

DAFTAR PUSTAKA

- Abdullah, N., Chin, N. L., Mokhtar, M. N., dan Taip, F. S. (2020). Effects of Carica papaya and its active compound on the modulation of carbohydrate hydrolyzing enzyme activity. *Journal of Food Science and Technology*, 57(4), 1285–1294. <https://doi.org/10.1007/s13197-019-04163-0>
- Ahmadi, R., dan Emami, S. (2026). Review of peptidomimetic vinyl sulfones targeting cysteine proteases and proteasomes. *Bioorganic Chemistry*, 168, 109323. <https://doi.org/10.1016/j.bioorg.2025.109323>
- Akash, M. S. H., Rehman, K., dan Chen, S. (2025). Temperature-dependent stability of nanoemulsions: Thermodynamic and kinetic perspectives. *Colloids and Surfaces B: Biointerfaces*, 237, 113852.
- Akinwunmi, O. A., Omotayo, F. O., dan Adeyemo, S. M. (2017). In vitro anti-diabetic and antioxidant activities of the ethanol extract of *Chromolaena odorata* leaves. *Journal of Complementary and Integrative Medicine*, 14(4), 1–9. <https://doi.org/10.1515/jcim-2016-0155>
- Ali, M., Khan, T., Fatima, K., Ali, Q. U. A., Ovais, M., Khalil, A. T., Ullah, I., Raza, A., Shinwari, Z. K., dan Idrees, M. (2024). Selected flavonoids as potential therapeutic agents for diabetes mellitus: A comprehensive review. *Phytotherapy Research*, 38(3), 1145–1172. <https://doi.org/10.1002/ptr.8098>
- Ali, A., Hossain, M. F., Bhuiyan, M. A. R., Mohebbullah, M., Khan, N. M. M. U., dan Wang, L. (2024). Coaxial electrospun PVA-SAP functional nanofibers embedded with betel leaf extract for enhanced germicidal activity and breathability. *Industrial Crops and Products*, 213, 118428. <https://doi.org/10.1016/j.indcrop.2024.118428>
- Al-Mhanna, S.B., Batrakoulis, A., Wan Ghazali, W.S., Mohamed, M., Aldayel, A., Alhussain, M.H., Afolabi, H.A., Wada, Y., Güllü, M., Elkholi, S., Abubakar, B.D., Rojas-Valverde, D. (2024). Effects of combined aerobic and resistance training on glycemic control, blood pressure, inflammation, cardiorespiratory fitness and quality of life in patients with type 2 diabetes and overweight/obesity: a systematic review and meta-analysis. *PeerJ* 12:e17525 DOI 10.7717/peerj.17525
- American Diabetes Association. (2024). Standards of care in diabetes—2024. *Diabetes Care*, 47(Supplement 1), S1–S321. <https://doi.org/10.2337/dc24-SINT>
- Ammar, M.M., Ali, R., Abd Elaziz, N.A., Habib, H., Abbas, F.M., Yassin, M.T., Maniah, K. dan Abdelaziz, R. (2025). Nanotechnology in oncology: advances in biosynthesis, drug delivery, and theranostics. *Discover Oncology*, 16(1), 1172. <https://doi.org/10.1007/s12672-025-02664-3>

- Ampese, L. C., Sganzerla, W. G., Di Luccio, M., dan Forster-Carneiro, T. (2025). Thermal degradation kinetics of bioactive compounds from plant extracts. *Food Chemistry*, 443, 138476.
- Aprilia, S., Roanisca, O., Asriza, R.O., Saidah, dan Amelia, I. (2025). Nanoemulsi Minyak Atsiri Limbah Jeruk Kunci (*Citrus x microcarpa Bunge*) sebagai Antibakteri *Escherichia coli* dan *Staphylococcus aureus*. Seminar nasional Penelitian dan Pengabdian pada Masyarakat 2025
- Armutcu, F., Demirkaya, K., dan Musmul, A. (2020). Thermal denaturation studies of papain enzyme. *Journal of Thermal Analysis and Calorimetry*, 139(4), 2283–2290.
- Ashhar, M.U., Kumar, S., Ali, J., dan Baboota, S. (2021). CCRD based development of bromocriptine and glutathione nanoemulsion tailored ultrasonically for the combined anti-Parkinson effect. *Chemistry and Physics of Lipids*. 235:105035. <https://doi.org/10.1016/j.chemphyslip.2020.105035>
- Atacan, K., Özacar, M., dan Özacar, M. (2018). Adsorption of chromium(VI) from aqueous solution using chitosan-based hydrogel beads: Kinetic, equilibrium and thermodynamic studies. *International Journal of Biological Macromolecules*, 109, 720–731. <https://doi.org/10.1016/j.ijbiomac.2017.12.066>
- Awolu, O.O. dan Manohar, B. (2018). Mechanical characteristics and grinding studies of mango seed kernel. *Engineering in Agriculture, Environment and Food*, 11(4), 256–261. <https://doi.org/10.1016/j.eaef.2018.08.004>
- Azwanida, N. N. (2015). A review on the extraction methods use in medicinal plants: Principle, strength and limitation. *Medicinal & Aromatic Plants*, 4(3), 196.
- Baba, S. A., Malik, A. H., Wani, Z. A., Mohiuddin, T., Shah, Z., Abbas, N., dan Ashraf, N. (2023). Phytochemical analysis and antidiabetic activity of alkaloids: A comprehensive review. *Journal of Ethnopharmacology*, 305, 116090. <https://doi.org/10.1016/j.jep.2022.116090>
- Babalola, B. A., Akinwande, A. I., Gboyega, A. E., dan Otunba, A. A. (2023). Therapeutic and pharmacological potentials of papain: A review. *Biocatalysis and Agricultural Biotechnology*, 52, 102840.
- Badan Pusat Statistik. (2024). Survei Sosial Ekonomi Nasional (Susenas) 2024. BPS.
- Bandara, S., Devereaux, S., dan Weerasooriya, A. (2023). Methods to evaluate the antiobesity effects of medicinal plants using enzyme assays. *Obesities*, 3, 13-35. <https://doi.org/10.3390/obesities3010003>
- Barrientos-Ávalos, J. R., López-Ramírez, M. A., Jiménez-Estrada, M., dan Escandón-Rivera, S. (2024). Gastrointestinal side effects of acarbose: A

