

DAFTAR PUSTAKA

- Abasalizadeh, F., Moghaddam, S. V., Alizadeh, E., Akbari, E., Kashani, E., Fazljou, S. M. B., & Khosh, M. H. M. (2020). Alginate-based hydrogels for biomedical applications: A review. *International Journal of Biological Macromolecules*, 162, 712-731. <https://doi.org/10.1016/j.ijbiomac.2020.06.211>
- Abd El-Hack, M. E., El-Saadony, M. T., Shafi, M. E., Zabermawi, N. M., Arif, M., Batiha, G. E., Khafaga, A. F., Abd El-Hakim, Y. M., & Al-Sagheer, A. A. (2020). Antimicrobial and antioxidant properties of chitosan and its derivatives and their applications: A review. *Dalam International Journal of Biological Macromolecules* (Vol. 164). <https://doi.org/10.1016/j.ijbiomac.2020.08.153>
- Aderibigbe, B. A., & Buyana, B. (2018). Alginate in wound dressings. *Pharmaceuticals*, 11(4), 78.
- Ahmed, S., & Ikram, S. (2016). Chitosan Based Scaffolds and Their Applications in Wound Healing. *Achievements in the Life Sciences*, 10(1). <https://doi.org/10.1016/j.als.2016.04.001>
- Arrieta, M. P., López, J., Ferrándiz, S., & Peltzer, M. A. (2014). Characterization of PLA-limonene blends for food packaging applications. *Polymer Testing*, 32(4), 760-768. <https://doi.org/10.1016/j.polymertesting.2013.12.01>
- Aydi, F., Albougami, R., Al-Salhi, O., & Ali, A. (2023). Sodium alginate: A green biopolymer resource-based for edible film applications. *International Journal of Biological Macromolecules*, 235, 124391. <https://doi.org/10.1016/j.ijbiomac.2023.124391>
- Bajpai, S. K., & Sharma, S. (2004). Investigation of *Swelling*/degradation behaviour of alginate beads crosslinked with Ca²⁺ and Ba²⁺ ions. *Reactive and Functional Polymers*, 59(2), 129-140. <https://doi.org/10.1016/j.reactfunctpolym.2004.01.002>
- Barboza, L. G. A., Vieira, L. R., Branco, V., Figueiredo, N., Carvalho, F., Carvalho, C., & Guilhermino, L. (2018). Microplastics cause neurotoxicity, oxidative damage and energy-related changes and interact with the bioaccumulation of mercury in the European seabass, *Dicentrarchus labrax* (Linnaeus, 1758). *Aquatic Toxicology*, 195. <https://doi.org/10.1016/j.aquatox.2017.12.008>
- Bercea, M. (2024). Recent advances in poly(vinyl alcohol)-based hydrogels. *Polymers*, 16(14), 2021. <https://doi.org/10.3390/polym16142021>

- Bhatia, A., Jawad, M., Khan, T. S., Shah, Y. A., Al-Harrasi, A., & Aydemir, L. Y. (2024). Development of STPP crosslinked alginate-chitosan biopolymer films for antioxidant food packaging. *Environmental Technology & Innovation*, 33, 103287. <https://doi.org/10.1016/j.eti.2023.103287>
- Bouزيد Rekik, S., Gassara, S., Bouaziz, J., Baklouti, S., & Deratani, A. (2023). Performance Enhancement of Kaolin/Chitosan Composite-Based Membranes by Cross-Linking with Sodium Tripolyphosphate: Preparation and Characterization. *Membranes*, 13(2), 229. <https://doi.org/10.3390/membranes13020229>
- Braccini, I., & Pérez, S. (2001). Molecular basis of Ca²⁺-induced gelation in alginates and pectins: The *egg-box* model revisited. *Biomacromolecules*, 2(4), 1089-1096.
- Brandrup, J., Immergut, E. H., & Grulke, E. A. (Eds.). (2004). *Polymer Handbook* (4th ed.). Wiley.
- Brettfeld, E.-G., Popa, D.-G., Somoghi, R., Nicolae, C. A., Birtas, A., Constantinescu-Aruxandei, D., & Oancea, F. (2023). The preparation and characterization of different types of eggshells acidified with acetic acid. *Chemistry Proceedings*, 13(1), 32. <https://doi.org/10.3390/chemproc2023013032>
- Budi, S., Suliasih, B. A., Rahmawati, I., & Erdawati. (2020). Size-controlled chitosan nanoparticles prepared using ionotropic gelation. *ScienceAsia*, 46(4), 457-461. <https://doi.org/10.2306/scienceasia1513-1874.2020.059>
- Caicedo, C., Díaz-Cruz, C. A., Jiménez-Regalado, E. J., & Aguirre-Loredo, R. Y. (2022). Effect of *plasticizer* content on mechanical and water vapor permeability of maize starch/PVOH/chitosan composite films. *Materials*, 15(4), 1274. <https://doi.org/10.3390/ma15041274>
- Calvo, P., Remuñán-López, C., Vila-Jato, J. L., & Alonso, M. J. (1997). Novel hydrophilic chitosan-polyethylene oxide nanoparticles as protein carriers. *Journal of Applied Polymer Science*, 63(1), 125-132. [https://doi.org/10.1002/\(SICI\)1097-4628\(19970103\)63:1<125::AID-APP13>3.0.CO;2-4](https://doi.org/10.1002/(SICI)1097-4628(19970103)63:1<125::AID-APP13>3.0.CO;2-4)
- Carvalho, F. A., Bilck, A. P., Yamashita, F., & Mali, S. (2019). Polyvinyl alcohol films with different degrees of hydrolysis and polymerization. *Semina: Ciências Exatas e Tecnológicas*, 40(2), 169-178.
- Chiellini, E., Corti, A., & Solaro, R. (1999). Biodegradation of poly(vinyl alcohol) based blown films under different environmental conditions. *International*

