

DAFTAR PUSTAKA

- Abdala-Díaz, R. T., J. García-Márquez, R. M. Rico, J. L. Gómez-Pinchetti, J. M. Mancera, F. L. Figueroa, F. J. Alarcón, E. Martínez-Manzanares, dan M. A. Moriñigo. 2021. Effects of a short pulse administration of *Ulva rigida* on innate immune response and intestinal microbiota in *Sparus aurata* juveniles. *Aquaculture Research* 52: 3038-3051. <https://doi.org/10.1111/are.15148>
- Abdallah, E. S. H., W. G. M. Metwally, M. A. M. Abdel-Rahman, M. Albano, dan M. M. Mahmoud. 2024. *Streptococcus agalactiae* Infection in Nile Tilapia (*Oreochromis niloticus*): A Review. *Biology (Basel)* 13: 914. <https://doi.org/10.3390/biology13110914>
- Abdelhamid, A. F., H. F. Ayoub, E. A. Abd El-Gawad, M. F. Abdelghany, dan M. Abdel-Tawwab. 2021. Potential effects of dietary seaweeds mixture on the growth performance, antioxidant status, immunity response, and resistance of striped catfish (*Pangasianodon hypophthalmus*) against *Aeromonas hydrophila* infection. *Fish and Shellfish Immunology* 119: 76-83.
- Abdel-Razek, N., R. H. Khalil, T. M. M. Abdelrahiem, M. Fathi, dan S. A. Metwaly. 2025. Isolation and Invitro Evaluation of Bacteriophage Therapy Targeting *Streptococcus agalactiae* in Nile Tilapia (*Oreochromis niloticus*): A Potential Approach to Sustainable Disease Management in Aquaculture. *Journal of Fish Diseases* e70019. <https://doi.org/10.1111/jfd.70019>
- Abouelmaatti, R. R., A. M. Algammal, W. M. Elfeil, N. M. Elshaffy, X. Li, J. Ma, M. Fawzy, A. Wahdan, R. El-Tarabili, dan I. I. Shabana. 2020. Genetic characterization, cloning, and expression of Toll-like Receptor 1 mRNA Nile tilapia (*Oreochromis niloticus*). *Veterinarski arhiv* 90: 185-196.
- Abo-Raya, M. H., K. M. Alshehri, R. F. A. Abdelhameed, Z. I. Elbially, S. S. Elhady, dan R. A. Mohamed. 2021. Assessment of growth-related parameters and immune-biochemical profile of Nile tilapia (*Oreochromis niloticus*) fed dietary *Ulva fasciata* extract. *Aquaculture Research* 52: 3233-3246. <https://doi.org/10.1111/are.15169>
- Akbar, M. R. L., D. M. Suci, dan I. Wijayanti. 2017. Evaluasi kualitas pellet pakan itik yang disuplementasi tepung daun mengkudu (*Morinda citrifolia*) dan disimpan selama 6 minggu. *Buletin makanan ternak* 104(2): 31-48.
- Alagan, V. T., R. N. Valsala, dan K. D. Rajesh. 2017. Bioactive chemical constituent analysis, in vitro antioxidant and antimicrobial activity of whole plant methanol extracts of *Ulva lactuca* Linn. *British Journal of Pharmaceutical Research*, 15(1): 1-14. <https://doi.org/10.9734/BJPR/2017/31818>
- Alcaraz, R., A. Hernández-Contreras, P. Iglesias, dan M. D. Hernández. 2021. Effect of the inclusion of microalgae on the physical properties of extruded feed for gilthead seabream (*Sparus aurata* L.). *Algal Resources* 53. <https://doi.org/10.1016/j.algal.2020.102167>
- Al-Dulaimi, K.A.K., J. Banks, V. Chandran, I. Tomeo-Reyes dan K. Nguyen Thanh. 2018. Classification of white blood cell types from microscope images: Techniques and challenges. *Microscopy Science: Last Approaches on*

Educational Programs and Applied Research (Microscopy Book Series, 8): 17-25.

