



DAFTAR PUSTAKA

- Ahmad, A. & Ashraf, S. S. 2023. Sustainable food and feed sources from microalgae: Food security and the circular bioeconomy. *Algal Research*, 74: 103185. <https://doi.org/10.1016/j.algal.2023.103185>
- Ajala, E. O., Eletta, O. A. A., Ajala, M. A. & Oyeniyi, S. K. 2018. Characterization and evaluation of chicken eggshell for use as a bio-resource. *Arid Zone Journal of Engineering, Technology and Environment*, 14(1): 26-40.
- Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. & Walter, P. 2002. ‘Proteins’, in *Molecular Biology of the Cell (4th Edition)*. New York: Garland Science.
- Arif, M., Bai, Y., Usman, M., Jalalah, M., Harraz, F. A., Al-Assiri, M. S., Li, X., Salama, E.-S. & Zhang, C. 2020. Highest accumulated microalgal lipids (polar and non-polar) for biodiesel production with advanced wastewater treatment: Role of lipidomics. *Bioresource Technology*, 298: 122299. <https://doi.org/10.1016/j.biortech.2019.122299>
- Arora, N. & Philippidis, G. P. 2021. Insights into the physiology of *Chlorella vulgaris* cultivated in sweet sorghum bagasse hydrolysate for sustainable algal biomass and lipid production. *Scientific Reports*, 11(1). <https://doi.org/10.1038/s41598-021-86372-2>
- Aznan, M. F. N., Yasin, N. H. M., Mohd, N. & Takriff, M. S. 2022. Growth kinetics determination using different mathematical models for microalgae *Characium* sp. UKM1, *Chlorella* sp. UKM2 and *Coelastrella* sp. UKM4. *ASM Science Journal*, 17: 1-12. <https://doi.org/10.32802/asmscj.2022.930>
- Baudelet, P. -H., Ricochet, G., Linder, M. & Muniglia, L. 2017. A new insight into cell walls of *Chlorophyta*. *Algal Research*, 25: 333-371. Baudelet, Paul-Hubert; Ricochet, Guillaume; Linder, Michel; Muniglia, Lionel (2017). A new insight into cell walls of Chlorophyta. *Algal Research*, 25(), 333–371. <https://doi.org/10.1016/j.algal.2017.04.008>
- Branyikova, I., Prochazkova, G., Potocar, T., Jezkova, Z. & Branyik, T. 2018. Harvesting of microalgae by flocculation. *Fermentation*, 4(4): 93. <https://doi.org/10.3390/fermentation4040093>
- Carlsson, N., Borde, A., Wölfel, S., Åkerman, B. & Larsson, A. 2011. Quantification of protein concentration by the Bradford method in the presence of pharmaceutical polymers. *Analytical Biochemistry*, 411(1): 116-121. <https://doi.org/10.1016/j.ab.2010.12.026>
- Chen, J., Kazzaz, A. E., Mazandarani, N. A., Feizi, Z. H. & Fatehi, P. 2018. Production of Flocculants, adsorbents, and dispersants from lignin. *Molecules*, 23(4): 868. <https://doi.org/10.3390/molecules23040868>
- Cheruiyot, K. R., Olila, D. & Kateregga, J. 2009. In-vitro antibacterial activity of selected medicinal plants from Longisa region of Bomet district, Kenya. *African Health Sciences*, 9(Suppl 1): S42-S46.
- Choi, H. J. 2015. Effect of eggshells for the harvesting of microalgae species. *Biotechnology & Biotechnological Equipment*, 29(4): 666-672. <https://doi.org/10.1080/13102818.2015.1031177>
- Coronado-Reyes, J. A., Salazar-Torres, J. A., Juárez-Campos, B. & González-Hernández, J. C. 2020. *Chlorella vulgaris*, a microalgae



important to be used in biotechnology: A review. *Food Science and Technology*, 42. <https://doi.org/10.1590/fst.37320>

Choudhary, A. R., Karmakar, R., Kundu, K. & Dahake, V. R. 2011. "Algal" biodiesel: Future prospects and problems. *Water & Energy International*, 68: 44-51.

