

DAFTAR PUSTAKA

- Abram, Q.H., B. Dixon & B.A. Katzenback. 2017. Impacts of Low Temperature on the Teleost Immune System. *Biology* 6(39)
- Ahn, G., W.W. Leeb, K.N. Kimc, J.H. Leeb, S.J. Heod, N. Kang, S.H. Lee, C.B. Ahnf, Y.J. Jeon. 2015. Sulfated polysaccharide of *Eclonia cava* inhibits the growth of colon cancer cells by inducing apoptosis. *EXCLI J.* 14:294-306 – ISSN 1611-2156.
- Al-Banaw, A., R. Kenngott, J.M. Al-Hassan, N. Mehana & F. Sinowatz. 2010. Histochemical analysis of glycoconjugates in the skin of a catfish (*Arius tenuispinis*, Day). *J. of Veterinary Medicine Seri C* 39(1): 42-50.
- Ale, M.T., J.D. Mikkelsen & A.S. Meyer. 2011. Important determinants for fucoidan bioactivity: A critical review of structure-function relations and extraction methods for fucose-containing sulfated polysaccharides from brown seaweeds. *Marine Drugs* 9:2106-2130.
- Allender, B. M. & G.T. Kraft. 1983. The marine algae of lord howe island (New South Wales): The dictyotales and cutleriales (Phaeophyta). *Brunonia* 6: 73-130.
- Ali, L., A. L. Khan, M. Al-Broumi, R. Al-Harrasi, L. Al-Kharusi, J. Hussain, A Al-Harrasi. 2017. New Enzyme-Inhibitory Triterpenoid from Marine Macro Brown Alga *Padina boergesenii* Allender & Kraft. *Marine. Drugs* 15(19).
- Altin, D. 2012. Perkembangan ikan lele di Indonesia. Diakses melalui <http://www.mb.ipb.ac.id/uploads/File/2012/perkembangan%20ikan%20lele%20di%20Indonesia.pdf> pada tanggal 31 Agustus 2017.
- Anderson, D.P. & A.K. Siwicki. 1994. Simplified assays for measuring non-specific defense mechanism in fish. Fish Health Section/American Fisheries Meeting, Seattle Washington.
- Andrade, L.R., L.T. Salgado, M. Farina, M.S. Pereira, P.A.S. Mourão & F.G.M. Amado, 2004. *J. Structural Biology* 145: 216-225.
- Angka, L. 2005. Kajian penyakit motile aeromonas septicemia pada ikan lele dumbo *Clarias sp.*: patologi, pencegahan dan pengobatannya dengan fitofarmaka. Disertasi. Bogor IPB.
- Anno, K., N. Seno & M. Ota. 1970. Isolation of L-fucose 4-sulfate from fucoidan. *Carbohydrate Research* 13:167-169.
- Anastyuk, S.D, N. Shevchenko, E.L. Nazarenko, P.S. Dmitrenok, T.N. Zvyagintseva. 2009. Structural analysis of a fucoidan from the brown alga *Fucus evanescens* by Maldi-Tof and tandem ESI mass spectrometry. *Carbohydrate Research* 344(6):779-87.
- Aoki, T., J.I. Hikima, S.D. Hwang & T.S. Jung. 2013. Innate immunity of finfish: Primordial conservation and function of viral RNA sensors in teleosts. *Fish & Shellfish Immunology*.
- Arunkumar, K., S.R. Sivakumar & R. Rengasamy. 2010. Review on bioactive potential in seaweeds (Marine Macroalgae): A special emphasis on bioactivity of seaweeds against plant pathogens. *Asian J. of Plant Science* 9: 227-240.
- El-Boshy, M., A. El-Ashramb, E. Rishac, F. Abdelhamidc, E. Zahrand, A. Gab-Alla. 2014. Dietary fucoidan enhance the non-specific immune response and disease resistance in African catfish, *Clarias gariepinus*, and immunosuppressed by cadmium chloride. *Veterinary Immunology & Immunopathology* 162:168-173.
- Baratawidjaja, K.G. & I. Rengganis. 2010. *Imunologi dasar*. Edisi ke-9. Balai Penerbit Fakultas Kedokteran Universitas Indonesia. Jakarta. 62-64p.



