

## DAFTAR PUSTAKA

- Abreu, D.C.A. and K.C.S. Figueiredo. 2019. Bromelin separation and purification processes from pineapple extract. *Brazilian Journal of Chemical Engineering*. 36(2): 1029 – 1039.
- Ahmed, I. and I. Ahmad. 2021. Dietary lysine modulates growth performance, haemato-biochemical indices, non-specific immune response, intestinal enzymatic activities and antioxidant properties of rainbow trout, *Oncorhynchus mykiss* fingerlings. *Aquaculture Nutrition*. 27, 124-139.
- Alahyaribeik, S., S.D. Sharifi, F. Tabandeh, S. Honarbakhsh, and S. Ghazanfari. 2020. Bioconversion of chicken feather wastes by keratinolytic bacteria. *Process Safety and Environmental Protection*. 135: 171 – 178.
- Anderson, D.P. and A.K. Siwicki. 1994. Simplified assays for measuring non-specific defense mechanism in fish. *Fish Health Section/American Fisheries Meeting*, Seattle.
- Andini, F. dan R. Widaryati. 2020. Pengaruh enzim Bromelin dosis berbeda terhadap pertumbuhan dan efisiensi pemanfaatan pakan ikan nila (*Oreochromis niloticus*). *Jurnal Ilmu Hewani Tropika*. 9(2): 68 – 74.
- AOAC (Association of Official Analytical Chemists). 1990. *Official Methods of Analysis 15<sup>th</sup> Edition*. Association of Official Analytical Chemists Inc, Virginia.
- Arfiati, D., K.F. Dina, P. Anugerah, R.H. Budiwardani, S. Lailiyah, A.N. Inayah, R.K. Pratiwi, dan N. Cokrowati. 2022. *Ikan Nila (Oreochromis niloticus)*. UB Media, Malang.
- Badan Pusat Statistik. 2023. Impor Kedelai Menurut Negara Asal Utama 2017 – 2023. [Impor Kedelai menurut Negara Asal Utama, 2017-2023 - Tabel Statistik - Badan Pusat Statistik Indonesia \(bps.go.id\)](https://bps.go.id/). diakses 28 Juni 2024.
- Badan Pusat Statistik. 2024. Produksi Daging Ayam Ras Pedaging Menurut Provinsi (Ton), 2021 – 2023. [Produksi Daging Ayam Ras Pedaging menurut Provinsi - Tabel Statistik - Badan Pusat Statistik Indonesia \(bps.go.id\)](https://bps.go.id/). diakses 28 Juni 2024.
- Badan Standardisasi Nasional. 2024. RSN 9043-11: 2024 tentang Pakan Buatan - Bagian 11: Ikan Nila (*Oreochromis spp.*).
- Baratawidjaja, K. G. 2006. *Imunologi Dasar*. Balai Penerbit FKUI. Jakarta.
- Biller-Takahashi, J. D and E. C. Urbinati. 2014. Fish immunology. The modification and manipulation of the innate immune system: Brazilian studies. *Scientific Electronic Library Online*. 86 (3): 1.483-1.495.

- Biller-Takahashi, J. D, H.J. Montassier, L.S. Takahashi, and E. C. Urbinati. 2014. Proposed method for agglutinating antibody titer analysis and its use as indicator of acquired immunity in pacu, *Piaractus mesopotamicus*. Brazilian Journal of Biology. 74 (1): 238 – 242.
- Biller-Takahashi, J. D, L.S. Takahashi, F. Pilarski, F.A. Sebastiao, and E.C. Urbinati. 2013. Serum bacterial activity as indicator of innate immunity in pacu *Piaractus mesopotamicus* (Holmberg, 1887). Arquivo Brasileiro de Medicina Veterinaria e Zootecnia. 65 (6): 1 - 9.
