

DAFTAR PUSTAKA

- Abidin, H.L., Sami, F.J., Utami, Y.P. 2024. Total flavonoid levels and antioxidant activity of kersen leaf extract (*Muntingia calabura* L.). *Jurnal Katalisator*. 9(1): 1-5.
- Abubakar, A, Haque, M., Al-Rashed, S., Siddiqui, M. 2022. Nanoemulsion-based delivery system for enhancing antioxidant and antimicrobial activities of *Nigella sativa* essential oil. *Journal of Nanobiotechnology*. 20(1): 185. <https://doi.org/https://doi.org/10.1186/s12951-022-01385-5>
- Adekunle, I.A., Salam, K.K., Dada, E.O., Salawudeen, T.O., Arinkoola, A.O. 2025. Regression modelling and optimization study with risk assessment analysis of process parameters in the transesterification of palm kernel oil using acid modified Itu clay. *Discover Chemistry*. 2(1): 1-5. <https://doi.org/10.1007/s44371-025-00412-8>
- Angeli, L., Morozova, K., Scampicchio, M. 2023. A kinetic-based stopped-flow DPPH• method. *Scientific Reports*. 13(1): 1-10. <https://doi.org/10.1038/s41598-023-34382-7>
- Aprilia, S., Roanisca, O., Asriza, R.O., Amelia, I., others. 2025. Nanoemulsi minyak atsiri limbah jeruk kunci (*Citrus x mircocarpa* Bunge) sebagai antibakteri *escherichia coli* dan *Staphylococcus aureus*. In: *Proceedings of National Colloquium Research and Community Service*. Vol. 9: hal. 61–65.
- Azizah, N., Hidayatullah, R. 2025. Validasi material penelitian tanaman obat: pentingnya determinasi botani dalam studi fitokimia. *Jurnal Farmasi Indonesia*. 12(1): 45–53.
- Azizah, P.S., Hidayatullah, M.H. 2025. Uji aktivitas antibakteri ekstrak etanol 70% dan etil asetat daun kersen terhadap *Pseudomonas aureuginosa* dan *Staphylococcus aureus*. *Usadha Journal of Pharmacy*. 1(1): 387–401.
- Azmi, N.A.N., Elgharbawy, A.A.M., Motlagh, S.R., Samsudin, N., Salleh, H.M. 2019. Nanoemulsions: factory for food, pharmaceutical and cosmetics. *Processes*. 7(9): 1-10. <https://doi.org/10.3390/pr7090617>
- Bhatt, P., Bhatt, K. 2019. Nanoemulsion: a cutting edge tool for delivery of bioactive phytochemicals. *Biomedical Journal of Scientific & Technical Research*. 21(1):15644–15654. <https://doi.org/https://doi.org/10.26717/BJSTR.2019.21.003562>
- Bitwell, C., Indra, S Sen, Luke, C., Kakoma, M.K. 2023. A review of modern and conventional extraction techniques and their applications for extracting phytochemicals from plants. *Scientific African*. 1(1): 19:e01585. <https://doi.org/https://doi.org/10.1016/j.sciaf.2023.e01585>
- Cahyanti, A.D, Taufikurohmah, T. 2022. Production and organoleptic test of body sanitizer nanogold, nanosilver, and eucalyptus oil in the pandemic covid 19. *International Journal of Current Science Research and Review*. 05(04): 1-10. <https://doi.org/10.47191/ijcsrr/v5-i6-06>
- Carpenter, J., Saharan, V.K. 2017. Ultrasonic assisted formation and stability of mustard oil in water nanoemulsion: effect of process parameters and their optimization.

- Ultrasonics Sonochemistry. 1(1): 35.
<https://doi.org/10.1016/j.ultsonch.2016.10.021>
- Che Sulaiman, I.S., Basri, M., Fard Masoumi, H.R., Chee, W.J, Ashari, S.E., Ismail, M. 2017. Effects of temperature, time, and solvent ratio on the extraction of phenolic compounds and the anti-radical activity of *Clinacanthus nutans* Lindau leaves by response surface methodology. *Chemistry Central Journal*. 11(1): 1-11.