- Biodeterioration & Biodegradation, 43(2-3), 69-76.
[https://doi.org/10.1016/S0964-8305\(98\)00085-0](https://doi.org/10.1016/S0964-8305(98)00085-0)
- Cucina, M. (2023). The lesser of two evils: Enhancing *biodegradable* bioplastics use to fight plastic pollution requires policy makers interventions in Europe. *Environmental Impact Assessment Review*, 103.
<https://doi.org/10.1016/j.eiar.2023.107230>
- DanaitNabar, S., Gharat, K., & Singhal, R. S. (2025). Sodium tripolyphosphate is a nontoxic and economic alternative to glutaraldehyde for preparation of Lasparaginase CLEAs to reduce acrylamide in potato fries. *Food Chemistry*, 472, 142894.
- Dash, M., Chiellini, F., Ottenbrite, R. M., & Chiellini, E. (2011). Chitosan-A versatile semi-synthetic polymer in biomedical applications. *Progress in Polymer Science*, 36(8), 981-1014.
<https://doi.org/10.1016/j.progpolymsci.2011.02.001>
- Decher, G., & Schlenoff, J. B. (2012). *Multilayer thin films: Sequential assembly of nanocomposite materials: Second edition (Vol. 1-2)*.
<https://doi.org/10.1002/9783527646746>
- Draget, K. I., Smidsrød, O., & Skjåk-Bræk, G. (2006). Alginates from algae. In P. A. Williams (Ed.), *Polysaccharides and their derivatives* (pp. 1-30). The Royal Society of Chemistry. <https://doi.org/10.1039/9781847550124-00001>
- EFSA Panel on Food Additives and Nutrient Sources added to Food (ANS). (2019). Re-evaluation of phosphates as food additives. *EFSA Journal*, 17(6), 5674.
<https://doi.org/10.2903/j.efsa.2019.5674>
- Elsabee, M. Z., & Abdou, E. S. (2013). Chitosan based edible films and coatings: A review. *Dalam Materials Science and Engineering C (Vol. 33, Nomor 4)*.
<https://doi.org/10.1016/j.msec.2013.01.010>
- Eslami, Z., Elkoun, S., Robert, M., & Adjallé, K. (2023). A review of the effect of *plasticizer* s on the physical and mechanical properties of alginate-based films. *Molecules*, 28(18), 6637.
<https://doi.org/10.3390/molecules28186637>
- European Commission. (2011). Commission Regulation (EU) No 10/2011 on plastic materials and articles intended to come into contact with food.
- Fabra, M. J., Hambleton, A., Talens, P., Debeaufort, F., & Chiralt, A. (2010). Influence of interactions on water and aroma permeability of sodium caseinate-beeswax films. *Journal of Agricultural and Food Chemistry*, 58(10), 6354-6364. <https://doi.org/10.1021/jf9045046>

