



DAFTAR PUSTAKA

- Agustina, E., R. Purnamasari., N.F. Erfansyah., F. Andiarna., N. Lusiana., dan I. Hidayati. 2024. Pemanfaatan limbah pucuk tebu sebagai sumber selulosa bahan baku plastik biodegradable. *BIOTROPIC The Journal of Tropical Biology*. 8(1): 39-54.
- Aldapa, G., C. A., Díaz-Cruz., C. A. Castro-Rosas., J. J. Regalado., E. J. Velazquez., G. Gutierrez, M. C., and Loreda, A. R. Y. 2021. Development of antimicrobial biodegradable films based on corn starch with aqueous extract of *Hibiscus sabdariffa* L. *Starch-Stärke*.73(1).
- Ali, H., A. Baehaki., dan S.D. Lestari. 2017. Karakteristik edible film gelatin-kitosan dengan tambahan ekstrak genjer (*limnocharis flava*) dan aplikasi pada pempek. *Fishtech*. 6(1): 26-38.
- Antoniou, J., F. Liu, H. Majeed., and F. Zhong. 2015. Characterization of tara gum edible films incorporated with bulk chitosan and chitosan nanoparticles: A comparative study. *Food Hydrocolloids*. 44. 309-319.
- Aranaz, I., A.R. Alcántara., M.C. Civera., C. Arias., B. Elorza., H. Caballero., N. Acosta. 2021. Chitosan: an overview of its properties and applications. *Polymers (basel)*. PMID. 13(19).
- Arham, R., M.T. Mulyati., M. Metusalach., and S. Salengke. 2016. Physical and mechanical properties of agar based edible film with glycerol plasticizer. *International Food Research Journal*. 23(4): 1669-1675.
- Arifin, M. H., N. E. Suyatma., dan D. Indrasti. 2022. Karakterisasi kitooligosakarida yang didepolimerisasi dengan metode berbeda dan kajiannya sebagai *active film*. *Jurnal Pengolahan Hasil Perikanan Indonesia*. 25(1):18-33.
- Aripin, S., B. Salng., dan E. Kustlyah. 2017. Studi pembuatan bahan alternatif plastik *biodegradable* dari pati ubi jalar dengan *plasticizer* gliserol dengan metode *melt intercalation*. *Jurnal Teknik Mesin*, 6(2):18-23
- Astuti, K. W., V. F. Rizqiyah., dan T. Adiarto. 2022. Pengaruh derajat deasetilisasi kitosan pada *coating* nata de coco sebagai bahan perban antibakteri penutup luka. *Jurnal Warta Akab*. 46 (2): 23-30.
- Ayyubi, M.S., Farikhah., dan N.M. Safitri. 2022. The effect of chitosan extracted from green mussel shells *Perna viridis* on *Sonneratia caseolaris* mangrove syrup preservation. *Jurnal Biologi Tropis*, 22(1): 251-264.
- Ahuja, A., and V.K. Rastogi. 2024. Physicochemical and thermal characterization of the edible shellac films incorporated with oleic acid to enhance flexibility, water barrier and retard aging. *Int J Biol Macromol*. 269(2): 132-136.



- Azwar, E., dan S.O. Simbolon. 2020. Karakterisasi plastik pengemas makanan dari tepung maizena dan batang pisang. *Inovasi Pembangunan. Jurnal Kelitbangan*, 17-27.
- Badan Standardisasi Nasional (BSN). 2022. SNI 7188-7:2022. Kriteria Ekolabel - Bagian 7: Kategori Produk, Kemasan Produk Dan Wadah Bioplastik Yang Dapat Dikomposkan. BSN. Jakarta
- European Bioplastics (2020). Bioplastics market data 2020. Diakses 2 Juni 2025 dari https://docs.europeanbioplastics.org/conference/Report_Bioplastics_Market_Data_2020_short_version.pdf.
- Baldwin, E.A., R. Hagenmaier., and J. Bai. 1994. *Edible Coatings And Films To Improve Food Quality*. CRC Press Taylor & Francis Group. London.
- Bangun, G.I. 2023. Pengaruh Rasio Volume Larutan Kitosan-Karagenan Terhadap Sifat Fisik Dan Kimia Bioplastik. *Skripsi*. Fakultas Pertanian. Universitas Gadjah Mada.
- Barbut, S., and B.A. Harper. 2019. Dried Ca-alginate films: Effects of glycerol, relative humidity, soy fibers, and carrageenan. *Food Science and Technology*. 103: 260–265.
- Bartolo, A.D., G. Infurna., and T. Dintcheva. 2021. A review of bioplastics and their adoption in the circular economy. *Polymers*. 13(8): 12-29.
- Bonilla, J., L. Atarés., M. Vargas., and A. Chiralt. 2013. Effect of essential oils and homogenization conditions on properties of chitosan-based films. *Food Hydrocolloids*. 30(1): 287–294.
- Bourtoom, T., and Chinan, M. 2008. Preparation and properties of rice starch chitosan blend biodegradable film. *Food Science and Technology*. 41 :1633-1641.
- Bonilla, J., Talón, E., Atarés, L., Vargas, M., dan Chiralt, A. 2014. Effect of the incorporation of antioxidants on physicochemical and antioxidant properties of wheat starch–chitosan films. *Journal of Food Engineering*. 118(3): 271–278.
- Bravin, B., D. Peressini., and Sensidoni, A. 2004. Influence of emulsifier type and content on functional properties of polysaccharide lipid-based edible films. *J Agric Food Chem*. 52(21): 6448-55.
- Brudzyńska, P., and A. Sionkowska. 2025. The effects of shellac and glycerol on the physicochemical properties of chitosan films. *Polymers*. 17(10).
- Butnaru, E., E. Stoleru., M.A. Brebu., R. N. Darie-Nita., A. Bargan., C. Vasile. 2019. Chitosan-Based Bionanocomposite Films Prepared by Emulsion Technique for Food Preservation. *Food Packaging: Materials and Techonology*. 12(3).



