

DAFTAR PUSTAKA

- Abbasi-Kesbi, F., Rashidi, A.M., and Astinchap, B., 2018, Preparation of Ultrafine Grained Copper Nanoparticles Via Immersion Deposit Method, *Appl. Nanosci.*, 8(3), 221–230.
- Abdulrahman, A.F., Ahmed, S.M., Hamad, S.M., Almessiere, M.A., Ahmed, N.M. and Sajadi, S.M., 2021, Effect of different pH values on growth solutions for the ZnO nanostructures, *Chin. J. Phys.*, 71, 175–189.
- Abuzeid, H.M., Julien, C.M., Zhu, L. and Hashem, A.M., 2023, Green synthesis of nanoparticles and their energy storage, environmental, and biomedical applications, *Crystals*, 13, 1576.
- Afshar, M., Rezaei, A., Eghbali, S., Nasirizadeh, S., Alemzadeh, E., Alemzadeh, E., Shadi, M. and Sedighi, M., 2024, Nanomaterial strategies in wound healing: A comprehensive review of nanoparticles, nanofibres and nanosheets, *Int. Wound J.*, 21(7), 2505–2524.
- Ahmadi, M., Elikaei, A. and Ghadam, P., 2023, Antiviral activity of biosynthesized copper nanoparticle by *Juglans regia* green husk aqueous extract and iron nanoparticle: molecular docking and in-vitro studies, *J. Appl. Biotechnol. Rep.*, 15(1), 138–148.
- Ahmed, S., Annu, Chaudhry, S.A. and Ikram, S., 2017, A review on biogenic synthesis of ZnO nanoparticles using plant extracts and microbes: A prospect towards green chemistry, *J. Photochem. Photobiol. B*, 166, 272–284.
- Al-Hakkani, M.F., 2020, Biogenic copper nanoparticles and their applications: A review, *SN Appl. Sci.*, 2(3), 1–20.
- Alam, A.N., Bintari, S.H. dan Mubarak, I. (2017). Penentuan konsentrasi minimum ekstrak daun anting-anting (*Acalypha indica* L.) sebagai antibakteri pada *Staphylococcus aureus*. *Life Science.*, 6(1), pp.34–39
- Aruan, N.M., Sriyanti, I., Edikreshna, D., Suciati, T., Munir, M.M. and Khairurrijal, 2017, Polyvinyl alcohol/soursop leaves extract composite nanofibers synthesized using electrospinning technique and their potential as antibacterial wound dressing, *Procedia Eng.*, 170, 31–35.
- Babayevska, N., Przysiecka, Ł., Iatsunskyi, I., Nowaczyk, G., Jarek, M., Janiszewska, E. and Jurga, S., 2022, ‘ZnO size and shape effect on antibacterial activity and cytotoxicity profile’, *Scientific Reports*, 12(814), 1–13.
- Balouiri, M., Sadiki, M. and Ibsouda, S.K., 2016, Methods for *in vitro* evaluating antimicrobial activity: A review, *J. Pharm. Anal.*, 6, 71–79.
- Bucataru, A., Balasoiu, M., Ghenea, A.E., Zlatian, O.M., Vulcanescu, D.D., Horhat, F.G., Bagiu, I.C., Sorop, V.B., Sorop, M.I., Oprisoni, A., Boeriu, E.

- and Mogoanta, S.S., 2024, Factors contributing to surgical site infections: A comprehensive systematic review of etiology and risk factors, *Clin. Pract.*, 14(1), 52–68.
- Catauro, M., Papale, F., Bollino, F., Piccolella, S., Marciano, S., Nocera, P. and Paci, S., 2015, Silica/quercetin sol–gel hybrids as antioxidant dental implant materials, *Sci. Technol. Adv. Mater.*, 16, 035001.
- Chan, Y.B., Aminuzzaman, M., Rahman, M.K., Win, Y.F., Sultana, S., Cheah, S.Y., Watanabe, A., Wong, L.S., Guha, S.K., Djearamane, S., Rajendran, V., Akhtaruzzaman, M. and Tey, L.H., 2024, Green synthesis of ZnO nanoparticles using the mangosteen (*Garcinia mangostana* L.) leaf extract: Comparative preliminary in vitro antibacterial study, *Green Process. Synth.*, 13(1), 1–12.
