

## DAFTAR PUSTAKA

- Abd El-Hack, M. E., El-Saadony, M. T., Salem, H. M., El-Tahan, A. M., Soliman, M. M., Youssef, G. B., & Swelum, A. A. 2022. Alternatives to antibiotics for organic poultry production: types, modes of action and impacts on bird's health and production. *Poultry science*. 101(4): 101696.
- Abdelghany, A. E., & Ahmad, M. H. 2002. Effects of feeding rates on growth and production of Nile tilapia, common carp and silver carp polycultured in fertilized ponds. *Aquaculture Research*. 33(6). 415-423.
- Abdel-Warith, A. W. A., Younis, E. S. M., & Al-Asgah, N. A. 2016. Potential use of green macroalgae *Ulva lactuca* as a feed supplement in diets on growth performance, feed utilization and body composition of the African catfish, *Clarias gariepinus*. *Saudi Journal of Biological Sciences*. 23(3), 404-409.
- Abo-Raya, M. H., Alshehri, K. M., Abdelhameed, R. F., Elbially, Z. I., Elhady, S. S., & Mohamed, R. A. 2021. Assessment of growth-related parameters and immune-biochemical profile of Nile tilapia (*Oreochromis niloticus*) fed dietary *Ulva fasciata* extract. *Aquaculture Research*. 52(7): 3233-3246.
- Abo-Raya, M. H., Shi, Y., Wang, Y., Sayed, S. M., & Shukry, M. 2024. Enhancing immune and antioxidant responses in Nile tilapia through dietary supplementation with *Ulva fasciata* extract: a study on gene expression and resistance to *Aeromonas hydrophila*. *Journal of Animal Physiology and Animal Nutrition*. 108(5): 1415-1429.
- Admantin, C. Y., Turner, M., Lo, R., & Paul, N. 2023. Fermentation of green seaweed *Ulva fasciata* using six different strain of Lactic Acid Bacteria (LAB). In 3rd International Conference on Smart and Innovative Agriculture (ICoSIA 2022) (pp. 611-624). Atlantis Press.
- Adler-Nissen, J. 1979. Determination of the degree of hydrolysis of food protein hydrolysates by trinitrobenzenesulfonic acid. *Journal of Agricultural and Food chemistry*. 27(6): 1256-1262.
- Ahmed, N.S. and Hamza, M.A. 1990. Chemical composition and Utilization of some marine algae collected from Alexandria coast. *Com. Sci and Dev. Res*. 32: 17-36.
- Aslamyah, S., & Karim, M. Y. 2017. Fermentation of seaweed flour with various fermenters to improve the quality of fish feed ingredients. *Jurnal Akuakultur Indonesia*. 16(1): 8-14.
- Al-Dulaimi, K. A. K., Banks, J., Chandran, V., Tomeo-Reyes, I., & Nguyen Thanh, K. 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.

- Almatsier S. 2006. Prinsip Dasar Ilmu Gizi. Jakarta: PT. Gramedia Pustaka Utama.
- Alejo, A., & Tafalla, C. 2011. Chemokines in teleost fish species. *Developmental & Comparative Immunology*. 35(12): 1215-1222.
- Amin, M. A., Chondra, U., Mostafa, E., & Alam, M. M. 2022. Green seaweed *Ulva lactuca*, a potential source of bioactive peptides revealed by in silico analysis. *Informatics in Medicine Unlocked*. 33: 101099.
- Anderson, D. P. 1974. *Fish Immunology*. TFH Publication Ltd Hongkong. 239 ps. Enzyme. *Food Cos. Toxicol*. 14: 417-419.
- Anisha, G. S., Augustianath, T., Padmakumari, S., Singhanian, R. R., Pandey, A., & Patel, A. K. 2023. Ulvan from green macroalgae: Bioactive properties advancing tissue engineering, drug delivery systems, food industry, agriculture and water treatment. *Bioresource Technology Reports*. 101457.
- AOAC. 1980. Official methods of analysis. Association of official analytical chemists, (ed. W. Horwitz) 13th edition, Washington DC. 988 pp.
- Ashour, M., Mabrouk, M. M., Ayoub, H. F., El-Feky, M. M., Zaki, S. Z., Hoseinifar, S. H., & Goda, A. M. S. 2020. Effect of dietary seaweed extract supplementation on growth, feed utilization, hematological indices, and non-specific immunity of Nile Tilapia, *Oreochromis niloticus* challenged with *Aeromonas hydrophila*. *Journal of Applied Phycology*. 32(5): 3467-3479.
- Aslamyah, S., & Karim, M. Y. 2017. Fermentation of seaweed flour with various fermenters to improve the quality of fish feed ingredients. *Jurnal Akuakultur Indonesia*. 16(1): 8-14.
- Association of Official Analytical Chemist [AOAC]. 2005. Official methods of analysis (18 Edn). Association of Official Analytical Chemist Inc. Mayland. USA.
- Arakaki, N., Flores Ramos, L., Oscanoa Huaynate, A. I., Ruíz Soto, A., & Ramírez, M. E. 2023. Biochemical and Nutritional Characterization of Edible Seaweeds from the Peruvian Coast. *Plants*. 12(9): 1795.
- Azaza, M. S., Mensi, F., Ksouri, J., Dhraief, M. N., Brini, B., Abdelmouleh, A., & Kraïem, M. M. 2008. Growth of Nile tilapia (*Oreochromis niloticus* L.) fed with diets containing graded levels of green algae *Ulva* meal (*Ulva rigida*) reared in geothermal waters of southern Tunisia. *Journal of applied ichthyology*. 24(2): 202-207.
- Bahnasawy, M. H. 2009. Effect of dietary protein levels on growth performance and body composition of monosex Nile tilapia, *Oreochromis niloticus* L. reared in fertilized tanks. *Pakistan Journal of Nutrition*. 8(5): 674-678.
- Bashir-Tanoli, S., & Tinsley, M. C. 2014. Immune response costs are associated with changes in resource acquisition and not resource reallocation. *Functional Ecology*. 28(4): 1011-1019.