- Campos S. H., P.R. Souza., B.C. Peghini., da Silva J.S., and C.R. Cardoso. 2013. An overview of the modulatory effects of oleic acid in health and disease. *Mini Rev Med Chem.* 13(2):201-10.
- Cardenas, G., P. Anaya., C. Plessing., and C. Rojas. 2008. Chitosan composite films: Biomedical applications. *Journal of Materials Science: Materials in Medicine.* 19(8): 2397–2405.
- Carrillo, C., Cavia-Mdel M., and Alonso-Torre S. 2012. Role of oleic acid in immune system; mechanism of action; a review. *Nutr Hosp.* 27(4): 978-90.
- Castelló, M., O. Mateo., and J. Salinas. 2018. Production and characterization of chitosan and glycerol films. *Universidad Nacional de La Plata Institutional Repository (SEDICI).*
- Caz'on, P., G. Velazquez., J. Ramírez., and V'azquez, M. 2017. Polysaccharide-based films and coatings for food packaging: A review. *Food Hydrocolloids.* 68: 136–148.
- Charles A.L., N. Motsa., and A.A. Abdillah. 2022. A comprehensive characterization of biodegradable edible films based on potato peel starch plasticized with glycerol. *Polymers (Basel).* 14(17): 3462.
- Chen, H., Q. Zhong., M. Jin., and Y. Huang. 2012. Synergistic effect of oleic acid and glycerol on zein film plasticization. *Journal of Agricultural and Food Chemistry.* 60(24): 6230–6236.
- Chen, M., T. Runge., L. Wang., R. Li., J. Feng., X. Shu., and Q.S. Shi. 2018. Hydrogen bonding impact on chitosan plasticization. *Carbohydrate Polymers.* 200:115–121.
- Chen, G., B. Zhang., and J. Zhao. 2015. Dispersion process and effect of oleic acid on properties of cellulose sulfate- oleic acid composite film. *Materials (Basel).* 8(5): 2346–60.
- Coppola, G., M.T. Gaudio., C.G. Lopresto., V. Calabro., S. Curcio., and S. Chakraborty. 2021. Bioplastic from renewable biomass: a facile solution for a greener environment. *Earth Systems And Environment.* 5(4): 1-21.
- Cox, K.D., G.A. Conventon., H.L. Davies., J.F. Dower., F. Juanes., and S.E. Dudas. 2019. Human consumption of microplastics. *Environmental Science Technology.* 5(3): 7068-7074.
- Chandra D.K., A. Kumar., and C. Mahapatra. 2024. Ecofriendly bioplastics from biowaste: antimicrobial and functional enhancement for sustainable packaging. *European Polymer Journal.* 2(21): 1-35.
- Darni, Y., T.M. Sitorus., dan M. Hanif. 2014. Pengaruh penambahan selulosa dari rumput laut *eucheuma spinosum* pada sintesa bioplastik berbasis sorgum. *Jurnal Rekayasa Kimia dan Lingkungan.* 10(2): 55-63.