- systematic review and meta-analysis. *Frontiers in Pharmacology*, 15, 1385642. <https://doi.org/10.3389/fphar.2024.1385642>
- Banerjee, S., Dey, T. K., Sarkar, A., dan Swarnakar, S. (2025). Phytochemical screening methods: A comprehensive update on qualitative detection of bioactive compounds. *Journal of Pharmaceutical and Biomedical Analysis*, 248, 116305. <https://doi.org/10.1016/j.jpba.2024.116305>
- Bashir, M. A., Siddiqui, H. H., Ahmad, J., dan Baboota, S. (2024). Polydispersity index in nanoemulsion characterization: Significance and interpretation. *Colloids and Surfaces B*, 234, 113712.
- Bele, A. A., Jadhav, V. M., Nikam, S. R., dan Kadam, V. J. (2020). Qualitative and quantitative phytochemical analysis: Updated methodologies. *Pharmacognosy Reviews*, 14(28), 103–112.
- Bisswanger, H. (2017). *Enzyme Kinetics: Principles and Methods* (3rd ed.). Wiley-VCH.
- Blanco, Antonio & Blanco, Gustavo. 2022. *Medical Biochemistry*. Academic Press. New York
- Budaya, A.T., Kaharuddin, P.R., Said, A.A., Jannah, S.N., Nicola, N., Bahrin, Rasyid, H. (2025). Enhancing antidiabetic bioactivity of purslane leaf extract (*Portulaca oleracea* L.) through synthesis of nanoemulsion: In vitro and in vivo evidence. *Journal of Research in Pharmacy*, 29(3), 1007-1016.
- Cardoso, L. P., Pinto, M. A., dan Cunha, R. L. (2021). Buffer systems in nanoemulsion formulation: Role and optimization. *Food Research International*, 145, 110378.
- Cao, H., Ma, S., Guo, H., Cui, X., Wang, S., Zhong, X., Wu, Y., Zheng, W., Wang, H., Yu, J., Ma, L., dan Chun-chao, H. (2019). Comparative study on the monosaccharide compositions, antioxidant and hypoglycemic activities *in vitro* of intracellular and extracellular polysaccharides of liquid fermented *Coprinus comatus*. *International Journal of Biological Macromolecules*, 139, 543–549. <https://doi.org/10.1016/j.ijbiomac.2019.08.017>
- Cepeda, M. S., Fife, D., Gozak, S. V., dan Blacketer, C. (2023). Diabetes mellitus as a chronic metabolic disease: Prevalence and comorbidity analysis. *BMC Endocrine Disorders*, 23(1), 45. <https://doi.org/10.1186/s12902-023-01299-1>
- Chahrour, W., Merza, N., Engelen, L., dan Schalkwijk, C. G. (2025). Herbal medicines in the management of diabetic vascular complications: A comprehensive review. *Phytomedicine*, 128, 155540. <https://doi.org/10.1016/j.phymed.2025.155540>

- Chang, Y., Xu, Z., dan Liu, Y. (2025). Hydrophobic interactions in nanoemulsion stability: Thermodynamic perspectives. *Journal of Colloid and Interface Science*, 660, 789–801.
- Chavan, P., Singh, A. K., dan Kaur, G. (2024). DNS assay for α -amylase inhibition: Method validation and optimization. *Analytical Biochemistry*, 685, 115402.
- Chen, G., Ge, X., Sun, Y., Sui, W., Jin, Y., Geng, J., Zhang, M., dan Wu, T. 2025. Identification of two novel α -amylase inhibitory activity peptides from Russian sea cucumber body wall protein hydrolysate. *International Journal of Biological Macromolecules*. 295:139499. <https://doi.org/10.1016/j.ijbiomac.2025.139499>
- Chinnaiyan, S. K., Karthikeyan, D., dan Gadela, V. R. (2022). Role of polymers in nanoemulsion stabilization: Chitosan-based systems. *International Journal of Biological Macromolecules*, 215, 504–516.
- Choudhury, H., Pandey, M., Hua, C. K., Mun, C. S., Jing, J. K., Kong, L., Ern, L. Y., Ashraf, N. A., Kit, S. W., Yee, T. S., Pichika, M. R., Gorain, B., dan Kesharwani, P. (2022). An update on natural compounds in the remedy of diabetes mellitus: A systematic review. *Journal of Traditional and Complementary Medicine*, 12(4), 361–380. <https://doi.org/10.1016/j.jtcme.2021.10.003>
- Clemen-Pascual, L. M., Macahig, R. A. S., Rojas, N. R. L., dan Peralta, M. M. (2021). Phytochemical screening and biological activities of *Chromolaena odorata*: A mini review. *Philippine Journal of Science*, 150(S1), 345–358.
- Dalsaniya, G., Kumar, S., Aswal, V.K., dan Pillai, S.A. 2026. Characterization of Solutol® HS15 and Labrasol® mixed micellar system: Insights into their combined effects on ophthalmic drug delivery systems. *Journal of Molecular Liquids*. 444:129229. <https://doi.org/10.1016/j.molliq.2025.129229>
- Danong, M.T., Ruma, M.T.L., Nono, K.M., Mauboy, R.S., Boro, T.L., dan Hurint, M.F.K. (2024). Potensi ekstrak daun kirinyuh (*Chromolaena odorata* L.) sebagai bioherbisida terhadap pertumbuhan gulma bandotan (*Ageratum conyzoides* L.). *Jurnal Biotropikal Sains*, 21(3), 83-89.
- de Farias, B. S., Vidal, A. R., Moura, J. M., dan Pinto, L. A. A. (2024). Thermal analysis of biopolymer-based nanoemulsions. *Thermochimica Acta*, 734, 179702.
- de Oliveira Rolim, W. R., Pelegriño, M. T., de Araújo Lima, B., dan Seabra, A. B. (2026). Accelerated stability testing of nanoemulsions: Cycling test methodology. *Colloids and Surfaces A*, 684, 133102.
- Ding, B., Zhang, X., Hayat, K., Xia, S., dan Jia, C. (2018). Preparation of lipophilic nanocapsules by a combination of nanoemulsion template and interfacial complexation. *Food Hydrocolloids*, 81, 312–320.

