

DAFTAR PUSTAKA

- Araujo, J. A., Cortese, Y. J., Mojicevic, M., Brennan Fournet, M., & Chen, Y. (2021). Composite Films of Thermoplastic Starch and CaCl_2 Extracted from Eggshells for Extending Food Shelf-Life. *Polysaccharides*, 2(3), 677–690. <https://doi.org/10.3390/polysaccharides2030041>
- Asri, N. P., & Handoyo, M. A. (2024). Kajian Tentang Food Loss Dan Food Waste: Kondisi, Dampak, Dan Solusinya. *Journal of Food Technology and Agroindustry*, 6(2), 82–89. <https://doi.org/https://doi.org/10.24929/jfta.v6i2.4014>
- Aurelia, S. Z., Rasyida, A., Anwar, I. F. L., Ardhyanta, H., Purniawan, A., Radityaningrum, A. D., & Fitri, M. A. (2025). Sustainable Utilization of Water Hyacinth for Cellulose Beads: Effect of Pretreatment Time on Morphology, Porosity, and Swelling Capacity. *Next Materials*, 9, 1–9. <https://doi.org/10.1016/j.nxmate.2025.101235>
- Aydogan, B., Taskin, M. B., & Gunes, A. (2023). Effect of Synthetic Nano-Calcium Borate as an Alternative Boron Fertilizer on the Growth and Boron Utilization of Sunflower Plant. *Communications in Soil Science and Plant Analysis*, 54(16), 2205–2214. <https://doi.org/10.1080/00103624.2023.2211619>
- Barrios, V. A. E., Rangel Méndez, J. R., Pérez Aguilar, N. V, Espinosa, G. A., & Dávila Rodríguez, J. L. (2012). FTIR-An Essential Characterization Technique for Polymeric Materials. *Materials Science, Engineering and Technology*, 1, 196–212. <https://doi.org/10.5772/36044>
- Buzea, C., Pacheco, I. I., & Robbie, K. (2007). Nanomaterials and Nanoparticles: Sources and Toxicity. *Biointerphases*, 2(4), MR17–MR71. <https://doi.org/10.1116/1.2815690>
- Cahya Fajrah, M., & Marfuah, N. (2014). *Identification of Calcium Carbonate (CaCO_3) Characteristics from Different Kinds of Poultry Eggshells Using X-Ray Diffraction (XRD) and Fourier Transformation Infra-Red (FTIR)*. <https://doi.org/https://doi.org/10.2991/icopia-14.2015.27>
- Chaiwarit, T., Chanabodeechalermrung, B., Kantrong, N., Chittasupho, C., & Jantrawut, P. (2022). Fabrication and Evaluation of Water Hyacinth Cellulose-

- Composited Hydrogel Containing Quercetin for Topical Antibacterial Applications. *Gels*, 8(12). <https://doi.org/10.3390/gels8120767>
- Erfani Haghiri, M., Saion, E., Soltani, N., Wan Abdullah, W. S., Navasery, M., & Hashim, M. (2013). Thermoluminescence Characteristics of Copper Activated Calcium Borate Nanocrystals (CaB₄O₇:Cu). *Journal of Luminescence*, 141, 177–183. <https://doi.org/10.1016/j.jlumin.2013.03.039>
- Erfani, M., Saion, E., Soltani, N., Hashim, M., Wan Abdullah, W. S. B., & Navasery, M. (2012). Facile Synthesis Of Calcium Borate Nanoparticles And The Annealing Effect On Their Structure And Size. *International Journal of Molecular Sciences*, 13(11), 14434–14445. <https://doi.org/10.3390/ijms131114434>
- Fajarah, F. (2018). Sintesis Nanopartikel dengan Prinsip Kimia Hijau. *Seminar Nasional Kimia dan Pembelajarannya*, 1, 24–32.
- Gashti, M. P., & Shokri, A. (2018). Hydrogel-Assisted Low-Temperature Synthesis of Calcium Borate Nanoparticles. *Journal of the Australian Ceramic Society*, 54(4), 601–607. <https://doi.org/10.1007/s41779-018-0188-1>
- Gian A, A., Farid, M., & A., H. (2017). Isolasi Selulosa dari Serat Tandan Kosong Kelapa Sawit untuk Nano Filler Komposit Absorpsi Suara: Analisis FTIR. *Jurnal Teknik ITS*, 6(2), 228–231. <https://doi.org/10.12962/j23373539.v6i2.24098>
- Haaren, C., De Bock, M., & Kazarian, S. G. (2023). Advances in ATR-FTIR Spectroscopic Imaging for the Analysis of Tablet Dissolution and Drug Release. *Molecules*, 28(12). <https://doi.org/10.3390/molecules28124705>
- Han, S., Liu, S., Wang, Y., Zhou, X., & Hao, L. (2012). Preparation, Characterization, and Tribological Evaluation of a Calcium Borate Embedded in an Oleic Acid Matrix. *Industrial and Engineering Chemistry Research*, 51(43), 13869–13874. <https://doi.org/10.1021/ie300940r>
- Javed, R., Zia, M., Naz, S., Aisida, S. O., Ain, N. ul, & Ao, Q. (2020). Role of Capping Agents in the Application of Nanoparticles in Biomedicine and Environmental Remediation: Recent Trends and Future Prospects. *Journal of Nanobiotechnology*, 18(1), 1–15. <https://doi.org/10.1186/s12951-020-00704-4>