<https://doi.org/10.1186/s13065-017-0285-1>
- Cheong, A., Tan, C., Nyam, K., Lai, O. 2018. Optimization of nanoemulsion formulation and in vitro antioxidant activity of kenaf seed oil nanoemulsions. *Journal of Food Science and Technology*. 55(9): 3637–3648.
<https://doi.org/https://doi.org/10.1007/s13197-018-3292-z>
- Depkes RI. 2008. Farmakope herbal indonesia edisi i 2008 departemen kesehatan republik indonesia. *Farmakope Herbal Indonesia*: 1–220.
<https://farmalkes.kemkes.go.id/unduh/farmakope-herbal-indonesia-edisi-i/>
- Fallah, A.A., Sarmast, E., Jafari, T., Mousavi, Khaneghah, A. 2023. Vegetable oil-based nanoemulsions for the preservation of muscle foods: a systematic review and meta-analysis. *Critical Reviews in Food Science and Nutrition*. 63(27): 1-10.
<https://doi.org/10.1080/10408398.2022.2057415>
- Ferdinan, A., Rizki, F.S., Rahmawati, N. 2021. Isolasi dan identifikasi senyawa alkaloid dalam ekstrak etanol daun pandan hutan jenis baru (*Freycinetia sessiliflora* Rizki). *Jurnal Komunitas Farmasi Nasional*. 1(2): 1-15.
- Fluhr, J.W, Menzel, P., Schwarzer, R., Kaestle, B., Arens-Corell, M., Praefke, L., Tsankov, N.K., Nikolaeva, D.G., Misery, L., Darlenski, R. 2022. Acidic skin care promotes cutaneous microbiome recovery and skin physiology in an acute stratum corneum stress model. *Skin Pharmacology and Physiology*. 35(5): 1-10.
<https://doi.org/10.1159/000526228>
- Gandi, M.S., Ahmad, K., Mokhtar, N., Zakaria, M.R. 2025. Nanoemulsion formulation of lemongrass essential oil using pseudomonas-derived rhamnolipids for targeted phytopathogen suppression. 3 *Biotech*. 15(11): 1-5.
<https://doi.org/10.1007/s13205-025-04579-w>
- Grzeszczak, A., Zaremba-Czogalla, M., Zagórska, A., Walczak, M., Gawlik, M., Zarnowski, R., Andes, D.R., Gubernator, J., Jaromin, A. 2025. Nanoemulsion-based nanoplatform as a new PEITC nano - delivery system to pancreatic cancer cells. *Journal of Drug Delivery Science and Technology*. 1(1): 110.
<https://doi.org/10.1016/j.jddst.2025.106987>
- Gupta, A., Eral, H.B., Hatton, T.A., Doyle, P.S. 2016. Nanoemulsions: formation, properties and applications. *Soft Matter*. 12(11): 1-10.
<https://doi.org/10.1039/c5sm02958a>
- Hanum, T.I., Maha, H.L., Wahyuni, H.S., Fadli, R., Saragih, I.Y. 2024. Nanoparticles of *Muntingia calabura* L. ethanol extract: preparation and anti-inflammatory activity. *Research Journal of Pharmacy and Technology*. 17(10): 1-15.
<https://doi.org/10.52711/0974-360X.2024.00721>
- Harborne, J. 1987. *Metode fitokimia: penuntun cara modern menganalisis tumbuhan*, diterjemahkan oleh kosasih padmawinata dan iwang soediro. (Bandung).

- Hardani, R., Widjaja, S., Hadisaputro, S., Setiadi, H. 2021. Stability testing of pharmaceutical products: Principles and practices based on ICH guidelines. *Indonesian Journal of Clinical Pharmacy*. 10(1): 1–15.
