UNIVERSITAS
GADJAH MADA
Optimasi formula dan karakterisasi sediaan implan nanofiber vankomisin dengan matriks bovine hydroxyapatite (BHA) â€“ polylactic-co-glycolic acid (PLGA)
Teguh Imanto, Prof. Dr. apt. Teuku. Nanda. Saifullah Sulaiman, S.Si., M.Si. ; Dr. Nonni Soraya Sambudi, S.T., M.S. ;
Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

DAFTAR PUSTAKA

Abo-almaged, H.H., Eissa, S.I.S., El-Sherbiny, S.A., Amin, S.K., dan Khattab, R.M., 2025. Microstructure, Physical Properties, and Mechanical Behavior of Porous Hydroxyapatite Prepared by Various Advanced Casting Techniques. *Chemistry Africa*, .

Aisah, N., Effendi, M.D., Setiawan, J., Tenaga, B., dan Nasional, N., 2019. Synthesis and Characterizations of Hydroxyapatite from Bovine Bone Using Alkaline Hydrolysis Method.

Ajalloueian, F., Tavanai, H., Hilborn, J., Donzel-Gargand, O., Leifer, K., Wickham, A., dkk., 2014. Emulsion electrospinning as an approach to Fabricate PLGA/chitosan nanofibers for biomedical applications. *BioMed Research International*, **2014**: .

Al Haris, Ahmad Fadli, S.R.Y., 2016. Synthesis of Hydroxyapatite from Bovine Bone Waste Using the Precipitation Method with Variations in the Ca/P Ratio and H_3PO_4 Concentration. *JOM FTEKNIK*, **Volume 3 N**: .

Aldabib, J.M. dan Ishak, Z.A.M., 2020. Effect of hydroxyapatite filler concentration on mechanical properties of poly (methyl methacrylate) denture base. *SN Applied Sciences*, **2**: 1–14.

Alegrete, N., Sousa, S.R., Padrão, T., Carvalho, Â., Lucas, R., Canadas, R.F., dkk., 2023. Vancomycin-Loaded, Nanohydroxyapatite-Based Scaffold for Osteomyelitis Treatment: In Vivo Rabbit Toxicological Tests and In Vivo Efficacy Tests in a Sheep Model. *Bioengineering*, **10**: 1–19.

Alshaikh, R.A., Chullipalliyalil, K., Waeber, C., dan Ryan, K.B., 2024. Extended siponimod release via low-porosity PLGA fibres: a comprehensive three-month in vitro evaluation for neovascular ocular diseases. *Biomaterials Science*, **12**: 4823–4844.

Alvarado, C., Alfaro, A., Cisneros, M., dan Alvarado-Quintana, H., 2023. Preparation and Characterization of Hydroxyapatite Obtained from Bovine Bones. *Proceedings of the LACCEI international Multi-conference for Engineering, Education and Technology*, **2023-July**: 1–6.

AOAC International, 2002. Guidelines for Single Laboratory Validation of Chemical Methods for Dietary Supplements and Botanicals. *Gaithersburg, MD, USA*, .

Azadeh, S., 2017. Stability-Indicating Hplc Method for Determination Of Vancomycin Hydrochloride in The Pharmaceutical Dosage Forms **74**: 73–79.

Badaraev, A.D., Tran, T.H., Drozd, A.G., Plotnikov, E. V., Dubinenko, G.E., Kozelskaya, A.I., dkk., 2023. Effect of PLGA Concentration in Electrospinning Solution on Biocompatibility, Morphology and Mechanical Properties of Nonwoven Scaffolds. *Technologies*, **11**: .

UNIVERSITAS
GADJAH MADA
Optimasi formula dan karakterisasi sediaan implan nanofiber vankomisin dengan matriks bovine hydroxyapatite (BHA) â€“ polylactic-co-glycolic acid (PLGA)
Teguh Imanto, Prof. Dr. apt. Teuku. Nanda. Saifullah Sulaiman, S.Si., M.Si. ; Dr. Nonni Soraya Sambudi, S.T., M.S. ;
Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Bakhsheshi-Rad, H.R., Chen, X.B., Ismail, A.F., Aziz, M., Hamzah, E., dan Najafinezhad, A., 2019. A new multifunctional monticellite-ciprofloxacin scaffold: Preparation, bioactivity, biocompatibility, and antibacterial properties. *Materials Chemistry and Physics*, **222**: 118–131.

Baxter Healthcare Corporation, 2015. Vancomycin injection, USP, for intravenous use only, prescribing information.

Bee, S.L., Mariatti, M., Ahmad, N., Yahaya, B.H., dan Abdul Hamid, Z.A., 2019. Effect of the calcination temperature on the properties of natural hydroxyapatite derived from chicken bone wastes. *Materials Today: Proceedings*, **16**: 1876–1885.

Berbari, E.F., Kanj, S.S., Kowalski, T.J., Darouiche, R.O., Widmer, A.F., Schmitt, S.K., dkk., 2015. 2015 Infectious Diseases Society of America (IDSA) Clinical Practice Guidelines for the Diagnosis and Treatment of Native Vertebral Osteomyelitis in Adults a **61**: 26–46.

Berebichez-fridman, R., Montero-olvera, P., Gómez-garcía, R., dan Berebichez-fastlicht, E., 2017. An intramedullary nail coated with antibiotic and growth factor nanoparticles : An individualized state-of-the-art treatment for chronic osteomyelitis with bone defects. *Medical Hypotheses*, **105**: 63–68.

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

Bruniera, F.R., Ferreira, F.M., Saviolli, L.R.M., Bacci, M.R., Feder, D., Pedreira, M.D.L.G., dkk., 2015. The use of vancomycin with its therapeutic and adverse effects: A review. *European Review for Medical and Pharmacological Sciences*, **19**: 694–700.

Bulina, N. V., Makarova, S. V., Baev, S.G., Matvienko, A.A., Gerasimov, K.B., Logutenko, O.A., dkk., 2021. A study of thermal stability of hydroxyapatite. *Minerals*, **11**: 1–15.

Buzia, O.D., Dima, C., dan Dima, Ș T., 2015. Preparation and Characterization of Chitosan Microspheres for Vancomycin Delivery **63**: .