- Bikker, P., van Krimpen, M. M., van Wikselaar, P., Houweling-Tan, B., Scaccia, N., van Hal, J. W., & López-Contreras, A. M. 2016. Biorefinery of the green seaweed *Ulva lactuca* to produce animal feed, chemicals and biofuels. *Journal of applied phycology*. 28: 3511-3525.
- Bilej, M. (2015). Mucosal immunity in invertebrates. In *Mucosal immunology* (pp. 135-144). Academic Press.
- Biller-Takahashi, J.D., L.S. takahashi, F. Pilarski, F.A. Sebastiao, and E.C. Urbinati. 2013. Serum bactericidal activity as indikator of innate immunity in pacu *Piaractus mesopotamicus* (Holmberg, 1887). *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*. 65(6):1745-1751.
- Blier, P. U., Lemieux, H., & Pichaud, N. 2014. Holding our breath in our modern world: will mitochondria keep the pace with climate changes?. *Canadian Journal of Zoology*. 92(7): 591-601.
- Borowitzka, L. J., & Borowitzka, M. A. 1989.  $\beta$ -carotene (provitamin A) production with algae. In *Biotechnology of vitamins, pigments and growth factors* (pp. 15-26). Dordrecht: Springer Netherlands.
- Buchmann, K., & Secombes, C. J. 2022. Principles of fish immunology. *Principles Fish Immunol.*
- Buchanan, J. T., Simpson, A. J., Aziz, R. K., Liu, G. Y., Kristian, S. A., Kotb, M., & Nizet, V. 2006. DNase expression allows the pathogen group A *Streptococcus* to escape killing in neutrophil extracellular traps. *Current Biology*. 16(4): 396-400.
- Calder, P. C. 1995. Fuel utilization by cells of the immune system. *Proceedings of the Nutrition Society*. 54(1): 65-82.
- Calder, P. C. 2006. Branched-chain amino acids and immunity. *The Journal of nutrition*. 136(1): 288S-293S.
- Cao, J., Liu, Z., Zhang, D., Guo, F., Gao, F., Wang, M., & Lu, M. 2022. Distribution and localization of *Streptococcus agalactiae* in different tissues of artificially infected tilapia (*Oreochromis niloticus*). *Aquaculture*. 546: 737370.
- Castro, R., Zarra, I., & Lamas, J. 2004. Water-soluble seaweed extracts modulate the respiratory burst activity of turbot phagocytes. *Aquaculture*. 229(1-4): 67-78.
- Castro, R., Piazzon, M. C., Zarra, I., Leiro, J., Noya, M., & Lamas, J. 2006. Stimulation of turbot phagocytes by *Ulva rigida* C. Agardh polysaccharides. *Aquaculture*. 254(1-4): 9-20.
- Chapman, F. A. 2000. Culture of hybrid tilapia: A reference profile. Gainesville: University of Florida Cooperative Extension Service, Institute of Food and Agriculture Sciences, EDIS.
- Cocolin, L., & Ercolini, D. (Eds.). 2007. Molecular techniques in the microbial ecology of fermented foods. Springer Science & Business Media.

- Corvillo, F., & Akinci, B. A. R. I. Ş. 2019. An overview of lipodystrophy and the role of the complement system. *Molecular immunology*, 112, 223-232.
- Dawood, M. A. 2021. Nutritional immunity of fish intestines: important insights for sustainable aquaculture. *Reviews in Aquaculture*. 13(1): 642-663.
- de Jesus Raposo, M. F., De Morais, A. M. B., & De Morais, R. M. S. C. 2015. Marine polysaccharides from algae with potential biomedical applications. *Marine drugs*. 13(5): 2967-3028.
- de Jorge, E. G., Lera, A. L., Bayarri-Olmos, R., Yebenes, H., Lopez-Trascasa, M., & de Córdoba, S. R. 2018. Common and rare genetic variants of complement components in human disease. *Molecular immunology*. 102: 42-57.
- del Rocío Quezada-Rodríguez, P., & Fajer-Ávila, E. J. 2017. The dietary effect of Ulvan from *Ulva clathrata* on hematological-immunological parameters and growth of tilapia (*Oreochromis niloticus*). *Journal of Applied Phycology*. 29(1): 423-431.
- Dewi, Y. L., Yuniza, A., Sayuti, K., & Mahata, M. E. 2019. Fermentation of Sargassum binderi seaweed for lowering alginate content of feed in laying hens. *Journal of World's Poultry Research*. 9(3): 147-153.
- Djajasewaka, H., 1985. *Pakan Ikan (Makanan Ikan)*. CV. Yasaguna. Jakarta.45 hlm.
- Dominguez, H., & Loret, E. P. 2019. *Ulva lactuca*, a source of troubles and potential riches. *Marine drugs*. 17(6): 357.
- Effendie, M. I. 1997. *Biologi perikanan*. Yayasan Pustaka Nusatama. Yogyakarta. 163: 57-62.
- Ellis, A. E. 1999. Immunity to bacteria in fish. *Fish & shellfish immunology*. 9(4): 291-308.
- Ellis, A.E. 2001. Innate host defense mechanisms of fish against viruses and bacteria. *Dev. Comp. Immunol*. 25: 827–839.
- El-Sayed, A. F. M. 2002. Effects of stocking density and feeding levels on growth and feed efficiency of Nile tilapia (*Oreochromis niloticus* L.) fry. *Aquaculture research*. 33(8): 621-626.
- El-Tawil, N. E. 2010. Effects of green seaweeds (*Ulva sp.*) as feed supplements in red tilapia (*Oreochromis sp.*) diet on growth performance, feed utilization and body composition. *Journal of the Arabian Aquaculture Society*. 5(2): 179-194.
- Elmowalid, G. A., W. A. M. Ghonimi, H. M. A. Allah, H. Abdallah, A. El-Murr, dan A. M. Abdelwahab. 2023.  $\beta$ -1,3-glucan improved the health and immunity of juvenile African catfish (*Clarias gariepinus*) and neutralized the histological changes caused by lead and fipronil pollutants. *BMC Veterinary Research*. 19(45): 1-13.