- Hegde, N., Juvale, K., Puri, S., Chavan, A., Shah, S. 2024. Box-behnken design based optimization of polyvinylpyrrolidone stabilized valproic acid nanoemulsion and evaluation of its anticancer potential. *Colloid and Polymer Science*. 302(10): 1-10. <https://doi.org/10.1007/s00396-024-05283-6>
- Hidayat, R., Patricia, Wulandari. 2021. Methods of extraction: maceration, percolation and decoction. *Eureka Herba Indonesia*. 2(1): 1-5. <https://doi.org/10.37275/ehi.v2i1.15>
- Inmuangkham, N., Sukjarernchaikul, P., Thepwatee, S., lemsam-Arng, J. 2024. Fatty acid profiles of olive oil and moringa oil and their influence on nanoemulsion formation via D-phase emulsification using bakuchiol as a model active compound. *Industrial Crops and Products*. 1(1): 209. <https://doi.org/10.1016/j.indcrop.2024.118052>
- Innaya, A.Y., Rohmawati, N.V., Ramadhani, M.W., Raisya, N., Hidayah, U., Faisal. 2024. Uji skrining fitokimia pada kulit delima merah (*Punica Granatum L.*) di taman alquran universitas islam Malang. *Era Sains : Journal of Science, Engineering and Information Systems Research*. 2(1): 1-10.
- Iordănescu, O.A., Băla, M., Gligor, D., Zippenfening, S.E., Cugerean MI, Petroman MI, Hădărugă DI, Hădărugă NG, Rivis M. 2021. A DPPH· kinetic approach on the antioxidant activity of various parts and ripening levels of papaya (*Carica papaya L.*) ethanolic extracts olimpia. *Plants*. 10(1679): 1–14. <https://doi.org/https://doi.org/10.3390/plants10081679>
- Islamiyati, D., Hartini, N., Fajriyah, K. 2024. Formulasi dan evaluasi aktivitas antioksidan nanoemulsi minyak atsiri. *Indonesian Journal of Pharmaceutical Sciences*. 20(1):78–87.
- Joshi, S., Sahu, J.K., Prakash, S., Naik, S.N. 2024. Modulating the 3D printability of vitamin D3-nanoemulsion-based dairy gels: influence of emulsifier on gel structure, printing behaviour and vitamin D3 retention. *Journal of Food Engineering*. 373(1): 112032.
- Khalid, A., Arshad, M.U., Imran, A., Haroon, Khalid, S., Shah, M.A. 2023. Development, stabilization, and characterization of nanoemulsion of vitamin D3-enriched canola oil. *Frontiers in Nutrition*. 10(1): 1-5. <https://doi.org/10.3389/fnut.2023.1205200>
- Khotimah, H., Mulyani, S., Rahayu, W. 2023. Uji aktivitas antioksidan nanoemulsi ekstrak tumbuhan dengan metode DPPH. *Jurnal Ilmu Kefarmasian Indonesia*. 21(2): 156–164.
- Komaiko, J.S., Mcclements, D.J. 2016. Formation of food-grade nanoemulsions using low-energy preparation methods: a review of available methods. *Comprehensive Reviews in Food Science and Food Safety*. 15(2): 1-15. <https://doi.org/10.1111/1541-4337.12189>
- Krishnaveni, M., Banu, C.R., Kumari, G.K., Kalaivani, M. 2015. GCMS/MS analysis of *Muntingia calabura* stem and its antimicrobial effect. *World Journal of Pharmacy*

- and Pharmaceutical Sciences. 1(1): 1-3.