- Bittencourt, N.D.L.R., L.M. Monari, D.D.O. Scoaris, R. Pedroso, C.V. Nakamura, T.U. Nakamura, and B.A.DA. Filho. 2003. Haematological and biochemical values for Nile tilapia *Oreochromis niloticus* cultured in semi-intensive system. Agricultural and Food Science. 25(2): 385 – 389.
- Blazer, V.S., and R.E. Wolke. 1984. The effect of  $\alpha$ -tocopherol on the immune response and non-specific resistance factors of rainbow trout (*Salmo gairdneri* Richardson). Aquaculture, 37: 1 – 9.
- Campos, I., E. Matos, A. Marques, L.M.P. Valente. 2017. Hydrolyzed feather meal as a partial fishmeal replacement in diets for European seabass (*Dicentrarchus labrax*) juveniles. Aquaculture. 476: 152 – 159.
- Castro, R. and C. Tafalla. 2015. Overview of fish immunity. Mucosal Health in Aquaculture Cambridge. 3 – 54.
- Chakraborty, A.J., S. Mitra, T.E. Tallei, A.M. Tareq, F. Nainu, D. Cicia, K. Dhama, T.B. Emran, J. Simal-Gandara, R. Capasso. 2021. Bromelain a potential bioactive compound: A comprehensive overview from a Pharmacological Perspective. Life. 11(4): 1 – 24.
- Cunha, I.C., A. Brandelli, A.R.C. Braga, L. Sala, and S.J. Kalil. 2023. Feather meal as a source of peptides with antioxidant activity from enzymatic hydrolysis. Waste and Biomass Valorization. 14: 421 – 430.
- Dailami, M., A. Rahmawati, D. Saleky, dan A.H.A. Toha. 2021. Ikan Nila. Brainy Bee, Malang.
- Dalle, N.S., H.D. Tukan, dan E.Y. Nugraha. 2022. Perbandingan nilai nutrien antara tepung bulu broiler dan tepung bulu broiler terfermentasi. Jurnal Ilmiah Peternakan Terpadu. 10(3): 246 – 253.
- Debnath, S.C., J. McMurtrie, B. Temperton, J.D. Deboutteville, C.V. Mohan, and C.R. Tyler. 2023. Tilapia aquaculture, emerging diseases, and the roles of the skin microbiomes in health and disease. Aquaculture International. 31: 2945 – 2976.
- Dhanarso, P., H. Yunissa, I. Istiqomah, and A. Isnansetyo. 2021. Complement system activation in red tilapia (*Oreochromis sp.*) orally administered with probiotics

SEAL. The 3rd International Conference on Fisheries and Marine Sciences. 781: 1 – 6.

- Doerner, S.K., E.S. Reis, E.S. Leung, J.S. Ko, J.D. Heaney, N.A. Berger, J.D. Lambris, and J.H. Nadeau. 2016. High-fat diet-induced complement activation mediates intestinal inflammation and neoplasia, independent of obesity. *Mol Cancer Res.* 14(10): 953 – 965.
- Effendi, D.B., N.H.R. Rosyid, A.B.D. Nandiyanto, dan A. Mudzakir. 2015. Review: Sintesis nanoselulosa. *Jurnal Integrasi Proses.* 5(2): 61 – 74.
- El Basuini, M. F., S.A. Shahin, Teiba, I.I., Zaki, M.A., El-Hais, A.M., Sewilam, H. 2021. The influence of dietary coenzyme Q10 and vitamin C on the growth rate, immunity, oxidative-related genes, and the resistance against *Streptococcus agalactiae* of Nile tilapia (*Oreochromis niloticus*). *Aquaculture.* 531: 1 – 10.
- FAO. 1980. Fish Feed Technology. University of Washington, Seattle, Washington, U.S.A.
- Fazio, F. Fish hematology analysis as an important tool of aquaculture: A review. *Aquaculture.* 500: 237 – 242.
- Firdaus-Nawi, M. and M. Zamri-Saad. 2016. Major components of fish immunity: a review. *Pertanika Journal of Tropical Agricultural Science.* 39(4): 393 – 420.
