

DAFTAR PUSTAKA

- Afriani, Y., Rahayu, R., & Santoso, P. 2023. Fatty acid and haematology profile of Black Soldier Fly (*Hermetia illucens*) Maggot oil in wound healing. *International Journal of Progressive Science and Technologies*, 39(2), 429-433.
- Agbohessou, P. S., Robert, M., Wouter, M., Aude, B., Mazarine, G., Mutien, G., Jerome, L., Pierre, C., Nicole, T., Philippe, A., Laleye & Patrick, K. 2024. Effect of fatty acid-enriched black soldier fly larvae meal combined with chitinase on the metabolic processes of Nile tilapia. *British Journal of Nutrition*, 131, 1326–1341.
- Agbohessou, P. S., Syaghalirwa, N. M. M., Serge, R. M. B., Valerie, C., Thi, M. N., Jerome, L., Thierry, J., Philippe, A. L., & Patrick, K. 2022. Intestinal histopathology and immune responses following *Escherichia coli* lipopolysaccharide challenge in Nile Tilapia fed enriched Black Soldier Fly larva (BSF) meal supplemented with chitinase. *Fish & Shellfish Immunology*, 128 : 620-633.
- Ahmed, F., Soliman, F.M., Adly, M.A., Soliman, H.A.M., El-Matbouli, M., & Saleh, M. 2021. Dietary Chitosan Nanoparticles: potential role in modulation of Rainbow Trout (*Oncorhynchus mykiss*) Antibacterial defense and intestinal immunity against enteric redmouth disease. *Mar. Drugs* 19 (2), 72.
- AOAC. 2000. Official Methods of Analysis. 17 th edition. *Gaithersburg, MD, USA*.
- AOCS. 1993. Preparation of methyl esters of long-chain fatty acid. *The American Oil Chemist Society*.
- Arshad, I., Abdul, M., Muhammad, R., Zulekha, I., Hajra, S., Rana, A., Muhammad, I., & Muhammad, T. 2023. Fatty Acid Profile And Growth Performance Of Nile Tilapia Under The Influence Of 20%, 40% And 60% Fish Meal Replacement With Black Soldier Fly Maggot Meal In Diet. *Journal of Survey in Fisheries Sciences*, 10(3) 317-32.
- Azri, N. A. M., Low K. C., Hadura, A. H., Annette, J., Zulhisyam, A. K., & Noor, K. A. H. 2022. The effects of partial replacement of fishmeal with *Hermetia* meal on the growth and fatty acid profile of African Catfish fry. *Agriculture reports*, 1(1): 17-27.
- Badan Pusat Statistik (BPS). 2024. Peternakan Dalam Angka 2024. *Badan Pusat Statistik*.