- Chen, S., Li, A., Wang, Y.P., Zhang, Y., Liu, X., Ye, Z., Gao, S., Xu, H., Deng, L., Dong, A. and Zhang, J., 2023, ‘Janus polyurethane sponge as an antibiofouling, antibacterial, and exudate-managing dressing for accelerated wound healing’, *Acta Biomaterialia*, 171, 428–439.
- Cotton, G.C., Lagesse, N.R., Parke, L.S. and Meledandri, C.J., 2019, *Antibacterial nanoparticles in Comprehensive Nanoscience and Nanotechnology*, 2nd Ed., Elsevier, New Zealand.
- Ebrahimzadeh, F., and Fung, K.Z., 2016, One-Pot Synthesis of Size and Shape Controlled Copper Nanostructures in Aqueous Media and Their Application for Fast Catalytic Degradation of Organic Dyes, *J. Chem. Res.*, 40(9), 552–557.
- Elkamel, I., Hamdaoui, N., Mezni, A., Ajjel, R. and Beji, L., 2019, Synthesis and characterization of Cu doped ZnO nanoparticles for stable and fast response UV photodetector at low noise current, *J. Mater. Sci.: Mater. Electron.*, 30, 9444–9454.
- Ezealisiji, K.M., Siwe-Noundou, X., Maduelosi, B., Nwachukwu, N. and Krause, R.W.M., 2019, Green synthesis of zinc oxide nanoparticles using *Solanum torvum* (L) leaf extract and evaluation of the toxicological profile of the ZnO nanoparticles–hydrogel composite in Wistar albino rats, *Int. Nano Lett.*, 9, 99–107.
- Fakhari, S., Jamzad, M. and Kabiri Fard, H., 2019, Green synthesis of zinc oxide nanoparticles: a comparison, *Green Chem. Lett. Rev.*, 12(1), 19–24.
- Falaro, T.F. and Tesfaye, S., 2020, Antibacterial efficacy of *Aloe vera*, *Psidium guajava* and their combined leaf extracts against *Staphylococcus aureus* and *Escherichia coli* isolated from mastitic dairy cows: An in-vitro study, *Egypt. J. Biol. Sci.*, 16(1), 1–9.
- Geioushy, R.A., El-Sherbiny, S., and Mohamed, E.T., 2024, Mechanical characteristics and antibacterial activity against *Staphylococcus aureus* of

- sustainable cellulosic paper coated with Ag and Cu modified ZnO nanoparticles, *Sci. Rep.*, 14, 29722.
- Guan, R., Li, J., Zhang, J., Zhao, Z., Wang, D., Zhai, H. and Sun, D., 2019, Photocatalytic performance and mechanistic research of ZnO/g-C₃N₄ on degradation of methyl orange, *ACS Omega*, 4(24), 20742–20747.
- Gudkov, S.V., Burmistrov, D.E., Serov, D.A., Rebezov, M.B., Semenova, A.A. and Lisitsyn, A.B., 2021, A mini review of antibacterial properties of ZnO nanoparticles, *Front. Phys.*, 9, 641481.
- Hamdan, S., Pastar, I., Drakulich, S., Dikici, E., Tomic-Canic, M., Deo, S. and Daunert, S., 2017, Nanotechnology-driven therapeutic interventions in wound healing: Potential uses and applications, *ACS Cent. Sci.*, 3, 163–175.
- Handayani, W., Ningrum, A.S., and Imawan, C., 2020, The role of pH in synthesis silver nanoparticles using *Pometia pinnata* (Matoa) leaves extract as bioreduktor, *J. Phys.: Conf. Ser.*, 1428, 012021.
- Hasanin, M., 2022, Antimicrobial and antiviral activities of durable cotton fabrics treated with nanocomposite based on zinc oxide nanoparticles, acyclovir, nanochitosan, and clove oil, *Apl Biochem Biotechnol.*, 194(2), 783-800.