- Alfonso, S., E. Fiocchi, L. Toomey, M. Boscarato, A. Manfrin, A. Dimitroglou, L. Papaharisis, E. Passabi, A. Stefani, G. Lembo, dan P. Carbonara. 2024. Comparative analysis of blood protein fractions in two Mediterranean farmed fish, *Dicentrarchus labrax* and *Sparus aurata*. BMC Veterinary Research, 20(322). <https://doi.org/10.1186/s12917-024-04182-w>
- Appel, R. J. C., K. N. Siqueira, I. Konstantinidis, M. I. M. Martins, R. Joshi, L. G. Pretto-Giordano, L. A. Vilas-Boas, dan J. M. d. O. Fernandes. 2025. Comparative transcriptome analysis reveals a serotype-specific immune response in Nile tilapia (*Oreochromis niloticus*) infected with *Streptococcus agalactiae*. Frontiers in Immunology, 15, Article 1528721. <https://doi.org/10.3389/fimmu.2024.1528721>
- Aslamyah, S., M. Y. Karim, dan Badraeni. 2017. Fermentation of seaweed flour with various fermentors to improve the quality of fish feed ingredients. Jurnal Akuakultur Indonesia, 16(1): 8–14. <https://doi.org/10.19027/jai.16.1.8-14>
- Ashry, A. M., M. M. Habiba, A. A. Abdel-Warith, E. M. Younis, S. J. Davies, M. A. Elnakeeb, M.F. Abdelghany, A. M. El-Zayat, A. M. El-Sebaey. 2024. Dietary effect of powdered herbal seeds on zootechnical performance, hemato-biochemical indices, immunological status, and intestinal microbiota of European sea bass (*Dicentrarchus labrax*). Aquaculture Reports 36: 102074. <https://doi.org/10.1016/j.aqrep.2024.102074>
- Babich, O., S. Ivanova, P. Michaud, E. Budenkova, E. Kashirskikh, V. Anokhova, dan S. Sukhikh. 2024. Fermentation of micro- and macroalgae as a way to produce value-added products. Biotechnology Reports 41: e00827. <https://doi.org/10.1016/j.btre.2023.e00827>
- Bardhan, A., T. J. Abraham, R. Das, dan P. K. Patil. 2022. Biological Responses of Nile tilapia *Oreochromis niloticus* as Influenced by Dietary Florfenicol. Toxics 10, 571. <https://doi.org/10.3390/toxics10100571>
- Bastiaansen, T. M. M., R. T. Benders, J. A. Dijkman, M. Thomas, W. H. Hendriks, S. de Vries, dan G. Bosch. 2023. Changes in thermomechanical properties of feed in relation to composition and their effect on pellet manufacturing. Anim. Feed Sci. Technol. 295. <https://doi.org/10.1016/j.anifeedsci.2022.115540>
- Blazer, V. S. dan Wolke, R. E.. 1984. The effects of α -tocopherol on the immune response and non-specific resistance factors of rainbow trout (*Salmo gairdneri* Richardson). Aquaculture, 37(1): 1-9.
- Bolton, J. J., M. D. Cyrus, M. J. Brand, M. Joubert dan B. M. Macey. 2016. Why grow *Ulva*? Its potential role in the future of aquaculture. Perspectives in Phycology, 3(3): 113-120.
- Boonanuntanasarn, S., A. Jangprai, S. Kumkhong, E. Plagnes-Juan, V. Veron, C. Burel, L. Marandel, dan S. Panserat. 2018. Adaptation of Nile tilapia (*Oreochromis niloticus*) to different levels of dietary carbohydrates: New insights

from a long term nutritional study. *Aquaculture* 496: 58–65.
<https://doi.org/10.1016/j.aquaculture.2018.07.011>

- Bota, W., M. Martosupono dan F. S. Rondonuwu. 2015. Potensi senyawa minyak sereh wangi (*Citronella oil*) dari tumbuhan *Cymbopogon nardus* L. sebagai agen antibakteri. Prosiding Seminar Nasional Sains dan Teknologi, Fakultas Teknik, Universitas Muhammadiyah Jakarta, 17 November 2015.
- Bradford, M. M. (1976). A rapid and sensitive method for the quantitation of microgram quantities of protein utilizing the principle of protein–dye binding. *Analytical Biochemistry* 72(1–2), 248–254. [https://doi.org/10.1016/0003-2697\(76\)90527-3](https://doi.org/10.1016/0003-2697(76)90527-3)
- Buchmann, K. (2022). Neutrophils and aquatic pathogens. *Parasite Immunology*, 44(e12915). <https://doi.org/10.1111/pim.12915>
- Bury, N. R., J. M. Wilson, dan A. Sturm. 2024. Evolutionarily conserved mechanisms regulating stress-induced neutrophil redistribution in fish. *Developmental & Comparative Immunology* 155, 105788.
- Bwalya, P., C. Simukoko, B. M. Hang'ombe, S. C. Støre, P. Støre, A. A. Gamil dan S. Mutoloki. 2020. Characterization of *Streptococcus*-like bacteria from diseased *Oreochromis niloticus* farmed on Lake Kariba in Zambia. *Aquaculture* 523: 735185.
- Chandra, E. H., W. P. Lokapirnasari, S. Hidanah, M. A. Al-Arif, W. M. Yuniarti dan E. M. Luqman. 2022. Probiotic potential of lactic acid bacteria on feed efficiency, weight and carcass percentage in ducks. *Jurnal Medik Veteriner* 5(1): 69-73.
- Chowdhury, S. dan Saikia, S. 2020. Oxidative stress in fish: A review. *J. Sci. Res.* 12: 145–160. <https://doi.org/10.3329/jsr.v12i1.41716>.
- Costa, D. S., S. A. P. Dutra, I. L. Pereira, L. Cardoso, P. B. Medeiros, L. V. P. de, Riofrio, M. C. M. Libanori, T. A. Soligo, E. Yamashita, U. d. P. Pereira, J. L. P. Mourinõ, dan M. L. Martins. 2024. Hematoimmunological responses of juvenile Nile tilapia (*Oreochromis niloticus*) receiving the dietary supplementation of immunomodulators and different levels of vitamins after challenge with physical stress. *Brazilian Journal of Veterinary Medicine* 46, e001124–e001124. <https://doi.org/10.29374/2527-2179.bjvm001124>
- Craig, S. R., L. A. Helfrich, D. Kuhn, dan M. H. Schwarz. 2017. Understanding fish nutrition, feeds, and feeding.
- Dawood, M. A. dan Koshio, S. 2020. Application of fermentation strategy in aquafeed for sustainable aquaculture. *Reviews in Aquaculture* 12(2): 987-1002.
- Day, K. S., L. Rempel, F. M. V. Rossi, dan M. Theret. 2024. Origins and functions of eosinophils in two non-mucosal tissues. *Frontiers in Immunology* 15, 1368142. <https://doi.org/10.3389/fimmu.2024.1368142>
- Demska-Zakęś, K., M. Rożyński, P. Gomułka, R. Rożyński, K. Formicki, dan Z. Zakęś. 2023. Do immunomodulatory substances facilitate recovery from stress caused by feed changes in juvenile brown trout (*Salmo trutta m. fario* L.)? *Fisheries and Aquatic Life* 31. <https://doi.org/10.2478/aopf-2023-0013>