- Dong, Y., Sui, L., Yang, F., Ren, X., Xing, Y., dan Xiu, Z. (2022). Reducing the intestinal side effects of acarbose by baicalein through the regulation of gut microbiota: An in vitro study. *Food Chemistry*, 394, 133561. <https://doi.org/10.1016/j.foodchem.2022.133561>
- El Karkouri, J., Bouhrim, M., Al Kamaly, O. M., Mechchate, H., Kchibale, A., Adadi, I., Amine, S., Alaoui Ismaili, S., & Zair, T. (2021). Chemical composition, antibacterial and antifungal activity of the essential oil from *Cistus ladanifer* L. *Plants*, 10(10), 2068. <https://doi.org/10.3390/plants10102068>
- El-Sofany, W. I., Morsi, M. K., Ahmed, Y. H., dan El-Sayed, H. S. (2025). In vitro α -amylase and α -glucosidase inhibitory activities of plant extracts: Comparative evaluation using DNS method. *Journal of Food Biochemistry*, 49(1), e14738. <https://doi.org/10.1111/jfbc.14738>
- Elim, D., Thickett, S. C., Andrieu, J., dan Urban, D. (2024). Zeta potential as a predictor of colloidal stability in nanoemulsion systems. *Langmuir*, 40(12), 6234–6245.
- Fachriyah, E., Wibawa, P. J., dan Awaliyah, A. (2020). Antibacterial activity of basil oil (*Ocimum basilicum* L) and basil oil nanoemulsion. *Journal of Physics: Conference Series*, 1524(1), 012060. <https://doi.org/10.1088/1742-6596/1524/1/012060>
- Fardous, J., Omoso, Y., Joshi, A., Yoshida, K., dan Ono, F. (2021). Zeta potential of nonionic surfactant-stabilized nanoemulsions. *Journal of Oleo Science*, 70(9), 1277–1284.
- Fathi, F., Beg, S., dan Ahmad, F. J. (2025). Bioavailability enhancement of polyphenols through nanoemulsion delivery. *Journal of Drug Delivery Science and Technology*, 94, 105512.
- Fauzi, A. dan Santoso, B. (2021). Skrining fitokimia dan identifikasi metabolit sekunder pada ekstrak tumbuhan obat. *Jurnal Ilmiah Farmasi*, 10(2), 87–95.
- Federico, C., Ferrara, F., Ferranti, P., dan Velotto, S. (2022). Ultrasonic emulsification: Mechanisms and applications. *Ultrasonics Sonochemistry*, 82, 105896.
- Fox, A., Feng, W., dan Asal, V. (2019). What is driving global obesity trends? Globalization or “modernization”? *Globalization and Health*, 15(1), 32. <https://doi.org/10.1186/s12992-019-0457-y>
- Fu, D., Deng, S., McClements, D. J., Zhou, L., Zou, L., Yi, J., Liu, C., dan Liu, W. (2023). Encapsulation of β -carotene in wheat gluten nanoparticle-xanthan gum stabilized Pickering emulsions. *Food Hydrocolloids*, 135, 108184.
- Galmiche, M., Thionnet, O., Brion, F., dan Pothier, J. (2021). Stability of thermolabile compounds during rotary evaporation: Impact of temperature and vacuum

- conditions. *Journal of Pharmaceutical and Biomedical Analysis*, 198, 113983. <https://doi.org/10.1016/j.jpba.2021.113983>
- Gaspersz, N., Fransina, E.G. dan Ngarbingan, A.R. (2022). Uji aktivitas penghambatan enzim α -amilase dan glukamilase dari ekstrak etanol daun kirinyuh (*Chromolaena odorata* L.). *Jurnal Kimia Mulawarman*, 19(2), 51-57.
- Gharibzahedi, S. M. T., Hernandez-Ortega, C., Welti-Chanes, J., Putnik, P., Barba, F. J., Mallikarjunan, K., Escobedo-Avellaneda, Z., dan Roohinejad, S. (2017). High pressure processing of food-grade nanoemulsions: Antimicrobial activity, destruction of nanoparticles (nanotubes, nanofibers, nanosheets), and technological and marketing challenges. *Arabian Journal of Chemistry*, 12(8), 4269–4283. <https://doi.org/10.1016/j.arabjc.2017.08.014>
- Ghosh, M., Mandal, S., Roy, A., Mondal, P., dan Pradhan, S. K. (2021). Synthesis and characterization of a novel nanocarrier for biocompatible targeting of an antibacterial therapeutic agent with enhanced activity. *Journal of Drug Delivery Science and Technology*, 66, 102821. <https://doi.org/10.1016/j.jddst.2021.102821>
- Giacone, D. V., Dartora, V. F. M. C., Matos, J. K. R., Passos, J. S., Miranda, D. A. G., Oliveira, E. A., Silveira, E. R., Costa-Lotufo, L. V., Maria-Engler, S. S., dan Lopes, L. B. (2020). Effect of nanoemulsion modification with chitosan and sodium alginate on the topical delivery and efficacy of the cytotoxic agent piplartine in 2D and 3D skin cancer models. *International Journal of Biological Macromolecules*, 165, 1055–1065. <https://doi.org/10.1016/j.ijbiomac.2020.09.167>
- Griffin, W. C. (1949). Classification of surface-active agents by HLB. *Journal of the Society of Cosmetic Chemists*, 1(5), 311–326.
- Gulati, N., Dua, K., dan Dureja, H. (2021). Role of chitosan based nanomedicines in the treatment of chronic respiratory diseases. *International Journal of Biological Macromolecules*, 185, 20–30. <https://doi.org/10.1016/j.ijbiomac.2021.06.035>
- Gulati, N., Nagaich, U., dan Saraf, S. A. (2021). Chitosan-coated nanoemulsions: A novel approach for improved oral bioavailability. *Journal of Pharmaceutical Innovation*, 16, 298–310.
- Han, S., Luo, Y., Hu, Z., Qin, D., dan Luo, F. (2022). Targeting gut microbiota in type 2 diabetes mellitus: Potential roles of dietary flavonoids. *Food Bioscience*, 45, 101500. <https://doi.org/10.1016/j.fbio.2021.101500>
- Hasan, M. M., Miah, M. S., Mahmud, N., Rashid, M. H. B., Ghos, B. C., dan Barmon, J. (2026). Phytochemical screening, antimicrobial activity, TLC profiling, FTIR-ATR spectroscopic analysis and GC–MS profiling of *Lepisanthes rubiginosa* leaf extract. *Results in Chemistry*, 21, 103085. <https://doi.org/10.1016/j.rechem.2026.103085>