Cao, Z., Jiang, D., Yan, L., dan Wu, J., 2016. In vitro and in vivo osteogenic activity of the novel vancomycin-loaded bone-like hydroxyapatite / poly (amino acid) scaffold **30**: 1566–1577.

Caramella, C., Conti, B., Modena, T., Ferrari, F., Bonferoni, M.C., Genta, I., dkk., 2016. Journal of Drug Delivery Science and Technology Controlled delivery systems for tissue repair and regeneration. *Journal of Drug Delivery Science and Technology*, **32**: 206–228.

CeCe, R., Jining, L., Islam, M., Korvink, J.G., dan Sharma, B., 2024. An Overview of the Electrospinning of Polymeric Nanofibers for Biomedical Applications Related to Drug Delivery. *Advanced Engineering Materials*, **26**: .

UNIVERSITAS
GADJAH MADA
Optimasi formula dan karakterisasi sediaan implan nanofiber vankomisin dengan matriks bovine hydroxyapatite (BHA) â€“ polylactic-co-glycolic acid (PLGA)
Teguh Imanto, Prof. Dr. apt. Teuku. Nanda. Saifullah Sulaiman, S.Si., M.Si. ; Dr. Nonni Soraya Sambudi, S.T., M.S. ;
Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Che Hashim, N. dan Nordin, D., 2019. Nano-Hydroxyapatite Powder for Biomedical Implant Coating. *Materials Today: Proceedings*, **19**: 1562–1571.

Crawford Scientific, 2011. The Theory of HPLC: Chromatographic Parameters. *Crawford Scientific*, 23.

Danaei, M., Dehghankhold, M., Ataei, S., Hasanzadeh Davarani, F., Javanmard, R., Dokhani, A., dkk., 2018. Impact of particle size and polydispersity index on the clinical applications of lipidic nanocarrier systems. *Pharmaceutics*, **10**: 1–17.

Darestani-Farahani, M., Vasheghani-Farahani, E., Mobedi, H., dan Ganji, F., 2016. The effect of solvent composition on vancomycin hydrochloride and free base vancomycin release from in situ forming implants. *Polymers for Advanced Technologies*, **27**: 1653–1663.

Domalik-pyzik, P., Sterna, J., Bielecki, W., dan Bonecka, J., 2018. Biodegradable intramedullary nails reinforced with carbon and alginate fibers: I n vitro and in vivo biocompatibility.

Drugs, N.A., Lefnaoui, S., Zeghdaoui, A., Amrane, A., Jaouadi, B., dan Zhang, J., 2023. SS symmetry The Effect of the Stationary Phase on Resolution in the HPLC-Based Separation of Racemic Mixtures Using Vancomycin as a Chiral Selector : A Case Study with Profen.

Ekhtiari-Sadegh, S., Samani, S., Barneh, F., Dashtbin, S., Shokrgozar, M.A., dan Pooshang Bagheri, K., 2024. Rapid eradication of vancomycin and methicillin-resistant Staphylococcus aureus by MDP1 antimicrobial peptide coated on photocrosslinkable chitosan hydrogel: in vitro antibacterial and in silico molecular docking studies. *Frontiers in Bioengineering and Biotechnology*, **12**: 1–17.

El-Kady, A.M., Ahmed, M.M., Abd El-Hady, B.M., Ali, A.F., dan Ibrahim, A.M., 2019. Optimization of ciprofloxacin release kinetics of novel Nano-bioactive glasses: Effect of glass modifier content on drug loading and release mechanism. *Journal of Non-Crystalline Solids*, **521**: 119471.

Endriyatno, N.C., Wikantyasning, E.R., dan Indrayudha, P., 2023. Optimization Synthesis of Zinc Oxide Nanoparticles Using Factorial Design and Its Antibacterial Activity. *Rasayan Journal of Chemistry*, **16**: 773–778.

Farah, K., Syed, M.F.H., Madiha, M., Rabia, N., Sana, G., Iyad, N.M., dkk., 2020. Comparative analysis of biopharmaceutic classification system (BCS) based biowaiver protocols to validate equivalence of a multisource product. *African Journal of Pharmacy and Pharmacology*, **14**: 212–220.

Farjaminejad, S., Farjaminejad, R., Hasani, M., Garcia-Godoy, F., Abdouss, M., Marya, A., dkk., 2024. Advances and Challenges in Polymer-Based Scaffolds for Bone Tissue Engineering: A Path Towards Personalized Regenerative Medicine. *Polymers*, **16**: .

UNIVERSITAS
GADJAH MADA
Optimasi formula dan karakterisasi sediaan implan nanofiber vankomisin dengan matriks bovine hydroxyapatite (BHA) â€“ polylactic-co-glycolic acid (PLGA)
Teguh Imanto, Prof. Dr. apt. Teuku. Nanda. Saifullah Sulaiman, S.Si., M.Si. ; Dr. Nonni Soraya Sambudi, S.T., M.S. ;
Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Fathi, H.A., Abdelkader, A., AbdelKarim, M.S., Abdelaziz, A.A., El Mokhtar, M.A., Allam, A., dkk., 2020. Electrospun vancomycin-loaded nanofibers for management of methicillin-resistant Staphylococcus aureus-induced skin infections. *International Journal of Pharmaceutics*, **586**: 119620.

Fathi, M., Akbari, B., dan Taheriazam, A., 2019. Antibiotics drug release controlling and osteoblast adhesion from Titania nanotubes arrays using silk fibroin coating. *Materials science & engineering. C, Materials for biological applications*, **103**: 109743.

Figueiredo, M., Fernando, A., Martins, G., Freitas, J., Judas, F., dan Figueiredo, H., 2010. Effect of the calcination temperature on the composition and microstructure of hydroxyapatite derived from human and animal bone. *Ceramics International*, **36**: 2383–2393.

Gama e Silva, G.L., Sato de Souza Bustamante Monteiro, M., dos Santos Matos, A.P., Santos-Oliveira, R., Kenechukwu, F.C., dan Ricci-Júnior, E., 2022. Nanofibers in the treatment of osteomyelitis and bone regeneration. *Journal of Drug Delivery Science and Technology*, **67**: 102999.

