

DAFTAR PUSTAKA

- Aasen, I. M., Ertesvåg, H., Heggeset, T. M. B., Liu, B., Brautaset, T., Vadstein, O., & Ellingsen, T. E. 2016. *Thraustochytrids* as production organisms for docosahexaenoic acid (DHA), squalene, and carotenoids. *Applied microbiology and biotechnology*, 100(10), 4309-4321.
- Al Idrus, A., Mertha, I.G., Marhus, M., & Husain, P. 2023. Characteristics of Sentigi (*Pemphis acidula*) As Environmental Bioindicators of Mangrove Conservation in the Regional Marine Conservation Area Gili Sulat, East Lombok, Indonesia. *Jurnal Penelitian pendidikan IPA*, 9(1), 542-549.
- Alam, M. J. (2026). 6% Polyacrylamide Gel (TBE system).
- Arifanti, V. B., Sidik, F., Mulyanto, B., Susilowati, A., Wahyuni, T., Yuniarti, N., ... & Novita, N. 2022. Challenges and strategies for sustainable mangrove management in Indonesia: a review. *Forests*, 13(5), 695.
- Bagul, V. P., & Annapure, U. S. (2021). Isolation and characterization of docosahexaenoic acid-producing novel strain *Aurantiochytrium* sp. ICTFD5: A sterol with vitamin d-cholecalciferol, and cellulase and lipase producing thraustochytrid. *Bioresource Technology Reports*, 14, 100688.
- Budiarti, R. S., & Subagyo, A. 2023. Study on the Utilization of Mangrove Forest Plants. *Jurnal Penelitian Pendidikan IPA*, 9(12), 12082-12097.

- Cheng, S. Y., Chen, Y. J., Lin, H. C., Chang, H. Y., & Huang, M. D. (2025). Genetic analysis of polyunsaturated fatty acids biosynthesis pathway determines four distinct Thraustochytrid types. *Environmental Microbiology*, 27(4), e70090.
- Cheng, S. Y., Chen, Y. J., Lin, H. C., Chang, H. Y., & Huang, M. D. 2025. Genetic Analysis of Polyunsaturated Fatty Acids Biosynthesis Pathway Determines Four Distinct Thraustochytrid Types. *Environmental Microbiology*, 27(4), e70090.
- Christiningrum, O. D., Budiharjo, A., & Kusdiyantini, E. 2016. Karakterisasi molekuler tanaman sambung nyawa (*Gynura procumbens* [Lour.] Merr) berdasarkan 18S rRNA. *Jurnal Akademika Biologi*, 5(3), 60-70.
- Dellero, Y., Maës, C., Morabito, C., Schuler, M., Bournaud, C., Aiese Cigliano, R., ... & Rébeillé, F. 2020. The zoospores of the thraustochytrid *Aurantiochytrium limacinum*: transcriptional reprogramming and lipid metabolism associated to their specific functions. *Environmental Microbiology*, 22(5), 1901-1916.
- Dighriri, I. M., Alsubaie, A. M., Hakami, F. M., Hamithi, D. M., Alshekh, M. M., Khobrani, F. A., ... & Tawhari, M. (2022). Effects of omega-3 polyunsaturated fatty acids on brain functions: a systematic review. *Cureus*, 14(10).
- Fu, J., Chen, T., Lu, H., Lin, Y., Xie, X., Tian, H., ... & He, D. (2016). Enhancement of docosahexaenoic acid production by low-energy ion implantation coupled with screening method based on *Sudan Black B* staining in *Schizochytrium* sp. *Bioresource technology*, 221, 405-411.
- Ganuza, E., Yang, S., Amezcuita, M., Giraldo-Silva, A., & Andersen, R. A. (2019). Genomics, biology and phylogeny of *Aurantiochytrium acetophilum* sp. nov.