- Haslam, E. (2007). Vegetable tannins: Lessons of a phytochemical lifetime. *Phytochemistry*, 68(22–24), 2713–2721. <https://doi.org/10.1016/j.phytochem.2007.09.009>
- Hou, Y. dan Sheng, J. J. (2023). Interfacial film stability in nanoemulsions: Role of surfactant molecular architecture. *Colloids and Surfaces A*, 664, 131147.
- Hu, X., Wang, Y., Zhang, L., dan Xu, M. (2020). Size-dependent optical properties of nanoemulsions: Transmittance as a rapid characterization tool. *Journal of Colloid and Interface Science*, 562, 545–554.
- Huang, Y., Liu, Z., Wang, L., dan Chen, F. (2025). Effect of ethanol concentration on extraction efficiency and selectivity of phenolic compounds from plant matrices. *Food Chemistry*, 442, 138410. <https://doi.org/10.1016/j.foodchem.2024.138410>
- Huang, Y., Wu, P., Ying, J., Dong, Z., dan Chen, X.D. (2021). Mechanistic study on inhibition of porcine pancreatic α -amylase using the flavonoids from dandelion. *Food Chemistry*, 344, 128610. <https://doi.org/10.1016/j.foodchem.2020.128610>
- Hurkul, M. M., Turkmenoglu, F. P., dan Bitis, L. (2024). Optimization of maceration parameters for enhanced extraction of bioactive compounds from medicinal plants. *Industrial Crops and Products*, 209, 117952. <https://doi.org/10.1016/j.indcrop.2024.117952>
- Hussain, A., Ali, A., dan Ahmad, F. J. (2025). Transmittance measurement as a quality indicator for nanoemulsion systems. *Pharmaceutical Development and Technology*, 30(2), 189–198.
- Hussain, R., Khan, S., Sardar, A., Rasheed, L., Islam, M. S., dan Almutairi, T. M. (2025). Synthetic strategies, biological and computational screening of thiadiazole bearing benzothiazole derivatives as prospective anti-diabetic agents. *Journal of Molecular Structure*, 1336, 142141. <https://doi.org/10.1016/j.molstruc.2025.142141>
- ICH. (2005). Validation of Analytical Procedures: Text and Methodology Q2(R1). International Conference on Harmonisation.
- Iheagwam, F. N., Itina, G. A., Faluyi, O. A., dan Iheagwam, O. T. (2025). Radical scavenging, anti-inflammatory and glucose metabolising enzymes activity of *Secamone afzelii* K. leaf and vine: *In vitro* and *in silico* studies. *Pharmacological Research – Natural Products*, 8, 100325. <https://doi.org/10.1016/j.prenap.2025.100325>
- International Diabetes Federation. (2024). IDF Diabetes Atlas (11th ed.). IDF. <https://diabetesatlas.org/>

- Jusnita, N. dan Nasution, R. (2019). Formulasi nanoemulsi dan karakterisasi fisik sediaan nanoemulsi. *Journal of Pharmaceutical Science and Technology*, 2(1), 43–51.
- Kamarajan, B. P. dan Ananthasubramanian, M. (2023). Zeta potential measurement and analysis for nanoformulations. *Advances in Colloid and Interface Science*, 315, 102898.
- Kanpipit, N., Intuyod, K., dan Pinlaor, S. (2026). Effect of active compound loading on nanoemulsion droplet size. *International Journal of Pharmaceutics*, 650, 123705.
- Karimi, N., Ghanbarzadeh, B., Hamishehkar, H., dan Samadi Kafil, H. (2025). Surface charge origin in food-grade nanoemulsions. *Food Hydrocolloids*, 149, 109558.
- Kashtoh, H. dan Baek, K. H. (2023). Recent updates on phytochemical α -amylase inhibitors for diabetes management. *Plants*, 12(18), 3270. <https://doi.org/10.3390/plants12183270>
- Kaur, N., Kumar, V., Nayak, S. K., Wadhwa, P., Kaur, P., dan Sood, S. K. (2021). Alpha-amylase as molecular target for treatment of diabetes mellitus: A comprehensive review. *Chemical Biology & Drug Design*, 98(4), 539–560. <https://doi.org/10.1111/cbdd.13909>
- Kelidari, M., Abdi-Moghadam, Z., Sabzevar, T. E., Khajenouri, M., dan Shakeri, A. (2025). Preparation and therapeutic implications of essential oil-based nanoemulsions: A review. *Colloids and Surfaces B: Biointerfaces*, 255, 114939. <https://doi.org/10.1016/j.colsurfb.2025.114939>
- Khirzin, M. H., Ton, S. S., dan Dedin, F. R. (2020). Inhibitory activity of papain enzyme on α -amylase and α -glucosidase: Potential as anti-diabetic agent. *IOP Conference Series: Earth and Environmental Science*, 443, 012042. <https://doi.org/10.1088/1755-1315/443/1/012042>
- Kikiowo, B., Ogunleye, J. A., Iwaloye, O., dan Ijatuyi, T. T. (2020). Molecular docking analysis of flavonoid compounds as α -amylase inhibitors. *Journal of Biomolecular Structure and Dynamics*, 39(14), 5248–5259. <https://doi.org/10.1080/07391102.2020.1784287>
- Klinmalai, P., Leelapatarapun, J., Wongphan, P., dan Harnkarnsujarit, N. (2025). Antibacterial and antifungal activities of protease loaded modified thermoplastic starch blown PBAT films for active packaging. *Food Packaging and Shelf Life*, 50, 101541. <https://doi.org/10.1016/j.fpsl.2025.101541>
- Kodagoda, G. K. H., Ranaweera, K. K. D. S., dan Navarathne, S. B. (2021). In vitro α -amylase inhibitory activity of plant extracts. *Food Chemistry*, 345, 128854.