- Dewanto, E.B. 2023. Bangun, G.I. 2023. Pengaruh Rasio Volume Larutan Kitosan-Karagenan Terhadap Sifat Fisik Dan Kimia Bioplastik. *Skripsi*. Fakultas Pertanian. Universitas Gadjah Mada. *Skripsi*. Fakultas Pertanian. Universitas Gadjah Mada.
- Dias, A. M. A., S. Marceneiro., M. E. M. Braga., J. F. J. Coelho., A. G. M. Ferreira., P. N. Simões., H. I. M. Veiga., L. C. Tomé., I.M. Marrucho., J. M. S. S. Esperança., A. A. Matias., C. M. M. Duarte., L. P. N. Rebelo., and de-Sousa. 2012. Phosphonium-based ionic liquids as modifiers for biomedical grade *poly(vinyl chloride)*. *Acta Biomaterialia*. 8(3):1366-1379.
- Dong, J., D.L. Man., Z.Y. Sun., and L.Y. Dong. 2022. Preparation of chitosan-antimicrobial peptides antimicrobial composite film and its application in the packaging of cheese. *Food and Fermentation Industries*. 48(21): 133-139.
- Duan, Q., Y. Chen., L. Yu., Xie F. Chitosan-gelatin films: plasticizers/nanofillers affect chain interactions and material properties in different ways. *Polymers (Basel)*. 11(18):3797.
- Elsabee, M. Z., and Abdou, E. S. 2013. Chitosan based edible films and coatings: a review. *Materials Science and Engineering*. 33(4): 1819–1841.
- Eslami Z, Elkoun S, Robert M, Adjallé K. 2023. A review of the effect of plasticizers on the physical and mechanical properties of alginate-based films. *Molecules*. 28(18):6637
- Favian, E., and P.S. Nugraheni. 2023. Effect of carragenan addition on the characteristic of chitosan-based bioplastic. *International Symposium on Marine and Fisheries Research*. 1289(1): 1-15.
- Febri, O.N. 2018. *Gliserol:Sampah Biodiesel Bernilai Emas*. Deepublish Production. Yogyakarta.
- Fitria, F.R. 2023. Pengaruh Rasio Volume Larutan Kitosan -CMC (Carboxymethyl Cellulose) Terhadap Sifat Fisik dan Kimia Bioplastik. *Skripsi*. Fakultas Pertanian. Universitas Gadjah Mada.
- Foster, L. J. R., Ho, S., J. Hook., M. Basuki., and H. Marçal. 2015. Chitosan as a biomaterial: Influence of degree of deacetylation on its physiochemical, material and biological properties. *PLOS ONE*.10(8)
- Ghanbarzadeh, B., Almasi, H. and Entezami, A.A. 2011. Improving the barrier and mechanical properties of corn starch-based edible films: effect of citric acid and carboxymethyl cellulose. *Industrial Crops and Products*.33: 229-235.
- Ghasemlou, M., Khodaiyan, F., and Oromiehie, A. 2011. Physical, mechanical, barrier, and thermal properties of polyol-plasticized biodegradable edible film made from kefiran. *Carbohydrate Polymers*. 84(1) : 477–483.



- Giyatmi., T. A. E. Poetri., H. E. Irianto., D. Fransiska., dan Agusman. 2020. Effect of alginate and polyethylene glycol addition on physical and mechanical characteristics of k- carrageenan-based edible film. *Buletin of Marine Fisheries Postharvest and Biotechnology*. 15(1) : 41-51.
- González, S. L., Chiralt, A., Martínez, M.C., Nàcher, MT. 2011. Effect of essential oils on properties of film forming emulsions and films based on HPMC and chitosan. *Journal of Food Engineering*. 105(2):246-253.
- Gozali, T., W. P. Wijaya, & M. I. Rengganis. 2020. Pengaruh konsentrasi CMC dan konsentrasi gliserol terhadap karakteristik *edible packaging* kopi instan dari pati kacang hijau (*Vigna Radiata L.*).
- Han, J. H. 2014. *Innovations in Food Packaging Second Edition*. USA: Plano TX
- Handayani, J., dan Haryanto, H. 2020. Pengaruh Penambahan Kitosan dan Sorbitol pada Pembuatan Film Bioplastik dari Biji Alpukat terhadap Karakteristik Bioplastik. *Prosiding University Research Colloquium*. 41–47.
- Hanry, E. L., and Surugau, N. 2020. Characteristics and Properties of Biofilms Made from Pure Carrageenan Powder and Whole Seaweed (*Kappaphycus sp.*). *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences*. 76(2) : 99-110.
- Harahap, Y.A., A.C.K. Fitri., dan Y.E. Fajarwati. 2023. Analisis kelarutan bioplastik dari pati kulit singkong dengan penambahan variasi gliserol, selulosa jerami padi, dan kitosan. *Seminar Nasional Teknologi Industri Lingkungan dan Infrastruktur*, 3(1):31-40.
- Harussani M.M., Sapuan S.M., Firdaus A.H.M., El-Badry Y.A., Hussein E.E., El-Bahy ZM. 2021. Determination of the tensile properties and biodegradability of cornstarch-based biopolymers plasticized with sorbitol and glycerol. *Polymers (Basel)*. 13(21):3709.
- Hasanah, N., dan Mahyudin, A. 2022. Pengaruh variasi massa gliserol terhadap sifat mekanik film plastik pati umbi talas berpenguat nano serat pinang. *Jurnal Fisika Unand*.11(2): 194–200.
- Hidayati, S., Zulferiyenni dan W. Satyajaya. 2019. Optimasi pembuatan biodegradable film dari selulosa limbah padat rumput laut *eucheuma cottonii* dengan penambahan gliserol, kitosan, cmc dan tapioka. *Jurnal Perikanan Hasil Perikanan Indonesia*. 22(2): 340-354.
- Houssini, K., J. Li., and Q. Tan. 2025. Complexities of the global plastics supply chain revealed in a trade-linked material flow analysis. *Communications Earth and Environment*. 6(1).
- Iglauer, S., Wu, Y., Shuler, P., Tang, Y., and Goddard III, W. A. 2011. Dilute iotaand kappa-carrageenan solutions with high viscosities in high salinity brines. *Journal of Petroleum science and Engineering*.75(3-4): 304-311.