- Fornari, D.C., S. Nazeer, A. Wedon, dan D.A. Davis. 2023. The efficacy of hydrolized feather meal as a protein source in diets for juvenile catfish *Ictalurus punctatus*. *Aquaculture.* 567.
- Fridovich, I. 1995. Superoxide radical and superoxide dismutases. *Annual Review of Biochemistry.* 64: 97–112.
- Gautam, S.S., S.K. Mishra, V. Dash, A.K. Goyal, and G. Rath. 2010. Comparative study of extraction, purification and estimation of bromelain from stem and fruit of pineapple plant. *Thai Journal Science Science.* 34: 67 – 76.
- Ghiasi, F., S.S. Mirzagar, H. Badakhshan & S. Shamsi. 2010. Effects of low concentration of cadmium on the level of lysozyme in serum, leukocyte count and phagocytic index in *Cyprinus carpio* under the wintering conditions. *Journal of Fisheries and Aquatic Science.* 5(2):113-119.
- Gomez, R.G. and J.L. Balcazar. 2007. A review on the interactions between gut microbiota and innate immunity of fish. *Immunology Medicine Microbiology.* 52: 145 – 154.
- Gupta, A., S.K. Gupta, M. Priyam, M.A.B. Siddik, N. Kumar, P.K. Mishra, K.K. Gupta, B. Sakrar, T.R. Sharma, and A. Pattanayak. 2021. Immunomodulation by dietary supplements: A preventive health strategy for sustainable aquaculture of tropical

- freshwater fish, *Labeo rohita* (Hamilton, 1822). Reviews in Aquaculture. 13(2): 1 – 31.
- Guyton, A.C. dan J.E. Hall. 1997. Buku Ajar Fisiologi Kedokteran. Edisi ke 9. Diterjemahkan oleh Setiawan Irawati. CV EGC. Jakarta.
- Hapsari, A.W., J. Hutabarat, dan D. Harwanto. 2020. Aplikasi komposisi filter yang berbeda terhadap kualitas air, pertumbuhan dan kelulushidupan ikan nila (*Oreochromis niloticus*) pada sistem resirkulasi. Jurnal Sains Akuakultur. 4(1): 39 – 50.
- Hastuti, S.D. 2012. Suplementasi  $\beta$ -glucan dari ragi roti (*Saccharomyces cerevisiae*) dalam pakan terhadap aktivitas fagositosis, aktivitas NBT, total protein plasma dan aktivitas aglutinasi darah ikan nila (*Oreochromis niloticus*). Jurnal Depik. 1(3): 149 – 155.
- Helmiati S., Rustadi, A. Isnansetyo, and 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 Conf. Series: Earth Environmental Science. 919: 1 – 10.
- Hu, Y., L. Feng, W. Jiang, P. Wu, Y. Liu, S. Kuang, L. Tang, and X. Zhou. 2021. Lysine deficiency impaired growth performance and immune response and aggravated inflammatory response of the skin, spleen and head kidney in grown-up grass carp (*Ctenopharyngodon idella*). Animal Nutrition. 7(2): 556 – 568.
- Igodharo, O.M. and O.A. Akinloye. 2018. First line defence antioxidants-superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GPX): their fundamental role in the entire antioxidant defence grid. Alexandria Journal of Medicine. 54(8): 287 - 293.
- Irmawati, Kamaruddin, M.F. Ulkhaq, S. Aslamsyah, I.A.K. Kadriah, D.S. Budi, S.H. Larekeng, dan Iswanto. 2022. Pakan Mandiri Bersuplemen untuk Budidaya Ikan Nila. Nas Media Indonesia, Yogyakarta.
- Isnansetyo, A., 2006. Petunjuk Praktikum Evaluasi Pertahanan Non Spesifik Ikan. Jurusan Perikanan Fakultas Pertanian. Universitas Gajah Mada. Yogyakarta.