Chowdury, K. H., Nahar, N. & Deb, U. K. 2020. The growth factors involved in microalgae cultivation for biofuel production: A review. *Computational Water, Energy, and Environmental Engineering*, 9: 185-215. <https://doi.org/10.4236/cweee.2020.94012>

Chu, R., Li, S., Yin, Z., Hu, D., Zhang, L., Xiang, M. & Zhu, L. 2021. A fungal immobilization technique for efficient harvesting of oleaginous microalgae: Key parameter optimization, mechanism exploration and spent medium recycling. *Science of The Total Environment*, 790: 148174. <https://doi.org/10.1016/j.scitotenv.2021.148174>

Daliry, S., Hallajisani, A., Mohammadi Roshandeh, J., Nouri, H. & Golzary, A. 2017. Investigation of optimal condition for Chlorella vulgaris microalgae growth. *Global Journal of Environmental Science and Management*, 3(2): 217-230.

De Souza, P. M., Sanchez-Barrios, A., Rizzetti, M. T., Benitez, B. L., Hoeltz, M., Schneider, R. C. de S. de & Neves, F., F. de. 2020. Concepts and trends for extraction and application of microalgae carbohydrates. *IntechOpen*.

Demir, I., Besson, A., Guiraud, P. & Formosa-Dague, C. 2020. Towards a better understanding of microalgae natural flocculation mechanisms to enhance flotation harvesting efficiency. *Water Science & Technology*, 82(6): 1009–1024. <https://doi.org/10.2166/wst.2020.177>

Eilam, Y., Khattib, H., Pintel, N. & Avni, D. 2023. Microalgae-Sustainable source for alternative proteins and functional ingredients promoting gut and liver health. *Global Challenges*, 7(5). <https://doi.org/10.1002/gch2.202200177>

Elisabeth, B., Rayen, F. & Behnam, T. 2021. Microalgae culture quality indicators: A review. *Critical Reviews in Biotechnology*, 41(4): 457-473. <https://doi.org/10.1080/07388551.2020.1854672>

Gold Biotechnology. 2019. Bradford protein assay. <https://goldbio.com/documents/3604/Bardford%20Protein%20Assay.pdf>.

Guldhe, A., Misra, R., Singh, P., Rawat, I. & Bux, F. 2015. An innovative electrochemical process to alleviate the challenges for harvesting of small size microalgae by using non-sacrificial carbon electrodes. *Algal Research*, 19: 292-298. <https://doi.org/10.1016/j.algal.2015.08.014>

Hadiyanto, H., Christwardana, M., Widayat, W., Jati, A. K. & Laes, S. I. 2021. Optimization of flocculation efficiency and settling time using chitosan and eggshell as bio-flocculant in *Chlorella pyrenoidosa* harvesting process. *Environmental Technology & Innovation*, 24: 101959. <https://doi.org/10.1016/j.eti.2021.101959>

Hadiyanto, H., Widayat, W., Christwardana, M. & Pratiwi, M. E. 2022a. The flocculation process of *Chlorella* sp. using chitosan as a bio-flocculant: Optimization of operating conditions by response surface methodology. *Current Research in Green and Sustainable Chemistry*, 5: 100291. <https://doi.org/10.1016/j.crgsc.2022.100291>

Hadiyanto, H., Widayat, W., Pratiwi, M. E., Christwardana, M. & Muylaert, K.