- Elumalai, P., Soltani, M., & Lakshmi, S. (Eds.). 2023. Immunomodulators in Aquaculture and Fish Health. CRC Press.
- Ergün, S., Soyutürk, M., Güroy, B., Güroy, D., & Merrifield, D. 2009. Influence of *Ulva* meal on growth, feed utilization, and body composition of juvenile Nile tilapia (*Oreochromis niloticus*) at two levels of dietary lipid. *Aquaculture Internasional*. 17: 355-361.
- Eroldoğan, O. T., Glencross, B., Novoveska, L., Gaudêncio, S. P., Rinkevich, B., Varese, G. C., ... & Rotter, A. 2023. From the sea to aquafeed: A perspective overview. *Reviews in Aquaculture*. 15(3): 1028-1057.
- Fadilah, F., Lumbessy, S. Y., & Mulyani, L. F. L. F. 2023. Pemanfaatan tepung Rumput Laut *Ulva lactuca* sebagai bahan baku pakan ikan nila (*Oreochromis niloticus*). *Jurnal Ruaya: Jurnal Penelitian dan Kajian Ilmu Perikanan dan Kelautan*. 11(2).
- FAO (Food and Agriculture Organization). 2017. Feeding global aquaculture growth. *FAO Aquaculture Newsletter*. (56): II.
- Fazio, F. 2019. Fish hematology analysis as an important tool of aquaculture: a review. *Aquaculture*. 500: 237-242.
- Foey, A., & Picchiatti, S. 2014. Immune defences of teleost fish. *Aquaculture nutrition: gut health, probiotics and prebiotics*. 14-52.
- Furuya, W. M., Cruz, T. P. D., & Gatlin III, D. M. 2023. Amino acid requirements for Nile tilapia: An update. *Animals*. 13(5): 900.
- Ganguly, D., Haak, S., Sisirak, V., & Reizis, B. 2013. The role of dendritic cells in autoimmunity. *Nature Reviews Immunology*. 13(8): 566-577.
- Giri, N. A., Suwiry, K., Pithasari, A. I., & Marzuqi, M. 2007. Pengaruh kandungan protein pakan terhadap pertumbuhan dan efisiensi pakan benih ikan kakap merah (*Lutjanus argentimaculatus*). *Jurnal Perikanan Universitas Gadjah Mada*. 9(1): 55-61.
- Guerreiro, I., Magalhães, R., Coutinho, F., Couto, A., Sousa, S., Delerue-Matos, C., ... & Peres, H. 2019. Evaluation of the seaweeds *Chondrus crispus* and *Ulva lactuca* as functional ingredients in gilthead seabream (*Sparus aurata*). *Journal of Applied Phycology*. 31: 2115-2124.
- Guiry, M. D. 2013. AlgaeBase. World-wide electronic publication. <http://www.algaebase.org>.
- Güroy, B. K., Cirik, Ş. Ü. K. R. A. N., Güroy, D., Sanver, F., & Tekinay, A. A. 2007. Effects of *Ulva rigida* and *Cystoseira barbata* meals as a feed additive on growth performance, feed utilization, and body composition of Nile tilapia, *Oreochromis niloticus*. *Turkish Journal of Veterinary & Animal Sciences*. 31(2): 91-97.
- Güroy, B., Ergün, S., Merrifield, D. L., & Güroy, D. 2013. Effect of autoclaved *Ulva* meal on growth performance, nutrient utilization and fatty acid profile of

rainbow trout, *Oncorhynchus mykiss*. *Aquaculture Internasional*. 21(3): 605-615.

Haenen, O. L., Dong, H. T., Hoai, T. D., Crumlish, M., Karunasagar, I., Barkham, T., & Bondad-Reantaso, M. G. 2023. Bacterial diseases of tilapia, their zoonotic potential and risk of antimicrobial resistance. *Reviews in Aquaculture*. 15: 154-185.

Hafedh, Y. A. 1999. Effects of dietary protein on growth and body composition of Nile tilapia, *Oreochromis niloticus* L. *Aquaculture research*. 30(5): 385-393.

Hames, D., & Hooper, N. 2006. BIOS instant notes in biochemistry.

Handajani, H., & Widodo, W. 2024. *Nutrisi ikan*. UMMPress.

Hanley, F. 1991. Effects of feeding supplementary diets containing varying levels of lipid on growth, food conversion, and body composition of Nile tilapia, *Oreochromis niloticus* L.. *Aquaculture*. 93(4): 323-334.

Hashim, R., & Saat, M. A. M. 1992. The utilization of seaweed meals as binding agents in pelleted feeds for snakehead (*Channa striatus*) fry and their effects on growth. *Aquaculture*. 108(3-4): 299-308.

Hardy, R. W., & Kaushik, S. J. (Eds.). 2021. *Fish nutrition*. Academic press.

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

Harpeni, E. 2015. Kajian *Ulva* sp. sebagai suplemen pakan terhadap performa pertumbuhan dan respon imun non-spesifik ikan nila (*Oreochromis niloticus*). *Maspari Journal*. 7(2): 65-84.

Harvie, E. A., & Huttenlocher, A. 2015. Neutrophils in host defense: new insights from zebrafish. *Journal of Leucocyte Biology*. 98(4): 523-537.

Helmiati, S., Rustadi, A. Isnansetyo, & Zuprizal. 2021. The replacement of fish meal with fermented Moringa leaves meal and its effect on the immune response of red tilapia (*Oreochromis* sp.). *ResearchIOP Conf. Series: Earth and Environmental Science*. 919: 1-10.

Henderson, R. J., & Tocher, D. R. 1987. The lipid composition and biochemistry of freshwater fish. *Progress in lipid research*. 26(4): 281-347.

Hidayah, N. 2023. Hubungan Kelimpahan dan Biomassa *Ulva lactuca* dengan Kualitas Air di Pantai Trenggole Kabupaten Gunungkidul pada September-Desember 2022 (Doctoral dissertation, Universitas Gadjah Mada).

Hughes, C. E., & Nibbs, R. J. 2018. A guide to chemokines and their receptors. *The FEBS journal*. 285(16): 2944-2971.