- FAO. (2019). The State of Food and Agriculture 2019. Moving forward on food loss and waste reduction. Rome. Licence: CC BY-NC-SA 3.0 IGO. The. Dalam Routledge Handbook of Religion and Ecology.
- Fu, Z.-Z., Guo, S.-J., Li, C.-X., Wang, K., Zhang, Q., & Fu, Q. (2022). Hydrogen-bond-dominated mechanical stretchability in PVA films: from phenomenological to numerical insights. *Physical Chemistry Chemical Physics*, 24(3), 1885-1895. <https://doi.org/10.1039/D1CP03893A>
- Gewert, B., Plassmann, M. M., & Macleod, M. (2015). Pathways for degradation of plastic polymers floating in the marine environment. Dalam *Environmental Sciences: Processes and Impacts* (Vol. 17, Nomor 9). <https://doi.org/10.1039/c5em00207a>
- Giz, A. S., Berberoglu, M., Bener, S., Aydelik-Ayazoglu, S., Bayraktar, H., Alaca, B. E., & Catalgil-Giz, H. (2020). A detailed investigation of the effect of calcium crosslinking and glycerol plasticizing on the physical properties of alginate films. *International Journal of Biological Macromolecules*, 148. <https://doi.org/10.1016/j.ijbiomac.2020.01.103>
- Gontard, N., Guilbert, S., & Cuq, J. L. (1994). Edible wheat gluten films: Influence of the main process variables on film properties using response surface methodology. *Journal of Food Science*, 59(3), 493-496. <https://doi.org/10.1111/j.1365-2621.1994.tb05553.x>
- Grant, G. T., Morris, E. R., Rees, D. A., Smith, P. J. C., & Thom, D. (1973). Biological interactions between polysaccharides and divalent cations: The *egg-box* model. *FEBS Letters*, 32(1), 195-198. [https://doi.org/10.1016/0014-5793\(73\)80518-4](https://doi.org/10.1016/0014-5793(73)80518-4)
- Grant, G. T., Morris, E. R., Rees, D. A., Smith, P. J. C., & Thom, D. (1973). Biological interactions between polysaccharides and divalent cations: The *egg-box* model. *FEBS Letters*, 32(1), 195-198. [https://doi.org/10.1016/0014-5793\(73\)80770-7](https://doi.org/10.1016/0014-5793(73)80770-7)
- Grant, G. T., Morris, E. R., Rees, D. A., Smith, P. J. C., & Thom, D. (1973). Biological interactions between polysaccharides and divalent cations: The *egg-box* model. *FEBS Letters*, 32(1), 195-198. [https://doi.org/10.1016/0014-5793\(73\)80770-7](https://doi.org/10.1016/0014-5793(73)80770-7)
- Haider, T. P., Völker, C., Kramm, J., Landfester, K., & Wurm, F. R. (2019). Plastics of the Future? The Impact of *Biodegradable* Polymers on the Environment and on Society. Dalam *Angewandte Chemie - International Edition* (Vol. 58, Nomor 1). <https://doi.org/10.1002/anie.201805766>
- Harussani, M. M., Sapuan, S. M., Firdaus, A. H. M., El-Badry, Y. A., Hussein, E. E., & El-Bahy, Z. M. (2021). Determination of the tensile properties and

- biodegradability of cornstarch-based biopolymers plasticized with sorbitol and glycerol. *Polymers*, 13(21), 3709. <https://doi.org/10.3390/polym13213709>
- Hu, Y., Li, X., Zhang, Y., & Chen, G. (2018). Dual-crosslinked amorphous polysaccharide hydrogels based on chitosan/alginate for wound healing applications. *Carbohydrate Polymers*, 198, 349-358. <https://doi.org/10.1016/j.carbpol.2018.06.112>
- Huang, J., Wang, Q., & Zhang, H. (2020). Influence of UV and moisture exposure on the degradation mechanism of chitosan-based bioplastics. *Carbohydrate Polymers*, 247, 116689.
- Huang, M., Wang, Y., Liu, D., & Wang, W. (2020). Acid-catalyzed in-situ cross-linking of polyol on sodium alginate to improve its strength and hydrophobic properties. *Carbohydrate Polymers*, 237, 116177. <https://doi.org/10.1016/j.carbpol.2020.116177>
- Hwang, J., Choi, D., Han, S., Choi, J., & Hong, J. (2019). An assessment of the toxicity of polypropylene microplastics in human derived cells. *Science of the Total Environment*, 684. <https://doi.org/10.1016/j.scitotenv.2019.05.071>
- Islam, M. K., Tusty, T. A., Akhand, A. A., & Ahsan, N. (2019). Human uptake of eggshell powder as an alternate source of calcium: Assessment of heavy metal contamination. *Dhaka University Journal of Pharmaceutical Sciences*, 18(2), 249-255
- Jain, N., Singh, V. K., & Chauhan, S. (2017). A review on mechanical and water absorption properties of polyvinyl alcohol based composites/films. *Journal of the Mechanical Behavior of Materials*, 26(5-6), 213-222. <https://doi.org/10.1515/jmbm-2017-0027>
- Jamal, T., Sapuan, S. M., & Khalina, A. (2021). Effect of glycerol *plasticizer* loading on the physical, mechanical, thermal, and barrier properties of arrowroot (*Maranta arundinacea*) starch biopolymers. *Scientific Reports*, 11, 13900. <https://doi.org/10.1038/s41598-021-93094-y>
- Jiménez, A., Fabra, M. J., Talens, P., & Chiralt, A. (2012). Edible and *biodegradable* starch films: A review. *Food and Bioprocess Technology*, 5, 2058-2076. <https://doi.org/10.1007/s11947-012-0835-4>
- Jonassen, H., Kjøniksen, A.-L., & Hiorth, M. (2012). Stability of chitosan nanoparticles cross-linked with sodium tripolyphosphate. *Biomacromolecules*, 13(11), 3747-3756. <https://doi.org/10.1021/bm301207a>