- 2022b. Effect of pH, cationic inducer, and clam shells as bio-flocculant in the optimization of the flocculation process for enhanced microalgae harvesting using response surface methodology. *Environmental Pollutants and Bioavailability*, 34(1): 338-351. <https://doi.org/10.1080/26395940.2022.2110520>
- Hadiyanto, H., Isaroyati, L., Christwardana, M., Suherman, S. & Susilaningsih, D. 2023. Respond surface optimization of bioflocculation of *Chlorella vulgaris* using filamentous fungus *Aspergillus niger* pellets to improve harvesting efficiency. *Bioresource Technology Reports*, 21: 101378. <https://doi.org/10.1016/j.biteb.2023.101378>
- Kang, K. -H., Qian, Z. -J., Ryu, B. -M. & Kim, S. -K. 2011. Characterization of growth and protein contents from microalgae *Navicula incerta* with the investigation of antioxidant activity of enzymatic hydrolysates. *Food Science and Biotechnology*, 20(1): 183-191. <https://doi.org/10.1007/s10068-011-0025-6>
- Khan, S., Khan, A., Khattak, F. S. & Naseem, A. 2012. An accurate and cost effective approach to blood cell count. *International Journal of Computer Applications*, 50(1): 18-24. <https://doi.org/10.5120/7734-0682>
- Khazaie, A., Mazarji, M., Samali, B., Osborne, D., Minkina, T., Sushkova, S., Mandzhieva, S. & Soldatov, A. 2022. A review on coagulation/flocculation in dewatering of coal slurry. *Water*, 14(6): 918. <https://doi.org/10.3390/w14060918>
- Krishnan, V., Uemura, Y., Thanh, N. T., Khalid, N. A., Osman, N. & Mansor, N. 2015. Three types of marine microalgae and *Nannochloropsis oculata* cultivation for potential source of biomass production. *Journal of Physics: Conference Series*, 622: 012034. <https://doi.org/10.1088/1742-6596/622/1/012034>
- Krzemińska, I., Pawlik-Skowrońska, B., Trzcińska, M. & Tys, J. 2014. Influence of photoperiods on the growth rate and biomass productivity of green microalgae. *Bioprocess and Biosystems Engineering*, 37: 735–741. <https://doi.org/10.1007/s00449-013-1044-x>
- Lasmarito, T. C., Widianingsih, W. & Endrawati, H. 2022. Kandungan lutein mikroalga *Chlorella vulgaris* dengan salinitas berbeda pada media kultur. *Journal of Marine Research*, 11(2): 320-326. <https://doi.org/10.14710/jmr.v11i2.33819>
- Lee, E., Jalalizadeh, M. & Zhang, Q. 2015. Growth kinetic models for microalgae cultivation: A review. *Algal Research*, 12: 497-512. <https://doi.org/10.1016/j.algal.2015.10.004>
- Leyva, A., Quintana, A., Sánchez, M., Rodríguez, E. N., Cremata, J. & Sánchez, J. C. 2008. Rapid and sensitive anthrone-sulfuric acid assay in microplate format to quantify carbohydrate in biopharmaceutical products: method development and validation. *Biologicals : journal of the International Association of Biological Standardization*, 36(2): 134-141. <https://doi.org/10.1016/j.biologicals.2007.09.001>
- Liu, J., Huang, J. & Chen, F. 2011. ‘Microalgae as feedstocks for biodiesel production’, in Margarita, S. & Montero, G. (Eds.) *Biodiesel - Feedstocks and Processing Technologies*. InTech. <https://doi.org/10.5772/25600>
- Liu, J., Zhu, Y., Tao, Y., Zhang, Y., Li, A., Li, T., Sang, M. & Zhang, C. 2013.