- Hrubec, T. C., Cardinale, J. L., & Smith, S. A. 2000. Hematology and plasma chemistry reference intervals for cultured tilapia (*Oreochromis hybrid*). *Veterinary clinical pathology*, 29(1), 7-12.
- Ibrahim, M. I., Amer, M. S., Ibrahim, H. A., & Zaghloul, E. H. 2022. Considerable production of Ulvan from *Ulva lactuca* with special emphasis on its antimicrobial and anti-fouling properties. *Applied Biochemistry and Biotechnology*. 194(7): 3097-3118.
- Ismail, M. S., Siti-Zahrah, A., Syafiq, M. R. M., Amal, M. N. A., Firdaus-Nawi, M., & Zamri-Saad, M. 2016. Feed-based vaccination regime against streptococcosis in red tilapia, *Oreochromis niloticus* x *Oreochromis mossambicus*. *BMC Veterinary Research*. 12(1): 194.
- Isnansetyo, A., Irpani, H. M., Wulansari, T. A., & Kasanah, N. 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., Fikriyah, A., Kasanah, N., & Murwantoko. 2016. Non-specific immune potentiating activity of fucoidan from a tropical brown algae (Phaeophyceae), *Sargassum cristaefolium* in tilapia (*Oreochromis niloticus*). *Aquaculture Internasional*. 24: 465-477.
- Jaffar, N., Okinaga, T., Nishihara, T., & Maeda, T. 2018. Enhanced phagocytosis of *Aggregatibacter actinomycetemcomitans* cells by macrophages activated by a probiotic *Lactobacillus* strain. *Journal of Dairy Science*. 101(7): 5789-5798.
- Janeway Jr, C. A., & Medzhitov, R. 2002. Innate immune recognition. *Annual review of immunology*. 20(1): 197-216.
- Jayapala, N., Perumal, M. K., Baskaran, R., & Vallikannan, B. 2022. Pharmacological importance of bioactive molecules of seaweeds. In *Sustainable Global Resources of Seaweeds Volume 2: Food, Pharmaceutical and Health Applications* (pp. 597-613). Cham: Springer International Publishing.
- Junaedi, A. W. 2004. Rumput Laut, Jenis Dan Morfologisnya. Departemen Pendidikan Nasional Direktorat Jenderal Pendidikan Dasar Dan Menengah Direktorat Pendidikan Menengah Kejuruan.
- Kadi, A., Atmadja, W. S . 1988. Rumput Laut (Alga), Spesies, Reproduksi, Produksi, Budidaya dan Pasca Panen. Jakarta: LIPI.
- Kaushik, S. J., & Schrama, J. W. 2022. Bioenergetics. In *Fish Nutrition* (pp. 17-55). Academic Press.
- Kavitha. 2017. Nutritional composition of *Ulva lactuca* for human consumptions *Int. J. Curr. Sci. Res.* 3(9): 1378-1384
- Khairuman, S. P., Amri, K., & Spi, M. 2013. Budi Daya Ikan Nila. Agromedia.

- Khairy, H. M., & El-Shafay, S. M. 2013. Seasonal variations in the biochemical composition of some common seaweed species from the coast of Abu Qir Bay, Alexandria, Egypt. *Oceanologia*. 55(2): 435-452.
- Khalafalla, M. M., & El-Hais, A. E. M. 2015. Evaluation of seaweeds *Ulva rigida* and *Pterocladia capillacea*s dietary supplements in Nile tilapia fingerlings.
- Kidgell, J. T., Magnusson, M., de Nys, R., & Glasson, C. R. 2019. Ulvan: A systematic review of extraction, composition and function. *Algal research*. 39: 101422
- Kobayashi, M., Msangi, S., Batka, M., Vannuccini, S., Dey, M. M., & Anderson, J. L. 2015. Fish to 2030: the role and opportunity for aquaculture. *Aquaculture economics & management*. 19(3): 282-300.
- Koenig, J. M., Bliss, J. M., & Mariscalco, M. M. 2017. Normal and abnormal neutrophil physiology in the newborn. In *Fetal and neonatal physiology* (pp. 1216-1229). Elsevier.
- Kordon, A. O., A. Karsi, dan L. Pinchuk. 2018. Innate immune responses in fish: Antigen presenting cells and professional phagocytes. *Turkish Journal of Fisheries and Aquatic Sciences*. 18: 1123-1139.
- Kumar, S., Choubey, A. K., & Srivastava, P. K. 2022. The effects of dietary immunostimulants on the innate immune response of Indian major carp: A review. *Fish & Shellfish Immunology*. 123: 36-49.
- 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
- Labh, S. N., & Shakya, S. R. 2014. Application of immunostimulants as an alternative to vaccines for health management in aquaculture. *International Journal of Fisheries and Aquatic Studies*. 2(1):153-156.
- Labib, E. H., Mabrouk, H. A., & Zaki, M. A. 2010. Trial to improve the utilization of water lettuce (*Ulva lactuca*) and water fern (*Azolla pinnata*) in Nile tilapia (*Oreochromis niloticus*) diets. In *Proceedings of the 3rd Global Fisheries and Aquaculture Research Conference, Foreign Agricultural Relations (FAR)*. El Cairo (Egypt) (pp. 336-354).
- Lailvaux, S. P., & Husak, J. F. 2014. The life history of whole-organism performance. *The Quarterly Review of Biology*. 89(4): 285-318
- Lauzon, Q. D., & Serrano Jr, A. E. 2015. Ulvan extract from *Enteromorpha intestinalis* enhances immune responses in *Litopenaeus vannamei* and *Penaeus monodon* juveniles. *Animal Biology & Animal Husbandry*. 7(1): 1-10.
- Le Marc, Y., Baert, L., Da Silva, N. B., Postollec, F., Huchet, V., Baranyi, J., & Ellouze, M. 2021. The effect of pH on the growth rate of *Bacillus cereus* sensu lato: quantifying strain variability and modelling the combined effects

of temperature and pH. *International Journal of Food Microbiology*. 360: 109420.