- Hemmami, H., Chandran, D., Ben Amor, I., Zeghoud, S., Mohankumar, P. and Bin Emran, T., 2023, ZnO nanotherapeutics for the treatment of burn wounds: Recent advances: Correspondence, *Ann. Med. Surg.*, 85(5), 2261–2263.
- Ijaz, M., Zafar, M., Islam, A., Afsheen, S. and Iqbal, T., 2020, A review on antibacterial properties of biologically synthesized zinc oxide nanostructures, *J. Inorg. Organomet. Polym. Mater.*, 30(8), 2815–2826.
- Islam, M.J., Khatun, N., Bhuiyan, R.H., Sultana, S., Ali Shaikh, M.A., Amin Bitu, M.N., Chowdhury, F. and Islam, S., 2023, '*Psidium guajava* leaf extract mediated green synthesis of silver nanoparticles and its application in antibacterial coatings', *RSC Advances*, 13(28), 19164–19172.
- Izadiyan, Z., Shameli, K., Miyake, M., Hara, H., Mohamad, S.E.B., Kalantari, K., Taib, S.H.M. and Rasouli, E., 2020, Cytotoxicity assay of plant-mediated synthesized iron oxide nanoparticles using *Juglans regia* green husk extract, *Arab. J. Chem.*, 13, 2011–2023.
- Jayasimha, H.N., Chandrappa, K.G., Sanaulla, P.F., Dileepkumar, V.G., Nakaramontri, Y. and Pruthviraj, R.D., 2024, Synergistic effect of Cu doped ZnO nanoparticles for enhanced electrochemical sensor and photocatalytic activity, *Results Surf. Interfaces*, 17(2024), 1–10.
- Joe, A., Park, S.H., Shim, K.D., Kim, D.J., Jhee, K.H., Lee, H.W., Heo, C.H., Kim, H.M. and Jang, E.S., 2017, Antibacterial mechanism of ZnO nanoparticles under dark conditions, *J. Ind. Eng. Chem.*, 45, 430–439.

- Jubu, P.R., Yam, F.K., Igba, V.M. and Beha, K.P., 2020, Tauc-plot scale and extrapolation effect on bandgap estimation from UV-vis-NIR data – A case study of β -Ga₂O₃, *J. Solid State Chem.*, 290, 121576.
- Kachare, K., Shendage, S., Matwal, S., Walvekar, M., Vhanbatte, S., Chang, J.-Y. and Ghule, A., 2024, Bio-mediated synthesized zinc oxide coated on cotton fabric for antibacterial and wound healing application. *Surf. Coat. Technol.*, 491, 131171.
- Kale, G., Arbuji, S., Kawade, U., Kadam, S., Nikam, L. and Kale, B., 2019, Paper templated synthesis of nanostructure Cu-ZnO and its enhanced photocatalytic activity under sunlight, *J. Mater. Sci. Mater. Electron.*, 30, 7031–7042.
- Kanha, P. and Saengkwamsawang, P., 2022, Effect of stirring time on morphology and crystalline features of MnO₂ nanoparticles synthesized by co-precipitation method, *Inorg. Nano-Metal Chem.*, 47(8), 1129–1133.
- Kayani, Z.N., Iram, S., Rafi, R., Riaz, S. and Naseem, S., 2018, Effect of Cu doping on the structural, magnetic and optical properties of ZnO thin films, *Appl. Phys. A*, 124, 468.
- Kemala, P., Idroes, R., Khairan, K., Ramli, M., Ginting, B., Helwani, Z., Aulia, R., Idroes, G.M. and Yusuf, M., 2025, Eco-friendly synthesis of silver nanoparticles: Enhancing optimization reaction, characterization, and antimicrobial properties with *Lantana camara* from geothermal area, *S. Afr. J. Chem. Eng.*, 51, 57–67.
- Khalid A., Ahmad P., Alharthi A.I, Muhammad S., Khandaker M.U., and Faruque M.R.I., 2021 Synergistic effects of Cu-doped ZnO nanoantibiotic against Gram-positive bacterial strains. *PLoS ONE*, 16(5): e0251082.