- Kurek, J. 2019. Introductory chapter: alkaloids - their importance in nature and for human life. In: *Alkaloids - Their Importance in Nature and Human Life*. <https://doi.org/10.5772/intechopen.85400>
- Lima, T.L., da Silva, W., Ferreira, H., de Freitas, R. 2024. Rheological properties and stability of nanoemulsions: influence of surfactant concentration and processing conditions. *Journal of Food Engineering*. 368(1): 111904. <https://doi.org/https://doi.org/10.1016/j.jfoodeng.2024.111904>
- Luu, N.A., To, T.T., Tran, N.H., Vu, G.M., Ngo, N.Y.L., Tran, M.P.L., Nguyen, N.M., Dinh, T.N.N., Dam, A.N., Lieu, N.N., Nguyen, D.Q. 2025. Optimization of plant oil-based nanoemulsions prepared via phase inversion temperature and evaluation of their antioxidant capacity. *Oil Crop Science*. 10(3): 1-5. <https://doi.org/10.1016/j.ocsci.2025.02.004>
- Maded, Z.K., Sfar, S., Taqa, G.A.A., Lassoued, M.A., Ben, Hadj, Ayed, O., Fawzi, H.A. 2024. Development and optimization of dipyrindamole- and roflumilast-loaded nanoemulsion and nanoemulgel for enhanced skin permeation: formulation, characterization, and in vitro assessment. *Pharmaceuticals*. 17(6): 1-5. <https://doi.org/10.3390/ph17060803>
- Mahmoud, B.S., McConville, C. 2023. Box-behnken design of experiments of polycaprolactone nanoparticles loaded with irinotecan hydrochloride. *Pharmaceutics*. 15(4): 1-5. <https://doi.org/10.3390/pharmaceutics15041271>
- Mahmud, J., Muranyi, P., Shankar, S., Sarmast, E., Salmieri, S., Lacroix, M. 2024. Physiological and antimicrobial properties of a novel nanoemulsion formulation containing mixed surfactant and essential oils: optimization modeling by response surface methodology. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*. 686(1): 133405.
- Marwa, A., Lubis, R., Harahap, U. 2023. Stabilitas fisik nanoemulsi: evaluasi sentrifugasi dan penyimpanan jangka panjang. *Majalah Farmasetika*. 8(3): 234–243.
- McClements, D. 2015. *Food emulsions: principles, practices, and techniques*, third edition (3rd ed.): CRC Press. <https://doi.org/https://doi.org/10.1201/b18868>
- McClements, D.J., Jafari, S.M. 2018. Improving emulsion formation, stability and performance using mixed emulsifiers: a review. *Advances in Colloid and Interface Science*. 1(1): 251. <https://doi.org/10.1016/j.cis.2017.12.001>
- Mishra, I., Mishra, R., Dubey, A., Dhakad, P.K. 2024. A perspective on various facets of nanoemulsions and its commercial utilities. *Assay and Drug Development Technologies*. 22(3): 1-5. <https://doi.org/10.1089/adt.2023.042>
- Mo, S., Chen, J., Yu, Y., Chen, Yufen, Jia, L., Chen, Ying. 2024. Development and thermal characteristics of phase change nanoemulsions for low-temperature thermal energy storage. *International Journal of Refrigeration*. 161(1): 1-5. <https://doi.org/10.1016/j.ijrefrig.2024.02.018>
- Molyneux, P. 2004. The use of the stable free radical diphenylpicryl-hydrazyl (DPPH) for estimating antioxidant activity. *Songklanakarin Journal of Science and Technology*. 26(2): 1-6.