- (Thraustochytriaceae), including first evidence of sexual reproduction. *Protist*, 170(2), 209-232. <https://doi.org/10.1016/j.protis.2019.02.004>.
- Hanifa, Y. R., Pujiyanto, S., Ferniah, R. S., & Kusumaningrum, H. P. 2021. Identifikasi Molekuler Jeruk Nipis Tegal Berdasarkan Fragmen Gen 18s Ribosomal RNA. *Jurnal Bioteknologi & Biosains Indonesia (JBBi)*, 8(2), 244-254.
- Heggeset, T. M., Ertesvåg, H., Liu, B., Ellingsen, T. E., Vadstein, O., & Aasen, I. M. (2019). Lipid and DHA-production in *Aurantiochytrium* sp.—responses to nitrogen starvation and oxygen limitation revealed by analyses of production kinetics and global transcriptomes. *Scientific reports*, 9(1), 19470.
- Huang, J., Liu, Y., Zhu, T., & Yang, Z. (2021). *The Asymptotic Behavior of Bootstrap Support Values in Molecular Phylogenetics*. *Systematic Biology*, 70(4), 774–785.
- Hutari, A., Nisaa, R. A., Suhendra, S., Agustin, Y., & Ayunda, K. A. 2022. Exploration of high economic value microalgae in the mangrove area of Pari Island, Seribu Islands, Jakarta. *Jurnal Pembelajaran Dan Biologi Nukleus*, 8(3), 662-672.
- Ishibashi, Y., Goda, H., Hamaguchi, R., Sakaguchi, K., Sekiguchi, T., Ishiwata, Y., ... & Ito, M. 2021. PUFA synthase-independent DHA synthesis pathway in *Parietichytrium* sp. and its modification to produce EPA and n-3DPA. *Communications Biology*, 4(1), 1378.
- Iwata, I., Kimura, K., Tomaru, Y., Motomura, T., Koike, K., Koike, K., & Honda, D. 2017. Bothrosome formation in *Schizochytrium aggregatum* (Labyrinthulomycetes, Stramenopiles) during zoospore settlement. *Protist*, 168(2), 206-219.

- Jaseera, K. V., Kaladharan, P., Vijayan, K. K., Sandhya, S. V., Antony, M. L., & Pradeep, M. A. 2019. Isolation and phylogenetic identification of heterotrophic *thraustochytrids* from mangrove habitats along the southwest coast of India and prospecting their PUFA accumulation. *Journal of Applied Phycology*, 31, 1057-1068.
- Kalidasan K, Vinithkumar NV, Peter DM, Dharani G, Dufossé L. Thraustochytrids of Mangrove Habitats from Andaman Islands: Species Diversity, PUFA Profiles and Biotechnological Potential. *Mar Drugs*, 19(10), 571.
- Kalidasan, K., Asmathunisha, N., Gomathi, V., Dufossé, L., and Kathiresan, K. 2021. Isolation and optimization of culture conditions of *Thraustochytrium kinnei* for biomass production, nanoparticle synthesis, antioxidant and antimicrobial activities. *Journal of Marine Science and Engineering*. 9(6): 678.
- Kalidasan, K., Suchana, C., Kathiresan, K., Mohanchander, P., Niyom, K., Yousuke, T., & Voranop, V. (2023). PUFA and carotenoid producing *Thraustochytrids* and their anti-microbial and antioxidant activities. *Frontiers in Marine Science*, 10. <https://doi.org/10.3389/fmars>.
- Kalidasan, K., Vinithkumar, N. V., Peter, D. M., Dharani, G., & Dufossé, L. (2021). *Thraustochytrids* of Mangrove Habitats from Andaman Islands: Species Diversity, PUFA Profiles and Biotechnological Potential. *Marine Drugs*, 19(571). <https://doi.org/10.3390/md19100571>.
- Kusuma, Nava Indah and Nasrullah Bai Arifin, S.Pi., M.Sc. and Aulia Rahmawati., S.P., M.Sc. 2023. *Identifikasi Isolat Thraustochytrids dari Habitat Mangrove di*

Kabupaten Sidoarjo Sebagai Penghasil Asam Lemak. Sarjana thesis, Universitas Brawijaya.

Lee Chang, K. J., Nichols, C. M., Blackburn, S. I., Dunstan, G. A., Koutoulis, A., & Nichols, P. D. 2014. Comparison of *Thraustochytrids Aurantiochytrium* sp., *Schizochytrium* sp., *Thraustochytrium* sp., and *Ulkenia* sp. for production of biodiesel, long-chain omega-3 oils, and exopolysaccharide. *Marine Biotechnology*, 16(4), 396-411.