- Istiqomah, I., A. Isnansetyo, I.N. Atitus, dan A.F. Rohman. 2019. Isolasi bakteri selulolitik *Staphylococcus sp.* JC20 dari saluran pencernaan gurita (*Octopus sp.*) untuk kandidat probiotik ikan. Jurnal Perikanan Universitas Gadjah Mada. 21(2): 93 - 98.
- Iwama, G. and T. Nakashi. 1996. “The Fish Immune System” Organism, Patogen, and Environment. Academic Press, Japan.
- Jolles P. 1969. Lysozymes: a chapter of molecular biology. Angewandte Chemie. 8: 227-239.

- Kementerian Kelautan dan Perikanan. 2022. Rilis Data Kelautan dan Perikanan Triwulan I Tahun 2022. Pusat Data, Statistik, dan Informasi Sekretariat Jenderal Kementerian Kelautan dan Perikanan, Jakarta.
- Kementerian Kelautan dan Perikanan. 2024. Kelautan dan Perikanan dalam Angka Tahun 2024. Pusat Data, Statistik, dan Informasi Kementerian Kelautan dan Perikanan, Jakarta.
- Kim, W.K. and P.H. Patterson. 2000. Nutritional Value of Enzyme or Sodium Hydroxide-Treated Feathers from Dead Hens. *Journal of Poultry Science*. 79: 528 – 534.
- Kristiana, I., K. Sembiring, W.P. Astiyani, dan A. Tiawati. 2021. Pengaruh penambahan duckweed (*Lemna* sp) dan tepung ikan pada pakan terhadap pertumbuhan dan kelangsungan hidup ikan nila nirwana iii (*Oreochromis niloticus*). *Jurnal Agibisnis Perikanan*. 14(2): 495 - 503.
- 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.
- Lee, M.J., J. Kim, S.I. Baek, and S.H. Cho. 2023. Substitution effect of fish meal with meat in diet on growth performance, feed consumption, feed utilization, chemical composition, hematology, and innate immune responses of rockfish (*Sebastes schlegeli*). *Journal of Aquaculture*. 571: 1 - 13.
- Li, X., W. Mu, X. Wu, Y. Dong, Z. Zhou, X. Wang, L. Ma, B. Ye, and L. Geng. 2020. The optimum methionine requirement in diets of juvenile hybrid grouper (*Epinephelus fuscoguttatus*♀×*Epinephelus lanceolatus*♂): Effects on survival, growth performance, gut micromorphology and immunity. *Aquaculture*. 520: 1 – 10.
- Luo, J., T. Zhu, X. Wang, X. Cheng, Y. Yuan, M. Jin, M.B. Betancor, D.R. Tocher, and Q. Zhou. 2020. Toxicological mechanism of excessive copper supplementation: Effects on coloration, copper bioaccumulation and oxidation resistance in mud crab *Scylla paramamosain*. *Journal of Hazardous Materials*. 395: 1 – 10.
- Magnadottir, B. 2006. Innate immunity of fish (overview). *Fish and Shellfish Immunology*. 20: 137 – 151.
- Manik, R.R.D.S. dan J. Arleston. 2021. Nutrien dan Pakan Ikan. CV Widina Media Utama, Bandung.
- Marchi, A., E. Benini, F. Dondi, M.G. Ferrari, D. Scicchitano, G. Palladino, M. Candela, R. Cerri, A. Di Biase, A.J. Vizcaino, F.J. Alarcon-Lopez, F.G. Acien, P.P. Gatta, A. Bonaldo, and L. Parma. 2024. The use of fishery and aquaculture by-products with *Nannochloropsis* sp. allows total dietary replacement of wild-caught fishmeal, fish oil and soy protein in European sea bass juveniles. *Aquaculture*. 590: 1 – 13.

- Mdhluvu, R.M., V. Mlambo, M.J. Madibana, M. Mwanza, and G. O'Brien. 2021. Crocodile meat meal as a fishmeal substitute in juvenile dusky kob (*Argyrosomus japonicus*) diets: Feed utilization, growth performance, blood parameters, and tissue nutrient composition. *Aquaculture Reports*. 21: 1 – 10.