Gazińska, M., Krokos, A., Kobielarz, M., Włodarczyk, M., Skibińska, P., Stępak, B., dkk., 2020. Influence of hydroxyapatite surface functionalization on thermal and biological properties of poly(L-lactide)-and poly(l-lactide-co-glycolide)-based composites. *International Journal of Molecular Sciences*, **21**: 1–21.

Gentile, P., Chiono, V., Carmagnola, I., dan Hatton, P. V, 2014. An Overview of Poly (lactic- co -glycolic) Acid (PLGA) -Based Biomaterials for Bone Tissue Engineering 3640–3659.

Geurts, J., Chris Arts, J.J., dan Walenkamp, G.H.I.M., 2011. Bone graft substitutes in active or suspected infection. Contra-indicated or not? *Injury*, **42**: S82–S86.

Gherdaoui, D., Yahoum, M.M., Toumi, S., Tahraoui, H., Bouazza, F., Lefnaoui, S., dkk., 2023. The Effect of the Stationary Phase on Resolution in the HPLC-Based Separation of Racemic Mixtures Using Vancomycin as a Chiral Selector: A Case Study with Profen Nonsteroidal Anti-Inflammatory Drugs. *Symmetry*, **15**: .

Govoni, 2020. Demineralized bone matrix paste formulated with biomimetic PLGA microcarriers for the vancomycin hydrochloride controlled delivery : Release pro fi le , citotoxicity and e ffi cacy against S . aureus **582**: .

Govoni, M., Lamparelli, E.P., Ciardulli, M.C., Santoro, A., Oliviero, A., Palazzo, I., dkk., 2020. Demineralized bone matrix paste formulated with biomimetic PLGA microcarriers for the vancomycin hydrochloride controlled delivery: Release profile, citotoxicity and efficacy against S. aureus. *International Journal of Pharmaceutics*, **582**: 119322.

Grigoraviciute-Puroniene, I., Zarkov, A., Tsuru, K., Ishikawa, K., dan Kareiva, A.,

UNIVERSITAS
GADJAH MADA
Optimasi formula dan karakterisasi sediaan implan nanofiber vankomisin dengan matriks bovine hydroxyapatite (BHA) â€“ polylactic-co-glycolic acid (PLGA)
Teguh Imanto, Prof. Dr. apt. Teuku. Nanda. Saifullah Sulaiman, S.Si., M.Si. ; Dr. Nonni Soraya Sambudi, S.T., M.S. ;
Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

2019. A novel synthetic approach for the calcium hydroxyapatite from the food products. *Journal of Sol-Gel Science and Technology*, **91**: 63–71.

Haider, A., Gupta, K.C., dan Kang, I.K., 2014. PLGA/nHA hybrid nanofiber scaffold as a nanocargo carrier of insulin for accelerating bone tissue regeneration. *Nanoscale Research Letters*, **9**: 1–12.

Haider, M.K., Kharaghani, D., Sun, L., Ullah, S., Sarwar, M.N., Ullah, A., dkk., 2023. Synthesized bioactive lignin nanoparticles/polycaprolactone nanofibers: A novel nanobiocomposite for bone tissue engineering. *Biomaterials Advances*, **144**: 213203.

Hassan, M., Abdelnabi, H.A., dan Mohsin, S., 2024. Harnessing the Potential of PLGA Nanoparticles for Enhanced Bone Regeneration. *Pharmaceutics*, **16**: .

Huang, C.L., Steele, T.W.J., Widjaja, E., Boey, F.Y.C., Venkatraman, S.S., dan Loo, J.S.C., 2013. The influence of additives in modulating drug delivery and degradation of PLGA thin films. *NPG Asia Materials*, **5**: 1–11.

Imanto, T., Sambudi, N.S., Zai, K., Nanda, T., dan Sulaiman, S., 2024. Advances in Antibiotic-Loaded Nanofibers for the Treatment of Bone Infections : **21**: 161–175.

International Council for Harmonisation, 2023. ICH Harmonised Guideline Q2(R2) : Validation of Analytical Procedures. *Geneva: ICH.*, .

Iqbal, H., Ali, M., Zeeshan, R., Mutahir, Z., Iqbal, F., Nawaz, M.A.H., dkk., 2017. Chitosan/hydroxyapatite (HA)/hydroxypropylmethyl cellulose (HPMC) spongy scaffolds-synthesis and evaluation as potential alveolar bone substitutes. *Colloids and surfaces. B, Biointerfaces*, **160**: 553–563.

Islam, S., Chin, B., Andri, A., Amalina, A., dan Afifi, M., 2019. A review on fabrication of nanofibers via electrospinning and their applications. *SN Applied Sciences*, **1**: 1–16.

Ito, T., Ohbuchi, A., Nakano, K., Sasai, T., dan Xue, Z., 2019. Simple measurement of the major elemental composition with SEM-EDX and its application to a geological survey. *Bunseki Kagaku*, **68**: 373–380.

Jadidi, A., Salahinejad, E., Sharifi, E., dan Tayebi, L., 2020. Drug-delivery Ca-Mg silicate scaffolds encapsulated in PLGA. *International Journal of Pharmaceutics*, **589**: 119855.

Jiang, C., Zhu, G., dan Liu, Q., 2024. Current application and future perspectives of antimicrobial degradable bone substitutes for chronic osteomyelitis. *Frontiers in Bioengineering and Biotechnology*, **12**: 1–19.

Jiang, N., Wang, B., Chai, Y., Wu, X., Tang, P., Zhang, Y., dkk., 2019. Chinese expert consensus on diagnosis and treatment of infection after fracture fixation. *Injury*, **50**: 1952–1958.