- del Rocío Quezada-Rodríguez, P., dan Fajer-Ávila, E. J., 2017. The dietary effect of *ulvan* from *Ulva clathrata* on hematological-immunological parameters and growth of tilapia (*Oreochromis niloticus*). *J. Appl. Phycol.* 29: 423–431. <https://doi.org/10.1007/s10811-016-0903-7>
- Dhanarso, P., H. Yunissa, I. Istiqomah, dan A. Isnansetyo. 2021. Complement system activation in red tilapia (*Oreochromis sp.*) orally administered with probiotics SEAL. *IOP Conf. Ser.: Earth Environ. Sci.* 718 012055. <https://doi.org/10.1088/1755-1315/718/1/012055>
- Doan, H. V., S. H. Hoseinifar, W. Tapingkae, dan S. Jaturasitha. 2016. Effects of low molecular weight sodium alginate on growth performance, immunity, and disease resistance of tilapia (*Oreochromis niloticus*). *Fish and Shellfish Immunology* 58: 313–321. <https://doi.org/10.1016/j.fsi.2016.05.034>
- do Nascimento, T. M., C. F. Mansano, H. Peres, F. H. Rodrigues, K. U. Khan, R. S. Romanelli, dan J. B. Fernandes. 2020. Determination of the optimum dietary essential amino acid profile for growing phase of Nile tilapia by deletion method. *Aquaculture* 523: 735204.
- Dong, C., G. He, K. Mai, H. Zhou, dan W. Xu. 2016. Palatability of water-soluble extracts of protein sources and replacement of fishmeal by a selected mixture of protein sources for juvenile turbot (*Scophthalmus maximus*). *Journal of Ocean University of China* 15(3): 561-567. <https://doi.org/10.1007/s11802-016-2898-8>
- Elashry, M. A., E. Y. Mohammady, M. R. Soaudy, M. M. Ali, H. S. El-Garhy, J. A. Ragaza, dan M. S. Hassaan. (2024). Growth, health, and immune status of Nile tilapia *Oreochromis niloticus* cultured at different stocking rates and fed algal β -carotene. *Aquaculture Reports* 35: 101987. <https://doi.org/10.1016/j.aqrep.2024.101987>
- Fawole, F. J., S. Nazeemashahul, T. I. Chanu, A. Sharma, G. O. Kazeem, S. Ferosekhan, dan T. Kinnera. 2024. Application of immunostimulants for aquaculture health management. In *Immunomodulators in Aquaculture and Fish Health* (pp. 103-115). CRC Press.
- Felix, N., dan Brindo, R. A. 2014. Evaluation of raw and fermented seaweed, *Ulva sp.* as feed ingredient in giant freshwater prawn *Macrobrachium rosenbergii*. *Int. J. Fish Aquat. Stud.* 1(3): 199-204.
- Fernandes, H., N. Martins, L. Vieira, J. M. Salgado, C. Castro, A. Oliva-Teles, I. Belo, dan H. Peres. 2022. Pre-treatment of *Ulva rigida* improves its nutritional value for European seabass (*Dicentrarchus labrax*) juveniles. *Algal Research* 66: 102803.
- Fu, G. H., Z. Y. Bai, J. H. Xia, F. Liu, P. Liu, dan G. H. Yue. 2013. Analysis of two lysozyme genes and antimicrobial functions of their recombinant proteins in Asian seabass. *PLOS ONE* 8: e79743.
- Fumanal, M., D. E. Di Zeo, V. Anguís, C. Fernández-Díaz, F. J. Alarcón, R. Piñera, N. Albaladejo-Riad, M. A. Esteban, M. A. Moriñigo, dan M.C. Balebona. 2020. Inclusion of dietary *Ulva ohnoi* 5% modulates *Solea senegalensis* immune

response during *Photobacterium damsela* subsp. *piscicida* infection. *Fish & Shellfish Immunology* 100: 186-197.

Furuya, W. M., T. P. d. Cruz, dan D. M. III. Gatlin. 2023. Amino acid requirements for Nile tilapia: An update. *Animals* 13(5): 900. <https://doi.org/10.3390/ani13050900>

Gordeev, I. I., D. V. Mikryakov, L. V. Balabanova, dan V. R. Mikryakov. 2017. Composition of leucocytes in peripheral blood of Patagonian toothfish (*Dissostichus eleginoides*, Smitt, 1898) (Nototheniidae). *Polar Resources* 36: 1374126. <https://doi.org/10.1080/17518369.2017.1374126>.

Guiry, M. D., dan Guiry, G. M. 2024. *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway.

Hadiuzzaman, M., M. Moniruzzaman, M. Shahjahan, S. C. Bai, T. Min, dan Z. Hossain. 2022. β -Glucan: Mode of action and its uses in fish immunomodulation. *Frontiers in Marine Science* 9, 905986. <https://doi.org/10.3389/fmars.2022.905986>

Halver, J., dan Hardy, R. 2002. *Fish Nutrition*. Third edition. Academic Press, London-New York.