- Barragan-Fonseca, K. B., Dicke, M., & Van, L. J. J. A. 2017. Nutritional value of the Black Soldier Fly and its suitability as animal feed. *Journal of insect as food and feed*, 3(2),105-120.
- Burdge, G. C., & Calder, P. C. 2015. Introduction to fatty acids and lipids. *World Rev Nutr Diet*.
- Buyukdeveci, M.E., Cengizler, I., Balcazar, J.L., & Demirkale, I. 2023. Effects of two host associated probiotics *Bacillus mojavenensis* B191 and *Bacillus subtilis* MRS11 on growth performance, intestinal morphology, expression of immune-related genes and disease resistance (*Oreochromis niloticus*) Nile Tilapia against *Streptococcus iniae*. *Developmental and Comparative Immunology* 138, 1–11.
- Caimi, C., Lauea, G., Ilaria, B., Vanda, M., Katia, V., Marino, P., Paolo, P., Maria, C. B., Danila, R. F., Achille, S., Antonia, C. E., Ambrosius, J. M. D., & Francesco, G. 2020. Could Dietary Black Soldier Fly Meal Inclusion Affect the Liver and Intestinal Histological Traits and the Oxidative Stress Biomarkers of Siberian Sturgeon (*Acipenser baerii*) Juveniles?. *Animals*, 10, 155.
- Chen, Y., Shuyan, C., Shuan, Z., Xiaohui, D., Qihui, Y., Hongyu, L., Beiping, T., & Shiwei, X. 2021. Evaluation of the dietary Black Soldier Fly larvae meal (*Hermetia illucens*) on growth performance, intestinal health, and disease resistance to *Vibrio parahaemolyticus* of the pacific white shrimp (*Litopenaeus vannamei*). *Front. Mar. Sci.* 8:70646.
- Cickova, H., Larry, G. N., Curt, R. L., & Milan, K. 2015. The use of fly larvae for organic waste treatment. *Waste Management*, 35 : 68-80.
- Critchfield, A. S. 2013. Cervical mucus properties stratify risk for preterm birth. *PLoS ONE* 8, e69528.
- Dawood, M.A.O., Abdel-Razik, N.I., Gewaily, M.S., Sewilam, H., Paray, B.A., Soliman, A. A., Abdelhice, E.Y., Aboubakr, M., Van Doan, H., El-Sabagh, M., & El Basuini, M.F. 2020. β -Glucan improved the immunity, hepato-renal, and histopathology disorders induced by chlorpyrifos in Nile Tilapia. *Aquac. Rep.* 18, 100549.
- Eggink, K. M., Per, B. P., Ivar, L., & Johanne, D. 2022. Chitin digestibility and intestinal exochitinase activity in Nile tilapia and rainbow trout fed different Black Soldier Fly larvae meal size fractions. *Aquaculture Research*, 53:5536-5546.
- Elia, A. C., Capucchio, M. T., Caldaroni, B., Magara, G., Dörr, A. J. M., Biasato, I., Biasibetti, E., Righetti, M., Pastorino, P., & Prearo, M. 2018. Influence of *Hermetia illucens* meal dietary inclusion on the histological traits, gut

- mucin composition and the oxidative stress biomarkers in Rainbow Trout (*Oncorhynchus mykiss*). *Aquaculture*, 496, 50–57.
- Ermund, A., Schutte, A., Johansson, M. E., Gustafsson, J. K. & Hansson, G. C. 2013. Studies of mucus in mouse stomach, small intestine, and colon. I. Gastrointestinal mucus layers have different properties depending on location as well as over the Peyer's patches. *Am. J. Physiol. Gastrointest. Liver Physiol.* 305, G341–G347.
- Fantatto, R. R., Joana, M., Carolina, L., Ines, V., Leonardo, G. G., Marisa, S., & Daniel, M. 2024. Exploring Sustainable Alternatives in Aquaculture Feeding: The Role of Insects. *Aquaculture Reports*, 37.
- FAO. 2016. The state of world fisheries and aquaculture: contributing to food security and nutrition for all. *Food and Agriculture Organization*, FAO, Rome.
- Gasco L., Finke M., & van Huis A. 2018. Can Diets Containing Insects Promote Animal Health? *J. Insects Food Feed.* ;4:1–4.
- Global Biodiversity Facility (GBIF). 2023. *Hermetia illucens* (Linnaeus, 1758). GBIF Backbone Taxonomy.
- Global Biodiversity Facility (GBIF). 2023. *Oreochromis niloticus* (Linnaeus, 1758). GBIF Backbone Taxonomy.
- Glatz, J. F., & Luiken, J. J. 2015. Fatty acids in cell signaling: historical perspective and future outlook. *Prostaglandins Leukot Essent Fatty Acids*;92.
- Glencross, B. D., Johanna, B., Marc, H. G., Bertssen., Ronald, H., Simon, M., & Douglas, R. T. 2019. Risk assessment of the use of alternative animal and plant raw material resources in aquaculture feeds. *Acualculture*, 12 (2): 703-758.
- Gustafsson, J. K., Malin, E. V., & Johansson. 2022. The role of goblet cells and mucus in intestinal homeostasis. *Nature Reviews*.
- Hasanah, S., Resti, R., & Putra, S. 2025. Effect of Black Soldier Fly (*Hermetia illucens*, L) larva oil on blood profile and lung histopathology in mice exposed to cigarette smoke. *Unpublish Journal*.
- Hasibuan, N, A, B., Resti, R., & Efrizal. 2022. Growth rate of sangkuriang catfish (*Clarias gariepinus* var. Sangkuriang) subtituted with Black Soldier Fly (*Hermetia illucens* l.) Larva in artificial feed. *International Journal of Progressive Sciences and Technologies*, 35 (1) 292-297.