- Li, P., Yin, Y. L., Li, D., Kim, S. W., & Wu, G. 2007. Amino acids and immune function. *British Journal of Nutrition*. 98(2): 237-252.
- Libanori, M. C. M., Dos Santos, G. G., Souza, A. P., da Silva Costa, D., Saldana-Serrano, M., Ferreira, M. B., & Mourino, J. L. P. 2025. Anti-inflammatory, immunostimulant and antimicrobial properties of tannic acid in the diet of *Oreochromis niloticus* infected with *Aeromonas hydrophila*. *Fish & Shellfish Immunology*. 157: 110119.
- Lin, S. M., Jiang, Y., Chen, Y. J., Luo, L., Doolgindachbaporn, S., & Yuangsoi, B. 2017. Effects of *Astragalus polysaccharides* (APS) and *chitooligosaccharides* (COS) on growth, immune response and disease resistance of juvenile largemouth bass, *Micropterus salmoides*. *Fish & Shellfish Immunology*. 70: 40-47.
- Lochmiller, R. L., & Deerenberg, C. 2000. Trade-offs in evolutionary immunology: just what is the cost of immunity?. *Oikos*. 88(1): 87-98.
- Lordan, S., Ross, R. P., & Stanton, C. 2011. Marine bioactives as functional food ingredients: potential to reduce the incidence of chronic diseases. *Marine drugs*. 9(6): 1056-1100.
- López-Lera, A., Corvillo, F., Nozal, P., Regueiro, J. R., Sánchez-Corral, P., & López-Trascasa, M. 2019. Complement as a diagnostic tool in immunopathology. In *Seminars in Cell & Developmental Biology* (Vol. 85, pp. 86-97). Academic Press.
- Luo, J., Ye, C., Wen, Y., Bao, Y., & Quek, S. Y. 2025. Investigation of solid-state fermentation of red seaweed (*Pyropia* spp.) with lactic acid Bacteria: Effects on protein profile and in vitro digestibility. *Food Chemistry*. 469: 142667.
- Madigan, M. T., Martinko, J. M., Bender, K. S., Buckley, D. H., & Stahl, D. A. 2016. *Microbiologia de Brock-14<sup>a</sup> Edição*. Artmed Editora.
- Magnadottir, B., Lange, S., Gudmundsdottir, S., Børgwald, J., Dalmo, R.A. 2005. Ontogeny of humoral immune parameters in fish. *Fish Shellfish Immunol*. 19: 429–439.
- Magnadóttir, B. 2006. Innate immunity of fish (overview). *Fish & shellfish immunology*. 20(2): 137-151.
- Mahasu, N. H., Jusadi, D., Setiawati, M., & Giri, I. N. A. A. 2016. Potential use of *Ulva lactuca* as feed ingredient for tilapia. *Jurnal Ilmu dan Teknologi Kelautan Tropis*. 8(1): 259-267.
- Mangindaan, R. E., & Rumengan, I. F. 2014. The effectivity of polysaccharide extracted from marine algae, *Euchema cottonii*, on the immune response of tilapia, *Oreochromis niloticus*. *AQUATIC SCIENCE & MANAGEMENT*. 2(1): 1-6.

- Mangott, A., Nappi, J., Carini, A. D. P., Goncalves, P., Hua, K., Domingos, J. A., & Thomas, T. 2020. *Ulva lactuca* as a functional ingredient and water bioremediator positively influences the hepatopancreas and water microbiota in the rearing of *Litopenaeus vannamei*. *Algal Research*. 51: 102040.
- Marinho, G., Nunes, C., Sousa-Pinto, I., Pereira, R., Rema, P., & Valente, L. M. (2013). The IMTA-cultivated Chlorophyta *Ulva spp.* as a sustainable ingredient in Nile tilapia (*Oreochromis niloticus*) diets. *Journal of applied phycology*. 25: 1359-1367.
- Martins, M. L., Nomura, D. T., Myiazaki, D. M. Y., Pilarsky, F., Ribeiro, K., De Castro, M. P., & De Campos, C. F. M. 2004. Physiological and haematological response of *Oreochromis niloticus* (*Osteichthyes: Cichlidae*) exposed to single and consecutive stress of capture. *Acta Scientiarum. Animal Sciences*. 26(4): 449.
- Maryanty, Y., & Sumitro, S. B. 2020. Interaction of enzyme-substrate from indigenous cellulolytic bacteria by bioinformatics. In IOP conference series: materials science and engineering (Vol. 854, No. 1, p. 012068). IOP Publishing.
- Masagounder, K., Ramos, S., Reimann, I., & Channarayapatna, G. 2016. Optimizing nutritional quality of aquafeeds. In *Aquafeed Formulation* (pp. 239-264). Academic Press.
- McGinty, A. S., & Rakocy, J. E. 2007. Cage culture of tilapia. Oklahoma Cooperative Extension Service.
- McInnes, I. B. (Ed.). 2017. Kelley and Firestein's Textbook of Rheumatology. Elsevier.
- Mensi, F., Jamel, K., & Amor, E. A. 2005. Potential use of seaweeds in Nile tilapia (*Oreochromis niloticus*) diets. *Mediterranean Fish Nutrition*. 151-154.
- Mohan, E. H., Madhusudan, S., & Baskaran, R. 2023. The sea lettuce *Ulva sensu lato*: Future food with health-promoting bioactives. *Algal Research*. 103069.
- Moreira, A., Cruz, S., Marques, R., & Cartaxana, P. 2022. The underexplored potential of green macroalgae in aquaculture. *Reviews in Aquaculture*. 14(1): 5-26.
- Moyle, P. B., & Cech, J. J. 2000. *Fishes: an introduction to ichthyology*.
- Mulyani, R., Sukenda, S., & Nuryati, S. 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.
- Naiel, M. A., Negm, S. S., Abd El-hameed, S. A., & Abdel-Latif, H. M. 2021. Dietary organic selenium improves growth, serum biochemical indices, immune responses, antioxidative capacity, and modulates transcription of stress-

related genes in Nile tilapia reared under sub-optimal temperature. *Journal of Thermal Biology*. 99: 102999.

Nawi, M. Firdaus, & Zamri-Saad, M. 2016. Major components of fish immunity: a review. *Pertanika Journal of Tropical Agricultural Science*. 39(4).

Natify, W., Droussi, M., Berday, N., Araba, A., & Benabid, M. 2015. Effect of the seaweed *Ulva lactuca* as a feed additive on growth performance, feed utilization and body composition of Nile tilapia (*Oreochromis niloticus* L.). *International Journal of Agronomy and Agricultural Research*. 7(3): 85-92.