Harikrishnan, R., G. Devi, H. Van Doan, C. Balasundaram, J. Arockiaraj, dan C. Jagruthi. 2021. Efficacy of *ulvan* on immune response and immuno-antioxidant gene modulation in *Labeo rohita* against columnaris disease. *Fish and Shellfish Immunology* 117: 262-273.

Helmiati, S., Rustadi, A. Isnansetyo dan Zulprizal. 2020. Evaluasi kandungan nutrisi dan antinutrien tepung daun kelor terfermentasi sebagai bahan baku pakan ikan. *Jurnal Perikanan Universitas Gadjah Mada* 22(2): 149-158. <https://doi.org/10.22146/jfs.58526>.

Helmiati, S., Rustadi, A. Isnansetyo, dan Zuprizal. 2021. The replacement of fish meal with fermented Moringa leaves meal and its effect on the immune response of red tilapia (*Oreochromis sp.*). *IOP Conference Series: Earth and Environmental Science* 919: 012057.

Hibiya, T. 1982. "An Atlas of Fish Histology: Normal and Pathological Features." Kodansha, Tokyo.

Hubert, J. J. 1980. *Bioassay*. Kendall. Hunt Publishing Company. St. Louis. Toronto. London.

Hughes, A. D., G. C. Twigg, F. E. Msuya, K. P. Padmakumar, dan D. R. Tocher. 2025. The use of macroalgae in feeds for finfish aquaculture. *Front. Aquac.* 4. <https://doi.org/10.3389/faquc.2025.1570842>.

Ibrahim, R. E., S. A. A. Ahmed, S. A. Amer, N. A. Al-Gabri, A. I. Ahmed, A. W. A. Abdel-Warith, E. M. I. Younis, dan A. E. Metwally. 2020. Influence of vitamin C feed supplementation on the growth, antioxidant activity, immune status, tissue histomorphology, and disease resistance in Nile tilapia, *Oreochromis niloticus*. *Aquaculture Reports* 18: 100545. <https://doi.org/10.1016/j.aqrep.2020.100545>

- Ismail, M. 2017. Differentiation between some *Ulva* Spp. by morphological, genetic, and biochemical analyses. *Vavilov J. Genet. Breed.* 21: 360–367. <https://doi.org/10.18699/VJ17.253>.
- Isnansetyo, A., H. M. Irpani, T. A. Wulansari, dan N. Kasanah. 2014. Oral administration of alginate from a tropical brown seaweed, *Sargassum sp.*, to enhance non-specific defense in walking catfish (*Clarias sp.*). *Aquacultura Indonesiana* 15(1): 14-20.
- Isnansetyo, A., A. Fikriyah, N. Kasanah, dan Murwantoko. 2016. Non-specific immune potentiating activity of fucoidan from a tropical brown algae (Phaeophyceae), *Sargassum cristaefolium* in tilapia (*Oreochromis niloticus*). *Aquaculture International* 24: 465-477.
- Jansen, H. M., M. S. Bernard, M. A. J. Nederlof, I. M. Van Der Meer, dan A. Van Der Werf. 2022. Seasonal variation in productivity, chemical composition and nutrient uptake of *Ulva* spp. (Chlorophyta) strains. *J. Appl. Phycol.* 34: 1649-1660. <https://doi.org/10.1007/s10811-022-02708-z>.
- Jiang, W., X. Jia, N. Xie, C. Wen, S. Ma, G. Jiang, X. Li, C. Chi, D. Zhang, dan W. Liu. 2023. Aquafeed fermentation improves dietary nutritional quality and benefits feeding behavior, meat flavor, and intestinal microbiota of Chinese mitten crab (*Eriocheir sinensis*). *Animal Nutrition* 14: 1-19.
- Kazi, M. A., M. G. Kavale, dan V. V. Singh. 2016. Morphological and molecular characterization of *Ulva chaugulii* sp. nov., *U. lactuca* and *U. ohnoi* (Ulvophyceae, Chlorophyta) from India. *Phycologia* 55: 45-54. <https://doi.org/10.2216/15-11.1>.
- Kementerian Kelautan dan Perikanan. (2022). Rilis data kelautan dan perikanan triwulan III tahun 2022. Pusat Data, Statistik, dan Informasi Sekretariat Jenderal, Kementerian Kelautan dan Perikanan.
- Khunrang, T., C. Pooljun, dan S. Wuthisuthimethavee. 2023. Correlation of *Streptococcus agalactiae* concentration on immune system and effective dose of inactivated vaccine for Chitralada 3 strain Nile tilapia (*Oreochromis niloticus*) in Thailand. *BMC Veterinary Research* 19(1), Article 267. <https://doi.org/10.1186/s12917-023-03835-6>
- Kishore, A. R. N., A. Roy, P. Sivaperumal, dan T. Lakshmi. 2022. Antibacterial activity of the crude extract of the seaweed (*Ulva* species) using clinical isolates. *Journal of Complementary Medicine Research* 13(3): 24–28. <https://doi.org/10.5455/jcmr.2022.13.03.05>
- Klak, K., M. Maciuszek, L. Pijanowski, M. Marcinkowska, J. Homa, B. M. L. Verburg-van Kemenade, K. Rakus, dan M. Chadzinska. 2024. Evolutionarily conserved mechanisms regulating stress-induced neutrophil redistribution in fish. *Front Immunol* 15: 1330995. <https://doi.org/10.3389/fimmu.2024.1330995>
- Kuswoyo, T., A. Isnansetyo, Murwantoko, A. Husni, dan I. Istiqomah. 2023. Sodium alginate from *Padina australis* modulates innate immune and immune gene expression in red tilapia (*Oreochromis sp.*). *Jurnal Ilmiah Perikanan dan Kelautan* 15(1): 1-14.