- Jørgensen, T. E., Sletmoen, M., Draget, K. I., & Stokke, B. T. (2007). Evidence for *egg-box*-compatible interactions in calcium-alginate gels from fiber X-ray diffraction. *Biomacromolecules*, 8(8), 2388-2397. <https://doi.org/10.1021/bm070208d>
- Jorjani, M., Ebrahimi, M., Ghaffari, S. M., & Mahdavi, M. (2022). Preparation and in vitro characterization of chitosan nanoparticles containing *Mesobuthus eupeus* scorpion venom as an antigen delivery system. *Scientific Reports*, 12(1), 22274. <https://doi.org/10.1038/s41598-022-26785-5>
- Jost, W., & Reinelt, T. (2016). Effect of Ca²⁺ induced crosslinking on the mechanical and barrier properties of cast alginate films. *Food Hydrocolloids*, 51, 383-389. <https://doi.org/10.1016/j.foodhyd.2015.06.013>
- Kementerian Lingkungan Hidup dan Kehutanan. (2024). Data timbulan sampah nasional tahun 2024. Jakarta: Direktorat Jenderal Pengelolaan Sampah.
- Kim, H. J., Lee, K., Kumar, S., & Kim, J. (2005). Dynamic sequential layer-by-layer deposition method for fast and region-selective multilayer thin film fabrication. *Langmuir*, 21(18). <https://doi.org/10.1021/la0511182>
- Komoto, D., Furuike, T., & Tamura, H. (2022). Preparation of polyelectrolyte complex gel of sodium alginate with chitosan using basic solution of chitosan. *Journal of Polymers and the Environment*, 30(4), 1536-1544. <https://doi.org/10.1007/s10924-021-02273-7>
- Kulkarni, A. R., Kulkarni, B. A., & Sohankar, S. (2000). Preparation of cross-linked sodium alginate microparticles using glutaraldehyde in methanol. *Drug Development and Industrial Pharmacy*, 26(10), 1121-1124. <https://doi.org/10.1081/DDC-100100278>
- Kwok, D. Y., & Neumann, A. W. (1999). Contact angle interpretation in terms of solid surface tension. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, 161(1), 31-48. [https://doi.org/10.1016/S0927-7757\(99\)00107-6](https://doi.org/10.1016/S0927-7757(99)00107-6)
- Łabowska, M. B., Cierpiszewski, R., & Król, J. J. (2019). Methods of extraction, physicochemical properties of alginates and their applications in biomedical field - a review. *Open Chemistry*, 17(1), 738-751. <https://doi.org/10.1515/chem-2019-0085>
- Larobina, D., & Cipelletti, L. (2013). Hierarchical cross-linking in physical alginate gels: A rheological and dynamic light scattering investigation. *arXiv preprint*. <https://doi.org/10.48550/arXiv.1309.6349>