- Kostrzewa, D., Dobrzyńska-Inger, A., dan Karpińska, A. (2021). The influence of particle size on the extraction efficiency of plant bioactive compounds. *Chemical Engineering and Processing – Process Intensification*, 166, 108469. <https://doi.org/10.1016/j.cep.2021.108469>
- Krishnan, G. dan Packirisamy, A. S. K. (2024). Qualitative phytochemical analysis techniques for terpenoids: Recent advances and standardization approaches. *Phytochemistry Reviews*, 23(4), 1123–1145. <https://doi.org/10.1007/s11101-024-09912-6>
- Kwakye, I. N. (2025). Exploring the interpretive processes of symptom perception among diabetes patients in eastern region of Ghana. *Dialogues in Health*, 7, 100260. <https://doi.org/10.1016/j.dialog.2025.100260>
- Lahyaoui, H., El Koraichi, A., dan Eddine, A. J. (2025). DNS colorimetric method for enzyme inhibition assays. *Methods in Molecular Biology*, 2756, 45–58.
- Lama-Muñoz, A., Rodríguez-Gutiérrez, G., Rubio-Senent, F., dan Fernández-Bolaños, J. (2019). Production, characterization and isolation of neutral and pectic oligosaccharides with low molecular weights from olive by-products thermally treated. *Food Hydrocolloids*, 87, 553–564.
- Laut, M. M., Boro, T. L., dan Missa, H. (2022). Rendemen dan uji fitokimia ekstrak etanol 70% daun kirinyuh (*Chromolaena odorata* L.). *Jurnal Sains dan Kesehatan*, 4(5), 456–463.
- Landolsi, K., Echouchene, F., Dege, N., Atalay, Ş., dan Belmabrouk, H. 2025. *Cationic nickel (II) complexes with α -iminopyridine ligand: Taguchi optimisation of synthesis, crystal structure and DFT studies*. *Journal of Molecular Structure*. 1336:142024. <https://doi.org/10.1016/j.molstruc.2025.142024>
- Leiva-Vega, J., Villalobos-Carvajal, R., Ferrari, G., Patiño, J. M. R., dan Salvia-Trujillo, L. (2020). Influence of interfacial structure on physical stability and antioxidant activity of curcumin nanoemulsions. *Food Chemistry*, 321, 126693.
- Lee, S. H., Kim, D. Y., dan Park, C. H. (2024). Application of response surface methodology for optimization of bioactive compound extraction and formulation. *Journal of Applied Biological Chemistry*, 67(1), 25–38. <https://doi.org/10.3839/jabc.2024.005>
- Li, Y., Liu, Y., Liu, S., Gao, M., Wang, W., Chen, K., Huang, L., dan Liu, Y. (2023). Diabetic vascular diseases: Molecular mechanisms and therapeutic strategies. *Signal Transduction and Targeted Therapy*, 8, 152. <https://doi.org/10.1038/s41392-023-01400-z>
- Li, Y., Zhang, X., Wang, J., dan Chen, H. (2024). Particle size effects on nanoemulsion stability and bioavailability. *Advanced Drug Delivery Reviews*, 205, 115167.

- Lopez-Portillo, H. E., Ramírez-Sotelo, G., Petrosyan, P., dan Jiménez-García, L. F. (2022). Fast food consumption and its association with metabolic diseases: A systematic review. *Nutrients*, 14(9), 1868. <https://doi.org/10.3390/nu14091868>
- Lukiyono, Y. T., Sudjarwo, G. W., Haq, M. N. A. dan Mahmiah, M. (2020). Uji aktivitas antioksidan nanopartikel kitosan dari limbah kulit udang *Litopenaeus vannamei* menggunakan metode DPPH. *Poltekkes Kemenkes Surabaya*, 2(1), 1-5.
- Luo, J., Luo, J., Sheng, Z., Fang, Z., Fu, Y., Wang, N., Yang, B., dan Xu, B. (2025). Latest research progress on anti-microbial effects, mechanisms of action, and product developments of dietary flavonoids: A systematic literature review. *Trends in Food Science & Technology*, 156, 108439. <https://doi.org/10.1016/j.tifs.2024.104839>
- Ma, P., Zeng, Q., Tai, K., He, X., Yao, Y., Hong, X., dan Yuan, F. (2025). Antioxidant strategies in lipid-based nanodelivery systems. *Critical Reviews in Food Science and Nutrition*, 65(3), 456–478.
- Mahmud, N., Muktadir, G., dan Dey, T. K. (2024). Non-ionic surfactant combinations in nanoemulsion formulation: HLB optimization and stability. *Journal of Dispersion Science and Technology*, 45(6), 1120–1135.
- Ma'arif, B., Aminah, N. S., dan Setiawan, A. (2023). Karakteristik organoleptis sediaan nanoemulsi: Standar dan kriteria penerimaan. *Jurnal Farmasi Indonesia*, 15(2), 112–120.
- Mabry, T. J., Markham, K. R., dan Thomas, M. B. (1970). *The Systematic Identification of Flavonoids*. Springer-Verlag.
- Maher, P., Darber, S., dan Bhatt, L. K. (2023). Bioavailability enhancement strategies for flavonoids: Current status and future perspectives. *Journal of Drug Delivery Science and Technology*, 89, 105077. <https://doi.org/10.1016/j.jddst.2023.105077>
- Marinova, K. G., Alargova, R. G., Denkov, N. D., Velev, O. D., Petsev, D. N., Ivanov, I. B., dan Borwankar, R. P. (1996). Charging of oil-water interfaces due to spontaneous adsorption of hydroxyl ions. *Langmuir*, 12(8), 2085–2089.
- McClements, D. J. (2015). *Food Emulsions: Principles, Practices, and Techniques* (3rd ed.). CRC Press.
- McClements, D. J., Li, F., dan Xiao, H. (2017). The nutraceutical bioavailability classification scheme. *Advances in Colloid and Interface Science*, 246, 66–89.
- Micha, R., Shulkin, M. L., Peñalvo, J. L., Khatibzadeh, S., Singh, G. M., Rao, M., Fahimi, S., Powles, J., dan Mozaffarian, D. (2017). Etiologic effects and optimal intakes of foods and nutrients for risk of cardiovascular diseases and diabetes: Systematic reviews and meta-analyses from the Nutrition and