- Kwikiriza, G., M. J. Yegon, N. Byamugisha, A. Beingana, F. Atukwatse, A. Barekye, J. K. Nattabi, dan H. Meimberg. 2023. Morphometric variations of Nile Tilapia (*Oreochromis niloticus*) (Linnaeus, 1758) local strains collected from different fish farms in South Western Highland Agro-Ecological Zone (SWHAEZ), Uganda: screening strains for aquaculture. *Fishes*, 8: 217. <https://doi.org/10.3390/fishes8040217>.
- Lailaturramadhini, N., A. Yuniarti, Y. Maimunah, dan A. Ridwanudin. 2025. Supplementation of *Ulva sp.* in feed formulation to enhance the non-specific immune system of the Nile tilapia *Oreochromis niloticus*. *Egyptian Journal of Aquatic Biology & Fisheries* 29(3): 3221-3238. <https://ejabf.journals.ekb.eg>
- Lailler, R., K. R. Mittal, D. Leblanc, G. Lalonde, dan G. Oliver. 1981. Rapid methods for the differentiation of virulent and nonvirulent *Aeromonas hydrophila* strains. *Developments in Biological Standardization* 49: 119-125.
- Li, P., dan Wu, G. 2021. Important roles of amino acids in immune responses. *British Journal of Nutrition* 127(3): 398-402. <https://doi.org/10.1017/S0007114521004566>.
- Liu, H., S. Wang, Y. Cai, X. Guo, Z. Cao, Y. Zhang, S. Liu, W. Yuan, W. Zhu, Y. Zheng, Z. Lie, Z. Xie, W. Guo, dan Y. Zhou. 2017. Dietary administration of *Bacillus subtilis* HAINUP40 enhances growth, digestive enzyme activities, innate immune responses and disease resistance of tilapia (*Oreochromis niloticus*). *Fish and Shellfish Immunology* 60: 326-333.
- Liu, Y., Q. Xiao, S. Yang, L. Zhao, H. Fu, J. Du, Z. Du, T. Yan, dan H. Wu. 2017. Characterization of hematopoiesis in Dabry's sturgeon (*Acipenser dabryanus*). *Aquaculture and Fisheries* 2(6): 262-268. <https://doi.org/10.1016/j.aaf.2017.10.007>
- Lemos, L. S., L. M. Angarica, R. A. Hauser-Davis, dan N. Quinete. 2023. Cortisol as a stress indicator in fish: sampling methods, analytical techniques, and organic pollutant exposure assessments. *International Journal of Environmental Research and Public Health* 20: 6237.
- Lin, S. M., Y. Jiang, Y. J. Chen, L. Luo, S. Doolgindachbaporn, dan B. Yuangsoi. 2017. Effects of *Astragalus polysaccharides* (APS) and *chitooligosaccharides* (COS) on growth, immune response and disease resistance of juvenile largemouth bass, *Micropterus salmoides*. *Fish Shellfish Immunol.* 70: 40-47. <https://doi.org/10.1016/j.fsi.2017.08.035>
- Lu, X. J., dan Chen, J. 2019. Specific function and modulation of teleost monocytes: macrophages-polarization and phagocytosis. *Zoological Research* 40(3): 146-150. <https://doi.org/10.24272/j.issn.2095-8137.2019.035>
- Lusiastuti, A. M., A. Suhermanto, B. R. Hastilestari, S. Suryanto, M. Mawardi, D. Sugiani, D. Syahidah, P. E. Sudaryatma, dan D. Caruso. 2024. Impact of temperature on the virulence of *Streptococcus agalactiae* in Indonesian aquaculture: a better vaccine design is required. *Vet World* 17: 682-689. <https://doi.org/10.14202/vetworld.2024.682-689>.