- Larobina, D., & Cipelletti, L. (2013). Hierarchical cross-linking in physical alginate gels: A rheological and dynamic light scattering investigation. *Soft Matter*, 9(42), 10005-10015. <https://doi.org/10.1039/C3SM52006D>
- Li, W. C., Tse, H. F., & Fok, L. (2016). Plastic waste in the marine environment: A review of sources, occurrence and effects. *Dalam Science of the Total Environment* (Vol. 566-567). <https://doi.org/10.1016/j.scitotenv.2016.05.084>
- Li, X., Chen, Y., & Wang, Z. (2024). Chitosan-based composite featuring dual cross-linking networks for the removal of aqueous Cr(VI). *International Journal of Biological Macromolecules*, 244, 125836. <https://doi.org/10.1016/j.ijbiomac.2023.125836>
- Lin, C., Lu, T. W., Hsu, F., Huang, T. W., Ho, M. H., Lu, H.-T., & Mi, F.-L. (2025). An injectable in situ-forming hydrogel with self-activating genipin-chitosan cross-linking and an O₂/Ca²⁺ self-supplying capability for wound healing and rapid hemostasis. *Carbohydrate Polymers*, 351, 123051. <https://doi.org/10.1016/j.carbpol.2024.123051>
- Liu, Y., Wang, S., & Li, L. (2022). Studies on formulation and in vitro evaluation of PVA/chitosan blend films for drug delivery. *ACS Applied Bio Materials*, 5(3), 1302-1310. <https://doi.org/10.1021/acsabm.3c01209>
- Madhu, K. P., Dhal, M. K., Banerjee, A., & Kumar, A. (2025). Melt-processed cast films of calcite reinforced starch/guar-gum biopolymer composites for packaging applications. *Journal of Materials Science*. (Submitted January 2025).
- Malektaj, H., Drozdov, A. D., & Christiansen, J. d. C. (2023). Mechanical properties of alginate hydrogels cross-linked with multivalent cations. *Polymers*, 15(14), 3012. <https://doi.org/10.3390/polym15143012>
- Mohammed, A. A. B. A., Hasan, Z., Omran, A. A. B., Elfaghi, A. M., Khattak, M. A., Ilyas, R. A., & Sapuan, S. M. (2023). Effect of various *plasticizer* s in different concentrations on physical, thermal, mechanical, and structural properties of wheat starch-based films. *Polymers*, 15(1), 63. <https://doi.org/10.3390/polym15010063>
- Moustafa, H., Guizani, C., Dufresne, A., & Kahouli, A. (2022). Characterization of ionically crosslinked alginate films: Effect of different anion-based metal cations on the improvement of water-resistant properties. *Polymers*, 14(12), 2433.
- Müller, C. M. O., Laurindo, J. B., & Yamashita, F. (2012). Effect of cellulose fibers on the barrier properties of *biodegradable* films. *Journal of Food*

Engineering, 102(3), 189-195.
<https://doi.org/10.1016/j.jfoodeng.2010.08.007>

- Ngo, D. H., & Kim, S. K. (2014). Antioxidant effects of chitin, chitosan, and their derivatives. Dalam *Advances in Food and Nutrition Research* (Vol. 73). <https://doi.org/10.1016/B978-0-12-800268-1.00002-0>
- Nugraheni, A. D., Purnawati, D., & Kusumaatmaja, A. (2018). Physical evaluation of PVA/chitosan film blends with glycerine and calcium chloride. *Journal of Physics: Conference Series*, 1011, 012052. <https://doi.org/10.1088/1742-6596/1011/1/012052>
- Nunes de Lima Moreira, M., Vieira Moreira, F. K., & Nunes de Lima Moreira, M. (2023). Effect of adding micronized eggshell waste particles on the properties of *biodegradable* pectin/starch films. *Journal of Cleaner Production*, 434, 140229. <https://doi.org/10.1016/j.jclepro.2023.140229>
- OECD. (2022). *Global Plastics Outlook: Policy Scenarios to 2060*. Global Plastics Outlook.
- Olivas, G. I., & Barbosa-Cánovas, G. V. (2008). Alginate-calcium films: Water vapor permeability and mechanical properties as affected by *plasticizer* and relative humidity. *LWT - Food Science and Technology*, 41(2), 359-366. <https://doi.org/10.1016/j.lwt.2007.02.009>
- Oun, A. A., Shin, G. H., Rhim, J. W., & Kim, J. T. (2022). Recent advances in polyvinyl alcohol-based composite films and their applications in food packaging. Dalam *Food Packaging and Shelf Life* (Vol. 34). <https://doi.org/10.1016/j.fpsl.2022.100991>
- Park, S., Han, U., Choi, D., & Hong, J. (2018). Layer-by-layer assembled polymeric thin films as prospective drug delivery carriers: Design and applications. *Biomaterials Research*, 22. <https://doi.org/10.1186/s40824-018-0139-5>
- Pavia, D. L., Lampman, G. M., Kriz, G. S., & Vyvyan, J. R. (2015). *Introduction to spectroscopy* (5th ed.). Cengage Learning.
- Phumkacha, A., Leejarkpai, T., & Kirdponpattara, S. (2023). Effects of *plasticizer* s on physical and mechanical properties of tamarind kernel powder biopolymer films. *Materials Science Forum*, 1098, 65-69. <https://doi.org/10.4028/p-NBII0n>
- Phuong, N. N., Zalouk-Vergnoux, A., Poirier, L., Kamari, A., Châtel, A., Mouneyrac, C., & Lagarde, F. (2016). Is there any consistency between the microplastics found in the field and those used in laboratory experiments? Dalam *Environmental Pollution* (Vol. 211). <https://doi.org/10.1016/j.envpol.2015.12.035>

