C., Lisiecki, I., Brioude, A., Urban, J., Pileni, M.-P., 2004. Collections of Copper Nanocrystals Characterized by Different Sizes and Shapes: Optical Response of These Nanoobjects. *J. Phys. Chem. B* 108, 13242–13248. <https://doi.org/10.1021/jp048491n>
- Schröfel, A., Kratošová, G., Šafařík, I., Šafaříková, M., Raška, I., Shor, L.M., 2014. Applications of biosynthesized metallic nanoparticles – A review. *Acta Biomater.* 10, 4023–4042. <https://doi.org/10.1016/j.actbio.2014.05.022>
- Shahzadi, S., Zafar, N., Sharif, R., 2018. Antibacterial Activity of Metallic Nanoparticles. *Bact. Pathog. Antibact. Control.* <https://doi.org/10.5772/intechopen.72526>
- Shaikh, S., Nazam, N., Rizvi, S.M.D., Ahmad, K., Baig, M.H., Lee, E.J., Choi, I., 2019. Mechanistic Insights into the Antimicrobial Actions of Metallic Nanoparticles and Their Implications for Multidrug Resistance. *Int. J. Mol. Sci.* 20, 2468. <https://doi.org/10.3390/ijms20102468>
- Shams, M.H., Salehi, S.M.A., Ghasemi, A., 2008. Electromagnetic wave



- absorption characteristics of Mg–Ti substituted Ba-hexaferrite. *Mater. Lett.* 62, 1731–1733. <https://doi.org/10.1016/j.matlet.2007.09.073>
- Sharma, S., Uttam, K.N., 2017. Rapid analyses of stress of copper oxide nanoparticles on wheat plants at an early stage by laser induced fluorescence and attenuated total reflectance Fourier transform infrared spectroscopy. *Vib. Spectrosc.* 92, 135–150. <https://doi.org/10.1016/j.vibspec.2017.06.004>
- Siddiqui, H., Qureshi, M.S., Haque, F.Z., 2016. Surfactant assisted wet chemical synthesis of copper oxide (CuO) nanostructures and their spectroscopic analysis. *Optik* 127, 2740–2747. <https://doi.org/10.1016/j.ijleo.2015.11.220>
- Siddiqui, S., 2019. Chapter 14 - *Resistance in Pathogenic Microorganisms*, in: Gupta, V.K., Pandey, A. (Eds.), New and Future Developments in Microbial Biotechnology and Bioengineering. Elsevier, Amsterdam, pp. 183–191. <https://doi.org/10.1016/B978-0-444-63504-4.00014-1>
- Simon-Deckers, A., Loo, S., Mayne-L'hermite, M., Herlin-Boime, N., Menguy, N., Reynaud, C., Gouget, B., Carrière, M., 2009. Size-, composition- and shape-dependent toxicological impact of metal oxide nanoparticles and carbon nanotubes toward bacteria. *Environ. Sci. Technol.* 43, 8423–8429. <https://doi.org/10.1021/es9016975>
- Skrabalak, S.E., Au, L., Li, X., Xia, Y., 2007. Facile synthesis of Ag nanocubes and Au nanocages. *Nat. Protoc.* 2, 2182–2190. <https://doi.org/10.1038/nprot.2007.326>
- Slavin, Y.N., Asnis, J., Häfeli, U.O., Bach, H., 2017. Metal nanoparticles: understanding the mechanisms behind antibacterial activity. *J. Nanobiotechnology* 15, 65. <https://doi.org/10.1186/s12951-017-0308-z>
- Song, X., Sun, S., Zhang, W., Yin, Z., 2004. A method for the synthesis of spherical copper nanoparticles in the organic phase. *J. Colloid Interface Sci.* 273, 463–469. <https://doi.org/10.1016/j.jcis.2004.01.019>
- Stapleton, P.D., Taylor, P.W., 2002. Methicillin resistance in *Staphylococcus aureus*: mechanisms and modulation. *Sci. Prog.* 85, 57–72. <https://doi.org/10.3184/003685002783238870>
- Stefaniak, A.B., 2017. *Principal Metrics and Instrumentation for Characterization of Engineered Nanomaterials*, in: Metrology and Standardization of Nanotechnology. John Wiley & Sons, Ltd, pp. 151–174. <https://doi.org/10.1002/9783527800308.ch8>
- Strausbaugh, L.J., Crossley, K.B., Nurse, B.A., Thrupp, L.D., 1996. Antimicrobial resistance in long-term-care facilities. *Infect. Control Hosp. Epidemiol.* 17, 129–140. <https://doi.org/10.1086/647257>
- Sukhanova, A., Bozrova, S., Sokolov, P., Berestovoy, M., Karaulov, A., Nabiev, I., 2018. Dependence of Nanoparticle Toxicity on Their Physical and Chemical Properties. *Nanoscale Res. Lett.* 13, 44. <https://doi.org/10.1186/s11671-018-2457-x>
- Tamayo, L.A., Zapata, P.A., Vejar, N.D., Azócar, M.I., Gulppi, M.A., Zhou, X., Thompson, G.E., Rabagliati, F.M., Páez, M.A., 2014. Release of silver and copper nanoparticles from polyethylene nanocomposites and their