- Khanal, L.N., K.R. Sharma, H. Paudyal and K. Parajuli, 2022. Nanoparticle Properties and Their Applications: A Comprehensive Review. *J. Nanomater.*, 2022(1), 1–11.
- Klein, S.E., Alzagameem, A., Rumpf, J., Korte, I., Kreyenschmidt, J. and Schulze, M., 2019, Antimicrobial activity of lignin-derived polyurethane coatings prepared from unmodified and demethylated lignins, *Coatings*, 9, 494.
- Kuriakose, S., Satpati, B. and Mohapatra, S., 2014, Facile synthesis of Ag-ZnO hybrid nanospindles for highly efficient photocatalytic degradation of methyl orange. *Phys. Chem.*, 16(31), 17560–17568.
- Kushwaha, A., Goswami, L. and Kim, B.S., 2022, *Nanomaterial-Based Therapy for Wound Healing*, *Nanomaterials*, 12(4).
- Kumar, M., Tomar, M., Amarowicz, R., Saurabh, V., Sneha Nair, M., Maheshwari, C., Sasi, M., Prajapati, U., Hasan, M., Singh, S., Changan, S., Prajapat, R. K., Berwal, M. K., and Satankar, V., 2021, Guava (*Psidium guajava* L.) leaves: Nutritional composition, phytochemical profile, and health-promoting bioactivities, *Foods.*, 10(4).

- Li, J., Guan, R., Zhang, J., Zhao, Z., Zhai, H., Sun, D. and Qi, Y., 2020, Preparation and photocatalytic performance of dumbbell Ag₂CO₃-ZnO heterojunctions, *ACS Omega*, 5(1), 570–577.
- Li, K., Zhong, W., Li, P., Ren, J., Jiang, K. and Wu, W., 2023, Antibacterial mechanism of lignin and lignin-based antimicrobial materials in different fields, *Int. J. Biol. Macromol.*, 252, 126281.
- Ma, X., Zhou, S., Xu, X., dan Du, Q., 2022, Copper-containing nanoparticles: Mechanism of antimicrobial effect and application in dentistry - A narrative review. *Front. Surg.*, 9, 905892.
- Mahmood, A., Khan, M.I., Khan, S.A., Sadiq, A., Khalid, A. and Khurshid, U., 2024, Green synthesis of ZnO and Cu-doped ZnO nanoparticles using *Aloe vera* gel and investigation of their structural, photocatalytic, and antibacterial properties, *J. Mater. Res. Technol.*, 29, 2236–2249.
- Manzoor, U., Siddique, S., Ahmed, R., Noreen, Z., Bokhari, H. and Ahmad, I., 2016, Antibacterial, structural and optical characterization of mechano-chemically prepared ZnO nanoparticles, *PLoS ONE*, 11(5), 154704.
- Merkl, P., Long, S., McInerney, G.M. and Sotiriou, G.A., 2021, ‘Antiviral activity of silver, copper oxide and zinc oxide nanoparticle coatings against sars-cov-2’, *Nanomaterials*, 11(1312).
- Mirza, S., Hussaini, A.A., Öztürk, G., Turgut, M., Öztürk, T., Tugay, O., Ulukuş, D. and Yıldırım, M., 2023, Photocatalytic and antibacterial activities of ZnO nanoparticles synthesized from *Lupinus albus* and *Lupinus pilosus* plant extracts via green synthesis approach, *Inorg. Chem. Commun.*, 155, 110595.
- Mirzaei, H. and Darroudi, M., 2017, Zinc oxide nanoparticles: Biological synthesis and biomedical applications, *Ceramics International*, 43(1), 907–914.
- Mohamed, M. V., Ahamed, A. J., Thakur, A., Ahamed, F. M. M., and Kumar, A., 2024, Facile Green Synthesis of Undoped ZnO and Copper-Doped Zinc Oxide Nanoparticles using *Albizia lebbek* leaf extract: Electrochemical Insights and Anti-Corrosion Potential. *J. Bio-Tribo-Corros.* 10(4).