- Qureshi, D., Sahoo, A., Mohanty, B., Anis, A., Kulikouskaya, V., Hileuskaya, K., Kujawa, J., & Knozowska, K. (2021). Fabrication and characterization of poly(vinyl alcohol) and chitosan oligosaccharide-based blend films. *Gels*, 7(2), 55.
- Rhim, J.-W. (2004). Physical and chemical properties of water-resistant sodium alginate films. *LWT - Food Science and Technology*, 37(3), 323-330. <https://doi.org/10.1016/j.lwt.2003.09.008>
- Rinaudo, M. (2006). Chitin and chitosan: Properties and applications. Dalam *Progress in Polymer Science (Oxford)* (Vol. 31, Nomor 7). <https://doi.org/10.1016/j.progpolymsci.2006.06.001>
- Roquero, D. M., Bollella, P., Katz, E., & Melman, A. (2021). Controlling porosity of calcium alginate hydrogels by interpenetrating polyvinyl alcohol-diboronate polymer network. *ACS Applied Polymer Materials*, 3(3), 1455-1463. <https://doi.org/10.1021/acsapm.0c01358>
- Rosenboom, J. G., Langer, R., & Traverso, G. (2022). Bioplastics for a circular economy. Dalam *Nature Reviews Materials* (Vol. 7, Nomor 2). <https://doi.org/10.1038/s41578-021-00407-8>
- Russo, R., Malinconico, M., & Santagata, G. (2007). Effect of cross-linking with calcium ions on the physical properties of alginate films. *Biomacromolecules*, 8(10), 3193-3197. <https://doi.org/10.1021/bm700565h>
- Russo, R., Malinconico, M., & Santagata, G. (2007). Effect of the cross-linking with calcium ions on the structural and thermo-mechanical properties of alginate films. *Biomacromolecules*, 8(10), 3193-3197. <https://doi.org/10.1021/bm700565h>
- Sandıkçı, M. N., & Isik, B. (2025). Fabrication of calcium alginate/gum arabic/eggshell powder composite microbeads for adsorptive removal of methylene blue dye from aqueous solutions. *Macromolecular Research*. Advance online publication. link.springer.com
- Saswat, M., & Maheshwari, S. (2022). Development of *biodegradable* calcium alginate films for packaging applications. *Journal of Polymers and the Environment*, 30(5), 1892-1902. <https://doi.org/10.1007/s10924-021-02255-5>
- Schlegel, T. K., & Schönherr, J. (2002). Cuticular penetration of calcium salts: Effects of humidity, anions, and adjuvants. *Journal of Plant Nutrition and Soil Science*, 165(2), 174-178. [https://doi.org/10.1002/1522-2624\(200204\)165:2<174::AID-JPLN174>3.0.CO;2-Z](https://doi.org/10.1002/1522-2624(200204)165:2<174::AID-JPLN174>3.0.CO;2-Z)

- Seesanong, S., Seangarun, C., Boonchom, B., Laohavisuti, N., Boonmee, W., Thompho, S., & Rungrojchaipon, P. (2024). Low-cost and eco-friendly calcium oxide prepared via thermal decompositions of calcium carbonate and calcium acetate precursors derived from waste oyster shells. *Materials*, 17(15), 3875. <https://doi.org/10.3390/ma17153875>
- Senathirajah, K., Attwood, S., Bhagwat, G., Carbery, M., Wilson, S., & Palanisami, T. (2021). Estimation of the mass of microplastics ingested - A pivotal first step towards human health risk assessment. *Journal of Hazardous Materials*, 404. <https://doi.org/10.1016/j.jhazmat.2020.124004>
- Senturk Parreidt, T., Müller, K., & Schmid, M. (2018). Alginate-based edible films and coatings for food packaging applications. *Foods*, 7(10), 170. <https://doi.org/10.3390/foods7100170>
- Shtein, M., Paul-Ehrlich, O., Shoseyov, O., & Domb, A. J. (2016). A new insight to the effect of calcium concentration on gelation process and physical properties of alginate films. *Journal of Materials Science*, 51, 5791-5801. <https://doi.org/10.1007/s10853-016-9945-2>
- Silva, A. B., Bastos, A. S., Justino, C. I. L., da Costa, J. P., Duarte, A. C., & Rocha-Santos, T. A. P. (2018). Microplastics in the environment: Challenges in analytical chemistry - A review. *Dalam Analytica Chimica Acta* (Vol. 1017). <https://doi.org/10.1016/j.aca.2018.02.043>
- Singh, S., Habib, M., Rao, E. S., Kumar, Y., Bashir, K., Jan, S., & Jan, K. (2024). A comprehensive overview of *biodegradable* packaging films: Part I- sources, additives, and preparation methods. *Heliyon*. <https://doi.org/10.1016/j.heliyon.2024.eXXXXXX>
- Siti Xuan, T., Mohd Ishak, N. S., & Ahmad, I. (2021). Effect of chitosan reinforcement on the mechanical and water absorption properties of starch-based bioplastic films. *Journal of Polymers and the Environment*, 29, 1590-1601. <https://doi.org/10.1007/s10924-020-02000-0>
- Smith, B. C. (2011). *Fundamentals of Fourier transform infrared spectroscopy* (2nd ed.). CRC Press.
- Solaro, R., Corti, A., & Chiellini, E. (2000). Biodegradation of poly(vinyl alcohol) with different molecular weights and degree of hydrolysis. *Polymers for Advanced Technologies*, 11(8-12), 873-878. [https://doi.org/10.1002/1099-1581\(200008/12\)11:8/12<873::AID-PAT35>3.0.CO;2-V](https://doi.org/10.1002/1099-1581(200008/12)11:8/12<873::AID-PAT35>3.0.CO;2-V)
- Sothornvit, R., & Krochta, J. M. (2000). *Plasticizer* effect on mechanical properties of β -lactoglobulin films. *Journal of Food Engineering*, 50(3), 149-155. [https://doi.org/10.1016/S0260-8774\(00\)00103-0](https://doi.org/10.1016/S0260-8774(00)00103-0)