Juc, M., Fernanda, F., Tavares, A.A., Maciel, M.A., Lucena, B.D.M., dan Vin, M.,

UNIVERSITAS
GADJAH MADA
Optimasi formula dan karakterisasi sediaan implan nanofiber vankomisin dengan matriks bovine hydroxyapatite (BHA) â€“ polylactic-co-glycolic acid (PLGA)
Teguh Imanto, Prof. Dr. apt. Teuku. Nanda. Saifullah Sulaiman, S.Si., M.Si. ; Dr. Nonni Soraya Sambudi, S.T., M.S. ;
Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

2019. Physical and In Vitro Dexamethasone Release Properties of Chitosan / Hydroxyapatite Beads.

Kang, M., Kim, S., Kim, H., Song, Y., Jung, D., Kang, S., dkk., 2019. Calcium-Binding Polymer-Coated Poly (lactide- co -glycolide) Microparticles for Sustained Release of Quorum Sensing Inhibitors to Prevent Bio fi lm Formation on Hydroxyapatite Surfaces.

Kapoor, D.N., Kaur, R., Sharma, R., dan Dhawan, S., 2015. Therapeutic Delivery **6**: 41–58.

Kara, Y., He, H. and Molnár, K., 2020. J of Applied Polymer Sci - 2020 - Kara - Shear-aided high-throughput electrospinning A needleless method with enhanced jet.pdf.

Karbowniczek, J.E., Ura, D.P., dan Stachewicz, U., 2022. Nanoparticles distribution and agglomeration analysis in electrospun fiber based composites for desired mechanical performance of poly(3-hydroxybuty-rate-co-3-hydroxyvalerate (PHBV) scaffolds with hydroxyapatite (HA) and titanium dioxide (TiO2) towards me. *Composites Part B: Engineering*, **241**: 110011.

Kemenkes RI, 2020. *Farmakope Indonesia Edisi VI*.

Kemme, M. dan Heinzel-wieland, R., 2018. Quantitative Assessment of Antimicrobial Activity of PLGA Films Loaded with 4-Hexylresorcinol.

Khatib, M. El, Mauro, A., Di Mattia, M., Wyrwa, R., Schweder, M., Ancora, M., dkk., 2020. Electrospun PLGA fiber diameter and alignment of tendon biomimetic fleece potentiate tenogenic differentiation and immunomodulatory function of amniotic epithelial stem cells. *Cells*, **9**: 1–26.

Khaw, J.S., Xue, R., Cassidy, N.J., dan Cartmell, S.H., 2021. Electrical stimulation of titanium to promote stem cell orientation, elongation and osteogenesis. *Acta Biomaterialia*, .

Kim, H., Che, L., Ha, Y., dan Ryu, W., 2014. Mechanically-reinforced electrospun composite silk fibroin nanofibers containing hydroxyapatite nanoparticles. *Materials Science and Engineering C*, **40**: 324–335.

Kluin, O.S., Van Der Mei, H.C., Busscher, H.J., dan Neut, D., 2013. Biodegradable vs non-biodegradable antibiotic delivery devices in the treatment of osteomyelitis. *http://dx.doi.org/10.1517/17425247.2013.751371*, **10**: 341–351.

Kolmas, J., Krukowski, S., Laskus, A., dan Jurkitewicz, M., 2016. Synthetic hydroxyapatite in pharmaceutical applications. *Ceramics International*, **42**: 2472–2487.

Kose, N., Çaylak, R., Pekşen, C., Kiremitçi, A., Burukoglu, D., Koparal, S., dkk., 2016. Silver ion doped ceramic nano-powder coated nails prevent infection in open fractures: In vivo study. *Injury*, **47**: 320–324.

UNIVERSITAS
GADJAH MADA
Optimasi formula dan karakterisasi sediaan implan nanofiber vankomisin dengan matriks bovine hydroxyapatite (BHA) â€“ polylactic-co-glycolic acid (PLGA)
Teguh Imanto, Prof. Dr. apt. Teuku. Nanda. Saifullah Sulaiman, S.Si., M.Si. ; Dr. Nonni Soraya Sambudi, S.T., M.S. ;
Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Kumar, R. dan Mohanty, S., 2022. Hydroxyapatite: A Versatile Bioceramic for Tissue Engineering Application. *Journal of Inorganic and Organometallic Polymers and Materials*, **32**: 4461–4477.

Lao, L., Wang, Y., Zhu, Y., Zhang, Y., dan Gao, C., 2011. Poly(lactide-co-glycolide)/hydroxyapatite nanofibrous scaffolds fabricated by electrospinning for bone tissue engineering. *Journal of Materials Science: Materials in Medicine*, **22**: 1873–1884.

Leonardi, D., Barrera, M.G., Lamas, M.C., dan Salomón, C.J., 2007. Development of prednisone: Polyethylene glycol 6000 fast-release tablets from solid dispersions: Solid-state characterization, dissolution behavior, and formulation parameters. *AAPS PharmSciTech*, **8**: .

Li, D., Sun, H.H., Jiang, L., Zhang, K., Liu, W., Zhu, Y., dkk., 2014. Enhanced Biocompatibility of PLGA Nano fi bers with Gelatin / Nano- Hydroxyapatite Bone Biomimetics Incorporation.

Li, J.J.Y., Jian, T.F., dan Li, Z.X., 2012. Vancomycin-loaded nano-hydroxyapatite pellets to treat MRSA-induced chronic osteomyelitis with bone defect in rabbits 207–215.

Li, L., Lee, C., Cruz, D.F., Krovi, S.A., Hudgens, M.G., Cottrell, M.L., dkk., 2022. Reservoir-Style Polymeric Drug Delivery Systems: Empirical and Predictive Models for Implant Design. *Pharmaceuticals*, **15**: .

Li, L., Yu, M., Li, Y., Li, Q., Yang, H., Zheng, M., dkk., 2021. Synergistic anti-inflammatory and osteogenic n-HA/resveratrol/chitosan composite microspheres for osteoporotic bone regeneration. *Bioactive Materials*, **6**: 1255–1266.

Liu, H., Lu, J., Jiang, Q., Haapasalo, M., Qian, J., Tay, F.R., dkk., 2021. Biomaterial scaffolds for clinical procedures in endodontic regeneration. *Bioactive Materials*, .

Liu, K.S., Lee, C.H., Wang, Y.C., dan Liu, S.J., 2015. Sustained release of vancomycin from novel biodegradable nanofiber-loaded vascular prosthetic grafts: In vitro and in vivo study. *International Journal of Nanomedicine*, **10**: 885–891.