- Montgomery, D.C. 2017. Design and analysis of experiments: Wiley. <https://books.google.co.id/books?id=xJBEDwAAQBAJ>
- Montoro-Alonso, S., Duque-Soto, C., Rueda-Robles, A., Reina-Manuel, J., Quirantes-Piné, R., Borrás-Linares, I., Lozano-Sánchez, J. 2024. Functional olive oil production via emulsions: evaluation of phenolic encapsulation efficiency, storage stability, and bioavailability. *Nutrients*. 16(22): 1-7. <https://doi.org/10.3390/nu16223909>
- Myers, R.H., Montgomery, D.C., Anderson-Cook, C.M. 2016. Response surface methodology: process and product optimization using designed experiments : Wiley. <https://books.google.co.id/books?id=T-BbCwAAQBAJ>
- Ngan, C.L., oon., Basri, M., Lye, F.F an., Fard, Masoumi, H.R ez., Tripathy, M., Karjiban, R.A bed., Abdul-Malek, E. 2014. Comparison of process parameter optimization using different designs in nanoemulsion-based formulation for transdermal delivery of fullerene. *International journal of nanomedicine*. 9(1): 1-10. <https://doi.org/10.2147/IJN.S65689>
- Nikita, Agnihotri, S. 2025. Nanoemulsions as advanced delivery systems of bioactive compounds for sustainable food preservation applications. *Biocatalysis and Agricultural Biotechnology*. 1(1): 68. <https://doi.org/10.1016/j.bcab.2025.103702>
- Njus, D., Kelley, P.M., Tu, Y.J., Schlegel, H.B. 2020. Ascorbic acid: the chemistry underlying its antioxidant properties. *Free Radical Biology and Medicine*. 1(1): 159. <https://doi.org/10.1016/j.freeradbiomed.2020.07.013>
- Pasto, D., Johnson, C. 1979. Laboratory text for organic chemistry. New Jersey: Prentice-Hall.
- Pertiwi, V., Muhardi, Sri, H., Dewi, S. 2024. Karakteristik fisik dan sensori teh celup daun kersen (*Muntingia calabura* L.) dengan penambahan bunga melati (*Jasminum sambac* L.) dan kulit kayu manis (*Cinnamomum burmannii*). *Jurnal Agroindustri Berkelanjutan*. 3(1): 1-10.
- Pillai, P., Saw, R.K., Mandal, A. 2024. Formulation and characterization of ionic liquid-based nanoemulsion for enhanced oil recovery applications. *Journal of Molecular Liquids*. 1(1): 397. <https://doi.org/10.1016/j.molliq.2024.124189>
- Prasetyo, H., Sasongko, A.S., Fahira, D.D., Ayuningsih, T. 2023. Skrining fitokimia dan uji aktivitas antioksidan secara kualitatif pada ekstrak rumput laut *Eucheumma cottonii*. *Jurnal Kemaritiman: Indonesian Journal of Maritime*. 4(1): 1-5. <https://doi.org/10.17509/ijom.v4i1.60288>
- Pratiwi, E.D., Dewi, N.P. 2022. Screening of phytochemical secondary metabolites of *Muntingia calabura*: a potential as hepatoprotector. *Journal of Fundamental and Applied Pharmaceutical Science*. 2(2): 59–65.
- Rahma, H., Priani, S.E., Fakhri, T.M., Suarantika, F., Patricia, V.M., Laksono, B.T., Subekti, P.I. 2025. Nanoemulsion-based delivery system of tamanu (*Calophyllum inophyllum* L.) oil: formulation, characterization, and antibacterial activity. *Pharmacia*. 1(1): 72. <https://doi.org/10.3897/pharmacia.72.e153246>
- Rahmah, M.H., Markia, Rahman, S.R., Ramlah, Isdaryanti. 2024. Identifikasi kandungan fenolik pada ekstrak maserasi bertingkat dari daun segar dan daun. *Jurnal Ilmu*

Biologi. 6(1): 1-5.

- Raszewska-Famielec, M., Flieger, J. 2022. Nanoparticles for topical application in the treatment of skin dysfunctions—an overview of dermo-cosmetic and dermatological products. *International Journal of Molecular Sciences*. 23(24): 1-9. <https://doi.org/10.3390/ijms232415980>
- Raya, S.A., Saaïd, I.M., Mohd, Aji, A.Q., A Razak, A.A. 2022. Investigation of the synergistic effect of nonionic surfactants on emulsion resolution using response surface methodology. *RSC Advances*. 12(48): 1-8. <https://doi.org/10.1039/d2ra04816g>
- Rodríguez-Solana, R., Vega-Morales, T., Rosales-López, C., Salgado, M. 2021. Maceration versus soxhlet extraction of phenolic compounds from plant materials: a comparative review. *Molecules*. 26(23): 7345.