- Baratawidjaja, K.G. 2006. *Imunologi dasar*. Fakultas Kedokteran Indonesia. Jakarta. 6-7p.
- Baratawidjaja, K.G. 2004. *Imunologi dasar*. Edisi 6. Jakarta: Balai Penerbit FKUI.
- Bassity, E. 2009. Identification and characterization of specialized antigen presenting cells in rainbow trout. Disertation. Cornell University.
- Bianchi, M.E. 2007. DAMPs, PAMPs and alarmins: all we need to know about danger. *J. of Leukocyte Biology* 81:1-5.
- Bilan, M.I., A.S. Shashkov, A.I. Usov. 2014. Structure of a sulfated xylofucan from the brown alga *Punctaria plantaginea*. *Carbohydrate Research* 393:1–8.
- Bilan, M. I., A.A. Grachev, A.S. Shashkov, M. Kelly, C.J. Sanderson, N.E. Nifantiev. 2010. Further studies on the composition and structure of a fucoidan preparation from the brown alga *Saccharina latissima*. *Carbohydrate Research* 345(14): 2038-2047.
- Bilan, M.I., A.A. Grachev, A.S. Shashkov, N.E. Nifantiev & A.I. Usov. 2006. Structure of a fucoidan from the brown seaweed *Fucus serratus* L. *Carbohydr. Res.* 341: 238-245.
- Bird, S., J. Zou & C.J. Secombes. 2006. Advances in fish cytokine biology give clues to the evolution of a complex network. *Current Pharmaceutical Design* 2: 3051-3069.
- Bird, S., J. Zou, R. Savan, T. Kono, M. Sakai & J. Woo. 2005. Characterization and expression analysis of an interleukin 6 homologue in the Japanese puffer fish, *Fugu rubripes*. *Developmental and Comparative Immunology* 29: 775-789.
- Biswas, S.K. & A. Mantovani. 2012. Orchestration of metabolism by macrophages. *Cell Metab* 15(4): 432–437.
- Bixler, H.J. & H. Porse. 2010. A decade of change in the seaweed hydrocolloids industry. *J. Appl. Phycol.*, DOI 10.1007/s10811-010-9529-3.
- Björk, M., F. Mamboya, M. Mtolera, S. Engdahl, A. Semesi, 1998. The brown macroalga *Padina boergesenii* as an indicator of heavy metal contamination in the Zanzibar channel. *Ambio* 27(8).
- Boshra, H., T. Wang, L. Hove-Madsen, J. Hansen, J. Li & A. Matlapudi. 2005. Characterization of a C3a receptor in rainbow trout and *Xenopus*: the first identification of C3a receptors in nonmammalian species. *J. of Immunology* 175: 2427-437.
- Burrels, C., P.D. Williams & P.F. Fomo. 2001. Dietary nucleotide: A novel supplement in fish feed. 1 effects on resistance to disease in In Salmonids. *Aquaculture* 199: 159-169.
- Bugis, A.A. & H. Manoppo, 2014. Peningkatan pertumbuhan ikan nila (*Oreochromis niloticus*) melalui pemberian immunostimulan ragi roti (*Saccharomyces cerevisiae*). *Budidaya Perairan* 2 (3):1-7.
- Castro, R., I. Zarra & J. Lamas. 2004. Water soluble extracts modulate the respiratory burst activity of turbot phagocytes. *Aquaculture* 229: 67-78.
- Chaves-Pozo, E., P. Muñoz, A. López-Munoz, P. Pelegrín, A. Garcí'a Ayala & V. Mulero. 2005. Early innate immune response and redistribution of inflammatory cells in the bony fish gilthead seabream experimentally infected with *Vibrio anguillarum*. *Cell and Tissue Research* 320: 61-68.
- Chen, L., C. He, P. Baoprasertkul, P. Xu, P. Li & Serapion. 2005. Analysis of a catfish gene resembling interleukin-8: cDNA cloning, gene structure, and expression after infection with *Edwardsiella ictaluri*. *Developmental & Comparative Immunology* 29:135-142.
- Choi, J., H.R.B. Raghavendram, N.Y. Sung, J.H. Kim, B.S. Chun & D.H. Ahn. 2010. Effect of fucoidan on aspirin-induced stomach ulceration in rats. *Chemico-Biological Interactions* 183: 249-254.
- Chollet, L., P. Saboural, C. Chauvierre, J. Villemin, D. Letourneur & F. Chaubet. 2016.