Nelson N. 1944. A photometric adaption of the Somogyi method for the determination of glucose. *The Journal of Biological Chemistry*. 153: 375-380.

Newsholme, P., & Newsholme, E. A. 1989. Rates of utilization of glucose, glutamine and oleate and formation of end-products by mouse peritoneal macrophages in culture. *Biochemical Journal*. 261(1): 211-218.

Nie, X., Kitaoka, S., Tanaka, K., Segi-Nishida, E., Imoto, Y., Ogawa, A., & Furuyashiki, T. 2018. The innate immune receptors TLR2/4 mediate repeated social defeat stress-induced social avoidance through prefrontal microglial activation. *Neuron*. 99(3): 464-479.

NRC (National Research Council) . 2011. *Nutrient requirements of fish and shrimp*. The National Academies Press, Washington

NRC (National Research Council). 1983. *Nutrient requirement of warm water fishes and shellfishes*. Revised edition. National academy of sciences. Washington D.C. 102p.

Nobrega, R. O., Banze, J. F., Batista, R. O., & Fracalossi, D. M. 2020. Improving winter production of Nile tilapia: What can be done?. *Aquaculture Reports*. 18: 100453.

Norakma, M. N., Zaibunnisa, A. H., & Razarinah, W. W. 2022. The changes of phenolics profiles, amino acids and volatile compounds of fermented seaweed extracts obtained through microbial fermentation. *Materials Today: Proceedings*. 48: 815-821.

Norambuena, F., Hermon, K., Skrzypczyk, V., Emery, J. A., Sharon, Y., Beard, A., & Turchini, G. M. 2015. Algae in fish feed: performances and fatty acid metabolism in juvenile *Atlantic salmon*. *PLoS one*. 10(4): e0124042.

Øverland, M., Mydland, L. T., & Skrede, A. 2019. Marine macroalgae as sources of protein and bioactive compounds in feed for monogastric animals. *Journal of the Science of Food and Agriculture*. 99(1): 13-24.

Pappou, S., Valsamidis, M. A., Batjakas, J., & Bakopoulos, V. 2023. Antibacterial activity of *Ulva lactuca* against important aquaculture bacterial strains.

- Patel, A. K., Vadrale, A. P., Singhania, R. R., Michaud, P., Pandey, A., Chen, S. J., ... & Dong, C. D. 2023. Algal polysaccharides: current status and future prospects. *Phytochemistry Reviews*. 22(4): 1167-1196.
- Peixoto, M. J., Salas-Leitón, E., Pereira, L. F., Queiroz, A., Magalhães, F., Pereira, R., & de Almeida Ozório, R. O. 2016. Role of dietary seaweed supplementation on growth performance, digestive capacity and immune and stress responsiveness in European seabass (*Dicentrarchus labrax*). *Aquaculture Reports*. 3: 189-197.
- Petrunov, B., Nenkov, P., & Shekerdjiisky, R. 2007. The role of immunostimulants in immunotherapy and immunoprophylaxis. *Biotechnology & Biotechnological Equipment*. 21(4): 454-462.
- Pinandoyo, P., Hutabarat, J., Darmanto, D., Radjasa, O. K., & Herawati, V. E. 2019. Growth and nutrient value of tilapia (*Oreochromis niloticus*) fed with *Lemna minor* meal based on different fermentation time.
- Playfair, J.H., Chain, B.M., 2009. *Immunology: At a glance imunologi*, 9th ed. Blackwell Publishing. UK.
- Pratiwi, D. Y., & Pratiwy, F. M. 2021. Comparison of *Ulva lactuca* and *Ulva clathrata* as ingredients in *Litopenaeus vannamei* feeds. *Int J Fish Aquat Stud*. 9: 192-194.
- Pridgeon, J. W., & Klesius, P. H. 2012. Major bacterial diseases in aquaculture and their vaccine development. *CABI Reviews*. (2012): 1-16.
- Purbomartono, C., & Isnansetyo, A. 2019. Dietary fucoidan from *Padina boergesenii* to enhance non-specific immune of catfish (*Clarias sp.*). *Journal of Biological Sciences*. 19(2): 173-180.
- Rameshkumar, A., & Sivasudha, T. 2012. In vitro antioxidant and antibacterial activity of aqueous and methanolic extract of *Mollugo nudicaulis* Lam. leaves. *Asian Pacific Journal of Tropical Biomedicine*. 2(2): S895-S900.
- Ratana-arporn, P., & Chirapart, A. 2006. Nutritional evaluation of tropical green seaweeds *Caulerpa lentillifera* and *Ulva reticulata*. *Kasetsart J. Nat. Sci*. 40: 75-83
- Ray, B., & Lahaye, M. 1995. Cell-wall polysaccharides from the marine green algae *Ulva "rigida"* (*Ulvales*, Chlorophyta). Extraction and chemical composition. *Carbohydrate Research*. 274: 251-261.
- Reverter, M., Bontemps, N., Lecchini, D., Banaigs, B., & Sasal, P. 2014. Use of plant extracts in fish aquaculture as an alternative to chemotherapy: current status and future perspectives. *Aquaculture*. 433: 50-61.
- Ridlo, A., & Pramesti, R. 2009. Aplikasi ekstrak rumput laut sebagai agen imunostimulan sistem pertahanan non spesifik pada udang (*Litopennaeus vannamei*). *ILMU KELAUTAN: Indonesian Journal of Marine Sciences*. 14(3): 133-137.