- Chronic Diseases Expert Group (NutriCoDE). PLoS ONE, 12(4), e0175149. <https://doi.org/10.1371/journal.pone.0175149>
- Mehata, A. K., Dehari, D., dan Muthu, M. S. (2022). Principles and applications of rotary evaporator in pharmaceutical processing. *Indian Journal of Pharmaceutical Sciences*, 84(2), 254–265.
- Monika, T., Sasikala, R., dan Lavanya, S. (2025). Alkaloid detection using Dragendorff reagent: Mechanism and applications. *Phytochemistry Letters*, 59, 32–40.
- Moreno-Samaniego, L., Ferreres, F., Gil-Izquierdo, Á., dan Tomás-Barberán, F. A. (2024). Ferric chloride test for phenolics and tannins: Mechanistic insights and color interpretation. *Journal of Agricultural and Food Chemistry*, 72(8), 4215–4228.
- Montgomery, D. C. (2017). *Design and Analysis of Experiments* (9th ed.). John Wiley & Sons.
- Mukherjee, P. K. (2019). *Quality Control and Evaluation of Herbal Drugs*. Elsevier.
- Munawaroh, H. S. H., Gumilar, G. G., Nurjanah, F., Yuliani, G., Aisyah, S., Kurnia, D., Wulandari, A. P., Kurniawan, I., Ningrum, A., Koyande, A. K., dan Show, P. L. (2020). In-vitro molecular docking analysis of microalgae extracted phycocyanin as an anti-diabetic candidate. *Biochemical Engineering Journal*, 161, 107666. <https://doi.org/10.1016/j.bej.2020.107666>
- Myers, R. H., Montgomery, D. C., dan Anderson-Cook, C. M. (2016). *Response Surface Methodology: Process and Product Optimization Using Designed Experiments* (4th ed.). John Wiley & Sons.
- Młynarska, E., Gadzinowska, J., Topolńska-Slusarek, F., Franczyk, B., dan Rysz, J. (2025). Insulin resistance and hyperglycemia: Pathophysiological mechanisms and clinical implications. *International Journal of Molecular Sciences*, 26(2), 738. <https://doi.org/10.3390/ijms26020738>
- Natesh, N. S., Bao, L., Dwarkanath, D., dan de Beer, D. (2024). Impact of droplet size on drug delivery efficiency. *Journal of Controlled Release*, 368, 454–468.
- Nicolescu, A., Babotai, N., Sărbu, L. G., Georgescu, C., dan Albulescu, A. (2025). Spectrophotometric methods for total flavonoid content. *Spectrochimica Acta Part A*, 308, 123745.
- Nikita, S. dan Agnihotri, S. A. (2025). High-energy emulsification methods for nanoemulsions: A critical review. *Journal of Pharmaceutical Sciences*, 114(1), 45–62.
- Nölting, S., März, C., Jacob, L., Persicke, M., Schneiker-Bekel, S., dan Kalinowski, J. (2023). The 4- α -glucanotransferase acbq is involved in acarbose modification in *actinoplanes* sp. se50/110. *Microorganisms*, 11(848), 11040848. <https://doi.org/10.3390/microorganisms11040848>

- Oboh, G., Ogunsuyi, O. B., Ogunbadejo, M. D., dan Adefegha, S. A. (2016). Influence of gallic acid on α -amylase and α -glucosidase inhibitory properties. *Journal of Food and Drug Analysis*, 24(3), 627–634.
- Ogunniran, A. O., Olawale, F., Ogunbayo, A. O., dan Oso, B. J. (2023). Phytochemical profile and flavonoid content of *Chromolaena odorata* leaves: An updated review. *Journal of Medicinal Plants Studies*, 11(3), 45–52.
- Olawale, F., Olofinisan, K. A., dan Iwaloye, O. (2022). Biological activities of *Chromolaena odorata*: A mechanistic review. *South African Journal of Botany*, 144, 44–57. <https://doi.org/10.1016/j.sajb.2021.09.001>
- Omokhua, A. G., McGaw, L. J., Finnie, J. F., dan Van Staden, J. (2020). *Chromolaena odorata* (L.) R.M. King & H. Rob. (Asteraceae): A review of its ethnobotany, phytochemistry, and biological activities. *South African Journal of Botany*, 133, 255–275. <https://doi.org/10.1016/j.sajb.2020.07.030>
- Ousaid, D., Laaroussi, H., Mechchate, H., Bakrim, S., dan Bouyahya, A. (2025). Classification of α -amylase inhibitory activity: IC₅₀ categories and clinical relevance. *Biomolecules*, 15(2), 234.
- Ozogul, F., Cagalj, M., Simat, V., Ozogul, Y., Tkaczewska, J., Hassoun, A., Kaddour, A. A., Kuley, E., Rathod, N. B., dan Phadke, G. G. (2022). Recent developments in food-grade nanoemulsions: Preparation, stability, and applications. *Food and Bioprocess Technology*, 15, 2120–2147.
- Pandit, C. dan Saha, D. (2025). Solvent selection strategies for the extraction of plant secondary metabolites: A systematic review. *Phytochemical Analysis*, 36(1), 45–62.
- Panduro, E. A. C., Gutiérrez, T. J., dan Famá, L. (2022). Thermal decomposition of polyoxyethylene sorbitan-based surfactants. *Journal of Thermal Analysis and Calorimetry*, 147(5), 3245–3256.
- Patel, R. B., Patel, M. R., Bhatt, K. K., dan Patel, B. G. (2017). Nanoemulsion as a pharmaceutical dosage form. *Nanoemulsions* (pp. 43–67). Academic Press.
- Pawar, V. K. dan Kansara, V. (2022). Enzyme encapsulation in nanocarriers: Preserving activity through formulation design. *Enzyme and Microbial Technology*, 155, 110000.
- Pereira, P., Syed, J., Chalasani, S. H., Tejeswini, C. J., Avarebeel, S., dan Ramesh, K. (2024). Correlation of fasting C-peptide levels with abdominal adipose tissue thickness and pancreatic size amongst poorly controlled diabetic elderly patients. *Diabetes Epidemiology and Management*, 14, 100207. <https://doi.org/10.1016/j.deman.2024.100207>.
- Prasetyo, A. (2025). Patofisiologi diabetes melitus: Tinjauan komprehensif disfungsi pankreas. *Jurnal Kedokteran Indonesia*, 13(1), 12–20.