Lee Chang, K. J., Nichols, C. M., Blackburn, S. I., Dunstan, G. A., Koutoulis, A., & Nichols, P. D. 2014. Comparison of *Thraustochytrids Aurantiochytrium* sp., *Schizochytrium* sp., *Thraustochytrium* sp., and *Ulkenia* sp. for production of biodiesel, long-chain omega-3 oils, and exopolysaccharide. *Marine Biotechnology*, 16(4), 396-411.

Leyland, B., Leu, S., & Boussiba, S. 2017. Are *thraustochytrids* algae?. *Fungal biology*, 121(10), 835-840.

Lin, H. C., Li, W. H., Chen, C. C., Cheng, T. H., Lan, Y. H., Huang, M. D., ... & Chang, H. Y. (2020). Diverse enzymes with industrial applications in four *thraustochytrid* genera. *Frontiers in microbiology*, 11, 573907.

Lyu, L., Wang, Q., & Wang, G. 2021. Cultivation and diversity analysis of novel marine *thraustochytrids*. *Marine Life Science & Technology*, 3, 263-275.

Majluf, P., Matthews, K., Pauly, D., Skerrett, D. J., & Palomares, M. L. D. (2024). A review of the global use of fishmeal and fish oil and the Fish In: Fish Out metric. *Science advances*, 10(42), eadn5650.

- Manikan, V., Nazir, M. Y. M., Kalil, M. S., Isa, M. H. M., Kader, A. J. A., Yusoff, W. M. W., & Hamid, A. A. (2015). A new strain of docosahexaenoic acid producing microalga from Malaysian coastal waters. *Algal Research*, 9, 40-47.
- Marchan, L. F., Chang, K. J. L., Nichols, P. D., Mitchell, W. J., Polglase, J. L., & Gutierrez, T. 2018. Taxonomy, ecology and biotechnological applications of *thraustochytrids*: A review. *Biotechnology advances*, 36(1), 26-46.
- Meesapyodsuk, D., & Qiu, X. 2016. Biosynthetic mechanism of very long chain polyunsaturated fatty acids in *Thraustochytrium* sp. 26185. *Journal of lipid research*, 57(10), 1854-1864.
- Menzorov, A. G., Iukhtanov, D. A., Naumenko, L. G., Bobrovskikh, A. V., Zubairova, U. S., Morozova, K. N., & Doroshkov, A. V. (2024). Thraustochytrids: evolution, ultrastructure, biotechnology, and modeling. *International Journal of Molecular Sciences*, 25(23), 13172.
- Morabito, C., Bournaud, C., Maës, C., Schuler, M., Cigliano, R. A., Dellerio, Y., ... & Rébeillé, F. 2019. The lipid metabolism in *thraustochytrids*. *Progress in Lipid Research*, 76, 101007.
- Nabilah, Salma., and Prof. Dr. Ir. Antonius Suwanto, M.Sc. and Dr. Dra. Yohana Caecilia Sulistyaningsih, M. Si. 2023. *Preferensi Thrustochytruds terhadap Beberapa Jenis Umpan Serbuk Sari*. Sarjana Thesis, Institut Pertanian Bogor.
- Oyeku, O. G., & Mandal, S. K. (2021). Taxonomy and okadaic acid production of a strain of *Prorocentrum lima* (Dinophyceae) isolated from the Bay of Bengal, North Indian Ocean. *Toxicon*, 196, 32-43.

- Pan, J., Del Campo, J., & Keeling, P. J. 2016. Reference tree and environmental sequence diversity of Labyrinthulomycetes. *Journal of Eukaryotic Microbiology*, 64(1), 88-96.
- Patel, A., Liefeldt, S., Rova, U., *et al.* (2020). Co-production of DHA and squalene by thraustochytrid from forest biomass. *Scientific Reports*, 10, 1992. <https://doi.org/10.1038/s41598-020-58728-7>.
- Ponnambalan, R., Prabhakaran, P., Sam-on, M. F. S., Joe, L. S., Sairi, F., Zaini, N. A. M., ... & Nazir, M. Y. M. (2025). Isolation and characterization of Thraustochytrids from Malaysian mangrove ecosystem for fatty acids and terpenoid production. *Journal of Applied Phycology*, 37(5), 3513-3527.
- Phumphumirat, W., Ferguson, D. K., & Gleason, F. H. (2016). The colonization of palynomorphs by chytrids and thraustochytrids during pre-depositional taphonomic processes in tropical mangrove ecosystems. *Fungal ecology*, 23, 11-19.
- Prakoso, S. P., Wirajana, I. N., & Suarsa, I. W. 2016. Amplifikasi fragmen gen 18S rRNA pada DNA metagenomik madu dengan teknik PCR (Polymerase Chain Reaction). *Indonesian Journal of Legal and Forensic Sciences*, 7, 1-7.
- Prasetya, J. D., Ambariyanto, Supriharyono, & Purwanti, F. 2017. Mangrove health index as part of sustainable management in Mangrove ecosystem at Karimunjawa national marine park Indonesia. *Advanced Science Letters*, 23(4), 3277-3282. <https://doi.org/10.1166/asl.2017.9155>.