- Morais-Braga, M.F.B., Carneiro, J.N.P., Machado, A.J.T., dos Santos, A.T.L., Sales, D.L., Lima, L.F., Figueredo, F.G. and Coutinho, H.D.M., 2016, *Psidium guajava* L., from ethnobiology to scientific evaluation: Elucidating bioactivity against pathogenic microorganisms, *J. Ethnopharmacol.*, 194, 1140–1152.
- Naik, E.I., Naik, H.S.B., Swamy, B.E.K., Viswanath, R., Gowda, I.K.S., Prabhakara, M.C., and Chetankumar, K., 2021, Influence of Cu doping on ZnO nanoparticles for improved structural, optical, electrochemical properties and their applications in efficient detection of latent fingerprints. *Chem. Data Collect.*, 33, 100671.

- Naseer, S., Hussain, S., Naeem, N., Pervaiz, M. and Rahman, M., 2018, The phytochemistry and medicinal value of *Psidium guajava* (guava), *Clin. Phytosci.*, 4(1), 8.
- Niranjana, K., Dutta, S., Varghese, S., Ray, A.K. and Barshilia, H.C., 2017, Role of defects in one-step synthesis of Cu-doped ZnO nano-coatings by electrodeposition method with enhanced magnetic and electrical properties, *Appl. Phys. A*, 123, 250
- Novarini, E., dan Wahyudi, T., 2011, Sintesis Nanopartikel Seng Oksida (ZnO) Menggunakan Surfaktan Sebagai Stabilisator dan Aplikasinya Pada Pembuatan Tekstil Antibakteri, *Arena Tekstil*, 26(2), 81–87.
- Okeke, I., Agwu, K., Ubachukwu, A., Maaza, M. and Ezema, F., 2020, Impact of Cu doping on ZnO nanoparticles phyto-chemically synthesized for improved antibacterial and photocatalytic activities, *J. Nanopart. Res.*, 22(9), 1–12.
- Olajire, A.A., Ifediora, N.F., Bello, M.D. and Benson, N.U., 2018, Green Synthesis of Copper Nanoparticles Using *Alchornea laxiflora* Leaf Extract and Their Catalytic Application for Oxidative Desulphurization of Model Oil. *Iran. J. Sci. Technol. Trans. Sci.*, 42, 1935–1946.
- Ozdamar, M. and Gurkok, S., 2022, Recent advances in nanoparticles as antibacterial agent, *ADMET DMPK*, 10(2), 115–129.
- Pandian, M., Reshma, G., Arthi, C., Másson, M. and Rangasamy, J., 2023, Biodegradable polymeric scaffolds and hydrogels in the treatment of chronic and infectious wound healing, *Eur. Polym. J.*, 198, 112390.
- Pang, Q., Jiang, Z., Wu, K., Hou, R. and Zhu, Y., 2023, Nanomaterials-Based Wound Dressing for Advanced Management of Infected Wound, *Antibiotics*, 12(2).
- Pasaribu, F., Ervina, I., and Suryanto, D., 2018, The Effectiveness Antimicrobial Activity Test of Citrus Peel Extract on Some Periodontal Pathogenic Bacteria (*In vitro*), *Int. J. Appl. Decis.*, 4(3), 146–150.
- Pereira, G.A., Chaves, D.S. de A., Silva, T.M. e., Motta, R.E. de A., Silva, A.B.R. da, Patricio, T.C. da C., Fernandes, A.J.B., Coelho, S. de M. de O., Ożarowski, M., Cid, Y.P. and Karpiński, T.M., 2023, Antimicrobial activity of *Psidium guajava* aqueous extract against sensitive and resistant bacterial strains, *Microorganisms*, 11(7), 1712.
- Peres, M.L., Delucis, R.A., Amico, S.C. and Gatto, D.A., 2019, Zinc oxide nanoparticles from microwave-assisted solvothermal process: Photocatalytic performance and use for wood protection against *Xylophagous fungus*, *Nanomater. Nanotechnol.*, 9, 1–8.
- Poggio, C., Colombo, M., Arciola, C.R., Greggi, T., Scribante, A. and Dagna, A., 2020, Copper-alloy surfaces and cleaning regimens against the spread of SARS-CoV-2 in dentistry and orthopedics., *Materials.*, 13(15), 3260.