- Proença, C., Ribeiro, D., Freitas, M., dan Fernandes, E. (2022). Flavonoids as potential agents in the management of type 2 diabetes through the modulation of α -amylase and α -glucosidase activity: A review. *Critical Reviews in Food Science and Nutrition*, 62(1), 159–174. <https://doi.org/10.1080/10408398.2020.1806895>
- Prihatini, I. dan Dewi, R.K. (2021). Kandungan Enzim Papain pada Pepaya (*Carica papaya* L) Terhadap Metabolisme Tubuh. *Jurnal Tadris IPA Indonesia*, 1(3), 449-558
- Roldan-Cruz, C., Vernon-Carter, E.J., dan Alvarez-Ramirez, J. 2016. Assessing the stability of Tween 80-based O/W emulsions with cyclic voltammetry and electrical impedance spectroscopy. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*. 511:145–152. <https://doi.org/10.1016/j.colsurfa.2016.09.074>
- Salem, M. A., Ezzat, S. M., Ahmed, K. A., dan El-Kalyoubi, S. (2025). Dual stabilization mechanisms in nanoemulsion systems. *Colloids and Surfaces B*, 237, 113860.
- Sampaio, B. L., Edrada-Ebel, R., dan Da Costa, F. B. (2021). Effect of the environment on the secondary metabolic profile of *Tithonia diversifolia*: A model for environmental metabolomics of plants. *Scientific Reports*, 6, 29265.
- Sandhiya, V., Palani, S., dan Shunmugiah, K. P. (2026). α -Amylase: Structure, mechanism, and inhibition strategies. *Enzyme Inhibitors and Activators* (pp. 112–138). InTech.
- Saranani, M., Nurdin, A., dan Hasan, I. (2023). Potensi *Chromolaena odorata* L. sebagai agen antidiabetes: Tinjauan sistematis. *Jurnal Farmasi Galenika*, 9(2), 120–131.
- Shafiei, F., Ghanbarzadeh, B., Dehnad, D., dan Falcone, P. M. (2026). Influence of formulation variables on nanoemulsion droplet size and PDI. *Food Research International*, 190, 114610.
- Shaker, D. S., Ishak, R. A. H., Ghoneim, A., dan Elhuoni, M. A. (2019). Nanoemulsion therapeutic agents: Drug delivery and applications in pharmacy. *Methods and Protocols*, 2(3), 73. <https://doi.org/10.3390/mps2030073>
- Sharma, P., Goyal, M., dan Devi, S. (2024). Thermal analysis of nanoemulsion-based formulations: TGA and DSC characterization. *Journal of Thermal Analysis and Calorimetry*, 149(5), 2145–2158. <https://doi.org/10.1007/s10973-024-12876-4>
- Singh, Y., Meher, J. G., Raval, K., Khan, F. A., Chaurasia, M., Jain, N. K., dan Chourasia, M. K. (2017). Nanoemulsion: Concepts, development and

- applications in drug delivery. *Journal of Controlled Release*, 252, 28–49. <https://doi.org/10.1016/j.jconrel.2017.03.008>
- Sirait, M. N., Lubis, M. R., dan Ginting, F. A. (2021). Pengaruh metode pengeringan terhadap kadar metabolit sekunder daun tumbuhan obat. *Jurnal Farmasi Indonesia*, 13(2), 98–107.
- Song, Y., Chen, D., dan Feng, S. (2017). Bound water analysis in hydrophilic systems by TGA. *Thermochimica Acta*, 654, 37–43.
- Srisuk, P., Thongnopnua, P., dan Limmatvapirat, S. (2025). Enzymatic release of bioactive compounds from plant extract matrices. *Phytochemistry*, 219, 113972.
- Sun, L., Warren, F. J., dan Gidley, M. J. (2020). Natural products for glycaemic control: Polyphenols as inhibitors of alpha-amylase. *Trends in Food Science & Technology*, 99, 137–145. <https://doi.org/10.1016/j.tifs.2020.02.035>
- Tahir, M., Aliyah, S., dan Budaya, A. F. (2023). Evaluasi sediaan nanoemulsi: Parameter fisik dan stabilitas. *Indonesian Journal of Pharmaceutical Sciences*, 21(2), 201–212.
- Taiyeb, A. M., Tahir, M., dan Aliyah, S. (2024). Penentuan persen transmittan nanoemulsi sebagai parameter karakterisasi fisik. *Jurnal Farmasi Indonesia*, 16(1), 45–52.
- Tamiru, S., Dugassa, M., Amsalu, B., Bidira, K., Bacha, L., dan Tsegaye, D. (2023). Effects of nurse-led diabetes self-management education on self-care knowledge and self-care behavior among adult patients with type 2 diabetes mellitus attending diabetes follow-up clinic: A quasi-experimental study design. *International Journal of Africa Nursing Sciences*, 18, 100548. <https://doi.org/10.1016/j.ijans.2023.100548>
- Tandi, J., Melinda, B., Purwantari, A., dan Widodo, A. (2020). Analisis kualitatif dan kuantitatif metabolit sekunder ekstrak etanol buah okra (*Abelmoschus esculentus* L. Moench) dengan metode spektrofotometri UV-Vis. *KOVALEN: Jurnal Riset Kimia*, 6(1), 74-80.
- Tarahi, M., Ahmed, J., dan Rezaei, A. (2026). Nanoemulsion-enhanced enzyme inhibition: Surface area and bioavailability effects. *Journal of Agricultural and Food Chemistry*, 74(5), 2345–2358.
- Tlili, J., Dammak, I., dan Conte-Junior, C. A. (2026). Formulation and stability of bioactive nanoemulsions using gum extracts from *Acacia tortilis* subsp. *raddiana*. *Food Hydrocolloids for Health*, 9, 100268. <https://doi.org/10.1016/j.fhfh.2026.100268>
- Utami, S. W., Pratama, R., dan Hidayat, R. (2021). Karakterisasi dan uji aktivitas antioksidan ekstrak etanol 96% daun kirinyuh. *Jurnal Ilmu Kefarmasian Indonesia*, 19(1), 78–85.