- Rousta, N., Aslan, I., Isleten, S.M., Ertl, E. 2025. Thermal analysis (TGA/DSC) of biopolymer-based nanocomposite films: characterization and stability evaluation. *Carbohydrate Polymers*. 341(1): 122301. <https://doi.org/https://doi.org/10.1016/j.carbpol.2025.122301>
- Rousta, P., Yazdanpanah S., Shahamirian, M., Shirazinejad, A. 2025. Fabrication and analysis of nanoemulsion-based edible films loaded with vitamin D3 and *Cordia myxa* mucilage. *Scientific Reports*. 15(1): 1-10. <https://doi.org/10.1038/s41598-025-07214-z>
- Sambi, A.I., Saputra, B.W., Setiawati, A. 2024. Exploring the anti-acne potential of *Muntingia calabura* L leaves against *Staphylococcus epidermidis*: in vitro and in silico perspective. *Journal of HerbMed Pharmacology*. 13(2): 1-6. <https://doi.org/10.34172/jhp.2024.48170>
- Sarapis, K., George, E.S., Marx, W., Mayr, H.L., Willcox, J., Esmaili, T., Powell, K.L., Folasire, O.S., Lohning, A.E., Garg, M. 2022. Extra virgin olive oil high in polyphenols improves antioxidant status in adults: a double-blind, randomized, controlled, cross-over study (OLIVAUS). *European Journal of Nutrition*. 61(2): 1-7. <https://doi.org/10.1007/s00394-021-02712-y>
- Saratale, R.G., Karuppusamy, I., Saratale, G.D., Pugazhendhi, A., Kumar, G., Park, Y., Ghodake, G.S., Bharagava, R.N., Banu, J.R., Shin, H.S. 2018. A comprehensive review on green nanomaterials using biological systems: recent perception and their future applications. *Colloids and Surfaces B: Biointerfaces*. 170(1): 20–35. <https://doi.org/https://doi.org/10.1016/j.colsurfb.2018.05.045>
- Sari, T.P., Mann, B., Kumar, R., Singh, R.R.B., Sharma, R., Bhardwaj, M., Athira, S. 2015. Preparation and characterization of nanoemulsion encapsulating curcumin. *Food Hydrocolloids*. 1(1): 43. <https://doi.org/10.1016/j.foodhyd.2014.07.011>
- Schaich, K.M., Tian, X., Xie, J. 2015. Hurdles and pitfalls in measuring antioxidant efficacy: a critical evaluation of ABTS, DPPH, and ORAC assays. *Journal of Functional Foods*. 14(1): 111–125. <https://doi.org/https://doi.org/10.1016/j.jff.2015.01.043>
- da Silva, B.D., do Rosário, D.K.A., Neto, L.T., Lelis, C.A., Conte-Junior, C.A. 2023. Antioxidant, antibacterial and antibiofilm activity of nanoemulsion-based natural

- compound delivery systems compared with non-nanoemulsified versions. *Foods*. 12(9): 1-10. <https://doi.org/10.3390/foods12091901>
- Sinela, A., Rawat, N., Mertz, C., Achir, N., Fulcrand, H., Dornier, M. 2017. Anthocyanins degradation during storage of Hibiscus sabdariffa extract and evolution of its degradation products. *Food Chemistry*. 1(1): 214. <https://doi.org/10.1016/j.foodchem.2016.07.071>
- Singh, R., Iye, S., Prasad, S., Deshmukh, N., Gupta, U., Zanje, A., Patil, S., Joshi, S. 2017. Phytochemical analysis of Muntingia calabura extracts possessing anti-phytochemical analysis of Muntingia calabura extracts possessing anti-microbial and anti-fouling activities. *International Journal of Pharmacognosy and Phytochemical Research*. 1(1): 1-15.