- Henry, M., Gasco, L., Piccolo, G., & Fountoulaki, E. 2015. Review on the use of insects in the diet of farmed fish: past and future. *Anim. Feed Sci. Tech.* 203, 1-22.
- Hossan, M.K., Hossain, M.M., Mim, Z.T., Khatun, H., Hossain, M.T., & Shahjahan, M. 2022. Multi-species probiotics improve growth, intestinal microbiota and morphology of Indian major carp mrigal *Cirrhinus cirrhosus*. *Saudi Journal of Biological Sciences*, 29 (9), 103399.
- Hu, Y., Yanhua, H, Tao, T., Lei, Z., Wuying, C., Zhenyan, D., Kaijian, C., & Yi, H. 2020. Effect of partial Black Soldier Fly (*Hermetia illucens* L.) larvae meal replacement of fish meal in practical diets on the growth, digestive enzyme and related gene expression for Rice Field Eel (*Monopterus albus*). *Aquaculture Reports*, 17, 100345.
- ISO 16958:2015. Milk, milk products, infant formula and adult nutritionals — Determination of fatty acids composition — Capillary gas chromatographic method.
- Kapoor, B., Kapoor, D., Gautam, S., Singh, R., & Bhardwaj, S. 2021. Dietary Polyunsaturated Fatty Acids (PUFAs): Uses and Potential Health Benefits. *Curr. Nutr. Rep*, 10, 242
- Kovacik, A., Helczman, M., Arvay, J., Jambor, T., & Kovacikova, E. 2025. Toxic elements and fatty acid composition in the freshwater fish family Cyprinidae (Rafinesque 1815): balancing nutritional benefits and health risks. *EnvironmMonit Assess*. 197(6):676.
- Kuebutornye, F. K.A., Zhiwen, W., Yishan, L., & Emmanuel, D. A., Michael, E. S., Yuan, L., Cai, X. X., & Vivian, H. 2020. Effects of three host-associated *Bacillus* species on mucosal immunity and gut health of Nile Tilapia, *Oreochromis niloticus* and its resistance against *Aeromonas hydrophila* infection. *Fish and Shellfish Immunology*, 97: 83–9.
- Larouche, J. 2019. Processing methods for the Black Soldier Fly (*Hermetia illucens*) larvae: from feed withdrawal periods to killing methods. MSc Thesis, Universite Laval, Canada, 78 pp.
- Li, S., Ji, H., Zhang, B., Tian, J., Zhou, J., & Yu, H. 2016. Influence of black soldier fly (*Hermetia illucens*) larvae oil on growth performance, body composition, tissue fatty acid composition and lipid deposition in juvenile Jian carp (*Cyprinus carpio* var. *Jian*). *Aquaculture* 465, 43–52.
- Li, S., Ji, H., Zhang, B., Zhou, J., & Yu, H. 2017. Defatted black soldier fly (*Hermetia illucens*) larvae meal in diets for juvenile Jian carp (*Cyprinus carpio* var. *Jian*): Growth performance, antioxidant enzyme activities,

digestive enzyme activities, intestine and hepatopancreas histological structure. *Aquaculture* 477, 62–70.

Limbu, S.M., Shoko, A.P., Ulotu, E.E., Luvanga, S.A., Munyi, F.M., John, J.O. & Opiyo, M.A. 2022. Black soldier fly (*Hermetia illucens*, L.) larvae meal improves growth performance, feed efficiency and economic returns of Nile Tilapia (*Oreochromis niloticus*, L.) fry. *Aquaculture Fish and Fisheries*, 2, 167–178.

Liu, W., Wu, J., Li, Z., Duan, Z., & Wen, H. 2018. Effects of dietary coated protease on growth performance, feed utilization, nutrient apparent digestibility, intestinal and hepatopancreas structure in juvenile Gibel carp (*Carassius auratus gibelio*). *Aquaculture Nutrition*, 24(1), 47–55.