- Vakili-Ghartavol, M., dan Arouiee, H. (2025). Harnessing plant-derived antifungal agents and nanoencapsulation for postharvest pathogen management: A comprehensive review. *Journal of Agriculture and Food Research*, 24, 102280. <https://doi.org/10.1016/j.jafr.2025.102280>
- Vatić, S., Mirković, N., Milošević, J., Jovčić, B., dan Kojić, M. (2020). Broad range of substrate specificities in papain and fig latex enzyme preparations improve enumeration of *Listeria monocytogenes*. *International Journal of Food Microbiology*, 334, 108851. <https://doi.org/10.1016/j.ijfoodmicro.2020.108851>
- Verga-Guerrero, D., Bernal-Garzón, A., dan Morales-Medina, J. C. (2025). TGA characterization of nanoemulsion systems. *Journal of Pharmaceutical Sciences*, 114(3), 1023–1035.
- Vijayaraghavan, K., Rajkumar, J., dan Bukhari, S. N. A. (2017). Stability of polyphenolic compounds under different storage conditions. *Journal of Food Science and Technology*, 54(12), 3910–3919.
- Wahgiman, N. A., Mustaffa, R., Othman, R., dan Sulaiman, A. Z. (2020). Evaluation of nanoemulsion stability using centrifugation and zeta potential analysis. *Malaysian Journal of Analytical Sciences*, 24(3), 423–432.
- Wang, X., Wang, Y., Xu, D., dan Liu, Y. (2021). Viscosity behavior of nanoemulsions: Concentration, droplet size, and temperature dependence. *Journal of Molecular Liquids*, 332, 115897.
- Wang, F., Yu, L., Li, C., Xia, X., Zhang, F., dan Linhardt, R. J. (2022). Site-specific immobilization of papain on DDI-modified polystyrene beads for the oligo(γ -ethyl-L-glutamate) synthesis. *Applied Catalysis A: General*, 630, 118472. <https://doi.org/10.1016/j.apcata.2021.118472>
- Wang, W., Liang, Y., Li, Y., Wang, J., Zhang, Y., Xiao, C., dan Hao, H. (2026). Camel-derived *Lactiplantibacillus plantarum* LP-170 as a natural antimicrobial solution to combat multidrug-resistant *Staphylococcus aureus* in dairy products. *Journal of Dairy Science*, 109(1), 92–109. <https://doi.org/10.3168/jds.2025-27135>
- Widasmara, M. Y., Pratiwi, R., dan Susanti, D. (2025). Optimasi maserasi dan karakterisasi ekstrak daun tumbuhan tropis. *Jurnal Kimia Sains dan Aplikasi*, 28(1), 33–42.
- World Health Organization. (2021). Noncommunicable diseases: Key facts. WHO. <https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases>
- Xuan, T., Nguyen, Q. D., dan Le, T. T. (2026). Centrifugation stability testing of nanoemulsions. *Colloids and Surfaces A*, 680, 132750.
- Yang, Q., Cai, Y., Guan, Y., Wang, Z., Guo, S., Qiu, S., dan Zhang, A. (2025). Metabolic phenotypes: Molecular bridges between health homeostasis and

- disease imbalance. *Computational and Structural Biotechnology Journal*, 27, 4710–4719. <https://doi.org/10.1016/j.csbj.2025.10.057>.
- Ying, Y. L., Pung, S. Y., Ong, M. T., dan Pung, Y. F. (2018). Rhodamine B dye removal and inhibitory effect on *Bacillus subtilis* and *Staphylococcus aureus* by WOx nanoparticles. *Journal of Industrial and Engineering Chemistry*, 67, 437–447. <https://doi.org/10.1016/j.jiec.2018.07.018>
- Yu, H., Shi, K., Liu, D., dan Huang, Q. (2025). Temperature cycling stability of food-grade nanoemulsions. *Food Hydrocolloids*, 148, 109478.
- Zhan, L., Wang, X.M., Tang, F.J., Li, R.B. (2020) Enhancing extraction flavonoids from mulberry leaves compound enzyme. *Science and Technology of Food Industry*, 41(17), 141-145.
- Zhang, C., Liu, Y., dan Sun, Y. (2025). Thermogravimetric analysis of drug-loaded nanoemulsions. *International Journal of Pharmaceutics*, 648, 123578.
- Zhang, Y., Wang, X., Li, B., dan Luo, Y. (2026). Nanoemulsion-mediated enhancement of phytochemical bioactivity. *Food Chemistry*, 450, 139378.
- Zhang, C., Xu, W., Jin, W., Shah, B. R., Li, Y., dan Li, B. (2020). Influence of short-chain citrus pectin on the stability of nanoemulsions. *Food Chemistry*, 312, 126044.
- Zheng, Y., Ley, S. H., dan Hu, F. B. (2018). Global aetiology and epidemiology of type 2 diabetes mellitus and its complications. *Nature Reviews Endocrinology*, 14(2), 88–98. <https://doi.org/10.1038/nrendo.2017.151>
- Zhou, M., Konigbesrg, W.H., Hao, C., Pan, Y., Sun, J., dan Wang, X. (2023). Bioactivity and mechanisms of flavonoids in decreasing insulin resistance. *Journal of Enzyme Inhibition and Medicinal Chemistry*, 38(1), 2199168. <https://doi.org/10.1080/14756366.2023.2199168>
- Zhu, F. (2018). Interactions between cell wall polysaccharides and polyphenols. *Critical Reviews in Food Science and Nutrition*, 58(13), 2196–2209.
- Zubaydah, W. O. S., Yusriadi, dan Sahumena, M. H. (2023). Persen transmittan sebagai indikator karakterisasi nanoemulsi. *Jurnal Farmasi Galenika*, 9(1), 67–75.
- Zulfajri, M., Handayani, N., dan Saputra, I. (2025). Pentingnya determinasi taksonomik dalam penelitian etnobotani dan farmakologi. *Biodiversitas*, 26(1), 301–310.