- Prakashan, D., Roberts, A. and Gandhi, S., 2023, Recent advancement of nanotherapeutics in accelerating chronic wound healing process for surgical wounds and diabetic ulcers, *Biotechnol. Genet. Eng. Rev.*, 39(1), 26–50.
- Pricop, A., Negrea, A., Pascu, B., Nemeş, N.S., Ciopec, M., Negrea, P., Ianăşi, C., Svera, P., Muntean, D., Ivan, A. and Cristea, I.M., 2025, Copper nanoparticles synthesized by chemical reduction with medical applications, *Int. J. Mol. Sci.*, 26(4), 1234.
- Rafee, V., Razaghizadeh, A., Nakhaei, R. and Hosini, R., 2025, Eco-friendly dye-sensitized solar cells: Green synthesis of ZnO nanoparticles using *Sargassum* algae and performance enhancement through optimized dye combinations, *Mater. Sci. Eng. B*, 317, 130000.
- Rafique, S., Bashir, S., Akram, R., Jawaid, S., Bashir, M., Aftab, A., Attique, A. and Awan, S.U., 2023, *In vitro* anticancer activity and comparative green synthesis of ZnO/Ag nanoparticles by *Moringa oleifera*, *Mentha piperita*, and *Citrus lemon*, *Ceram. Int.*, 49(4), 5613–5620.
- Raju, P., Deivatamil, D., Martin Mark, J.A. and Jesuraj, J.P., 2022, Antibacterial and catalytic activity of Cu doped ZnO nanoparticles: structural, optical, and morphological study, *J. Iran. Chem. Soc.*, 19(3), 861–872.
- Ramos-Zúñiga, J., Bruna, N. and Pérez-Donoso, J.M., 2023, Toxicity mechanisms of copper nanoparticles and copper surfaces on bacterial cells and viruses, *Int. J. Mol. Sci.*, 24(13), 1–15.
- Rauwel, P., Rauwel, E., Ferdov, S. and Singh, M.P., 2015, Silver nanoparticles: Synthesis, properties, and applications, *Adv. Mater. Sci. Eng.*, 2015, 624394.
- Rawiningtyas, S., 2022, Evaluasi antibakteri kain kasa termodifikasi Ag, kristalin TiO₂/Ag, dan kitosan/Ag dengan variasi urutan pelapisan terhadap aktivitas *Escherichia coli*, *Warta Akab*, 46(1), 8–15.
- Sabeni, A., Fahdiran, R. dan Sugihartono, I., 2022, Review metode pseudopotensial untuk analisis band gap semikonduktor, *Pros. Sem. Nas. Fis.*, 10
- Shaba, E.Y., Jacob, J.O., Tijani, J.O. and Suleiman, M.A.T., 2021, A critical review of synthesis parameters affecting the properties of zinc oxide nanoparticle and its application in wastewater treatment, *Appl. Water Sci.*, 11, 48.
- Siagian, S.M. dan Chrisna, S., 2021, Analisis semikonduktor ZnO-Cu terhadap efisiensi, *J. Elementer*, 7(2), 51–57.
- Singh, A., Wan, F., Yadav, K., Salvi, A., Thakur, P. and Thakur, A., 2023, Synergistic effect of ZnO nanoparticles with Cu²⁺ doping on antibacterial and photocatalytic activity, *Inorg. Chem. Commun.*, 157, 111425.
- Singh, K., Mishra, A., Sharma, D. and Singh, K., 2019, *Applications of Targeted Nano Drugs and Delivery Systems*, Elsevier, Amsterdam.

- Singh, P., Kim, Y.J., Zhang, D. and Yang, D.C., 2016, Biological synthesis of nanoparticles from plants and microorganisms, *Trends Biotechnol.*, 34(7), 588–599.
- Sirelkhatim, A., Mahmud, S., Seeni, A., Kaus, N.H.M., Ann, L.C., Bakhori, S.K.M., Hasan, H. and Mohamad, D., 2015, Review on zinc oxide nanoparticles: Antibacterial activity and toxicity mechanism, *Nano-Micro Lett.*, 7(3), 219–242.