- Strelec, I., Tomičić, Z., Zajec, Z., Ostojić, S. B., & Budžaki, S. (2023). Eggshell-waste-derived calcium acetate, calcium hydrogen phosphate and corresponding eggshell membranes. *Applied Sciences*, 13(2), 987. <https://doi.org/10.3390/app13020987>
- Su, C. Y., Li, D., & Wang, L. J. (2025). From micropores to mechanical strength: Fabrication and characterization of edible corn starch-sodium alginate double network hydrogels with Ca²⁺ cross-linking. *Food Chemistry*, 467, 142276. <https://doi.org/10.1016/j.foodchem.2024.142276>
- Szekalska, M., Puciłowska, A., Szymańska, E., Ciosek, P., & Winnicka, K. (2021). Development of double crosslinked sodium alginate/chitosan based hydrogels for controlled release of metronidazole and its antibacterial activity. *International Journal of Molecular Sciences*, 22(4), 1764. <https://doi.org/10.3390/ijms22041764>
- Szekalska, M., Puciłowska, A., Szymańska, E., Ciosek, P., & Winnicka, K. (2016). Alginate: Current use and future perspectives in pharmaceutical and biomedical applications. *International Journal of Polymer Science*, 2016, Article ID 7697031.
- Szymańska, E., & Winnicka, K. (2015). Stability of chitosan-a challenge for pharmaceutical and biomedical applications. *Marine Drugs*, 13(4), 1819-1846. <https://doi.org/10.3390/md13041819>.
- Tang, X., Alavi, S., & Herald, T. J. (2008). Barrier and mechanical properties of starch-clay nanocomposite films. *Cereal Chemistry*, 85(3). <https://doi.org/10.1094/CCHEM-85-3-0433>
- Tarique, J., Sapuan, S. M., & Khalina, A. (2021). Effect of glycerol *plasticizer* loading on the physical, mechanical, thermal, and barrier properties of arrowroot starch biopolymer films. *Scientific Reports*, 11, Article 13900. <https://doi.org/10.1038/s41598-021-93094-y>
- Tarique, J., Sapuan, S. M., Sherif, E. M., & Khalina, A. (2021). Effect of glycerol on the structure and properties of thermoplastic starch/poly(butylene succinate) composites: FTIR and SEM analysis. *Scientific Reports*, 11, 10861. <https://doi.org/10.1038/s41598-021-90356-0>
- Van Rooyen, B., De Wit, M., Osthoff, G., Van Niekerk, J., & Hugo, A. (2023). Microstructural and Mechanical Properties of Calcium-Treated Cactus Pear Mucilage (*Opuntia* spp.), Pectin and Alginate Single-Biopolymer Films. *Polymers*, 15(21), 4295. <https://doi.org/10.3390/polym15214295>
- Vanthana Sree, K., & Nagaraaj, R. (2022). Enhancement of PVA packaging using calcined eggshell waste. *Food Packaging and Shelf Life*, 34, 100983. <https://doi.org/10.1016/j.foodchem.2022.100983>