Marie, R., Syukron, M.A., & Rahardjo, S. S. P. 2017. Enlargement techniques Tilapia (*Oreochromis niloticus*) with feeding waste bread. *Journal of Natural Resources and Environment*, 6 (2).

Marno, M., Adelina, A., & Netti, A. 2016. Utilization of flour maggot (*Hermetia illucens* L) as a substitute fish flour for growth of Selais fish (*Ompok hypophthalmus*) seed. *Online Journal of Students of the Faculty of Fisheries and Marine Sciences, University of Riau*, 3(1): 1-11.

Meneguz, M., Schiavone, A., Gai, F., Dama, A., Lussiana, C., Renna, M., & Gasco, L. 2018. Effect of rearing substrate on growth performance, waste reduction efficiency and chemical composition of Black Soldier Fly (*Hermetia illucens*) larvae. *J. Sci. Food Agric.* 98, 5776–5784.

Mescher, A. L. 2018. Junqueira's basic histology. *McGraw-Hill Education*.

Mitilelu, M., Lupuliasa, D., Neacșu, S. M., Olteanu, G., Busnatu, Ș. S., Mihai, A. Popovici, V., Măru, N., Boroghina, S. C., Mihai, S., Ioniță-Mîndrican, C. B., & Scafa-Udriște, A. 2024. Polyunsaturated Fatty Acids and Human Health: A Key to Modern Nutritional Balance in Association with Polyphenolic Compounds from Food Sources. *Foods*. 2024 Dec 27;14(1):46.

Moretta, A. Salvia, R., & Scieuzo, C. 2020. A bioinformatic study of antimicrobial peptides identified in Black Soldier Fly (BSF) *Hermetia illucens* (Diptera: Stratiomyidae). *Sci Rep* 10, 168775.

Munguti, J., Mavindu, M., Jimmy, B. M., Domitila, K., Menaga, M., & Chrysantus, M. T. 2025. Unraveling the potential of Black Soldier Fly larvae as a sustainable protein source for Nile Tilapia production in diverse aquaculture systems. *Aquaculture Nutrition* 3598843.

Murti, F. A. U., Ma'rufa, N. L., Indah, I., Senny, H., Alim, I., Romi, N., & Ahmad, S. K. 2023. Intestinal enzymes and lactic acid bacteria of Red Tilapia

- (*Oreochromis* sp.) fed Black Soldier Fly (*Hermetia illucens*) larvae and probiotics. *Aquacultura Indonesiana*, 24(1): 20-29.
- Nitzan, T., Pazit, R., & Avner, C. 2017. Differential expression of amino-acid transporters along the intestine of Mozambique Tilapia (*Oreochromis mossambicus*) and the effect of water salinity and time after feeding. *Aquaculture* 472: 71–75.
- Obirikorang, K.A., Gyamfi, S., Goode, M.E., Amisah, S., Edziyie, R.E., Quagrainie, K., Egna, H. & Frimpong, E. 2020. Effect of soybean meal diets on the growth performance, ammonia excretion rates, gut histology and feed cost of Nile tilapia (*Oreochromis niloticus*) fry. *Aquaculture Research*, 51, 3520–3532.
- Octaviani, Y. N., Mochamad, A. B., & Sri, S. 2024. The impact of food waste mitigation with Black Soldier Fly assistance on climate change in Indonesia – a systematic review. *Ecological Engineering & Environmental Technology*, 25(1), 60–72.
- Putri, W. R., Helmi, H., Kusuma, H., & Rangga, B. 2019. Kombinasi Maggot Pada Pakan Komersial Terhadap Pertumbuhan, Kelangsungan Hidup, FCR, Dan Biaya Pakan Ikan Patin Siam (*Pangasius hypophthalmus*). *Jurnal Ilmu Perikanan dan Budidaya*, 14 (1): 7-16.
- Rahayu, R., Kamsiah, W. P. S., Robby, J., Fuji, A. F., & Risa, U. M. 2025. Larval performance of Black Soldier Fly (*Hermetia illucens*) on fermented corn cob and rice straw supplemented with effective microorganisms. *International Journal of Agriculture & Biology*, 34.
- Rahayu, R., Muhammad, S. F., Yona, A., Edwin, M. T., Sri, Z. M., Yeliza, F., Yopi, I., & Rosdalia. Teknologi Rekayasa Pengolahan Maggot *Black Soldier Fly* (BSF) Untuk Pakan Ikan Nila (*Oreochromis niloticus*). *Unpublish Journal*.
- Rahayu, R., Rahmawati, R., Mairawita, Devianto, D., & Putra, R.E. 2023. Performance of tropical fruit wastes as oviposition attractants and growing substrates in rearing Black Soldier Fly (*Hermetia illucens*). *International Journal of Agriculture and Biology*, 30(3): 221-228.
- Ramos, M. A., Batista, S., Pires, M. A., Silvi, A. P., Pereira, L. F., Saavedra, M. J., Ozorio, R. O. A., & Rema, P. 2017. Dietary probiotic supplementation improves growth and the intestinal morphology of Nile Tilapia. *Animal Consortium*, 1 (11).
- Ratnayake, W.M.N., Hansen, S.L., & Kennedy M, P. 2006. Evaluation of the CP-Sil. 88 and SP-2560 GC columns used in the recent approval of AOCS Official Method Ce 1h-05: Determination of cis-, trans-, saturated, monounsaturated,