- Indriyani, N., L.P. Ramadhani., N. Muzdalifah., A.P. Sari., dan Fathurrahman. 2024. Synthesis of red fruit oil (*Pandanus Conoideus*) emulsion with tween 80 surfactant and alginate co-surfactant. *Jurnal Teknik Kimia Lingkungan*. 8(2):89-98
- Jabeen F, Zil-E-Aimen, Ahmad R, Mir S, Awwad NS, Ibrahim HA. 2025. Carrageenan: structure, properties and applications with special emphasis on food science. *RSC Adv*. 15(27):22035-22062.
- Janik, W., Nowotarski, M., Ledniowska, K., Biernat, N., Abdullah., D. Yfetar., K. Krukiewicz., R. Turczyn., Gołombek, K., and Dudek, G. 2023. Effect of Time on the Properties of Bio-Nanocomposite Films Based on Chitosan with Bio-Based Plasticizer Reinforced with Nanofiber Cellulose. *International Journal of Molecular Sciences*. 24(17).
- Juliani, D., N.E. Suyatma., dan F.M. Taqi. 2022. Pengaruh waktu pemanasan, jenis dan konsentrasi plasticizer terhadap karakteristik *edible film k-karagenan*. *Jurnal Keteknik Pertanian*. 10(1):29-40.
- Jimenez, A., Fabra, M.J., Talens, P., dan Chiralt. 2010. Effect of lipid self-association on the microstructure and physical properties of hydroxypropyl-methylcellulose edible films containing fatty acids. *Carbohydrate Polymer*. 82: 585-593.
- Jiménez, A., Fabra, M. E., Talens, P., & Chiralt, A. (2012). Effect of sodium caseinate on properties and ageing behaviour of corn starch based films. *Food Hydrocolloids*. 29(2) : 265-271.
- Juwita, W. P., Wirawan, S. K., dan Mindaryani, A. 2019. Pengaruh proses pengeringan dan konsentrasi gliserol terhadap karakteristik mekanik pektin *edible film*. *Prosiding Seminar Nasional Teknik Kimia "Kejuangan"*. (pp. C1-1–C1-6)
- Kapadnis, G., A. Dey., P. Dandekar., and R. Jain. 2019. Effect of degree of deacetylation on solubility of low-molecular-weight chitosan produced via enzymatic breakdown of chitosan. *Polymer International*. 68(4):1054-1068.
- Karbowiak, T., R.D. Gougeon., S. Rigolet., L. Delmotte., F. Debeaufort., and Voilley, A. 2008. Diffusion of small molecules in edible films: effect of water and interactions between diffusant and biopolymer. *Food Chemistry*. 106(4):1340–1349.
- Kaya M, Baran T, Erdoğan S, Menteş A, Özusağlam MA, Çakmak YS. 2014. Perbandingan fisikokimia kitin dan kitosan yang diperoleh dari larva dan kumbang kentang Colorado dewasa (*Leptinotarsa decemlineata*). *Mater Sci Eng C Mater Biol Appl*. 45:72–81.
- Khotimah, A. Ridlo, and C. A. Suryono. 2022. Sifat fisik dan mekanik bioplastik komposit dari alginat dan karagenan, *Journal of Marine Research*. 11(3) : 409-419.
- Kim, H., G. Shin., M. Jang., F. Nilsson., M. Hakkarainen., H.J. Kim., S.Y. Hwang., J. Lee., S.B. Park., J. Park., and J.M. Koo. 2023. Toward sustaining bioplastiks:



add a pinch of seasoning. *ACS Sustainable Chemistry and Engineering*. 11(5): 1846-1856.

- Kowalczyk D, Kazimierzak W, Zięba E, Lis M, Wawrzkievicz M. 2024. Structural and physicochemical properties of glycerol-plasticized edible films made from pea protein-based emulsions containing increasing concentrations of candelilla wax or oleic acid. *Molecules*. (24):5998.
- Krochta, J.M., E.A. Baldwin, and M.O. Nisperos-Carriedo. 1994. *Edible Coatings and Films to Improve Food Quality*. Lancaster Pa. Technomic Publishing.
- Krochta JM, Johnston CDM. 1997. Edible and biodegradable polymer film. *Journal of Food Technology*. 52(2): 61-74.
- Kurek, M., S. Galus., and F. Debeaufort. 2014. Surface, mechanical and barrier properties of bio-based composite films based on chitosan and whey protein. *Food Packaging and Shelf Life*. 1(1):56-67.
- Kurniasih, D., Atikah dan H. Sulistyarti. 2013. Karakterisasi Elektroda Selektif Ion (Esi) Kromat Tipe Kawat Terlapis Berbasis Kitosan Characterization. *Sains dan Terapan Kimia*. 7(1):10–18.
- Kusumawati, H.D., dan Putri, D.R., Widya. 2013. Karakteristik fisik dan kimia *edible film* pati jagung yang diikorporasi dengan perasan temu hitam. *Jurnal pangan dan agroindustry*. 1(1).
- Laohakunjit. N dan A. Noomhorm. 2004. Effect of plasticizer on mechanical and barrier properties of rice starch Film. *Journal Food Science*. 56(2): 348-356.
- Lastruyanto, A., B.D. Argo., H.S. Sumarlam., N. Komar., L.C. Howa., dan M.B. Hermanto. 1992. Koefisien permeabilitas *film edible* terhadap transmisi uap air, gas o₂, dan gas Co₂ determination. 182-187.
- Le Goué, E., Gardrat, C., Romain, M., Rollini, M., Moresoli, C., and Coma, V. 2022. Effect of oleic acid on the release of tetrahydrocurcumin in chitosan-based films. *Food Hydrocolloids*. 12(4) : 187-202.
- Leceta, I., Guerrero, P., and de la Caba, K. 2013. Functional properties of chitosan-based films, *Carbohydr. Polym.* 93(1), 339-346.
- Loredo, R.Y.A., A.I. Hernandez., and N.C. Hernandez. 2014. Physical properties of emulsified films based on chitosan and oleic acid. *Journal of Food*. 12(4):305-312
- Lu, Z., Tian, N., Wei, N., Wei, L., Chen, G., and Liang, S. 2010. A fungi degrading nonionic surfactant tween 80: screening and its biodegradation characteristics. *Environmental Science*. 31(8): 1903-1908.
- Luo, Z.-G., and Shi, Y.-C. 2012. Preparation of acetylated waxy, normal, and high-amylose maize starches with intermediate degrees of substitution in aqueous