Mahmutoglu, G., Topsakal, A., Altan, E., Kuskonmaz, N., Daglilar, S., Oktar, F.N., dkk., 2023. Effects of temperature and pH on the synthesis of nanohydroxyapatite powders by chemical precipitation. *Journal of the Australian Ceramic Society*, **59**: 1433–1441.

Makadia, H.K. dan Siegel, S.J., 2011. Poly Lactic-co-Glycolic Acid (PLGA) as Biodegradable Controlled Drug Delivery Carrier. *Polymers*, **3**: 1377–1397.

Mardiyah, U., Nur, S., Jamil, A., Sandra, L., Studi, P., Hasil, T., dkk., 2022. Characterization of Microstructure and Elemental Composition of Pink Perch Head Gelatin (Nemipterus Bathybius) Using Scanning Electron Microscopy-

UNIVERSITAS
GADJAH MADA
Optimasi formula dan karakterisasi sediaan implan nanofiber vankomisin dengan matriks bovine hydroxyapatite (BHA) â€“ polylactic-co-glycolic acid (PLGA)
Teguh Imanto, Prof. Dr. apt. Teuku. Nanda. Saifullah Sulaiman, S.Si., M.Si. ; Dr. Nonni Soraya Sambudi, S.T., M.S. ;
Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Energy Dispersive X-Ray (Sem-Edx). *Journal of Fisheries and Marine Research Vol.6*, **Vol.6 No.2**: 19–25.

Mehdipour-ataei, S. dan Oroujzadeh, M., 2017. Membranes , Polymeric : Biomedical Devices.

Mills, D.K., Jammalamadaka, U., Tappa, K., dan Weisman, J., 2018. Studies on the cytocompatibility, mechanical and antimicrobial properties of 3D printed poly(methyl methacrylate) beads. *Bioactive Materials*, **3**: 157–166.

Mills, H., Donnelly, L., dan Platt, S., 2024. Locally Delivered Antibiotics in Fracture-Related Infection. *Cureus*, **16**: .

Mistry, S., Burman, S., Roy, S., Maitra, N.J., Roy, R., dan Chanda, A., 2022. Biological analysis of an innovative biodegradable antibiotic eluting bioactive glass/gypsum composite bone cement for treating experimental chronic MRSA osteomyelitis. *Journal of Pharmaceutical Analysis*, **12**: 164–177.

Mohd Pu'ad, N.A.S., Abdul Haq, R.H., Mohd Noh, H., Abdullah, H.Z., Idris, M.I., dan Lee, T.C., 2019a. Synthesis method of hydroxyapatite: A review. *Materials Today: Proceedings*, **29**: 233–239.

Mohd Pu'ad, N.A.S., Koshy, P., Abdullah, H.Z., Idris, M.I., dan Lee, T.C., 2019b. Syntheses of hydroxyapatite from natural sources. *Heliyon*, **5**: e01588.

Mondal, S., Mondal, B., Dey, A., dan Mukhopadhyay, S.S., 2012. Studies on Processing and Characterization of Hydroxyapatite Biomaterials from Different Bio Wastes. *Journal of Minerals and Materials Characterization and Engineering*, **11**: 55–67.

Montes-Hernandez, G. dan Renard, F., 2020. Nucleation of Brushite and Hydroxyapatite from Amorphous Calcium Phosphate Phases Revealed by Dynamic in Situ Raman Spectroscopy. *Journal of Physical Chemistry C*, **124**: 15302–15311.

Mormeneo Bayo, S., Ferrer Cerón, I., Martín Juste, P., Lallana Dupla, J., Millán Lou, M.I., dan García-Lechuz Moya, J.M., 2020. A review of difficult-to-treat post-traumatic osteomyelitis: Role of Clostridium celerecrescens. *Revista Española de Cirugía Ortopédica y Traumatología (English Edition)*, **64**: 281–285.

Moydeen, A.M., Ali Padusha, M.S., Aboelfetoh, E.F., Al-Deyab, S.S., dan El-Newehy, M.H., 2018. Fabrication of electrospun poly(vinyl alcohol)/dextran nanofibers via emulsion process as drug delivery system: Kinetics and in vitro release study. *International Journal of Biological Macromolecules*, **116**: 1250–1259.

Muthu, D., Suresh Kumar, G., Gowri, M., Prasath, M., Viswabaskaran, V., Kattimani, V.S., dkk., 2022. Rapid synthesis of eggshell derived hydroxyapatite with nanoscale characteristics for biomedical applications. *Ceramics International*, **48**: 1326–1339.

UNIVERSITAS
GADJAH MADA
Optimasi formula dan karakterisasi sediaan implan nanofiber vankomisin dengan matriks bovine hydroxyapatite (BHA) â€“ polylactic-co-glycolic acid (PLGA)
Teguh Imanto, Prof. Dr. apt. Teuku. Nanda. Saifullah Sulaiman, S.Si., M.Si. ; Dr. Nonni Soraya Sambudi, S.T., M.S. ;
Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Naik, K., Chandran, V.G., dan Rajashekaran, R., 2016. Mechanical properties , biological behaviour and drug release capability of nano TiO 2 -HAp-Alginate composite scaffolds for potential application as bone implant material **31**: 387–399.

Nazarnezhad, S., Baino, F., Kim, H.W., Webster, T.J., dan Kargozar, S., 2020. *Electrospun Nanofibers for Improved Angiogenesis: Promises for Tissue Engineering Applications*, Nanomaterials.

NCSS dan LLC, 1992. NCSS Statistical Software D-Optimal Designs 1–29.

Nuamsrinuan, N., Kaewwiset, W., Limsuwan, P., dan Naemchanthara, K., 2017. Hydroxyapatite Synthesized from Waste Eggshell via Ball Milling. *Applied Mechanics and Materials*, **866**: 12–16.

Nuruzzaman Khan, M., Islam, M.S., Islam, M.S., Biswas, S., Rashid, T.U., Mallik, A.K., dkk., 2017. *Biomimetic Gelatin Nanocomposite as a Scaffold for Bone Tissue Repair*, Handbook of Composites from Renewable Materials.