- Makesh, M., M. K. Bedekar, dan K. V. Rajendran. (2022). Overview of Fish Immune System. In: Fish immune system and vaccines. Springer. Singapore. https://doi.org/10.1007/978-981-19-1268-9_1
- Madigan, M. T., J. M. Martinko, dan J. Parker. 1997. Brock Biology of Microorganisms (Vol. 11). Prentice Hall. Upper Saddle River, New Jersey.
- Magnusson, M., C. R. Glasson, M. J. Vucko, A. Angell, T. L. Neoh, dan R. de Nys. 2019. Enrichment processes for the production of high-protein feed from the green seaweed *Ulva ohnoi*. Algal Research 41: 101555.
- Mahasu, H. N., D. Jusadi, M. Setiawati, dan A. A. N. I. Giri. 2016. Potensi rumput laut *Ulva sp.* sebagai bahan baku pakan Ikan Nila (*Oreochromis niloticus*). Jurnal Ilmu dan Teknologi Kelautan Tropis. Vol. 8(1): 259- 267.
- Makwinja, R. dan Geremew, A. 2020. Roles and requirements of trace elements in tilapia nutrition: Review. Egypt. J. Aquat. Res. 46: 281-287. <https://doi.org/10.1016/j.ejar.2020.05.001>.
- Marmelo, I., M. Dias, A. Grade, P. Pousão-Ferreira, M. S. Diniz, A. Marques, dan A. L. Maulvault. 2024. Immunomodulatory and antioxidant effects of functional aquafeeds biofortified with whole *Laminaria digitata* in juvenile gilthead seabream (*Sparus aurata*). Front. Mar. Sci. 11.
- Martin, S. A. M., dan Król, E. 2017. Nutrigenomics and immune function in fish: New insights from omics technologies. Developmental and Comparative Immunology, 75, 86-98. <https://doi.org/10.1016/j.dci.2017.02.024>
- McCauley, J. I., P. C. Winberg, B. J. Meyer, dan D. Skropeta. 2018. Effects of nutrients and processing on the nutritionally important metabolites of *Ulva sp.* (Chlorophyta). Algal Research 35: 586-594.
- Mendivil, C. O., dan Pérez, S. A. 2021. Dietary fish, fish nutrients, and immune function: A review. Frontiers in Nutrition 7: 617652. <https://doi.org/10.3389/fnut.2020.617652>
- Mezdour, H., A. Menad, A. Gherib, M. Algabr, dan A. Souad. 2017. Immunomodulatory and anti-inflammatory activities of Algerian *Ulva sp.* World J. Pharm. Res. 6: 72-95. <https://doi.org/10.20959/wjpr201711-9478>.
- Mogensen, T. H. 2009. Pathogen recognition and inflammatory signaling in innate immune defenses. Clin. Microbiol. Rev. 22: 240-273. <https://doi.org/10.1128/cmr.00046-08>.
- Mohy El-Din, S. M. 2019. Temporal variation in chemical composition of *Ulva sp.* and *Corallina mediterranea*. International Journal of Environmental Science and Technology 16(10): 5783-5796.
- Mokhtar, D. M., G. Zaccone, A. Alesci, M. Kuciel, M. T. Hussein, dan R. K. A. Sayed. 2023. Main components of fish immunity: An overview of the fish immune system. Fishes 8(2): 93. <https://doi.org/10.3390/fishes8020093>

- Moura, G. de S., E. A. T. Lanna, K. Filer, D. L. Falkoski, J. L. Donzele, M. G. de A. Oliveira, S. T. de Rezende. 2012. Effects of enzyme complex SSF (solid state fermentation) in pellet diets for Nile tilapia. *R. Bras. Zootec.* 41: 2139-2143. <https://doi.org/10.1590/S1516-35982012001000001>
- Moreira, A. S. P., E. da Costa, T. Melo, D. Lopes, A. C. S. Pais, S. A. O. Santos, B. Pitarma, M. Mendes, M. H. Abreu, P. N. Collén, P. Domingues, dan M. R. Domingues. 2021. Polar lipids of commercial *Ulva* spp. of different origins: profiling and relevance for seaweed valorization. *Foods* 10: 914. <https://doi.org/10.3390/foods10050914>.
- Mulyani, R., Sukenda., dan S. Nuryati. 2019. Efficacy of *Aeromonas hydrophila* formalin-killed cells and lipopolysaccharides vaccines in maternal immunity of tilapia broodstock and the offspring resistance. *Jurnal Akuakultur Indonesia* 18(2): 141-151.
- Osman, M. A. 2011. Effect of traditional fermentation process on the nutrient and antinutrient contents of pearl millet during preparation of Lohoh. *Journal of the Saudi Society of Agricultural Sciences* 10(1): 1-6.
- Ostrander, G. 2000. *The Laboratory Fish*. Elsevier.
- Palladino, A., E. De Felice, C. Attanasio, C. M. A. Barone, A. Crasto, L. D'Angelo, D. Giaquinto, C. Lambiase, P. Scocco, F. Serrapica, dan L. Maruccio. 2023. A morphological and ultrastructural study of the anterior digestive tract of adult Nile tilapia (*Oreochromis niloticus*). *Animals* 13(3): 420.
- Pangestuti, R., M. Haq, P. Rahmadi, dan B. S. Chun. 2021. Nutritional value and biofunctionalities of two edible green seaweeds (*Ulva sp.* and *Caulerpa racemosa*) from Indonesia by subcritical water hydrolysis. *Mar. Drugs* 19: 578. <https://doi.org/10.3390/md19100578>.
- Playfair, J. H. L., dan Chain, B. M. 2012. *Immunology at a Glance*. John Wiley & Sons.
- Priyatharshni, A., C. Antony, B. Ahilan, A. Uma, P. Chidambaram, P. Ruby, dan E. Prabu. 2024. Effect of dietary seaweed supplementation on growth, feed utilization, digestibility co-efficient, digestive enzyme activity and challenge study against *Aeromonas hydrophila* of Nile Tilapia *Oreochromis niloticus*. *Indian Journal of Animal Research* 58: 1039-1046. <https://doi.org/10.18805/IJAR.B-5295>
- Qin, C., L. Gong, X. Zhang, Y. Wang, Y. Wang, B. Wang, Y. Li, dan W. Li. 2018. Effect of *Saccharomyces boulardii* and *Bacillus subtilis* B10 on gut microbiota modulation in broilers. *Anim. Nutr.* 4: 358-366. <https://doi.org/10.1016/j.aninu.2018.03.004>.
- Radwan, M., A. E. Mekky, M. A. Moussa, M. Fares, dan W. M. Al-Otaibi. 2025. Potential effects of dietary fermented *Sargassum muticum* on growth performance, intestinal health, immune-antioxidant related gene responses, and resistance to bacterial infection in Nile tilapia. *Fish and Shellfish Immunology* 167: 110695. <https://doi.org/10.1016/j.fsi.2025.110695>