- solution and their properties. *Journal of Agricultural and Food Chemistry*. 60(37): 9468–9475.
- Lusiana, S., Putri, D., Nurazizah, I. Z., and Bahruddin. 2019. Bioplastic properties of sago-pva starch with glycerol and sorbitol plasticizers. *Journal of Physics: Conference Series*. 1351(1): 1–8.
- Lutfi, M., Sumarlan, S. H., Susilo, B., Wignyanto, Zenata, R., and Perdana, L. P. R. 2017. The glycerol effect on mechanical behaviour of biodegradable plastic from the Walur (*Amorphophallus paenifolius* var. *sylvestris*). *Nature Environment and Pollution Technology*. 16(4): 1121-1124.
- Luz AM, Barbosa G, Manske C, Tavares FW. 2023. Tween-80 on water/oil interface: structure and interfacial tension by molecular dynamics simulations. *Langmuir*. 39(9):3255-3265.
- Ma, Q., D. Hu., H. Wang., and L. Wang. 2016. Tara gum edible film incorporated with oleic acid. *Food Hydrocolloids*. 5(6):127-133.
- Magfirah, A., Susilawati., M.Z. Sofyan., M.W. Siambaton., S.N.K Sitepu., and O.P. Putra. 2023. The characterization of porang starch (*Amorphophallus Oncophyllus*) biodegradable plastic using sorbitol plasticizer with the glycerol plasticizer addition. *Journal of Physics: Conference Series*. 26(72):1-9.
- Maneking, E., F.F. Sangian., dan S.H.J Tongkukut. 2020. Pembuatan dan karakteristik bioplastik berbahan dasar biomassa dengan plasticizer gliserol. *Jurnal Unsrat* 9(1):23-27.
- Maria, V., Giannakas, A., Katapodis, P., Stamatis, H., Ladavos, A., & Barkoula, N.-M. 2016. On the efficiency of oleic acid as plasticizer of chitosan/clay nanocomposites and its role on thermo-mechanical, barrier and antimicrobial properties – CoMParison with glycerol. *Food Hydrocolloids*. 57 : 10–19.
- Martiny, T.R., B.S. Pacheco., C.M.P. Pereira., A. Mansilla., M. S. Astorga-Espana., G.L. Dotto., C.C Moraes., and G.S. Rosa. 2020. A novel biodegradable film based on κ -carrageenan activated with olive leaves extract. *Food Science & Nutrition*.
- Maryuni, A.E., dan Mangiwa, S. 2018. Karakterisasi bioplastik dari karaginan dari rumput laut merah asal kabupaten biak yang dibuat dengan metode blending menggunakan pemlastis sorbitol. *Jurnal Avogadro*. 2(1):9-16.
- Masamba, K.G., Y. Li., J. Hategekimana., and F. Liu. 2015. Effect of type of plasticizers on mechanical and water barrier properties of transglutaminase cross-linked zein-oleic acid composite film. *International Journal of Food Engineering*. 12(4)
- Mitantsoa, J.T., P.H. Ravelonandro., F.Arimalala., R. Rafihavanana., and Rianaivoravelona. 2023. Elaboration and characterization of bioplastic films based on bitter cassava starch (*Manihot esculenta*) reinforced by chitosan extracted from crab (*Shylla seratta*) shells. *International Journal of Science Engineering and Technology*. 9(6):1-14.