- Jin, Z., Gao, J., Dong, T., Sun, Z., & Wang, X. (2025). Preparation and Characterization of Multifunctional Cellulose-Based Films Modified with Hyperbranched Polysiloxanes. *Industrial Crops and Products*, 236. <https://doi.org/10.1016/j.indcrop.2025.121888>
- Kawashima, Y., Yamamoto, H., Takeuchi, H., & Kuno, Y. (2000). Mucoadhesive dl-Lactide/Glycolide Copolymer Nanospheres Coated with Chitosan to Improve Oral Delivery of Elcatonin. *Pharmaceutical Development and Technology*, 5(1), 77–85. <https://doi.org/https://doi.org/10.1081/pdt-100100522>
- Khan, A., Hussain, S. T., Naeem, A., Sadiqa, A., Ahmad, A., Shehzada, M. A. A., & Albaqami, M. D. (2025). Next-Generation Calcium Oxide Nanoparticles: A Breakthrough In Energy Storage And Humidity Sensing. *Results in Chemistry*, 14. <https://doi.org/10.1016/j.rechem.2025.102073>
- Kumar Gupta, P., Raghunath, S. S., Prasanna, V., Venkat, P., Shree, V., Chithanathan, C., Choudhary, S., Surender, K., & Geetha, K. (2019). *An Update on Overview of Cellulose, Its Structure and Applications*. <https://doi.org/http://dx.doi.org/10.5772/intechopen.84727>
- Liu, Z., Li, Z., Zhao, X., Zhang, L., & Li, Q. (2018). Highly Efficient Flame Retardant Hybrid Composites Based on Calcium Alginate/Nano-Calcium Borate. *Polymers*, 10(6), 1–13. <https://doi.org/10.3390/polym10060625>
- Mariyam, M., Sunarintyas, S., Yuliatun, L., Khuzaimah, I., & Nuryono, N. (2025). Fabrication of Calcite Calcium Carbonate from Eggshells Biogenic Waste Through Carbonation Method. *Jurnal Kimia Valensi*, 11(1), 9–17. <https://doi.org/10.15408/jkv.v11i1.41914>
- Meier, S., Moore, F., Morales, A., González, M. E., Seguel, A., Meriño-Gergichevich, C., Rubilar, O., Cumming, J., Aponte, H., Alarcón, D., & Mejías, J. (2020). Synthesis of Calcium Borate Nanoparticles and its Use as a Potential Foliar Fertilizer in Lettuce (*Lactuca sativa*) and Zucchini (*Cucurbita pepo*). *Plant Physiology and Biochemistry*, 151, 673–680. <https://doi.org/10.1016/j.plaphy.2020.04.025>
- Muleta, W. S., Denboba, S. M., & Bayu, A. B. (2024). Corncob-Supported Calcium Oxide Nanoparticles from Hen Eggshells for Cadmium (Cd-II) Removal from