- Wang, J., Liu, X., Li, Y., Powell, T., Wang, X., Wang, G., & Zhang, P. (2019). Microplastics as contaminants in the soil environment: A mini-review. *Dalam Science of the Total Environment* (Vol. 691). <https://doi.org/10.1016/j.scitotenv.2019.07.209>
- Wang, X., Du, Y., Fan, L., Liu, H., & Hu, Y. (2005). Chitosan- metal complexes as antimicrobial agent: Synthesis, characterization and Structure-activity study. *Polymer Bulletin*, 55(1-2). <https://doi.org/10.1007/s00289-005-0414-1>
- Weligama Thuppahige, V. T., & Karim, M. A. (2022). A comprehensive review on the properties and functionalities of *biodegradable* and *semibiodegradable* food packaging materials. *Dalam Comprehensive Reviews in Food Science and Food Safety* (Vol. 21, Nomor 1). <https://doi.org/10.1111/1541-4337.12873>
- Weng, Y. X., Wang, L., Zhang, M., Wang, X. L., & Wang, Y. Z. (2013). Biodegradation behavior of P(3HB,4HB)/PLA blends in real soil environments. *Polymer Testing*, 32(1). <https://doi.org/10.1016/j.polymertesting.2012.09.014>
- Wong, J. P., & Azmi, N. S. (2020). Recent advances in alginate-based films for food packaging applications. *Polymers*, 12(12), 2776. <https://doi.org/10.3390/polym12122776>
- World Bank. (2021). *Indonesia Economic Prospects (Boosting The Recovery)*. World Bank Group, Juni.
- Yang, H., Wu, Y., Zhao, Y., & Zhang, M. (2022). Preparation and properties of PVA/chitosan *biodegradable* composite films. *Journal of Polymers and the Environment*, 30, 474-483.
- Yao, Y., Zhang, J., Zhang, R., Shi, Y., An, P., Hu, X., & Wan, Y. (2022). Optimization of preparation of calcium acetate from eggshell by response surface methodology. *Food Science and Technology (Campinas)*, 42, e114421. <https://doi.org/10.1590/fst.114421>
- Yuan, Y., & Lee, T. R. (2013). Contact angle and wetting properties. In G. Bracco & B. Holst (Eds.), *Surface science techniques* (pp. 3-34). Springer. https://doi.org/10.1007/978-3-642-34243-1_1
- Yusefi, M., Kia, P., Mohamad Sukri, S. N. A., Ali, R. R., & Shameli, K. (2021). Synthesis and Properties of Chitosan Nanoparticles Cross-Linked with Tripolyphosphate. *Journal of Research in Nanoscience and Nanotechnology*, 3(1), 46-52. <https://doi.org/10.37934/jrnn.3.1.4652>

- Zactiti, E. M., & Kieckbusch, T. G. (2009). Release of potassium sorbate from active films of sodium alginate crosslinked with calcium chloride. *Packaging Technology and Science*, 22(6), 349-358. <https://doi.org/10.1002/pts.858>
- Zehra, A., Wani, S. M., Jan, N., Bhat, T. A., Rather, S. A., Malik, A. R., & Hussain, S. Z. (2022). Development of chitosan-based *biodegradable* films enriched with thyme essential oil and additives for potential applications in packaging of fresh collard greens. *Scientific Reports*, 12(1). <https://doi.org/10.1038/s41598-022-20751-1>
- Zeng, W., Peng, R., Gao, D., Lin, J., Zeng, J., Li, Z., Xia, Z., & Wang, D. (2024). Chitosan-alginate sponge with multiple cross-linking networks for adsorption of anionic dyes. *Journal of Chromatography A*, 1713, 464507. <https://doi.org/10.1016/j.chroma.2023.464507>
- Zhang, J., Zhang, J., Huang, X., Arslan, M., Shi, J., Li, Z., & Zou, X. (2023). Fabrication and characterization of polyvinyl alcohol/sodium alginate/zein/chitosan bilayer film for dynamic visualization of pork quality. *International Journal of Biological Macromolecules*, 243, 125065. <https://doi.org/10.1016/j.ijbiomac.2023.125065>
- Zhang, Y., Kang, S., Allen, S., Allen, D., Gao, T., & Sillanpää, M. (2020). Atmospheric microplastics: A review on current status and perspectives. *Dalam Earth-Science Reviews* (Vol. 203).
- Zhang, Z., Zeng, J., Groll, J., & Matsusaki, M. (2022). Layer-by-layer assembly methods and their biomedical applications. *Biomaterials Science*, 10(15). <https://doi.org/10.1039/d2bm00497f>
- Zinina, O., Basyrova, L., Shalakhmetov, M., & Zainullin, R. (2023). Biodegradation and barrier properties of sodium alginate-based films crosslinked with calcium ions. *Sustainability*, 15(7), 5894. <https://doi.org/10.3390/su15075894>