- Chondrou, M.P., D. Mastellos & I.K. Zarkadis. 2006. cDNA cloning and phylogenetic analysis of the sixth complement component in rainbow trout. *Molecular Immunology* 43:1080-10877.
- Chotigeat, W., S. Tongsupa, K. Supamataya, A. Phongdara. 2004. Effect of fucoidan on disease resistance of black tiger shrimp. *Aquaculture* 233:23–30
- Chung, H., J. Jeun, S. Houg, H. Jun, D. Kweon & S. Lee. 2010. Toxicological evaluation of fucoidan from *Undaria pinnatifida* *in vitro* and *in vivo*. *Phytotherapy Research* 24:1078-1083.
- Chu, W.H. & C.P. Lu. 2005. Multiplex PCR assay for the detection of pathogenic *Aeromonas hydrophila*. *J. Fish Disease* 28: 437–441.
- Collazos, M.E., E. Ortega & C. Barriga. 1994. *Fish & Shellfish Immunology* 4(3):231-238
- Cone, R.A. 2009. Barrier properties of mucus. *Advanced Drug Delivery Reviews* 61(2): 75–85.
- Corripio-Miyar, Y., S. Bird, K. Tsamopoulos & C.J. Secombes. 2006. Cloning and expression analysis of two pro-inflammatory cytokines, IL-1beta and IL-8, in haddock (*Melanogrammus aeglefinus*). *Molecular Immunology* 44: 1361-1373.
- Costa, M.M., T. Maehr, P. Diaz-Rosales, C.J. Secombes & T. Wang. 2011. Bioactivity studies of rainbow trout (*Oncorhynchus mykiss*) interleukin-6: Effects on macrophage growth and antimicrobial peptide gene expression. *Molecular Immunology* 48: 1903-1916.
- Cumashi, A., N.A. Ushakova, A. Piccoli. 2007. A comparative study of the anti-inflammatory , anticoagulant , antiangiogenic , and antiadhesive activities of nine different fucoidans from brown seaweeds. *Glycobiology* 17(5):541-552.
- Danwattananusorn, T. 2009. Studies on peptidoglycan induced immune related genes of kuruma shrimp *Marsupenaeus japonicas*. Dissertation. Tokyo University of Marine Science and Technology.
- Daulay, A. H. 2010. Pemanfaatan larva diptera sebagai pakan tambahan pada budidaya ikan lele dumbo dalam upaya efisiensi biaya produksi. *J. Pengabdian Kepada Masyarakat* 16(56) : 1-6.
- Dawes, C. 1981. *Marine botany*. John Willey and Sons, New York.
- Deivasigamani, B & V. Subramanian. 2016. Applications of Immunostimulants in aquaculture: A Review. *International J. Current Microbiology Applied Science* 5(9): 447-453.
- Dinasarapu, A.R., C. Anjana, F. Teizo & S. Shankar. 2013. Mannose/mannan-binding lectin 2:1.
- Dodgson, K.S. & R.G. Price, 1962. A note on the determination of the ester sulphate content of sulphated polysaccharides. *Biochemistry* 84:106-110.
- Dulymamode, R., N. sukho, I. Bhugun. 2001. Evaluation of *Padina boergesenii* (Phaeophyceae) as a bioindicator of heavy metals: some preliminary results from Mauritius. *South African J. of Botany* 67:460-464.
- Dutta, S., B. Sinha, B. Bhattacharya, B. Chatterjee & S. Mazumder. 2005. Characterization of a galactose binding serum lectin from the Indian catfish, *Clarias batrachus*: possible involvement of fish lectins in differential recognition of pathogens. *Comparative Biochemistry Physiology C Toxicology Pharmacology* 141(1): 76–84.
- Easy, R.H. & N. W. Ross. 2009. Changes in atlantic salmon (*Salmo salar*) epidermal mucus protein composition profiles following infection with sea lice (*Lepeophtheirus salmonis*). *Comparative Biochemistry & Physiology Part D* 4(3): 159–167.