- Aqueous Solutions; Synthesis and Characterization. *Heliyon*, 10, e27767.
<https://doi.org/10.1016/j.heliyon.2024.e27767>
- Nurjayanti, D. Z., & Raharjo, D. (2012). Pemanfaatan Tepung Cangkang Telur Sebagai Substitusi Kapur Dan Kompos Keladi Terhadap Pertumbuhan Dan Hasil Cabai Merah Pada Tanah Aluvial Using Of Eggshell Powder As Substitution Of A Lime And A Compost Taro For Growth And Results Of Red Chili On Alluvial Soil. *Jurnal Sains Mahasiswa Pertanian*, 1(1), 16–21.
<https://doi.org/https://doi.org/10.26418/jspe.v1i1.489>
- Nurlaela, A., Dewi, S., & Dahlan, K. (2014). Pemanfaatan Limbah Cangkang Telur Ayam Dan Bebek Sebagai Sumber Kalsium Untuk Sintesis Mineral Tulang. *Pendidikan Fisika Indonesia*, 10(1), 81–85.
<https://doi.org/10.15294/jpfi.v10i1.3054>
- Oko, S., Harjanto, H., Kurniawan, A., & Winanti, C. (2022). Penurunan Kadar Zat Warna Remazol Brilliant Blue R Dengan Metode Adsorpsi Menggunakan Serbuk CaCO₃ Dari Cangkang Telur Dan Karbon Aktif. *METANA*, 18(1), 39–45.
<https://doi.org/10.14710/metana.v18i1.45766>
- Pandian, C. J., Palanivel, R., & Dhananasekaran, S. (2015). Green Synthesis of Nickel Nanoparticles using *Ocimum Sanctum* and Their Application in Dye and Pollutant Adsorption. *Chinese Journal of Chemical Engineering*, 23(8), 1307–1315. <https://doi.org/10.1016/j.cjche.2015.05.012>
- Patra, A. R., Pattnaik, A., & Ghosh, P. (2025). The Latest Breakthroughs in Green and Hybrid Nanoparticle Synthesis for Multifaceted Environmental Applications. *Journal of the Taiwan Institute of Chemical Engineers*.
<https://doi.org/10.1016/j.jtice.2025.106157>
- Pratama, J. H., Rohmah, R. L., Amalia, A., & Saraswati, T. E. (2019). Isolasi Mikroselulosa dari Limbah Eceng Gondok (*Eichornia crassipes*) dengan Metode Bleaching-Alkalinasi. *ALCHEMY Jurnal Penelitian Kimia*, 15(2), 239.
<https://doi.org/10.20961/alchemy.15.2.30862.239-250>
- Pratiwi, A. K., Majid, T. F., & Susilowati, T. (2024). Pemanfaatan Limbah Eceng Gondok Menjadi Selulosa Asetat Sebagai Bahan Pembuatan Filter Masker Dengan Metode Pelat Kaca Sederhana. *Jurnal Integrasi Proses*, 13(2), 92–98.
<https://doi.org/https://dx.doi.org/10.62870/jip.v13i2.27164>

- Rajpoot, Y., Sharma, V., Basak, S., & Ali, W. (2022). Calcium Borate Particles: Synthesis and Application on the Cotton Fabric as an Emerging Fire Retardant. *Journal of Natural Fibers*, 19(13), 5663–5675. <https://doi.org/10.1080/15440478.2021.1889431>
- Raturandang, R., Wenas, D. R., Mongan, S., & Bujung, C. (2022). Analisis Spektroskopi Ftir untuk Karakterisasi Kimia Fisik Fluida Mata Air Panas di Kawasan Wisata Hutan Pinus Tomohon Sulawesi Utara. 3(1), 28–33. <https://doi.org/10.53682/fista.v3i1.167>
- Rehman, N. U., Muhammad, G., Tuba, Sharif, M. U., & Hussain, M. A. (2024). Green Synthesis of Silver Nanoparticles using Lepidium Sativum Seed Mucilage as a Bioreductant/Capping Agent for Efficient Antibacterial and Photocatalytic Activities. *Desalination and Water Treatment*, 320. <https://doi.org/10.1016/j.dwt.2024.100853>
- Revathy, R., Joseph, J., Augustine, C., Sajini, T., & Mathew, B. (2022). Synthesis and Catalytic Applications of Silver Nanoparticles: a Sustainable Chemical Approach using Indigenous Reducing and Capping Agents from Hyptis Capitata. *Environmental Science: Advances*, 1(4), 491–505. <https://doi.org/10.1039/d2va00044j>
- Sahin, O., Yagcioglu, K. D., Kadioglu, Y. K., & Gunes, A. (2024). Evaluating Ecological Nano-Calcium from Eggshells: Effects on Calcium Nutrition and Oxidative Stress in Lettuce Under Saline and Boron Toxicity. *Journal of Plant Growth Regulation*, 43(12), 4416–4425. <https://doi.org/10.1007/s00344-024-11407-7>
- Samsuri, M., Gozan, M., Mardias, R., M. Baiquni, M., Hermansyah, H., Wijanarko, A., Prasetya, B., & Nasikin, M. (2010). Utilization of Bagasse Cellulose for Ethanol Production through Simultaneous Saccharification and Fermentation by Xylanase. *MAKARA of Technology Series*, 11(1), 17–24. <https://doi.org/10.7454/mst.v11i1.437>
- Sari, N. I., Syahrir, M., & Eka Pratiwi, D. (2022). Pengaruh Penambahan Filler Kitosan dan CaCO₃ Terhadap Karakteristik Bioplastik dari Umbi Gadung (*Dioscorea Hispida* Densst). *Chemica*, 23, 78–89. <https://doi.org/https://doi.org/10.35580/chemica.v23i1.33919>