- Mohammed, A.A.B.A., Z. Hasan., A.A.B. Omran., A.M. Elfaghi., M.A. Khattak., Ilyas., and S.M. Sapuan. 2022. Effect of various plasticizers in different concentrations on physical, thermal, mechanical, and structural properties of wheat starch-based films. *Polymers (Basel)*. 15(1).
- Mosallanezhad, M., Hasani, H., Jaleh, B., and Ghasemi, E. 2016. FTIR spectra of κ -carrageenan, chitosan, and their bionanocomposites. *Journal of Applied Polymer Science*. 133(22).
- Moura, J.M., B.S. Farias, T.R.S. Cadaval, L.A.A. Pinto. 2021. Chitin/Chitosan Based Films for Packaging Applications.
- Mudaffar, R.A. 2020. Karakteristik edible film dari limbah kulit singkong dengan penambahan kombinasi plasticizer serta aplikasinya pada buah nanas terolah minimal. *Journal Tabaro*. 4(2) : 473 – 483.
- Muthiah, U., R. Ningtyas., dan S. Imam. 2020. Pengaruh penambahan konsentrasi gliserol dan aloe vera pada pembuatan plastik biodegradable pati ubi terhadap sifat mekanik dan antimikroba. *Journal Printing and Packaging Technology*. 1(1):93-104.
- Necas, J., & Bartosikova, L. 2013. Carrageenan: a review. *Veterinari Medicina*. 58(4): 187–205.
- No, H. K., Meyers, S. P., Prinyawiwatkul, W., and Xu, Z. 2007. Applications of chitosan for improvement of quality and shelf life of foods: a review. *Journal of Food Science*. 72(5).
- Nur, R.A., N. Nazir., dan G. Taib. 2020. Karakteristik bioplastik dari pati biji durian dan pati singkong yang menggunakan bahan pengisi MCC (*Microcrystalline Cellulose*) dari kulit kakao. *Gema Adro*. 25(1) : 1-10.
- Nugroho, A. A., Basito, dan R. B. K. A. 2013. Kajian Pembuatan Edible Film Tapioka Dengan Pengaruh Penambahan Pektin Beberapa Jenis Kulit Pisang Terhadap Karakteristik Fisik Dan Mekanik. *Jurnal Teknosains Pangan Januari Jurusan Teknologi Hasil Pertanian Universitas Sebelas Maret Jurnal Teknosains Pangan* 2:2302–733.
- Perdones. Á., Escriche, I., Chiralt, A., and Vargas M. 2016. Effect of chitosan-lemon essential oil coatings on volatile profile of strawberries during storage. *Food Chem*.15(86).
- Pereira, T. 2021. Effect of fatty acids in polysaccharide-based film properties. *Carbohydrate Polymers*. 255: 117457.
- Pirinc, F. T., Dagdelen, A. F., and Saricaoglu, F. T. 2021. Mechanical, barrier, thermal, and microstructural properties of poly(lactic acid) and gelatin–beeswax emulsion bi-layer films. *Journal of Food Processing and Preservation*.45(12).



- Pongjanyakul, T., Puttipipatkachorn, S. 2007. Sodium alginate-magnesium aluminum silicate composite gels: characterization of flow behavior, microviscosity, and drug diffusivity. *AAPS PharmSciTech*. 7: 8(3). Development and Evaluation of a Stable Oil-in-Water Emulsion with High Ostrich Oil Concentration for Skincare Applications. 29(5) :982.
- Ponphaibon, J., S. Limmatvapirat., and C. Limmatvapirat. 2024. Development and Evaluation of a Stable Oil-in-Water Emulsion with High Ostrich Oil Concentration for Skincare Applications. *Molecules*. 2(29).
- Potivas, T., and Laokuldilok, T. 2014. Deacetylation of chitin and the properties of chitosan films with various deacetylation degrees. *Chiang Mai University Journal of Natural Sciences*. 13(1).
- Prasetyo, Ari E. 2012. Potensi gliserol dalam pembuatan turunan gliserol melalui proses esterifikasi. *Jurnal Ilmu Lingkungan Undip*. 10(1) : 26-31.
- Priyadarshi, R. dan J. Rhim. 2020. Chitosan-based biodegradable functional films for food packaging applications. *Innovative Food Science and Emerging Technologies*. 62: 120.
- Purnavita, S., Subandriyo, D. Y., and Anggraeni, A., 2020. Penambahan gliserol terhadap karakteristik bioplastik dari komposit pati aren dan glukomanan. *METANA*. 16(1): 19-25.
- Putra, E.P.D., dan H. Saputra. 2020. Karakterisasi plastik biodegradable dari pati limbah kulit pisang muli dengan plasticizer sorbitol. *Jurnal Teknologi Pertanian Andalas*. 24(1) : 31-36.
- Qiu, L., Luo, Q., Bai, C., Xiong, G., Jin, S., Li, H., and Liao, T. 2023. Preparation and characterization of a biodegradable film using irradiated chitosan incorporated with lysozyme and carrageenan and its application in crayfish preservation. *Foods*. 12(14).
- Rahmatullah., R.W. Putri., E. Nurisman., Yandriyani., A. Hadi., dan M.A. Raihan. 2024. Pembuatan *biodegradable bioplastic* dari campuran pati dan serat kapuk dengan variasi kitosan dan gliserol. *Agroindustrial Technology Journal*. 8(1):60-76.
- Rami, N., Rai, S., Basu, D., Patel, S., Patel, Y., Sanyal, A., & Sen, D. J. 2017. Scale ranging 1–20 of surfactant decides the solubility of water into oil or oil into water to produce monophasic formulation. *International Educational Scientific Research Journal*. 3(2).
- Rhim, J.W., A. K. Monhaty., S.P. Singh., and K.W. Perry. 2006. Effect of the processing methods on the performance of polylactide films: Thermocompression versus solvent casting. *Journal of Applied Polymer Science*. 101(6):3736-3742.
- Ridlo, S. Sedjati, E. Supriyantini, and D. A. Zanjabila, 2023. Pengembangan dan karakterisasi bioplastik karagenan-alginat-gliserol dengan perlakuan kalsium klorida. *Buletin Oseanografi Marina*. 12(1) : 43-53.