- Sirait, M., Nasution, A., Lubis, M.F. 2023. Preparasi dan standardisasi simplisia daun kersen (*Muntingia calabura* L.). *Jurnal Penelitian Farmasi Herbal*. 5(2):78–85.
- Smeriglio, A., Barreca, D., Bellocco, E., Trombetta, D. 2017. Proanthocyanidins and hydrolysable tannins: occurrence, dietary intake and pharmacological effects. *British Journal of Pharmacology*. 174(11): 1-5. <https://doi.org/10.1111/bph.13630>
- Syarif, S., Numaningsih, N., Pratama, M. 2020. Uji aktivitas ekstrak etanol daun kersen (*Muntingia calabura* L.) sebagai inhibitor enzim α -glukosidase dengan menggunakan elisa reader. *Jurnal Fitofarmaka Indonesia*. 7(2): 1-8. <https://doi.org/10.33096/jffi.v7i2.506>
- Tadros, T.F. 2009. Emulsion science and technology: Wiley. <https://books.google.co.id/books?id=3TPVwAEACAAJ>
- Thakur, D., Rana, P., Singh, S.K., Bakshi, M., Kumar, S., Singh, S. 2024. Nanoemulsion edible coating for shelf-life improvement and quality control in perishable products. *Plant Nano Biology*. 1(1): 10. <https://doi.org/10.1016/j.plana.2024.100114>
- Tominc, G.C., Dalmagro, M., Pereira, E., da C.A., Adamczuk, M.S., Bonato, F.G.C., Almeida, R.M de, Schneider, R., Negri, M.F.N., Gonçalves, D.D., Hoscheid, J. 2024. Formulation and characterization of nanoemulsion incorporating *Chamomilla recutita* L. extract stabilized with hyaluronic acid. *Pharmaceutics*. 16(6): 1-6. <https://doi.org/10.3390/pharmaceutics16060701>
- Ullah, N., Amin, A., Alamoudi, Rana, A., Rasheed, S.A., Alamoudi, Ruaa, A., Nawaz, A., Raza, M., Nawaz, T., Ishtiaq, S., Abbas, S.S. 2022. Fabrication and optimization of essential-oil-loaded nanoemulsion using box-behnken design against *Staphylococcus aureus* and *Staphylococcus epidermidis* isolated from oral cavity. *Pharmaceutics*. 14(8): 1-10. <https://doi.org/10.3390/pharmaceutics14081640>
- Vogel, A.I., Furniss, B.S. 1989. Vogel's textbook of practical organic chemistry: Longman. <https://books.google.co.id/books?id=2eQPAQAAMAAJ>
- Wan, Ishak, W.M., Zulfakar, M.H. 2022. Optimization, development, and safety evaluation of olive oil nanoemulsion for topical application: a response surface methodology. *Asian Journal of Pharmaceutical and Clinical Research*. 1(1):1-8. <https://doi.org/10.22159/ajpcr.2022.v15i9.45964>
- Wang, S., Cheng, Y., Wang, J., Ding, M., Fan, Z. 2023. Antioxidant activity, formulation,

- optimization and characterization of an oil-in-water nanoemulsion loaded with lingonberry (*Vaccinium vitis-idaea* L.) leaves polyphenol extract. *Foods*. 12(23): 1-9. <https://doi.org/10.3390/foods12234256>
- Wang, Z., Liu, F., Zeng, S., Huang, C. 2026. Unraveling stabilization mechanisms in advanced starch nanoemulsions: from fabrication to food preservation applications. *Food Hydrocolloids*. 1(1): 173. <https://doi.org/10.1016/j.foodhyd.2025.112249>
- Widodo, A., Sulastri, E., Ihwan, I., Cahyadi, M.H., Maulana, S., Zubair, M.S. 2024. Antidiabetic activity, phytochemical analysis, and acute oral toxicity test of combined ethanolic extract of *Syzygium polyanthum* and *Muntingia calabura* Leaves. *Scientific World Journal*. 1(3): 1-8. <https://doi.org/10.1155/2024/3607396>