- and polyunsaturated fatty acids in vegetable or non-ruminant animal oils and fats by capillary GLC method. *J Am Oil Chem Soc*, 83(6): 475–488.
- Rizzo, G., Baroni, L., & Lombardo, M. 2023. Promising Sources of Plant-Derived Polyunsaturated Fatty Acids: A Narrative Review. *Int. J. Environ. Res. Public Health*, 20, 1683.
- Rodriguez-Pineiro, A. M. 2013. Studies of mucus in mouse stomach, small intestine, and colon. II. Gastrointestinal mucus proteome reveals Muc2 and Muc5ac accompanied by a set of core proteins. *Am. J. Physiol. Gastrointest. Liver Physiol.* 305, G348–G356.
- Rostika R., Haetami K., Pratiwy F. M., Putra F. A., & Dewanti L. P., 2022. A comparison of the drying techniques for maggot of the Black Soldier (*Hermetia illucens*) as an insect-based protein source for the feed of juvenile tilapia fish (*Oreochromis niloticus*). *AACL Bioflux* 15(3):1492-1498.
- Salamah, Z., Budiantoro, A. & Suwartiningsih, N. 2018. Petunjuk Praktikum Mikroteknik Tumbuhan dan Hewan. *Yogyakarta: Universitas Ahmad Dahlan*. hlm: 35-40.
- Sangsawang, A., Satit, K., Akkanee, P., Uthaiwan, K., Attawit, K., Chantha, W., Satid, C., & Natthapong, P. 2024. Impacts of substituting fish meal with full-fat or defatted Black Soldier Fly (*Hermetia illucens*) larvae on growth, quality, and health of Nile Tilapia (*Oreochromis niloticus*) fingerlings. *Aquaculture Reports*, 38, 102348.
- Santoso, B., Limin, S., & Tarsim. 2018. Optimization of maggot *Hermetia illucens* combination with artificial feed against growth and survival rate of Mad Barb fish (Bleeker, 1851). *Fisheries Journal*, 46 (3).
- Schneider, H., Pelaseyed, T., Svensson, F. & Johansson, M. E. V. 2018. Study of mucin turnover in the small intestine by in vivo labeling. *Sci. Rep.* 8, 5760.
- Sepang, D. A., Joppy, D. M., Revol, D. M., Hariyani, S., & Jeffrie, F. M. 2021. Growth performance of Nile Tilapia (*Oreochromis niloticus*) feeding with combination of pellet and dry maggot (*Hermetia illucens*). *Aquaculture*, 9 (1): 33-44.
- Setiawan, A., Sarmila, Tarno, A., & Putri, H. K. 2022. Substitution of *Hermetia illucens* maggot with pellets against performance of the Maru fish *Channa maruloides*. *Samakia: Journal of Fisheries Science*, 13 (1): 44-50.
- Setiawan, H., Putra, I. L. I., Alfatah, R., & Nasikhudin, A. N. 2021. The effectiveness combination of maggot with commercial feed on growth,