Odusote, J.K., Danyuo, Y., Baruwa, A.D., dan Azeez, A.A., 2019. Synthesis and characterization of hydroxyapatite from bovine bone for production of dental implants.

Omidian, H. dan Wilson, R.L., 2025. PLGA Implants for Controlled Drug Delivery and Regenerative Medicine: Advances, Challenges, and Clinical Potential. *Pharmaceuticals*, **18**: .

Ou, S.F., Chiou, S.Y., dan Ou, K.L., 2013. Phase transformation on hydroxyapatite decomposition. *Ceramics International*, **39**: 3809–3816.

Pai, S., Kini, M.S., dan Selvaraj, R., 2021. A review on adsorptive removal of dyes from wastewater by hydroxyapatite nanocomposites. *Environmental Science and Pollution Research*, **28**: .

Panda, R. dan Lankalapalli, S., 2023. Design of Experiments and Optimization of Amorphous Solid Dispersion of a Bcs Class Iv Anti-Platelet Drug Through Factorial Design. *International Journal of Applied Pharmaceutics*, **15**: 353–364.

Parahita, I.G.A.A., Simpen, I.N., dan Suastuti, N.G.A.M.D.A., 2016. Ekstraksi Dan Karakterisasi Hidroksiapatit Dari Limbah Kerajinan Tulang Sapi Menggunakan Metode Kombinasi Alkali Hidrotermal Dengan Dekomposisi Termal. *Jurnal Kimia*, **10**: 228–235.

Pereira, E.D., Cerruti, R., Fernandes, E., Peña, L., Saez, V., Pinto, J.C., dkk., 2016. Influence of PLGA and PLGA-PEG on the dissolution profile of oxaliplatin. *Polimeros*, **26**: 137–143.

Pérez-Solis, R., Gervacio-Arciniega, J.J., Joseph, B., Mendoza, M.E., dan Moreno, A., 2018. Synthesis and characterization of a monoclinic crystalline phase of hydroxyapatite by synchrotron X-ray powder diffraction and piezoresponse

UNIVERSITAS
GADJAH MADA
Optimasi formula dan karakterisasi sediaan implan nanofiber vankomisin dengan matriks bovine hydroxyapatite (BHA) â€“ polylactic-co-glycolic acid (PLGA)
Teguh Imanto, Prof. Dr. apt. Teuku. Nanda. Saifullah Sulaiman, S.Si., M.Si. ; Dr. Nonni Soraya Sambudi, S.T., M.S. ;
Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

force microscopy. *Crystals*, **8**

Persano, L., Camposeo, A., Tekmen, C., dan Pisignano, D., 2013. Industrial upscaling of electrospinning and applications of polymer nanofibers: A review. *Macromolecular Materials and Engineering*, **298**: 504–520.

Pirmoradian, A., Behshad, Y., Sharifi, F., Alipour, S., Jiang, L., dan Sabzi, M., 2023. Development of Antibiotic Releasing Electrospun Nanofibrous Mats Based on Gelatin. *Materials Chemistry Horizons*, **2023**: 185–193.

Placente, D., Benedini, L.A., Baldini, M., Laiuppa, J.A., Santillán, G.E., dan Messina, P. V, 2018. Multi-drug delivery system based on lipid membrane mimetic coated nano-hydroxyapatite formulations. *International Journal of Pharmaceutics*, **548**: 559–570.

Pohshna, C. dan Mailapalli, D.R., 2023. Characterization and Testing of Nanohydroxyapatite Synthesized from Eggshells as a Phosphorus Source for Rice Crops. *Journal of Soil Science and Plant Nutrition*, **23**: 4491–4504.

Pohshna, C., Mailapalli, D.R., dan Laha, T., 2020. *Synthesis of Nanofertilizers by Planetary Ball Milling*.

Qayoom, I., Teotia, A.K., Panjla, A., Verma, S., dan Kumar, A., 2020. Local and Sustained Delivery of Rifampicin from a Bioactive Ceramic Carrier Treats Bone Infection in Rat Tibia.

Qi, Q., Yao, Y., Jia, X., Meng, Y., Zhao, K., dan Jian, Y., 2019. Effects of polyethylene glycol content on the properties of a silk fibroin/nano-hydroxyapatite/polyethylene glycol electrospun scaffold. *RSC Advances*, **9**: 33941–33948.

Ramesh, S., Aw, K.L., Tolouei, R., Amiriyan, M., Tan, C.Y., Hamdi, M., dkk., 2013. Sintering properties of hydroxyapatite powders prepared using different methods. *Ceramics International*, **39**: 111–119.

Ramesh, S., Natasha, A.N., Tan, C.Y., Bang, L.T., Niakan, A., Purbolaksono, J., dkk., 2015. Characteristics and properties of hydoxyapatite derived by sol–gel and wet chemical precipitation methods. *Ceramics International*, **41**: 10434–10441.

Ramesh, S., Tan, C.Y., Tolouei, R., Amiriyan, M., Purbolaksono, J., Sopyan, I., dkk., 2012. Sintering behavior of hydroxyapatite prepared from different routes. *Materials & Design*, **34**: 148–154.

Rani, K.C., Imanto, T., Primaharinastiti, R., Hariyadi, D.M., dan Hendradi, E., 2019. The effect of composite composition ratio on the physicochemical characteristics of bovine hydroxyapatite-chitosan-ciprofloxacin implant. *Proceedings of the Pakistan Academy of Sciences: Part B*, **56**: .

Rivera, L.R., Cochis, A., Biser, S., Canciani, E., Ferraris, S., Rimondini, L., dkk., 2021. Antibacterial, pro-angiogenic and pro-osteointegrative zein-bioactive

UNIVERSITAS
GADJAH MADA
Optimasi formula dan karakterisasi sediaan implan nanofiber vankomisin dengan matriks bovine hydroxyapatite (BHA) â€“ polylactic-co-glycolic acid (PLGA)
Teguh Imanto, Prof. Dr. apt. Teuku. Nanda. Saifullah Sulaiman, S.Si., M.Si. ; Dr. Nonni Soraya Sambudi, S.T., M.S. ;
Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

glass/copper based coatings for implantable stainless steel aimed at bone healing. *Bioactive Materials*, **6**: 1479–1490.