- Widyasanti, A., Dewi, K.H., Rohdiana, D., Putri, S.H. 2023. Physical stability testing of oil-in-water emulsion using centrifugation and freeze-thaw cycling methods. *Journal of Agricultural Engineering and Biotechnology*. 11(2): 45–54. <https://doi.org/https://doi.org/10.18343/jaeb.v11i2.2311>
- Widyastuti, A.I., Saryanti, D. 2023. Formulasi dan evaluasi sediaan nanoemulsi ekstrak umbi bawang putih (*Allium sativum* L.). *Jurnal Sains dan Kesehatan*. 5(2): 1-8. <https://doi.org/10.25026/jsk.v5i2.1677>
- Yadav, P., Rastogi, V., Verma, A. 2020. Application of box–behnken design and desirability function in the development and optimization of self-nanoemulsifying drug delivery system for enhanced dissolution of ezetimibe. *Future Journal of Pharmaceutical Sciences*. 6(1): 1-10. <https://doi.org/10.1186/s43094-020-00023-3>
- Yahya, S.M., Danish, M., Ahmed, A., Equbal, A., Khan, Z.A., Asjad, M. 2025. RSM based optimization of process parameters of biodiesel production from waste palm oil using modified nano-catalyst. *npj Clean Energy*. 1(1): 1–14. <https://doi.org/10.1038/s44406-024-00001-1>
- Yukuyama, M.N., Kato, E.T.M., de Araujo, G.L.B., Löbenberg, R., Monteiro, L.M., Lourenço, F.R., Bou-Chacra, N.A. 2019. Olive oil nanoemulsion preparation using high-pressure homogenization and D-phase emulsification – a design space approach. *Journal of Drug Delivery Science and Technology*. 1(1): 49. <https://doi.org/10.1016/j.jddst.2018.12.029>
- Zakaria, Z.A., Mohamed, A.M., Jamil, N.S.M., Rofiee, M.S., Hussain, M.K., Sulaiman, M.R., The, L.K., Salleh, M.Z. 2011. In vitro antiproliferative and antioxidant activities of the extracts of *Muntingia calabura* leaves. *American Journal of Chinese Medicine*. 39(1): 1-9. <https://doi.org/10.1142/S0192415X11008749>
- Zhang, Q.W., Lin, L.G., Ye, W.C. 2018. Techniques for extraction and isolation of natural products: a comprehensive review. *Chinese Medicine (United Kingdom)*. 13(1): 1-6. <https://doi.org/10.1186/s13020-018-0177-x>
- Zhao, S., Wang, Z., Wang, X., Kong, B., Liu, Q., Xia, X., Liu, H. 2023. Characterization of nanoemulsions stabilized with different emulsifiers and their encapsulation efficiency for oregano essential oil: tween 80, soybean protein isolate, tea saponin, and soy lecithin. *Foods*. 12(17): 1-10. <https://doi.org/10.3390/foods12173183>

- Zhou, J., Zheng, X., Yang, Q., Liang, Z., Li, D., Yang, X., Xu, J. 2024. Optimization of ultrasonic-assisted extraction and characterization of phenolics from different plant sources. *Ultrasonics Sonochemistry*. 92(1): 106275.
- Zolkeflee, N.K.Z., Isamail, N.A., Maulidiani, M., Abdul, Hamid, N.A., Ramli, N.S., Azlan, A., Abas, F. 2021. Metabolite variations and antioxidant activity of *Muntingia calabura* leaves in response to different drying methods and ethanol ratios elucidated by NMR-based metabolomics. *Phytochemical Analysis*. 32(1): 1-10. <https://doi.org/10.1002/pca.2917>