- Román-Doval, R., Martínez-Hernández, J. L., Aguilar-González, C. N., Hernández-Flores, J. L., Espinoza-Hicks, J. C., and Aguilar, C. N. 2023. Chitosan: Properties and its application in agriculture. *Polymers*. 15(13) : 2867.
- Rowe, R.C., J.S. Paul, and E.Q. Marian. 2009. *Handbook of Pharmaceutical Exipients*. Pharmaceutical Press and American Pharmacist Association, USA: 808-809.
- Sanyang, M. L., Sapuan, S. M., Jawaid, M., Ishak, M. R., & Sahari, J. 2016. Effect of plasticizer type and concentration on physical properties of biodegradable films based on sugar palm (*Arenga pinnata*) starch for food packaging. *Journal of Food Science and Technology*. 53(1) :326–336.
- Sari, D.K., W. Atmaka., dan D.R.A. Muhammad. 2013. Pengaruh penggunaan edible coating pari biji nangka (*Artocarpus heterophyllus*) dengan berbagai variasi gliserol sebagai plasticizer terhadap kualitas jenang dodol selama penyimpanan. *Jurnal Teknosains Pangan*. 2(2) : 103-111.
- Sari, Y.W., S.Y. Putri, S.Y., N. Intan., A. Bahtiar., M. Kurniati. 2023. The effect of sorbitol and sweet sorghum to carrageenan ratio on the physicochemical properties of sweet sorghum/carrageenan bioplastics. *Biomass Convers. Biorefinery*. 3 : 2719–2728
- Sarheed, O., Dibi, M., and Ramesh, K.V. 2020. Studies on the effect of oil and surfactant on the formation of alginate-based o/w lidocaine nanocarriers using nanoemulsion template. *Pharmaceutics*. 12(12) : 1223.
- Sasria, N., A. Asrilisyah., M.P.D. Lubis., A. Zulfikar., dan R.A. Tanjung. 2020. Sintesis dan karakterisasi plastik *biodegradable* berbasis pati nasi aking dan kitosan cangkang udang. *Jurnal Sains dan Teknologi*. 16(2):231-236.
- Saputro, A. N. C. dan A. L. Ovita. 2017. Sintesis dan karakterisasi bioplastik dari kitosanpati ganyong (*Canna edulis*). *Jurnal Kimia dan Pendidikan Kimia*. 1(2): 13-21.
- Serna C.P., and Filho, J.F. 2015. Biodegradable zein-based blend films: structural, mechanical and barrier properties. *Food Technol Biotechnol*. 53(3):348-353.
- Setiani, W., T. Sudiarti., dan L. Rahmidar. 2013. Preparasi dan karakterisasi *edible film* dari poliblnd pati sukun-kitosan. *Jurnal Valensi*. 3(2):100-109.
- Seyedi, S., Koocheki, A., Mohebbi, M., & Zahedi, Y. 2015. Improving the physical and moisture barrier properties of *Lepidium perfoliatum* seed gum biodegradable film with stearic and palmitic acids. *International Journal of Biological Macromolecules*. 77 : 151–158.
- Shen G, Yu G, Wu H, Li S, Hou X, Li M, Li Q, Liu X, Zhou M, Chen A, Zhang Z. 2021. Incorporation of lipids into wheat bran cellulose/wheat gluten composite film improves its water resistance properties. *Membranes (Basel)*. 12(1):18.