Ross, C., Syed, B., Pak, J., Jhanji, V., Yamaki, J., dan Sharma, A., 2021. Stability evaluation of extemporaneously compounded vancomycin ophthalmic drops: Effect of solvents and storage conditions. *Pharmaceutics*, **13**: 1–8.

Rousselle, S.D., Ramot, Y., Nyska, A., dan Jackson, N.D., 2019. Pathology of Bioabsorbable Implants in Preclinical Studies **47**: 358–378.

Rujitanapanich, S., Kumpapan, P., dan Wanjanoi, P., 2014. Synthesis of hydroxyapatite from oyster shell via precipitation. *Energy Procedia*, **56**: 112–117.

Sanosh, K.P., Chu, M.C., Balakrishnan, A., Lee, Y.J., Kim, T.N., dan Cho, S.J., 2009. Synthesis of nano hydroxyapatite powder that simulate teeth particle morphology and composition. *Current Applied Physics*, **9**: 1459–1462.

Sari, M. dan Yusuf, Y., 2018. Synthesis and Characterization of Hydroxyapatite based on Green Mussel Shells (Perna viridis) with Calcination Temperature Variation Using the Precipitation Method **11**: 357–370.

Sarwar, H., Martin, R.A., Coleman, H.M., dan Courtenay, A., 2025. Antibiotic-Loaded Bioglass 45S5 for the Treatment and Prevention of Staphylococcus aureus Infections in Orthopaedic Surgery : A Novel Strategy Against Antimicrobial Resistance 1–25.

Serri, A., Moghimi, H.R., Mahboubi, A., dan Zarghi, A., 2017. Stability-indicating HPLC method for determination of vancomycin hydrochloride in the pharmaceutical dosage forms. *Acta Poloniae Pharmaceutica - Drug Research*, **74**: 73–79.

Sharma, S., Sudhakara, P., Singh, J., Ilyas, R.A., Asyraf, M.R.M., dan Razman, M.R., 2021. Critical Review of Biodegradable and Bioactive Polymer Composites for Bone Tissue Engineering and Drug.

Shi, C., Ye, J., Xu, R., Jin, W., Xu, S., Teng, F., dkk., 2021. Effect of the vancomycin minimum inhibitory concentration on clinical outcomes in patients with methicillin-susceptible Staphylococcus aureus bacteraemia: A systematic review and meta-analysis. *BMJ Open*, **11**: 1–10.

Shimada, K. dan Kobayashi, H., 1994. Vancomycin hydrochloride. *Japanese Journal of Antibiotics*, **47**: 341–348.

Shuai, C., Yang, B., Peng, S., dan Li, Z., 2013. Development of composite porous scaffolds based via selective laser sintering 51–57.

Siepmann, J. dan Siepmann, F., 2012. Modeling of diffusion controlled drug delivery. *Journal of Controlled Release*, **161**: 351–362.

Slyamova, G., Gusmanov, A., Batpenov, A., Kaliev, N., dan Viderman, D., 2022. Risk Factors for Postoperative Osteomyelitis among Patients after Bone

UNIVERSITAS
GADJAH MADA
Optimasi formula dan karakterisasi sediaan implan nanofiber vankomisin dengan matriks bovine hydroxyapatite (BHA) â€“ polylactic-co-glycolic acid (PLGA)
Teguh Imanto, Prof. Dr. apt. Teuku. Nanda. Saifullah Sulaiman, S.Si., M.Si. ; Dr. Nonni Soraya Sambudi, S.T., M.S. ;
Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Fracture: A Matched Case–Control Study. *Journal of Clinical Medicine*, **11**: .

Sotome, S., Ae, K., Okawa, A., dan Ishizuki, M., 2016. Ef fi cacy and safety of porous hydroxyapatite / type 1 collagen composite implantation for bone regeneration : A randomized controlled study. *Journal of Orthopaedic Science*, **21**: 373–380.

Sulistyani, M., 2018. Spektroskopi Fourier Transform Infra Red Metode Reflektansi (Atr-Ftir) Pada Optimasi Pengukuran Spektrum Vibrasi Vitamin C. *Jurnal TEMAPELA*, **1**: 39–43.

Sun, H., Liu, C., Li, X., Liu, H., Zhang, W., Yang, H., dkk., 2020. A novel calcium phosphate–based nanocomposite for the augmentation of cement-injectable cannulated pedicle screws fixation: A cadaver and biomechanical study. *Journal of Orthopaedic Translation*, **20**: 56–66.

Sun, H.W., Zhang, H., Zhen, Q., Wang, S.F., Hu, J.J., Cui, J.Q., dkk., 2022a. Large-scale preparation of polylactic acid/polyethylene glycol micro/nanofiber fabrics with aligned fibers via a post-drafting melt blown process. *Journal of Polymer Research*, **29**: .

Sun, H.W., Zhang, H., Zhen, Q., Wang, S.F., Jie, J., Jing, H., dkk., 2022b. Large - scale preparation of polylactic acid / polyethylene glycol micro / nanofiber fabrics with aligned fibers via a post - drafting melt blown process. *Journal of Polymer Research*, .

Tan, S.Y., Kok, A., Cheong, H., Yun, X., Soo, D., Liu, Z., dkk., 2024. Electrospun PEO / PEG fibers as potential flexible phase change materials for thermal energy regulation.

Tao, F., Ma, S., Tao, H., Jin, L., Luo, Y., Zheng, J., dkk., 2021. Chitosan-based drug delivery systems: From synthesis strategy to osteomyelitis treatment - A review. *Carbohydrate polymers*, **251**: 117063.

Thanh, N.H., Olekhnovich, R., Sitnikova, V., Kremleva, A., Snetkov, P., dan Uspenskaya, M., 2023. PHB/PEG Nanofiber Mat Obtained by Electrospinning and Their Performances. *Technologies*, **11**: .

Udomluck, N., Lee, H., Hong, S., Lee, S.-H., dan Park, H., 2020. Surface functionalization of dual growth factor on hydroxyapatite-coated nanofibers for bone tissue engineering. *Applied Surface Science*, **520**: 146311.