- Rohani, M. F., T. Tarin, J. Hasan, S. M. Islam, dan M. Shahjahan. 2023. Vitamin E supplementation in diet ameliorates growth of Nile tilapia by upgrading muscle health. *Saudi Journal of Biological Sciences* 30: 103558. <https://doi.org/10.1016/j.sjbs.2023.103558>
- Saleh, A. A., A. Z. Mohamed, S. S. Elnesr, A. F. Khafaga, H. Elwan, M. F. Abdel-Aziz, A. A. Khaled, dan E. E. Hafez. 2024. Expression and immune response profiles in Nile tilapia (*Oreochromis niloticus*) and European sea bass (*Dicentrarchus labrax*) during pathogen challenge and infection. *International Journal of Molecular Sciences* 25(23): 12829. <https://doi.org/10.3390/ijms252312829>
- Sarker, B. S., A. Ali, S. S. Rahman, M. S. Alam, dan M. S. Islam. 2024. Monogamous hybridization of Nile tilapia (*Oreochromis niloticus*) with Mozambique tilapia (*O. mossambicus*) results in unprecedented all-female F1 hybrid. *Aquaculture and Fisheries* 10(5): 679-686. <https://doi.org/10.1016/j.aaf.2024.04.007>
- Sarker, B. S., M. S. Islam, M. S. R. Sarker, A. Ali, M. S. Alam, dan S. S. Rahman. 2023. Genetic assessment of farmed *Oreochromis mossambicus* populations in South Africa. *Aquaculture* 575: 739729. <https://doi.org/10.1016/j.aquaculture.2023.739729>
- Scapigliati, G., A. M. Fausto, dan S. Picchiatti. 2018. Fish lymphocytes: An evolutionary equivalent of mammalian innate-like lymphocytes? *Frontiers in Immunology* 9: 971. <https://doi.org/10.3389/fimmu.2018.00971>
- Schalm, O. W. dan Jain, N. C. 1986. *Schalm's Veterinary Hematology*. 4th Edition. Lea and Febiger, Philadelphia.
- Sharma, R., P. Garg, P. Kumar, S. K. Bhatia, dan S. Kulshrestha. 2020. Microbial fermentation and its role in quality improvement of fermented foods. *Fermentation* 6(4): 106.
- Sherif, E. M., I. M. Abd El-Razek, M. E. El-Sharawy, A. A. Amer, A. I. Zaineldin, M. S. Gewaily, A. M. Ashry, N. A. Younis, H. A. Ahmed, dan M. A. O. Dawood. 2024. Growth performance, antioxidative status, and immune response of Nile tilapia (*Oreochromis niloticus*) fed dietary fermented *Spirulina platensis*. *Aquaculture Reports* 39: 102324. <https://doi.org/10.1016/j.aqrep.2024.102324>
- Shi, C., Y. Zhang, Z. Lu, dan Y. Wang. 2017. Solid-state fermentation of corn-soybean meal mixed feed with *Bacillus subtilis* and *Enterococcus faecium* for degrading antinutritional factors and enhancing nutritional value. *Journal of Animal Science and Biotechnology* 8: 50. <https://doi.org/10.1186/s40104-017-0184-2>
- Siddik, M. A., J. Howieson, I. Ilham, dan R. Fotedar. 2018. Growth, biochemical response and liver health of juvenile barramundi (*Lates calcarifer*) fed fermented and non-fermented tuna hydrolysate as fishmeal protein replacement ingredients. *PeerJ*, 6, e4870.
- Siddiq, N. R. 2022. Pengaruh Pemberian Probiotik IW Secara Oral terhadap Sintasan dan Pertumbuhan Lele Dumbo (*Clarias sp.*) dengan Pakan Komersial Berprotein Rendah. Fakultas Pertanian. Universitas Gadjah Mada. Skripsi.