- Sitanggang, A.B., M.F. Irsali., dan S. Rawdkeun. 2020. Inkorporasi oleat dan ekstrak antosianin pada film gelatin sebagai indikator pH untuk kemasan pintar. *Jurnal Teknologi dan Industri Pangan*. 31(1):66-75.
- Sivarooban, T., Hettiarachchy, N.S. and Johnson, M.G. 2008. Physical and antimicrobial properties of grape seed extract, nisin, and EDTA incorporated soy protein edible films. *Food Res. Int.* 41:781–785.
- Smith, D. R., Escobar, A. P., Andris, M. N., Boardman, B. M., and Peters, G. M. (2021). Understanding the molecular-level interactions of glucosamine-glycerol assemblies: A model system for chitosan plasticization. *ACS Omega*. 6(39). 25227-25234.
- Sothornvit. R. dan J.M. Krochta. 2000. Plasticizer effect on oxygen permeability of tlagoglobulin films. *Journal of agric and food cherm*. 48: 6298-6302
- Souza, V.C., L. M.L. Monte., and L.A.A Pinto. 2011. Preparation of biopolymer film from chitosan modified with lipid fraction. *International Journal of Food Science & Technology*. 4(6):1856-1862.
- Sulistyo, F.T., Utomo, A.R., dan Setijawati, E. 2018. Pengaruh konsentrasi karagenan terhadap karakteristik fisikokimia edible film berbasis gelatin. *Jurnal Teknologi Pangan dan Gizi*. 17 (2) : 81-87.
- Supeni, G., A.A. Cahyaningtyas., dan A. Fitriana. .2015. Karakterisasi sifat fisik dan mekanik penambahan kitosan pada edible film karagenan dan tapioka termodifikasi. *Jurnal Kimia dan Kemasan*, 37(2):103-110
- Szymańska E, Winnicka K. 2025. Stability of chitosan-a challenge for pharmaceutical and biomedical applications. *Mar Drugs*. 13(4):1819-46.
- Tan SX, Ong HC, Andriyana A, Lim S, Pang YL, Kusumo F, Ngoh GC. 2022. Characterization and parametric study on mechanical properties enhancement in biodegradable chitosan-reinforced starch-based bioplastic film. *Polymers (Basel)*. 14(2):278.
- Tavares, K. M., A. de Campos, B. R. Luchesi, A. A. Resende, J. E. de Oliveira, and J. M. Marconcini. 2020. Effect of carboxymethyl cellulose concentration on mechanical and water vapor barrier properties of corn starch films.
- Thakur, Vijay Kumar and Thakur Manju Kumari. 2016. *Handbook of Polymers for Pharmaceutical Technologies Volume 4*. New Jersey : John Wiley & Sons.
- Tong L, Kang X, Fang Q, Yang W, Cen S, Lou Q, Huang T. 2022. Rheological properties and interactions of fish gelatin- κ -carrageenan polyelectrolyte hydrogels: The effects of salt. *J Texture Stud*. 53(1):122-132.
- Udomrati S, Cheetangdee N, Gohtani S, Surojanametakul V, Klongdee S. 2019. Emulsion stabilization mechanism of combination of esterified maltodextrin and Tween 80 in oil-in-water emulsions. *Food Sci Biotechnol*. 29(3):387-392.



- Valizadeh, S., M. Naseri., S. Babaei., S.M.H. Hosseini., Imani, A. 2019 Development of bioactive composite films from chitosan and carboxymethyl cellulose using glutaraldehyde, cinnamon essential oil and oleic acid. *International Journal Biology Macromol.* 1(134) : 604-612.
- Vargas, M., A. Albors., A. Chiralt., and C.G. Martinez. 2009. Characterization of chitosan-oleic acid composite films. *Food Hydrocolloids.* 23(9):536-547.
- Vieira, M.G.A., da Silva, M.A., dos Santos, L.O. and Beppu, M.M. 2011. Natural-Based Plasticizers and Biopolymer Films: A Review. *European Polymer Journal*, 47, 254-263.
- Wahyuningtyas, Meliana., dan Atmaja, Lukman. 2016. Pembuatan dan Karakterisasi Film Pati Kulit Ari Singkong/Kitosan dengan Plasticizer Asam Oleat. *Indonesian Journal of Chemical Science.* 5(1).
- Wang, Z., Liu, H., & Li, J. 2023. The role of tween surfactants in stabilizing biopolymer films. *Journal of Applied Polymer Science.* 140(12).
- Wang, Q., Peng, L., Du, J., and Ma, L. 2022. Effects of acetic acid on properties of gelatin-chitosan film and its application. *Packaging Engineering.* 43(3): 1-8.
- Widyaningsih, S., D. Kartika, dan Y. T. Nurhayati. 2012. Pengaruh penambahan sorbitol dan kalsium karbonat terhadap karakteristik dan sifat biodegradasi film dari pati kulit pisang. *Molekul.* 7(1): 69-81.
- Yadav, M., P. Goswami., K. Paritosh., M. Kumar., N. Pareek., and V. Vivekanand. 2019. Seafood waste: a source for preparation of commercially employable chitin/chitosan materials. *Bioresour Bioprocess.* 6(8):1-20.
- Yang J, Ching YC, Julai J S, Chuah CH, Nguyen DH, Lin P-C. 2022. Comparative study on the properties of starch-based bioplastics incorporated with palm oil and epoxidized palm oil. *Polymers and Polymer Composites.* 30.
- Younes, I., and M. Rinaudo. 2015. Chitin and chitosan preparation from marine sourcea. *Marine drugs.* 13(3):1133-1174.
- Yuang Keung, Lee. 2013. *Microbial Biotechnology Principles and Applications.* World Scientific.
- Zahedi, Y., Ghanbarzadeh, B. and Sedaghat, N. 2010. Physical properties of edible emulsified films based on pistachio globulin protein and fatty acids. *Journal of Food Engineering.* 100(1):102-108.
- Zakaria, Z., Izzah, Z., Jawaid, M., and Hassan, A. 2012. Effect of degree of deacetylation of chitosan on thermal stability and compatibility of chitosan polyamide blend. *Bioresources.* 7 (4) : 5568-5580.
- Zehra A, Wani SM, Jan N, Bhat TA, Rather SA, Malik AR, Hussain SZ. 2022. Development of chitosan-based biodegradable films enriched with thyme



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essential oil and additives for potential applications in packaging of fresh collard greens. *Sci Rep.* 12(1):16923.