- Mengistu, A., G. Andualem, M. Abewaa, dan D. Birhane. 2024. Keratin extraction optimization from poultry feather using response surface- Box-Behnken experimental design method. *Results in Engineering*. 22:1 - 10.
- Michel, C. and M-G. Hollebecq. 1999. Independence of phagocytic activity and susceptibility to furunculosis in families of rainbow trout (*Oncorhynchus mykiss*) genetically selected for differential resistance. *Fish and Shellfish Immunology*. 9: 81 – 93.
- Mu, L., X. Yin, Y. Yang, L. Wu, H. Wu, B. Li, Z. Guo, J. Ye. 2019. Functional characterization of a mannose-binding lectin (MBL) from Nile tilapia (*Oreochromis niloticus*) in non-specific cell immunity and apoptosis in monocytes/macrophages. *Fish Shellfish Immunology*. 87: 265 – 274.
- Mulia, D.S., A. Husin, dan J.R. Wulandari. 2021. Kandungan asam amino tepung bulu ayam yang difermentasi dengan *Bacillus licheniformis* B2560 dan *Bacillus subtilis* sebagai bahan baku pakan ikan. *SAINTEKS*. 18(2): 155 – 167.
- Mulia, D.S., R.T. Yuliningsih, H. Maryanto, dan C. Purbomartono. 2016. Pemanfaatan limbah bulu ayam menjadi bahan pakan ikan dengan hidrolisis *Bacillus subtilis*. *Jurnal Manusia dan Lingkungan*. 23(1): 49 – 57.
- Mulyani, R., Sukenda, dan S. Nurhayati. 2019. Efikasi vaksin formalin killed cells dan lipopolisakarida *Aeromonas hydrophila* pada imunitas maternal induk ikan nila dan ketahanan benih yang dihasilkan. *Jurnal Akuakultur Indonesia*. 18(2): 141 – 151.
- Mutia, A. dan A. Razak. 2018. Effect of Giving Fermented Liquid *Areca Cathecu* L. and Surian Leaves (*Toona sinensis* ROXB.) On Tilapia Wounds (*Oreochromis niloticus* L.). *Bio Sains*. 1(1): 41 – 50.
- Nisrinah, Subandiyono, dan T. Elfitasari. 2013. Pengaruh penggunaan Bromelin terhadap tingkat pemanfaatan protein pakan dan pertumbuhan lele dumbo (*Clarias gariepinus*). *Journal of Aquaculture Management and Technology*. 2(2): 57 – 63.
- Noman, A., Y. Xu, W.Q. Al-Bukhaiti, S.M. Abed, A.H. Ali, A.H. Ramadhan, and W. Xia. 2018. Influence of enzymatic hydrolysis conditions on the degree of hydrolysis and functional properties of protein hydrolysate obtained from Chinese sturgeon (*Acipenser sinensis*) by using papain enzyme. *Process Biochemistry*. 67: 19 – 28.
- Parekh, V.J., V.K. Rathod, and A.B. Pandit. 2011. 2.10 - Substrate Hydrolysis: Methods, Mechanism, and Industrial Applications of Substrate Hydrolysis. *Comprehensive Biotechnology* (Second Edition). 2: 103 - 118.



- Pascoli, F., G.S. Lanzano, E. Negrato, C. Poltronieri, A. Trocino, G. Radaelli, and D. Bertotto. 2011. Seasonal effects on hematological and innate immune parameters in sea bass *Dicentrarchus labrax*. *Fish and Shellfish Immunology*. 31(6): 1081 – 1087.
- Prajapati, S., S. Koirala, and A.K. Anal. 2021. Bioutilization of Chicken Feather Waste by Newly Isolated Keratinolytic Bacteria and Conversion into Protein Hydrolysates with Improved Functionalities. *Applied Biochemistry and Biotechnology*. 193(8): 2497 – 2515.