- Freshwater microalgae harvested via flocculation induced by pH decrease. *Biotechnology for Biofuels*, 6(1): 98. <https://doi.org/10.1186/1754-6834-6-98>
- Lubis, M., Ginting, M. H. S., Dalimunthe, N. F., Hasibuan, D. M. T. & Sastrodihardjo, S. 2017. The influence of chicken egg shell as fillers on biocomposite acrylic resin for denture based. *IOP Conference Series: Materials Science and Engineering*, 180: 012008. <https://doi.org/10.1088/1757-899X/180/1/012008>
- Lucakova, S., Branyikova, I. & Hayes, M. 2022. Microalgal proteins and bioactives for food, feed, and other applications. *Applied Sciences*, 12(9): 4402. <https://doi.org/10.3390/app12094402>
- Ma, W., Feng, C., Guan, F., Ma, D. & Cai, J. 2023. Effective *Chlorella vulgaris* biomass harvesting through sulfate and chloride flocculants. *Journal of Marine Science and Engineering*, 11(1): 47. <https://doi.org/10.3390/jmse11010047>
- Ma, X. & Jian, W. 2023. Growth conditions and growth kinetics of *Chlorella vulgaris* cultured in domestic sewage. *Sustainability*, 15(3): 2162. <https://doi.org/10.3390/su15032162>
- Mardalisa, M., Zalfiatri, Y. & Rahmayuni, R. 2022. The effect of culture media types on the growth of marine microalgae *Chlorella vulgaris*. *IOP Conference Series: Earth and Environmental Science*, 1118(1): 012029. <https://doi.org/10.1088/1755-1315/1118/1/012029>
- Markou, G., Angelidaki, I. & Georgakakis, D. 2012. Microalgal carbohydrates: An overview of the factors influencing carbohydrates production, and of main bioconversion technologies for production of biofuels. *Applied Microbiology and Biotechnology*, 96: 631-645. <https://doi.org/10.1007/s00253-012-4398-0>
- McKeen, L. W. 2012. 'Introduction to plastics and polymers', in McKeen, L. W. (Ed.) *Film Properties of Plastics and Elastomers (Third Edition)*. William Andrew Publishing. <https://doi.org/10.1016/B978-1-4557-2551-9.00001-3>
- Morales, M., Aflalo, C. & Bernard, O. 2021. Microalgal lipids: A review of lipids potential and quantification for 95 phytoplankton species. *Biomass and Bioenergy*, 150: 106108. <https://doi.org/10.1016/j.biombioe.2021.106108>
- Moreira, J. B., Santos, T. D., Duarte, J. H., Bezerra, P. Q. M., de Morais, M. G. & Costa, J. A. C. 2023. Role of microalgae in circular bioeconomy: from waste treatment to biofuel production. *Clean Technologies and Environmental Policy*, 25: 427-437.
- Mubarak, M., Shaija, A. & Suchithra, T. V. 2016. Ultrasonication: An effective pre-treatment method for extracting lipid from *Salvinia molesta* for biodiesel production. *Resource-Efficient Technologies*, 2: 126-132. <https://doi.org/10.1016/j.refft.2016.07.005>
- Mueller, J., Friedl, T., Hepperle, D., Lorenz, M. & Day, J. 2005. Distinction between multiple isolates of *Chlorella vulgaris* (*Chlorophyta, Trebouxiophyceae*) and testing for conspecificity using amplified fragment length polymorphism and its rDNA sequences. *Journal of Phycology*, 41: 1236-1247. <https://doi.org/10.1111/j.1529-8817.2005.00134.x>
- Nur, F., Erfianti, T., Andeska, D. P., Putri, R. A. E., Nurafifah, I., Sadewo, B. R. & Suyono, E. A. 2023. Enhancement of microalgal metabolite production