RESPON IMUN NON-SPEKIFIK LELE DUMBO (*Clarias sp.*) YANG DIBERI FUCOIDAN DARI RUMPUT LAUT COKELAT

(*Padina sp.*) SECARA ORAL

CAHYONO PURBOMARTONO, Dr.Ir. Alim Isnansetyo, M.Sc

Universitas Gadjah Mada, 2019 | Diunduh dari <http://etd.repository.ugm.ac.id/>

UNIVERSITAS
GADJAH MADA

- Enrig, K. & S. Alban S. 2015. Sulfated galactofucan from the brown alga *Saccharina latissimi*: variability of yield, structural composition and bioactivity. *Marine Drugs* 13:76–101.
- Esteban, M.A. 2012. An Overview of the immunological defenses in fish skin. *ISRN Immunology*.
- Falco, A., I. Brocal, L. Perez, J. M. Coll, A. Estepa & C. Tafalla. 2008. In vivo modulation of the rainbow trout (*Oncorhynchus mykiss*) immune response by the human alpha defensin 1, HNP1. *Fish & Shellfish Immunology* 24: 102-112.
- FAO, 2015. Produksi lele dunia. <http://www.djpb.kkp.go.id/index.php/arsip/c/258/komoditas-andalan-indonesia-masuki-jajaran-produsen-ikan-terbesar-unia/> (diakses 12 september 2018)
- Fast, M.D., S.C. Johnson & S.R. Jones. 2007. Differential expression of the pro-inflammatory cytokines IL-1 β -1, TNF α -1 and IL-8 in vaccinated pink (*Oncorhynchus gorboscha*) and chum (*Oncorhynchus keta*) salmon juveniles. *Fish & Shellfish Immunology* 22: 403-407.
- Figdor, C.G. & A.B. van Sriel. 2010. Fungal pattern-recognition receptors and tetraspanins: partners on antigen-presenting cells. *Trends Immunology* 31: 91-96
- Flannagan, R.S., B. Heit & D.E. Heinrichs. 2015. Antimicrobial mechanisms of macrophages and the immune evasion strategies of *Staphylococcus aureus*. *Pathogens* 4: 826-868
- Foley, S. A., B. Mulloy & M.G. Tuohy. 2011. An unfractionated fucoidan from *Ascophyllum nodosum*: Extraction, characterization, and apoptotic effects in vitro. *J. of Natural Products* 74(9): 1851-1861.
- Fu, Z.F., S.H. Guan & H.B. Liu. 2013. Advances in antitumor activity and structure-activity relationship of fucoidan. *China J. Marine Drugs* 32(4):76-82.
- Fuchs, V.I., J. Schmidt, M.J. Slater, J. Zentek, B.H. Buck, D. Steinhagen D. 2015. The effect of supplementation with polysaccharides, nucleotides, acids, fibers and *Bacillus* strains in fish meal and soy bean based diets on growth performance in juvenile turbot (*Scophthalmus maximus*). *Aquaculture* 437:243-251.
- Gao, L., C. He, X. Liu, H. Su, X. Gao, Y. Li & W. Liu. 2012. The innate immune-related genes in catfish. *International J. Molecular Science* 13: 14172-14202
- Galdiero, M.R., S.K. Biswas & A. Mantovani. 2014. Polarized Activation of macrophages. Springer Science+Business Media New York.
- Geraldino, P.J.L., L.M. Liao & S.M. Boo. 2005. Morphological study of the marine algal genus *Padina* (Dictyotales, Phaeophyceae) from southern Philippines: 3 Species new to Philippines. *Algae* 20 (2): 99-112.
- Gerasimenko, N.I., N.G. Busarova & O.P. Moiseenko. 2010. Seasonal changes in the content of lipids, fatty acids, and pigments in brown alga *Costaria costata*. *Russian J. Plant Physiology* 57 (2): 205-211.
- Goecke, F., M. Escobar, G. Collantes. 2012. Chemical composition of *Padina fernandeziana* (Phaeophyceae, Dictyotales) from Juan Fernandez Archipelago, Chile *Rev Latinoam Biotecnol Amb. Algal* 3(2):95-104.
- Gonzalez, S.F., K. Buchmann & M. E. Nielsen. 2007. Realtime gene expression analysis in carp (*Cyprinus carpio* L.) skin: inflammatory responses caused by the ectoparasite *Ichthyophthirius multifiliis*. *Fish & Shellfish Immunology* 22(6): 641–650.
- Gora, A.H., S. Sahoo, S. Rehman, I. Ahmad. 2018. Metabolic and haematological responses of *Labeo rohita* to dietary fucoidan. *J Applied Animal Research* ISSN. 46(1):1042-1050.