Unagolla, J.M. dan Jayasuriya, A.C., 2018. Drug transport mechanisms and in vitro release kinetics of vancomycin encapsulated chitosan-alginate polyelectrolyte microparticles as a controlled drug delivery system. *European Journal of Pharmaceutical Sciences*, **114**: 199–209.

Uyar, T., 2008. Electrospinning of uniform polystyrene fibers: The effect of solvent conductivity.

Wahaia, F., Kasalynas, I., Karaliunas, M., Urbanowicz, A., Seifert, B., Valusis, G.,

UNIVERSITAS
GADJAH MADA
Optimasi formula dan karakterisasi sediaan implan nanofiber vankomisin dengan matriks bovine hydroxyapatite (BHA) â€“ polylactic-co-glycolic acid (PLGA)
Teguh Imanto, Prof. Dr. apt. Teuku. Nanda. Saifullah Sulaiman, S.Si., M.Si. ; Dr. Nonni Soraya Sambudi, S.T., M.S. ;
Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

dkk., 2024. Effect of bone age and anatomy on the variability of the bovine bone by-product by Terahertz time-domain spectroscopy and energy-dispersive X-ray microanalysis. *Food Bioscience*, **59**: 103978.

Wang, J. dan Windbergs, M., 2018. Influence of polymer composition and drug loading procedure on dual drug release from PLGA:PEG electrospun fibers. *European Journal of Pharmaceutical Sciences*, **124**: 71–79.

Wang, J., Zhu, Y., Bawa, H.K., Ng, G., Wu, Y., Libera, M., dkk., 2011. with Antimicrobial Properties 67–73.

Wang, J.F., Jan, J.S., dan Hu, J.J., 2025. Heparin-Based Growth Factor Delivery Platforms: A Review. *Pharmaceutics*, **17**: 1–33.

Wang, T., Weng, Z., Liu, X., Yeung, K.W.K.K., Pan, H., dan Wu, S., 2017. Controlled release and biocompatibility of polymer/titania nanotube array system on titanium implants. *Bioactive Materials*, **2**: 44–50.

Wu, Y.H., Yu, D.G., Li, H.P., Wu, X.Y., dan Li, X.Y., 2017. Medicated structural PVP/PEG composites fabricated using coaxial electrospinning. *E-Polymers*, **17**: 39–44.

Xidaki, D., Agrafioti, P., Diomatari, D., Kaminari, A., Tsalavoutas-Psarras, E., Alexiou, P., dkk., 2018. Synthesis of hydroxyapatite, β-Tricalcium phosphate and biphasic calcium phosphate particles to act as local delivery carriers of curcumin: Loading, release and in vitro studies. *Materials*, **11**: .

Yang, J., Yao, J.L., Wu, Z.Q., Zeng, D.L., Zheng, L.Y., Chen, D., dkk., 2021. Current opinions on the mechanism, classification, imaging diagnosis and treatment of post-traumatic osteomyelitis. *Chinese Journal of Traumatology - English Edition*, **24**: 320–327.

Yang, J., Zeng, H., Luo, Y., Chen, Y., Wang, M., Wu, C., dkk., 2024. Recent Applications of PLGA in Drug Delivery Systems. *Polymers*, **16**: 1–25.

Yetri, Y., Ikhsan, Indra, A., Affi, J., dan Gunawarman, 2024. Extraction of hydroxyapatite from bovine bones: The manufacturing development and its behavior properties towards acrylic resin/hydroxyapatite/alumina composites. *Materials Chemistry and Physics*, **319**: 129244.

Zaki, M., Patil, S., Baviskar, D., dan Jain, D., 2012. Implantable Drug Delivery System: A Review. *International Journal of PharmTech Research*, **4**: .

Zapata, M.E.V., Tovar, C.D.G., dan Hernandez, J.H.M., 2020. The Role of Chitosan and Graphene Oxide in Bioactive and Antibacterial Properties of Acrylic Bone Cements. *Biomolecules*, **10**: .

Zhang, L., Wang, Z., Xiao, Y., Liu, P., Wang, S., Zhao, Y., dkk., 2018. Electrospun PEGylated PLGA nanofibers for drug encapsulation and release. *Materials Science and Engineering C*, **91**: 255–262.

Zhang, L., Yan, J., Yin, Z., Tang, C., Guo, Y., Li, D., dkk., 2014. Electrospun

UNIVERSITAS
GADJAH MADA
Optimasi formula dan karakterisasi sediaan implan nanofiber vankomisin dengan matriks bovine hydroxyapatite (BHA) â€“ polylactic-co-glycolic acid (PLGA)
Teguh Imanto, Prof. Dr. apt. Teuku. Nanda. Saifullah Sulaiman, S.Si., M.Si. ; Dr. Nonni Soraya Sambudi, S.T., M.S. ;
Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

vancomycin-loaded coating on titanium implants for the prevention of implant-associated infections. *International Journal of Nanomedicine*, **9**: 3027–3036.

Zhao, Y., Zhu, J., Zhang, J., Chen, Z., Li, W., Deng, L., dkk., 2018. Optimization of biodegradable PEG/PLGA nanofiber mats electrospinning process for anti-adhesion application. *Journal of Applied Polymer Science*, **135**: 1–10.

Zimmerli, W., 2015. Bone and joint infections: from microbiology to diagnostics and treatment., dalam: *Bone and Joint Infections: From Microbiology to Diagnostics and Treatment.* John Wiley & Sons Ltd.

Zou, Z., Wang, L., Zhou, Z., Sun, Q., Liu, D., Chen, Y., dkk., 2021. Simultaneous incorporation of PTH(1–34) and nano-hydroxyapatite into Chitosan/Alginate Hydrogels for efficient bone regeneration. *Bioactive Materials*, **6**: 1839–1851.

Zubieta-Otero, L.F., Gomez-Vazquez, O.M., Correa-Piña, B.A., dan Rodriguez-Garcia, M.E., 2023. Bio-inspired synthesis of bio-hydroxyapatite/synthetic hydroxyapatite hybrid nanosystems. *MedComm - Biomaterials and Applications*, **2**: 1–17.