- Qiu, X., Xie, X., & Meesapyodsuk, D. 2020. Molecular mechanisms for biosynthesis and assembly of nutritionally important very long chain polyunsaturated fatty acids in microorganisms. *Progress in Lipid Research*, 79, 101047.
- Rahmandhana, A. D., Kamal, M., & Wicaksono, P. 2022. Spectral reflectance-based mangrove species mapping from worldview-2 imagery of Karimunjawa and Kemujan Island, Central Java Province, Indonesia. *Remote Sensing*, 14(1), 183.
- Roslim, D. I., Nuryani, N., & Herman, H. 2018. Sekuen Penyandi 18S Ribosomal RNA dan Ubiquitin pada Pandanus sp. Asal Riau (Sequences Encoding 18S Ribosomal RNA and Ubiquitin on Pandanus sp. from Riau). *Jurnal Bios Logos*, 8(1).
- Ruggiero, M. A., Gordon, D. P., Orrell, T. M., Bailly, N., Bourgoin, T., Brusca, R. C., ... & Kirk, P. M. 2015. A higher level classification of all living organisms. *PloS one*, 10(4), e0119248.
- Russo, G. L., Langellotti, A. L., Oliviero, M., Sacchi, R., & Masi, P. 2021b. Sustainable production of food grade omega-3 oil using aquatic protists: Reliability and future horizons. *New Biotechnology*, 62, 32-39.
- Russo, G. L., Langellotti, A. L., Sacchi, R., & Masi, P. 2022. Techno-economic assessment of DHA-rich *Aurantiochytrium* sp. production using food industry by-products and waste streams as alternative growth media. *Bioresource Technology Reports*, 18, 100997.
- Shene, C., Paredes, P., Vergara, D., Leyton, A., Garcés, M., Flores, L., ... & Armenta, R. (2020). Antarctic thraustochytrids: Producers of long-chain omega-3 polyunsaturated fatty acids. *Microbiologyopen*, 9(1), e00950.

- Simon, Chris. (2022). An Evolving View of Phylogenetic Support, *Systematic Biology*, 71(4), Pages 921–928.
- Stefánsson, M. Ö., Baldursson, S., Magnusson, K. P., Eypórsdóttir, A., & Einarsson, H. (2019). Isolation, characterization and biotechnological potentials of thraustochytrids from Icelandic waters. *Marine drugs*, 17(8), 449.
- Tsui, C. K. M., Fan, K. W., Chow, R. K. K., Jones, E. B. G., & Vrijmoed, L. L. P. (2012). Zoospore production and motility of mangrove Thraustochytrids from Hong Kong under various salinities. *Mycoscience*, 53, 1-9.
- Visciano, P. (2024). Environmental contaminants in fish products: food safety issues and remediation strategies. *Foods*, 13(21), 3511.
- Wang, Q., Zhang, Y., Hui, R., & Zhu, Y. (2024). Marine thraustochytrid: exploration from taxonomic challenges to biotechnological applications. *Frontiers in Marine Science*, 11, 1371713.
- Wintah, W., Kiswanto, K., Hilmi, E., & Sastranegara, M. H. 2023. Mangrove diversity and its relationships with environmental conditions in Kuala Bubon Village, West Aceh, Indonesia. *Biodiversitas Journal of Biological Diversity*, 24(8).
- Xia, X. (2018). *Distance-Based Phylogenetic Methods*. Dalam *Bioinformatics and the Cell*.
- Xie, Y., & Wang, G. 2015. Mechanisms of fatty acid synthesis in marine fungus-like protists. *Applied microbiology and biotechnology*, 99(20), 8363-83.