- Smith, R. R. 1989. In "Fish Nutrition," 2nd ed., J. E. Halver, ed. pp. 1–29. Academic Press. New York.
- Speirs, Z. C., C. A. Loynes, H. Mathiessen, P. M. Elks, S. A. Renshaw, dan L. V. G. Jørgensen. 2024. What can we learn about fish neutrophil and macrophage response to immune challenge from studies in zebrafish. *Fish and Shellfish Immunology* 148: 109490. <https://doi.org/10.1016/j.fsi.2024.109490>
- Subramani, P. A., S. K. Priyadarshini, R. Balasubramanian, M. D. Gnaneswari, D. G. Kumar, P. Rajendran, C. Alexander, dan R. D. Michael. 2023. Current status and recent advancements with immunostimulants in aquaculture. In *Immunomodulators in Aquaculture and Fish Health* (1st ed., p. 30). CRC Press.
- Sugiharto, S., dan Ranjitkar, S. 2019. Recent advances in fermented feeds towards improved broiler chicken performance, gastrointestinal tract microecology and immune responses: A review. *Animal nutrition* 5(1): 1-10.
- Suhermanto, A., Suhermin, Ridwan, I. Astuti, dan I. Nurmawanti. 2020. Pola infeksi *Streptococcus agalactiae* strain NP105O dan N14G pada ikan nila (*Oreochromis niloticus*). *Jurnal Riset Akuakultur* 15(1): 51-58. <https://ejournal-balitbang.kkp.go.id/index.php/jra>
- Suryaningrum, L. H., dan Samsudin, R. 2020. Nutrient digestibility of green seaweed *Ulva* meal and the influence on growth performance of Nile tilapia (*Oreochromis niloticus*). *Emirates J. Food Agric.* 32: 488–494. <https://doi.org/10.9755/ejfa.2020.v32.i7.2131>.
- Taibi, M., M. Aouji, H. Imtara, F. Abujaber, A. Oubihi, A. Ouannou, L. Hajji, A. A. Shahat, O. M. Noman, M. Tarayrah, R. Bengueddour, dan O. Hassani. 2024. Novel biosynthesis of silver nanoparticles using *Ulva lactuca* and their potential toward environment and agricultural purposes. *Frontiers in Sustainable Food Systems*, 8: 1490880. <https://doi.org/10.3389/fsufs.2024.1490880>
- Tarigan, N., dan Tega, Y. R. 2022. Effectiveness of fermented *Ulva sp.* on feed on growth rate of Carp (*Cyprinus carpio*). *Aquasains* 10(2): 1131-1140.
- Vallejos-Vidal, E., F. Reyes-Lopez, M. Teles, dan S. MacKenzie. 2016. The response of fish to immunostimulant diets. *Fish & Shellfish Immunology* 56: 34-69. <https://doi.org/10.1016/j.fsi.2016.03.004>
- Vazirzadeh, A., A. Marhamati, R. Rabiee, dan C. Faggio. 2020. Immunomodulation, antioxidant enhancement and immune genes up-regulation in rainbow trout (*Oncorhynchus mykiss*) fed on seaweeds included diets. *Fish and shellfish immunology* 106: 852-858.
- Vijayagopal, P. 2004. Aquatic feed extrusion technology-an update. *Fishing chimes* 23(10 & 1): 35-38.
- Wahlström, N., F. Nylander, E. Malmhäll-Bah, K. Sjøvold, U. Edlund, G. Westman, dan E. Albers. 2020. Composition and structure of cell wall *ulvans* recovered from *Ulva* spp. along the Swedish west coast. *Carbohydr. Polym.* 233: 115852. <https://doi.org/10.1016/j.carbpol.2020.115852>.

- Wan, A. H. L., S. J. Davies, A. Soler-Vila, R. Fitzgerald, dan M. P. Johnson. 2019. Macroalgae as a sustainable aquafeed ingredient. *Rev. Aquac.* 11: 458–492. <https://doi.org/10.1111/raq.12241>.
- Wang, L., F. Sun, Z. Yang, M. Lee, S. Yeo, J. Wong, Y. Wen, dan G. H. Yue. 2024. Mapping the genetic basis for sex determination and growth in hybrid tilapia (*Oreochromis mossambicus* × *O. niloticus*). *Aquaculture* 593: 741310. <https://doi.org/10.1016/j.aquaculture.2024.741310>
- Wang, Yaqi, J. Wu, M. Lv, Z. Shao, M. Hungwe, J. Wang, X. Bai, J. Xie, Wang, Yanping, dan W. Geng. 2021. Metabolism Characteristics of Lactic Acid Bacteria and the Expanding Applications in Food Industry. *Front. Bioeng. Biotechnol.* 9: 612285. <https://doi.org/10.3389/fbioe.2021.612285>
- Weththasinghe, P., H. M. T. P. Thilakarathne, H. M. U. L. Herath, dan B. C. Jayawardana. 2026. Meta-analysis of the effects of seaweed inclusion in fish diets on growth performance. *Aquaculture* 611: 743085. <https://doi.org/10.1016/j.aquaculture.2025.743085>
- Wong, K. H., dan Cheung, P. C. 2000. Nutritional evaluation of some subtropical red and green seaweeds: Part I—proximate composition, amino acid profiles and some physico-chemical properties. *Food chemistry* 71(4): 475-482.
- Wongsathein, D., S. Raksri, dan T. Urit. 2019. Experimental *Streptococcus agalactiae* infection in Nile tilapia (*Oreochromis niloticus*) via different routes. *Veterinary Integrative Sciences* 17: 233–243.
- Xiao, L., L. Zhang, C. Guo, Q. Xin, X. Gu, C. Jiang, dan J. Wu. 2024. “Find me” and “eat me” signals: Tools to drive phagocytic processes for modulating antitumor immunity. *Cancer Communications* 44: 791-832. <https://doi.org/10.1002/cac2.12579>
- Yang, H., Z. B. Li, Q. Chen, W. J. Li, Y. Z. Sun, dan J. Lu. 2016. Effect of fermented *Enteromopha prolifera* on the growth performance, digestive enzyme activities and serum non-specific immunity of red tilapia (*Oreochromis mossambicus* × *Oreochromis niloticus*). *Aquaculture Research* 47(12): 4024-4031.
- Yao, Y., H. Li, J. Li, B. Zhu, dan T. Gao. 2021. Anaerobic solid-state fermentation of soybean meal with *Bacillus* sp. to improve nutritional quality. *Front. Nutr.* 8. <https://doi.org/10.3389/fnut.2021.706977>
- Yi, M., M. Wang, Z. Li, Z. Liu, C. Song, D. Zhang, F. Gao, X. Ke, J. Cao, dan M. Lu. 2019. An investigation into the effects of *Streptococcus agalactiae* on the 5-HT system and the behavior of GIFT tilapia (*Oreochromis niloticus*). *Aquaculture Reports* 15: 100232. <https://doi.org/10.1016/j.aqrep.2019.100232>