- Praptiwi, I.I. dan Wahida. 2021. Kualitas tepung ikan di pesisir Pantai Kabupaten Merauke sebagai bahan pakan. *Jurnal Ilmu Peternakan dan Veteriner Tropis*. 11(2): 157 – 164.
- Purbomartono, C., A. Isnansetyo, Murwantoko, and Triyanto. 2023. Improving resistance against *Aeromonas hydrophila* and growth performance by oral administration of fucoidan from *Padina boergesenii* Allender & Kraft, 1983 in catfish (*Clarias sp.*). *Aquaculture, Aquarium, Conservation, and Legislation Bioflux*. 16(3): 1294 – 1304.
- Qin, D., L. Wang, R. Fang, Z. Yu, L. Mo, and M. Liu. 2022. Peptidomics analysis of enzymatic hydrolysis beef. *Food Science Biotechnology*. 31: 1267 – 1275.
- Saanin, H. 1984. *Taksonomi dan Kunci Identifikasi Ikan 1*. Bina Cipta. Jakarta.
- Salinas I. 2015. The mucosal immune system of teleost fish. *Biology*. 4: 525 – 539.
- Salton M.R.J. 1957. The properties of lysozyme and its action on microorganisms. *Bacteriological Reviews*. 21: 82-99.
- Santos, M.M.F., C.V.B. Grisi, E.G.T. de Souza, J.M. Lima, V.C.S. Ferreira, L.E. Kurozawa, M.S. Madruga, F.A.P. da Silva. 2024. Biotransformation of free-range chicken feather into functional protein hydrolysates using microwave alkaline pretreatment. *Food Bioscience*. 59: 1 – 10.
- Saurabh, S. dan P.K. Sahoo. 2008. Lysozyme: an important defence molecule of fish innate immune system. *Aquaculture Research*. 39: 223 – 239.
- Sharma, P., A.B. Jha, R.S. Dubey, and M. Pessarakli. 2012. Reactive oxygen species, oxidative damage, and antioxidative defense mechanism in plants under stressful conditions. *Journal of Botany*. 2012: 1-26.
- Siwicki, A.K., M. Studnicka, M. Morand, F. Pozet, and E. Terech-Majewska. 1998. Comparative immunotoxicology – a new direction. *Acta Vet Brno*. 67: 295 – 301.
- Smith, N.C., M.L. Rise, and S.L. Christian. 2019. A comparison of the innate and adaptive immune system in cartilaginous fish, ray-finned fish, and lobe-finned fish. *Frontiers in Immunology*. 10: 1 - 23.

- SNI (Standar Nasional Indonesia). 2006. Pakan buatan untuk ikan nila (*Oreochromis spp.*) pada budidaya intensif Nomor 01-7242-2006.
- SNI (Standar Nasional Indonesia). 2009. Produksi benih ikan nila hitam (*Oreochromis niloticus Bleeker*) kelas benih sebar. Badan Standarisasi Nasional, Jakarta. SNI 6141-2009.
- Statistik - KKP. 2022. Produksi Perikanan. [Produksi Perikanan \(kkp.go.id\)](http://kkp.go.id). diakses 28 Juni 2024.
- Stolen J.S., T. Gahn, V. Kasper, J.J. Nagle. 1984. The effect of environmental temperature on the immune response of a marine teleost (*Faralichrhys denrufus*). Development and Comparative Immunology. 8: 89 – 98.
- Subandiyono dan S. Hastuti. 2016. Buku Ajar Nutrien Ikan. Catur Karya Mandiri, Semarang.
- Suryono, M., Harijono, dan Yuniarta. 2013. Pemanfatan ikan tuna (*Yellowfin tuna*), ubi jalar (*Ipomoea batatas*) dan sagu (*Metroxylon sago sp*) dalam pembuatan kamaboko. Jurnal Teknologi Pertanian. 14(1): 9 – 20.