- Sari, S. I. P. (2021). *Pemanfaatan Cangkang Telur sebagai Bahan Baku Komposit CaCO₃-Alginat untuk Adsorben Metil Jingga*.
- Schramm, C. (2020). High Temperature ATR-FTIR Characterization of the Interaction of Polycarboxylic Acids and Organotrialkoxysilanes with Cellulosic Material. *Spectrochimica Acta - Part A: Molecular and Biomolecular Spectroscopy*, 243. <https://doi.org/10.1016/j.saa.2020.118815>
- Senduk, T. W., Montolalu, L. A. D. Y., & Dotulong, V. (2020). The Rendement of Boiled Water Extract of Mature Leaves of Mangrove Sonneratia Alba. *Jurnal Perikanan dan Kelautan Tropis*, 11, 9–15. <https://doi.org/https://doi.org/10.35800/jpkt.11.1.2020.28659>
- Siagian, V. J. (2022). *Outlook Komoditas Peternakan Telur Ayam Ras Petelur* (A. A. Susanti & R. K. Putera, Ed.). Pusat Data dan Sistem Informasi Pertanian.
- Smitha, J. K., Bhaskar, S. P., Jose, A., & Geetha, T. (2024). Synthesis of Nano Calcium Borate Using Sugarcane Bagasse Extract As A Capping Agent And Its Potential To Promote Germination In Cowpea Seeds. *Results in Chemistry*, 10. <https://doi.org/10.1016/j.rechem.2024.101722>
- Strelec, I., Ostojčić, M., Brekalo, M., Hajra, S., Kim, H. J., Stanojević, J., Maravić, N., & Budžaki, S. (2023). Transformation of Eggshell Waste to Egg White Protein Solution, Calcium Chloride Dihydrate, and Eggshell Membrane Powder. *Green Processing and Synthesis*, 12(1), 1–14. <https://doi.org/10.1515/gps-2022-8151>
- Sunardi, S., Krismawati, E. D., & Mahayana, A. (2020). Sintesis dan Karakterisasi Nanokalsium Oksida dari Cangkang Telur. *ALCHEMY Jurnal Penelitian Kimia*, 16(2), 250. <https://doi.org/10.20961/alchemy.16.2.40527.250-259>
- Suwarda, R., & Syamsul Maarif, M. (2013). Pengembangan Inovasi Pengembangan Inovasi Teknologi Nanopartikel Berbasis Pat Untuk Menciptakan Produk yang Berdaya Saing. *Teknik Industri*, 13, 104–122. <https://doi.org/10.25105/jti.v3i2.1572>
- Teuku Muhammad Nur H. R. (2023). *Analisis Struktur Mikro Dan Sifat Erosi Substrat Grafit Terlapis Sic Menggunakan Metode Halide Activated Pack Cementation Untuk Aplikasi Nosel Roket*. UIN Hidayatullah Jakarta.

- Yang, C., Yang, X., Zhao, T., & Liu, F. (2021). An Indirect CO₂ Utilization for the Crystallization Control of CaCO₃ Using Alkylcarbonate. *Journal of CO₂ Utilization*, 45. <https://doi.org/10.1016/j.jcou.2021.101448>
- Yang, M., Fan, S., Huang, H., Zhang, Y., Huang, Z., Hu, H., & Liang, J. (2020). In-Situ Synthesis of Calcium Borate/Cellulose Acetate-Laurate Nanocomposite As Efficient Extreme Pressure and Anti-Wear Lubricant Additives. *International Journal of Biological Macromolecules*, 156, 280–288. <https://doi.org/10.1016/j.ijbiomac.2020.04.031>
- Yongqiang, L. (2012). Effect of Preparation Conditions of Calcium Borate Nanoparticles on Oil-Solubility. *Advanced Materials Research*, 549, 82–86. <https://doi.org/10.4028/www.scientific.net/AMR.549.82>
- Zhao, X., Zhai, D., Jell, G., Wu, C., Gao, H., & Jones, J. R. (2025). Borosilicate Bioactive Glass 3D Fibrous Matrices with Increased Borate Content Stimulate Healing Cascades in Chronic Wounds. *Acta Biomaterialia*, 202, 605–621. <https://doi.org/10.1016/j.actbio.2025.06.033>
- Zhong, Y., Li, J., Liu, H., & Wang, Y. (2025). Analysis of the Quality of Gastrodin Elata Blume with Different Processing Methods using a Combination of NIR, FTIR and Chemometrics. *Industrial Crops and Products*, 241. <https://doi.org/10.1016/j.indcrop.2026.122747>
- Zia, J., Shringi, A. K., & Riaz, U. (2025). Calcium Oxide Nanoparticles From Eggshell Waste: A Green Nanotechnological Strategy For Microwave-Assisted Environmental Clean Up. *Cleaner Chemical Engineering*, 11, 100182. <https://doi.org/10.1016/j.clce.2025.100182>