UNIVERSITAS
GADJAH MADA
Gury, M.D.

RESPON IMUN NON-SPEKIFIK LELE DUMBO (*Clarias sp.*) YANG DIBERI FUCOIDAN DARI RUMPUT LAUT COKELAT

(*Padina sp.*) SECARA ORAL

CAHYONO PURBOMARTONO, Dr.Ir. Alim Isnansetyo, M.Sc

Universitas Gadjah Mada, 2019 | Diunduh dari <http://etd.repository.ugm.ac.id/>

Gury, M.D. & G.M. Guiry. 2018. *AlgaeBase*. World-wide electronic publication. National University of Ireland, Galway. <http://www.algaebase.org>; searched on 29 September 2018.

- Haryani, A., R. Grandiosa, I.D. Buwono & A. Santika. 2012. Uji efektivitas daun pepaya (*Carica papaya*) untuk pengobatan infeksi bakteri *A. hydrophila* pada ikan mas koki (*Carassius auratus*). *J. Perikanan dan Kelautan* 3(3): 213-220.
- Hastuti, S. & Subandiyono. 2014. Performa produksi ikan lele dumbo (*Clarias gariepinus*, Burch) yang dipelihara dengan teknologi bioflok. *J. Saintek Perikanan* 10(1): 37-42.
- Hastuti, S.D. 2012. Suplementasi β -glucan dari ragi roti (*Saccharomyces cerevisiae*) dalam pakan terhadap aktivitas fagositosis, aktivitas NBT, total protein plasma dan aktivitas aglutinasi darah ikan nila (*Oreochromis niloticus*). *Depik* 1(3): 149-155.
- Haugarvoll, E., J. Thorsen, M. Lanne, Q. Huang & E.O. Koppang. 2006. Melanogenesis and evidence for melanosome transport to the plasma membrane in a CD83 β teleost leukocyte cell line. *Pigment Cell Research* 19: 214-225.
- Hayashi, K., T. Nakano, M. Hashimoto, K. Kanekiyo & T. Hayashi. 2008. Defensive effects of a fucoidan from brown alga *Undaria pinnatifida* against herpes simplex virus infection. *International Immunopharmacology* 8:109-116.
- Hegazi, M.M.I., A.P. Ruzafa, L. Almela & M.E. Candela. 1998. Separation and identification of chlorophylls and carotenoids from *Caulerpa prolifera*, *Jania rubens* and *Padina pavonica* by reversed-phase high-performance liquid chromatography. *J. Chromatography A*. 829: 153-159.
- Hemmingson, J.A., R. Falshow, R.H. Furneaux & K. Thompsom. 2006. Structure and antiviral activity of the galactofucans sulfates extracted from *Undaria pinnatifida* (Phaeophyta). *J. Appl. Phycol.* 18: 185–193.
- Hernández, A.J., A. Romero, R.G. Stegmaier, P. Dantagnan. 2016. The effects of supplemented diets with a phytopharmaceutical preparation from herbal and macroalgal origin on disease resistance in rainbow trout against *Piscirickettsia salmonis*. *Aquaculture* 454:109–117.
- Hernawati, R., Triyanto & Murwantoko. 2013. Studi pengaruh karboksimetil kitosan terhadap sistem pertahanan tubuh non-spesifik pada Ikan mas (*Cyprinus carpio*). *J. Sain Veteriner* 31(1): 67.
- Hodgkinson, J.W., L. Grayfer & M. Belosevic. 2015. Biology of bony fish macrophages. 881-906.
- Hosokawa, H. & J. Galindo-Villegas. 2004. Immunostimulants: towards temporary prevention of diseases in marine fish.
- Hosono, M., S. Sugawara, Y. Ogawa, T. Kohno, M. Takayanagi & K. Nitta. 2005. Purification, characterization, cDNA cloning, and expression of asialofetuin-binding C-type lectin from eggs of shishamo smelt (*Osmerus [Spirinchus] lanceolatus*). *Biochimica et Biophysica Acta* 1725:160-173.
- Huttenhuis, H.B., C.P. Grou, A.J. Taverne-Thiele, N. Taverne & J.H. Rombout. 2006. Carp (*Cyprinus carpio* L.) innate immune factors are present before hatching. *Fish & Shellfish Immunology* 20:586–596.
- Huynh, T.G., S.T. Yeh,, Y.C. Lin, J.F. Shyu, L.L. Chen, J.C. Chen. 2011. White shrimp *Litopenaeus vannamei* immersed in seawater containing *Sargassum hemiphyllum* var. chinense powder and its extract showed increased immunity and resistance against *Vibrio alginolyticus* and white spot syndrome virus. *Fish & Shellfish Immunology* 31: 286-293.