- Rieger, A. M., & Barreda, D. R. 2011. Antimicrobial mechanisms of fish leukocytes. *Developmental & Comparative Immunology*. 35(12): 1238-1245.
- Rohani-Ghadikolaei, K., Abdulalian, E., & Ng, W. K. 2012. Evaluation of the proximate, fatty acid and mineral composition of representative green, brown and red seaweeds from the Persian Gulf of Iran as potential food and feed resources. *Journal of food science and technology*. 49(6): 774-780.
- Robertson, E. S. 1996. AIDS testing in the 1990s. Primary Care Update for OB/GYNS. 3(2): 50-57.
- Ryan, M. T., Smith, A. G., O'Doherty, J. V., Bahar, B., Reilly, P., & Sweeney, T. 2010. Effects of nutrient supplementation with laminarin derived from *Laminaria hyperborea* and *Laminaria digitata* on mucin gene expression in the porcine ileum. *Livestock science*. 133(1-3): 236-238.
- Sakai, M. 1999. Current research status of fish immunostimulants. *Aquaculture*, 172(1-2): 63-92.
- Sánchez-Vázquez, F. J., & Fortes-Silva, R. 2021. Biology and aquaculture of tilapia (p. 20220124224). J. F. López-Olmeda (Ed.). Boca Raton, Florida: CRC Press.
- Sarathi, M., Ahmed, V. I., Venkatesan, C., Balasubramanian, G., Prabavathy, J., & Hameed, A. S. (2007). Comparative study on immune response of *Fenneropenaeus indicus* to *Vibrio alginolyticus* and white spot syndrome virus. *Aquaculture*. 271(1-4): 8-20.
- Sarıtaş, S., Duman, H., & Karav, S. 2024. Nutritional and functional aspects of fermented algae. *International journal of food science and technology*, 59(8): 5270-5284.
- Santiago, C. B., & Reyes, O. S. 1993. Effects of dietary lipid source on reproductive performance and tissue lipid levels of Nile tilapia *Oreochromis niloticus* (Linnaeus) broodstock. *Journal of Applied Ichthyology*. 9(1): 33-40.
- Saurabh, S., & Sahoo, P. K. 2008. Lysozyme: an important defence molecule of fish innate immune system. *Aquaculture research*. 39(3): 223-239.
- Secombes, C. J., & Ellis, A. E. 2012. The immunology of teleosts. In *Fish Pathology: Fourth Edition* (pp. 144-166). Wiley-Blackwell.
- Serrano Jr, A. E., & Aquino, J. I. 2014. Protein concentrate of *Ulva intestinalis* (Chlorophyta, *Ulvaceae*) could replace soybean meal in the diet of *Oreochromis niloticus* fry. *Aquaculture, Aquarium, Conservation & Legislation*. 7(4): 255-262.
- Sheldon, B. C., & Verhulst, S. 1996. Ecological immunology: costly parasite defences and trade-offs in evolutionary ecology. *Trends in ecology & evolution*. 11(8): 317-321.

- Shobihah, H. N., Andriani, Y., Wiyatna, M. F., Iskandar, I., Zidni, I., & Rustama, M. M. 2025. Effects of Fermentation on the Physico-Chemical Properties of Marine By-Products: A Review. *Journal of Coastal and Ocean Sciences*. 6(1): 51-58.
- Siddik, M. A. B., & Anh, N. T. N. 2015. Preliminary assessment of the Gut weed *Ulva intestinalis* as food for herbivorous fish. *International Aquatic Research*. 7: 41-46.
- Silva, D. M., Valente, L. M. P., Sousa-Pinto, I., Pereira, R., Pires, M. A., Seixas, F., & Rema, P. 2015. Evaluation of IMTA-produced seaweeds (*Gracilaria*, *Porphyra*, and *Ulva*) as dietary ingredients in Nile tilapia, *Oreochromis niloticus* L., juveniles. Effects on growth performance and gut histology. *Journal of Applied Phycology*. 27: 1671-1680.
- Soemardji, A., Immaculatawo, & Joseph. 2005. Uji Aktivitas Antidiabetes Ekstrak Etanol Buah Mengkudu (*Morinda citrifolia* L.). ITB. Bandung.
- Subagiyo, S., & Fatichah, D. I. 2016. Potensi hot water extract rumput laut *Caulerpa* sp. dan *Sargassum* sebagai Komponen Immunonutrisi Pada Budidaya Udang Vannamei (*Litopenaeus vanamei*). *Jurnal Kelautan Tropis*. 18(3): 154-159.
- Sueiro, M. C., Awruch, C., Gilardoni, C., Demetrio, M., & Palacios, M. G. 2020. Immunity and health of two wild marine fishes naturally exposed to anthropogenic pollution. *Science of the Total Environment*. 726: 138303.
- Suryaningrum, L. H., & Samsudin, R. 2020. Nutritional value and mineral content of seaweed from Binuangun Beach, Indonesia and potential use as fish feed ingredient. In *IOP Conference Series: Earth and Environmental Science* (Vol. 429, No. 1, p. 012064). IOP Publishing.
- Suryaningrum, L. H., & Samsudin, R. 2020. Nutrient digestibility of green seaweed *Ulva* meal and the influence on growth performance of Nile tilapia (*Oreochromis niloticus*). *Emirates Journal of Food and Agriculture*. 32(7): 488-494.
- Sunyer, J. O., & Tort, L. 1995. Natural hemolytic and bactericidal activities of sea bream *Sparus aurata* serum are effected by the alternative complement pathway. *Veterinary Immunology and Immunopathology*. 45(3-4): 333-345.
- Srivastava, P. K., & Pandey, A. K. 2015. Role of immunostimulants in immune responses of fish and shellfish. *Biochem Cell Arch*. 15(1): 47-73.
- Stillwell, W. 2016. *An introduction to biological membranes: composition, structure and function*. Elsevier.
- Sweilum, M. A., Abdella, M. M., & Salah El-Din, S. A. 2005. Effect of dietary protein-energy levels and fish initial sizes on growth rate, development and production of Nile tilapia, *Oreochromis niloticus* L. *Aquaculture research*. 36(14): 1414-1421.