- Susandi, F., Mulyana, dan Rosmawati. 2017. Peningkatan imunitas benih ikan gurami (*Osphronemus gouramy Lac.*) terhadap bakteri *Aeromonas hydrophila* menggunakan rosella (*Hibiscus sabdariffa L.*). Jurnal Mina Sains. 3(2): 1 – 13.
- Tacias-Pascacio, V.G., D. Castaneda-Valbuena, O. Tavano, P. Abellanas-Perez, D. de Andrades, J.A. Santiz-Gomez, A. Berenguer-Murcia, and R. Fernandez-Lafuente. 2024. A review on the immobilization of bromelin. International Journal of Biological Macromolecules. 273(2): 1 – 20.
- Tizard, I.R. 1988. An Introduction to Veterinary Immunology. 2<sup>nd</sup> edition. Saunders, Philadelphia.
- Tizard, I.R. 2017. Veterinary Immunology: An Introduction, 10<sup>th</sup> Edition. Elsevier Health Science, Missouri.
- Topper, J., S. Albrechtsen, B. Hope, and A. Aksnes. 2007. Chemical composition, mineral content and amino acid and lipid profiles in bones from various fish species. Comparative Biochemistry and Physiology Part B: Biochemistry and Molecular Biology. 146 (3): 395 - 401.
- Vijayaram, S., E. Ringo, A. Zuurro, H. van Doan, and Y. Sun. 2024. Beneficial roles of nutrients as immunostimulants in aquaculture: a review. Aquaculture and Fisheries. 9: 707 – 720.
- Wang, Y.B., J.R. Li, and J. Lin. 2008. Probiotics in aquaculture: challenges and outlook. Aquaculture. 281: 1 – 4.



- Warner, H.R. 1994. Superoxide dismutase, aging, and degenerative disease. *Free Radical Biology and Medicine*. 17(3): 249 – 258.
- Whyte, S.K. 2007. The innate immune response of finfish. *Fish and Shellfish Immunology*. 23(6): 1127 - 1151.
- Widhyari, S.D. 2012. Peran dan dampak defisiensi zinc (Zn) terhadap sistem tanggap kebal. *WARTOZOA*. 22(3): 141 – 148.
- Xu, Y., M. Galanopoulos, E. Sismour, S. Ren, Z. Mersha, P. Lynch, and A. Almutaimi 2020. Effect of enzymatic
- Yano, T. 1996. The nonspecific immune system: humoral defense. *Fish Physiology*. 15: 105 – 157.
- Yanto, H., A.E. Setiadi, dan D. Kurniasih. 2019. Pengaruh tingkat karbohidrat berbeda dalam pakan terhadap kinerja pertumbuhan ikan tengadak (*Barbonymus schawenfeldii*). *Jurnal Ruaya*. 7(2): 39 – 46.
- Yanuhar, U. dan N.R. Caesar. 2022. *Imunologi Molekuler untuk Ikan*. UB Press.
- Yuangsoi, B., R. Klahan, S. Charoenwattanasak, and S.M. Lin. 2018. Effects of supplementation of pineapple waste extract in diet of Nile tilapia (*Oreochromis niloticus*) on growth, feed utilization, and nitrogen excretion. *Journal of Applied Aquaculture*. 30(3): 227 – 237.
- Zaminhan-Hassemer, M., M. Michelato, W.R. Boscolo, A.V. Urbich, T.P. da Cruz, F.L.A. de Almeida, V.R.B. Furuya, and W.M. Furuya. 2020. Dietary histidine requirement of grow-out Nile tilapia (*Oreochromis niloticus*), based on growth performance, muscle development, expression of muscle-growth-related genes, and blood parameters. *Revista Brasileira de Zootecnia*. 49: 1 – 12.
- Zerdani, I., M. Faid, and A. Malki. 2004. Feather wastes digestion by new isolated strains *Bacillus* sp. in Morocco. *African Journal of Biotechnology*. 3(1): 67-70.