- penetration into *Listeria monocytogenes*. *Mater. Sci. Eng. C Mater. Biol. Appl.* 40, 24–31. <https://doi.org/10.1016/j.msec.2014.03.037>
- Tawakoli, P., Al-Ahmad, A., Hoth-Hannig, W., Hannig, M., Hannig, C., 2012. Comparison of different live/dead stainings for detection and quantification of adherent microorganisms in the initial oral biofilm. *Clin. Oral Investig.* 17. <https://doi.org/10.1007/s00784-012-0792-3>
- Todd, E.C.D., 2014. *Bacteria: Staphylococcus aureus*, in: Motarjemi, Y. (Ed.), Encyclopedia of Food Safety. Academic Press, Waltham, pp. 530–534. <https://doi.org/10.1016/B978-0-12-378612-8.00115-3>
- Umer, A., Naveed, S., Ramzan, N., Rafique, M.S., 2012. Selection of A Suitable Method for The Synthesis of Copper Nanoparticles. *Nano* 07, 1230005. <https://doi.org/10.1142/S1793292012300058>
- Usman, M.S., Zowalaty, M.E.E., Shameli, K., Zainuddin, N., Salama, M., Ibrahim, N.A., 2013. Synthesis, characterization, and antimicrobial properties of copper nanoparticles. *Int. J. Nanomedicine* 8, 4467–4479. <https://doi.org/10.2147/IJN.S50837>
- Varadaraj, M.C., 2010. Chapter 9 - *Capacity Building: Building Analytical Capacity for Microbial Food Safety*, in: Boisrobert, C.E., Stjepanovic, A., Oh, S., Lelieveld, H.L.M. (Eds.), Ensuring Global Food Safety. Academic Press, San Diego, pp. 151–176. <https://doi.org/10.1016/B978-0-12-374845-4.00009-6>
- Vincent, M., Duval, R.E., Hartemann, P., Engels- Deutsch, M., 2018. Contact killing and antimicrobial properties of copper. *J. Appl. Microbiol.* 124, 1032–1046. <https://doi.org/10.1111/jam.13681>
- Wang, L., Hu, C., Shao, L., 2017. The antimicrobial activity of nanoparticles: present situation and prospects for the future. *Int. J. Nanomedicine* 12, 1227–1249. <https://doi.org/10.2147/IJN.S121956>
- Wang, X., Yang, J., Shi, L., Gao, M., 2016. Surfactant-free Synthesis of CuO with Controllable Morphologies and Enhanced Photocatalytic Property. *Nanoscale Res. Lett.* 11, 125. <https://doi.org/10.1186/s11671-016-1278-z>
- Weaver, L., Noyce, J.O., Michels, H.T., Keevil, C.W., 2010. Potential action of copper surfaces on meticillin-resistant *Staphylococcus aureus*. *J. Appl. Microbiol.* 109, 2200–2205. <https://doi.org/10.1111/j.1365-2672.2010.04852.x>
- Wolf, P.L., Von der Muehl, E., Praisler, K., 1973. A Test for Bacterial Alkaline Phosphatase: Use in Rapid Identification of *Serratia* Organisms. *Clin. Chem.* 19, 1248–1249. <https://doi.org/10.1093/clinchem/19.11.1248>
- Yadav, S., Shrivastava, K., Bajpai, P.K., 2019. Role of precursors in controlling the size, shape and morphology in the synthesis of copper sulfide nanoparticles and their application for fluorescence detection. *J. Alloys Compd.* 772, 579–592. <https://doi.org/10.1016/j.jallcom.2018.08.132>
- Zhai, L., Zhang, Z., Zhao, Y., Tang, Y., 2018. Efficient Antibacterial Performance and Effect of Structure on Property Based on Cationic Conjugated Polymers. *Macromolecules* 51, 7239–7247. <https://doi.org/10.1021/acs.macromol.8b01530>
- Zhan, S., Yang, Y., Shen, Z., Shan, J., Li, Y., Yang, S., Zhu, D., 2014. Efficient



UNIVERSITAS
GADJAH MADA

SINTESIS DAN KARAKTERISASI SIFAT KIMIAWI DAN FISIS COPPER NANOPARTICLES (CuNPs)

DARI PREKURSOR

Cu(NO₃)₂ SEBAGAI ZAT ANTIBAKTERI

AINUL FITRIA M, Dr. Yekti Asih Purwestri. S. Si., M. Si.; Yuni Kusumastuti, S.T., M.Eng., D.Eng.

Universitas Gadjah Mada, 2022 | Diunduh dari <http://etd.repository.ugm.ac.id/>

removal of pathogenic bacteria and viruses by multifunctional amine-modified magnetic nanoparticles. *J. Hazard. Mater.* 274, 115–123.
<https://doi.org/10.1016/j.hazmat.2014.03.067>