- Sizar, O., Leslie, S.W. and Unakal, C.G., 2023, *Gram-positive Bacteria*, StatPearls Publishing, Finlandia.
- Somchaidee, P. and Tedsree, K., 2018, Green synthesis of high dispersion and narrow size distribution of zero-valent iron nanoparticles using guava leaf (*Psidium guajava L.*) extract. *Adv. Nat. Sci.: Nanosci. Nanotechnol.*, 9(3), 035006.
- Subha, P.P. and Jayaraj, M.K., 2019, Enhanced room temperature gas sensing properties of low temperature solution processed ZnO/CuO heterojunction, *BMC Chem.*, 13, 4.
- Thapa, M. and Choudhury, S.R., 2021, Green synthesized nanoparticles: Physicochemical properties and mode of antimicrobial activities, in *Compr. Anal. Chem.*, Elsevier, Amsterdam.
- Vasiliev, G., Kubo, A.L., Vija, H., Kahru, A., Bondar, D., Karpichev, Y. and Bondarenko, O., 2023, Synergistic antibacterial effect of copper and silver nanoparticles and their mechanism of action, *Sci. Rep.*, 9202 (2023).
- Vimbela, G.V., Ngo, S.M., Frazee, C., Yang, L. and Stout, D.A., 2017, Antibacterial properties and toxicity from metallic nanomaterials, *Int. J. Nanomedicine*, 12, 3941–3965.
- Wang, L., Wu, Y., Xie, J., Wu, S. and Wu, Z., 2018, Characterization, antioxidant and antimicrobial activities of green synthesized silver nanoparticles from *Psidium guajava L.* leaf aqueous extracts, *Mater. Sci. Eng. C*, 86, 1–8.
- Wang, Q., Li, Q., Zhu, L., Lin, C., Chen, Q. and Chen, H., 2024, Fabrication of Cu/ZnO-loaded chitosan hydrogel for an effective wound dressing material to advanced wound care and healing efficiency after caesarean section surgery, *Int. Wound J.*, 21, e14366.
- Wang, T., Guan, Q., Zhao, J., Mei, J., Shao, M., and Pan, Y., 2024, Amphipathic medical composite cotton gauze with unidirectional drainage and anti-adhesion properties for wound healing, *Cellulose*, 31(1), 942–952.
- Wang, Y., Li, H., Yuan, X., Jiang, Y., Xiao, Z. and Li, Z., 2022, Review of copper and copper alloys as immune and antibacterial elements, *Trans. Nonferrous Met. Soc. China*, 32, 3163–3181.

- Yudaev, P., Mezhuev, Y., and Chistyakov, E., 2022, Nanoparticle-Containing Wound Dressing: Antimicrobial and Healing Effects, *Gels*, 8(6).
- Yusof, N.A.A., Zain, N.M. and Pauzi, N., 2019, Synthesis of ZnO nanoparticles with chitosan as stabilizing agent and their antibacterial properties against Gram-positive and Gram-negative bacteria, *Int. J. Biol. Macromol.*, 124, 1132–1136.
- Zhang, D., Ma, X. L., Gu, Y., Huang, H. and Zhang, G. W., 2020, Green Synthesis of Metallic Nanoparticles and Their Potential Applications to Treat Cancer. *Front. Chem.*, 8.
- Zhao, X., Liang, Y., Huang, Y., He, J., Han, Y. and Guo, B., 2020, Physical double-network hydrogel adhesives with rapid shape adaptability, fast self-healing, antioxidant, and NIR/pH stimulus-responsiveness for multidrug-resistant bacterial infection and removable wound dressing, *Adv. Funct. Mater.*, 30(17), 2005952.
- Zhou, X.Q., Hayat, Z., Zhang, D.D., Li, M.Y., Hu, S., Wu, Q., Cao, Y.F. and Yuan, Y., 2023, Zinc oxide nanoparticles: Synthesis, characterization, modification, and applications in food and agriculture, *Processes*, 11(4), 1070.
- Zhu, X., 2016, Toxicity and bioaccumulation of nanoparticles in aquatic organisms, *Sci. Total Environ.*, 544, 48–55.