- through *Euglena* sp. local strain and Glagah strain consortia. *Biosaintifika*, 15(1): 36-47. <https://doi.org/10.15294/biosaintifika.v15i1.41895>
- Nurafifah, I., Hardianto, M. A., Erfianti, T., Amelia, R., Maghfiroh, K. Q., Kurnianto, D., Siswanti, D. U., Sadewo, B. R., Putri, R. A. E. & Suyono, E. A. 2023. The effect of acidic pH on growth kinetics, biomass productivity, and primary metabolite contents of *Euglena* sp. *Makara Journal of Science*, 27(2). <https://doi.org/10.7454/mss.v27i2.1506>
- Price, K. & Farag, I. 2013. Resources conservation in microalgae biodiesel production. *International Journal of Engineering and Technical Research*, 1(8).
- Praharyawan, S. & Rachmayati, R. 2021. The effect of Aceh's natural stone presence on the growth, produced biomass and primary metabolites production of *Chlorella vulgaris* LIPI12-AL042. *IOP Conference Series: Earth and Environmental Science*, 762(1): 012046. <https://doi.org/10.1088/1755-1315/762/1/012046>
- Pugazhendhi, A., Shobana, S., Bakonyi, P., Nemestóthy, N., Xia, A., Jeyakumar, R. B., & Kumar, G. 2019. A review on chemical mechanism of microalgae flocculation via polymers. *Biotechnology Reports*, 21: e00302. <https://doi.org/10.1016/j.btre.2018.e00302>
- Ravina, L. 1993. Everything you want to know about coagulation & flocculation. Zeta-Meter, Inc.: Virginia.
- Roy, M. & Mohanty, K. 2020. Valorization of waste eggshell-derived bioflocculant for harvesting *T. obliquus*: Process optimization, kinetic studies and recyclability of the spent medium for circular bioeconomy. *Bioresource Technology*, 307: 123205. <https://doi.org/10.1016/j.biortech.2020.123205>
- Ru, I. T. K., Sung, Y. Y., Jusoh, M., Wahid, M. E. A. & Nagappan, T. 2020. *Chlorella vulgaris*: a perspective on its potential for combining high biomass with high value bioproducts. *Applied Phycology*, 1(1): 2-11. <https://doi.org/10.1080/26388081.2020.1715256>
- Safi, C., Zebib, B., Merah, O., Pontalier, P. -Y. & Vaca-Garcia, C. 2014. Morphology, composition, production, processing and applications of *Chlorella vulgaris*: A review. *Renewable and Sustainable Energy Reviews*, 35: 265-278. <https://doi.org/10.1016/j.rser.2014.04.007>
- Salgueiro, J. L., Pérez, L., Maceiras, R., Sánchez, A. & Cancela, A. 2016. Bioremediation of wastewater using *Chlorella vulgaris* microalgae: Phosphorus and organic matter. *International Journal of Environmental Research*, 10(3): 465-470.
- Sathasivam, R., Radhakrishnan, R., Hashem, A. & Abd Allah, E. F. 2019. Microalgae metabolites: A rich source for food and medicine. *Saudi Journal of Biological Sciences*, 26(4): 709-722. <https://doi.org/10.1016/j.sjbs.2017.11.003>
- Serri, N. A., Anbalagan, L., Norafand, N. Z., Kassim, M. A. & Mansor, M. S. A. 2019. Preliminary study on the growth of *Tetraselmis suecica* in centred-light photobioreactor (CLPBR). *IOP Conference Series: Materials Science and Engineering*, 716(1): 012008. <https://doi.org/10.1088/1757-899X/716/1/012008>
- Silvello, M. A. C. de, Gonçalves, I. S., Azambuja, S. P. H., Costa, S. S., Silva, P.