- structure of intestine and skeletal muscle Mutiara catfish. *Journal of Aquaculture and Fish Health*, 11(1), 70–80.
- Setyono, B. D. H., Muhammad, M., Andre, R. S., & Sudirman. 2020. Efektifitas Tepung Ikan Lokal Dalam Penyusunan Ransum Pakan Ikan Nila (*Oreochromis niloticus*). *Jurnal Perikanan*, 10 (2): 183-194.
- Shi, Y., Zhong, L., Ma, X., Liu, Y., Tang, T., & Hu, Y., 2019. Effect of replacing fishmeal with stickwater hydrolysate on the growth, serum biochemical indexes, immune indexes, intestinal histology and microbiota of Rice Field Eel (*Monopterus albus*). *Aquaculture Reports* 15, 100223.
- Standen, B. T., Peggs, D. L., Rawling, M. D., Foey, A., Davies, S. J., Santos, G. A., & Merrifield, D. L. 2016. Dietary administration of a commercial mixed-species probiotic improves growth performance and modulates the intestinal immunity of tilapia, *Oreochromis niloticus*. *Fish & Shellfish Immunology*, 49: 427 – 435.
- Surendra, K. C., Jeffery, K. T., Arnold, V. H., Jonathan, A. C., Lars-Henrik, L., & Heckmann, S., K. K. 2020. Rethinking organic wastes bioconversion: Evaluating the potential of the black soldier fly (*Hermetia illucens* (L.)) (Diptera: Stratiomyidae) (BSF). *Waste Management*, 117 : 58–80.
- Tippayadara, N., Mahmoud, A. O., Patcharin, K., Seyed, H. H., Hien, V. D., & Marina, P. 2021. Replacement of fish meal by Black Soldier Fly (*Hermetia illucens*) larvae meal: effects on growth, haematology, and skin mucus immunity of Nile Tilapia, *Oreochromis niloticus*. *Journal Animals*, 11(1),193.
- Tran-Ngoc, K. T., Johan, W. S., Mai, T. T. L., Thinh, H. N., Arjen, J. R., & Johan, A. J. V. 2-17. Salinity and diet composition affect digestibility and intestinal morphology in Nile Tilapia (*Oreochromis niloticus*). *Aquaculture*, 469 : 36–43.
- Van, D. P. S. 2019. Structural weakening of the colonic mucus barrier is an early event in ulcerative colitis pathogenesis. *J. Gut*, 68, 2142–2151.
- Vasconi, M., Caprino, F., & Bellagamba, F. 2015. Fatty Acid Composition of Freshwater Wild Fish in Subalpine Lakes: A Comparative Study. *Lipids* 50, 283–302.
- Wallady, A. A., B.S. Rahardja, & H. Kenconoati. 2021. Dietary combination of maggot and commercial feed enhance the growth rate and feed conversion ratio of snakehead fish (*Channa striata*). *IOP Conference Series: Earth and Environmental Science*, 1036, 012085.

- Widmaier, E. P., Hershel, R., & Kevin, T. S. 2015. Human Physiology The Mechanisms Of Body Function. *Mc Graw Hill Education*. New York.
- Witten, J. & Ribbeck, K. 2017. The particle in the spider's web: transport through biological hydrogels. *Nanoscale* 9, 8080–8095.
- Xiao, X., Jin, P., Zheng, L., Cai, M., Yu, Z., Yu, J., & Zhang, J. 2018. Effects of *Black Soldier Fly* (*Hermetia illucens*) larvae meal protein as a fishmeal replacement on the growth and immune index of Yellow Catfish (*Pelteobagrus fulvidraco*). *Aquac. Res.* 49, 1569–1577.
- Zulkifli, N. F. N. M., Annita, Y. S. K., Lim, L. S., Saleem M., Yang, S. K., & Rossita, S. 2022. Nutritional value of Black Soldier Fly (*Hermetia illucens*) larvae processed by different methods. *PlosOnes*, 17 (2).