- Taufiqurrahman, M. D., & Jatmiko, Y. D. 2025. Screening and phylogenetic analysis of cellulolytic *Bacillus* spp. isolated from fermented brown algae (*Sargassum* sp.). In BIO Web of Conferences (Vol. 177, p. 07003). EDP Sciences.
- Tort, L., Sunyer, J. O., Gómez, E., & Molinero, A. 1996. Crowding stress induces changes in serum haemolytic and agglutinating activity in the gilthead sea bream *Sparus aurata*. *Veterinary Immunology and Immunopathology*. 51(1-2): 179-188.
- Ul-Haq, I., Butt, M. S., Amjad, N., Yasmin, I., & Suleria, H. A. R. 2019. Marine-algal bioactive compounds: A comprehensive appraisal. In *Handbook of Algal Technologies and Phytochemicals* (pp. 71-80). CRC Press.Ru
- Uthayakumar, V., Ramasubramanian, V., Senthilkumar, D., Sreedevi, P. R., & Munirasu, S. 2012. Specific and non-specific immune response and disease resistance of *Solanum torvum* leaf soluble fractions in freshwater carp *Cyprinus Carpio*.
- Vaghela, P., Trivedi, K., Anand, K. V., Nayak, J., Vyas, D., & Ghosh, A. 2023. Aqueous homogenate of fresh *Ulva lactuca* for ameliorating nutrient deficiency—A nutraceutical alternative to using whole seaweeds. *Algal Research*. 74: 103211.
- Vallejos-Vidal, E., Reyes-López, F., Teles, M., & MacKenzie, S. 2017. The response of fish to immunostimulant diets. *Fish & shellfish immunology*. 56: 34-69.
- Van Doan, H., Prakash, P., Hoseinifar, S. H., Ringø, E., El-Haroun, E., Faggio, C., ... & Dawood, M. A. 2023. Marine-derived products as functional feed additives in aquaculture: A review. *Aquaculture Reports*. 31: 101679.
- Vasta, G. R., Ahmed, H., Du, S. J., & Henrikson, D. 2004. Galectins in teleost fish: Zebrafish (*Danio rerio*) as a model species to address their biological roles in development and innate immunity. *Glycoconjugate journal*. 21(8): 503-521.
- Walsh, A. M., Sweeney, T., O'shea, C. J., Doyle, D. N., & O'doherty, J. V. 2013. Effect of dietary laminarin and fucoidan on selected microbiota, intestinal morphology and immune status of the newly weaned pig. *British Journal of Nutrition*. 110(9): 1630-1638.
- Wan, A. H., Davies, S. J., Soler-Vila, A., Fitzgerald, R., & Johnson, M. P. 2019. Macroalgae as a sustainable aquafeed ingredient. *Reviews in Aquaculture*. 11(3): 458-492.
- Wang, C., Li, Z., Wang, T., Xu, X., Zhang, X., & Li, D. 2021. Intelligent fish farm—the future of aquaculture. *Aquaculture Internasional*. 29(6): 2681-2711.
- Wichard, T., Charrier, B., Mineur, F., Bothwell, J. H., Clerck, O. D., & Coates, J. C. 2015. The green seaweed *Ulva*: a model system to study morphogenesis. *Frontiers in plant science*. 6: 72.

- Wijesekara, I., Pangestuti, R., & Kim, S. K. 2011. Biological activities and potential health benefits of sulfated polysaccharides derived from marine algae. *Carbohydrate polymers*. 84(1): 14-21.
- Winfree, R. A., & Stickney, R. R. 1981. Effects of dietary protein and energy on growth, feed conversion efficiency and body composition of *Tilapia aurea*. *The Journal of nutrition*. 111(6): 1001-1012.
- Wong, K. H., & 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.
- Wu, L., L. Li, A. Gao, J. Ye, & J. Li. 2023. Antimicrobial roles of phagocytosis in teleost fish: Phagocytic B cells vs professional phagocytes. *Aquaculture and Fisheries*. 1-10.
- Xuan, X., Li, W., Zhu, W., & Wang, S. 2019. Effects of different levels of macroalga *Gracilaria lemaneiformis* on growth performance and feed utilization on the red sea bream, *Pagrosomus major*. *Journal of Applied Phycology*. 31: 3213-3222.
- Yaich, H., Garna, H., Besbes, S., Paquot, M., Blecker, C., & Attia, H. 2011. Chemical composition and functional properties of *Ulva lactuca* seaweed collected in Tunisia. *Food chemistry*. 128(4): 895-901.
- Yang, W., & Li, A. 2009. Isolation and characterization of *Streptococcus dysgalactiae* from diseased *Acipenser schrenckii*. *Aquaculture*. 294(1-2): 14-17.
- Yangthong, M., Hutadilok-Towatana, N., Thawonsuwan, J., & Phromkunthong, W. 2016. An aqueous extract from *Sargassum* sp. enhances the immune response and resistance against *Streptococcus iniae* in the Asian sea bass (*Lates calcarifer* Bloch). *Journal of Applied Phycology*. 28(6): 3587-3598.
- Yangthong, M., & Ruensirikul, J. 2020. Feed intake stimulation of juvenile spotted scat (*Scatophagus argus Linnaeus*, 1766) using dietary seaweed supplementation (*Ulva* sp.). *Aquaculture*. 529: 735626.
- Younis, E. S. M., Al-Quffail, A. S., Al-Asgah, N. A., Abdel-Warith, A. W. A., & Al-Hafedh, Y. S. 2018. Effect of dietary fish meal replacement by red algae, *Gracilaria arcuata*, on growth performance and body composition of Nile tilapia *Oreochromis niloticus*. *Saudi journal of biological sciences*. 25(2): 198-203.
- Yudiati, E., A. Isnansetyo, Murwantoko, Ayuningtyas, Triyanto, & C.R. Handayani. 2016. Innate immune-stimulating and immune genes up-regulating activities of three types of alginate from *Sargassum siliquosum* in Pacific white shrimp, *Litopenaeus vannamei*. *Fish & Shellfish Immunology*. 54:46-53.
- Zhang, H., Yao, B., Wang, Y., Zhang, W., & Yuan, T. 2003. Characterization, gene cloning and expression of new xylanase XYNB with high specific activity. *Chinese Science Bulletin*. 48:761-765.

Zhu, L. Y., Nie, L., Zhu, G., Xiang, L. X., & Shao, J. Z. 2013. Advances in research of fish immune-relevant genes: a comparative overview of innate and adaptive immunity in teleosts. *Developmental & Comparative Immunology*. 39(1-2): 39-62.

Zonneveld, N., Huisman, E. A., & Boon, J. H. 1991. Prinsip-prinsip budidaya ikan. PT Gramedia Pustaka Utama