- G. P., Santos, L. O. & Goldbeck, R. 2022. Microalgae-based carbohydrates: A green innovative source of bioenergy. *Bioresource Technology*, 344(Pt B). <https://doi.org/10.1016/j.biortech.2021.126304>
- Suparmaniam, U., Lam, M. K., Uemura, Y. & Shuit, S. H. 2019. Development of bioflocculant from chicken's eggshell membrane to harvest *Chlorella vulgaris*. *IOP Conference Series: Earth and Environmental Science*, 268: 1-6. <https://doi.org/10.1088/1755-1315/268/1/012121>
- Surendhiran, D. & Vijay, M. 2013. Effect of different flocculants on harvesting of halotolerant microalgae *Chlorella salina* for biodiesel production. *International Journal of Green Chemistry and Bioprocess*, 3(1): 6-11. <https://doi.org/10.1016/j.jece.2013.08.016>
- Tahraoui, H., Toumi, S., Boudoukhani, M., Touzout, N., Sid., A. N. E. H., Amrane, A., Belhadj, A. -E., Hadjadj, M., Laichi, Y., Aboumustapha, M., Kebir, M., Bouguettoucha, A., Chebli, D., Assadi, A. A. & Zhang, J. 2024. Evaluating the effectiveness of coagulation-flocculation treatment using aluminum sulfate on a polluted surface water source: A year-long study. *Water*, 16(3). <https://doi.org/10.3390/w16030400>
- Tiwari, S. & Dhakal, N. 2023. Analysis of variations in biomolecules during various growth phases of freshwater microalgae *Chlorella* sp. *Applied Food Biotechnology*, 10(1): 73-84.
- Turmel, M., Ehara, M., Otis, C. & Lemieux, C. 2002. Phylogenetic relationships among streptophytes as inferred from chloroplast small and large subunit rRNA gene sequences. *Journal of Phycology*, 38: 364-375.
- Wang, C., Li, H., Wang, Q., & Wei, P. 2010. Effect of pH on growth and lipid content of *Chlorella vulgaris* cultured in biogas slurry. *Chinese Journal of Biotechnology*, 26(8): 1074-1079.
- Wang, Y., Tibbetts, S. M. & McGinn, P. J. 2021. Microalgae as sources of high-quality protein for human food and protein supplements. *Foods*, 10(12). <https://doi.org/10.3390/foods10123002>
- Ward, V.C.A. & Rehmann, L. 2019. Fast media optimization for mixotrophic cultivation of *Chlorella vulgaris*. *Scientific Reports*, 9. <https://doi.org/10.1038/s41598-019-55870-9>
- Widyaningrum, D. & Prianto, A. D. 2021. *Chlorella* as a source of functional food ingredients: Short review. *IOP Conference Series: Earth and Environmental Science*, 794. <https://doi.org/10.1088/1755-1315/794/1/012148>
- Xu, R. & Queneau, Y. 2014. 'How the polarity of carbohydrates can be used in chemistry', in Rauter, A. P., Lindhorst, T. & Queneau, Y. (Eds.) *Carbohydrate Chemistry: Chemical and Biological Approaches*. The Royal Society of Chemistry.
- Xu, R. & Queneau, Y. 2014. 'How the polarity of carbohydrates can be used in chemistry', in Rauter, A. P., Lindhorst, T. & Queneau, Y. (Eds.) *Carbohydrate Chemistry: Chemical and Biological Approaches*. The Royal Society of Chemistry. <https://doi.org/10.1039/9781849739986-00031>
- Xu, K., Zou, X., Mouradov, A., Spangenberg, G., Chang, W. & Li, Y. 2021. Efficient Bioflocculation of *Chlorella vulgaris* with a chitosan and walnut protein extract. *Biology (Basel)*, 10(5): 352. <https://doi.org/10.3390/biology10050352>
- Ye, J., Yang, C., Xia, L., Zhu, Y., Liu, L., Cao, H. & Tao, Y. 2023. Protoplast preparation for algal single-cell omics sequencing. *Microorganisms*, 11(2): 538. <https://doi.org/10.3390/microorganisms11020538>



UNIVERSITAS
GADJAH MADA

Pengaruh Bioflokulan Cangkang Telur dan Cationic Inducer Seng Klorida Terhadap Efektivitas Pemanenan

dan Kandungan Metabolit Primer dari Chlorella vulgaris Skala Laboratorium

Adhelia Intan Sabhira, Dr. Eko Agus Suyono, S.Si., M.App.Sc.

Universitas Gadjah Mada, 2024 | Diunduh dari <http://etd.repository.ugm.ac.id/>

- Yusof, Y. A. M., Basari, J. M. H., Mukti, N. A., Sabuddin, R., Muda, A. R., Sulaiman, S., Makpol, S. & Ngah, W. Z. W. 2011. Fatty acids composition of microalgae *Chlorella vulgaris* can be modulated by varying carbon dioxide concentration in outdoor culture. *African Journal of Biotechnology*, 10(62): 13536-13542. <https://doi.org/10.5897/AJB11.1602>
- Zhu, L., Li, Z. & Hiltunen, E. 2018. Microalgae *Chlorella vulgaris* biomass harvesting by natural flocculant: Effects on biomass sedimentation, spent medium recycling and lipid extraction. *Biotechnology for Biofuels*, 11. <https://doi.org/10.1186/s13068-018-1183-z>