UNIVERSITAS
GADJAH MADA

RESPON IMUN NON-SPEKIFIK LELE DUMBO (*Clarias sp.*) YANG DIBERI FUCOIDAN DARI RUMPUT LAUT COKELAT

(*Padina sp.*) SECARA ORAL

CAHYONO PURBOMARTONO, Dr.Ir. Alim Isnansetyo, M.Sc

Universitas Gadjah Mada, 2019 | Diunduh dari <http://etd.repository.ugm.ac.id/>

- Igawa, D., M. Sakai & R. Savan. 2006. An unexpected discovery of two interferon gamma-like genes along with interleukin (IL)-22 and -26 from teleost: IL-22 and -26 genes have been described for the first time outside mammals. *Molecular Immunology* 43: 999-1009.
- Immanuel, G., M. Sivagnanavelmurugan, B.J. Thaddaeus & A. Palavesam. 2014. Dietary effect of *Sargassum wightii* fucoidan to enhance growth, prophenoloxidase gene expression of *Penaeus monodon* and immune resistance to *Vibrio parahaemolyticus*. *Fish & Shellfish Immunology* 39:439-449.
- Immanuel, G., M. Sivagnanavelmurugan, T. Marudhupandi, S. Radhakrishnan & A. Palavesam. 2012. The effect of fucoidan from brown seaweed *Sargassum wightii* on WSSV resistance and immune activity in shrimp *Penaeus monodon* (Fab). *Fish & Shellfish Immunology* 32(4):551-564.
- Inoue, Y., S. Kamota, K. Ito, Y. Yoshiura, M. Ototake & T. Moritomo. 2005. Molecular cloning and expression analysis of rainbow trout (*Oncorhynchus mykiss*) interleukin-10 cDNAs. *Fish & Shellfish Immunology* 18:335-344.
- Ighodaro, O.M. & O.A. Akinloye. 2017. First line defense antioxidants-superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GPX): Their fundamental role in the entire antioxidant defense grid. *Alexandria J. of Medicine*. In press.
- Irianto, A. 2005. Patologi ikan teleostei. Yogyakarta : Gajah Mada Universitas Press. 256 hlm.
- Isnansetyo, A., A. Fikriyah, N. Kasanah & Murwantoko. 2016. Non-specific immune potentiating activity of fucoidan from a tropical brown algae (Phaeophyceae), *Sargassum cristaefolium* in tilapia (*Oreochromis niloticus*). *Aquaculture International*.
- Isnansetyo, A., N.L. Fadilah, N. Muhammad, Trijoko & A.S. Ratna. 2017. Cytotoxicity of fucoidan from three tropical brown algae against breast and colon cancer cell lines. *Pharmacognosy J.* 9(1): 14-20.
- Jin, J. & Q. Yu. 2014. Fucoidan delays apoptosis and induces pro-inflammatory cytokine production in human neutrophils. *Int. J. Biology Macromolecule* 73C:65-71.
- Ji C, de Zhang F., A.H. Li & X.N. Gong. 2012. Effect of berberine hydrochloride on grass carp *Ctenopharyngodon idella* serum bactericidal activity against *Edwardsiella ichtaluri*. *Fish & Shellfish Immunology* 33:143-145.
- Kanagarajeevitha, J. Damahe, S. Das, T. R. Chowdhury & S.S. Khora. 2014. *In Vitro* Antioxidant and Cytotoxic activity of Brown Alga *Padina boergesenii*. *International J. Drug Development & Research* 6 (2): 110-119
- Kania, P.W., R.R. Sorensen, C. Koch, J. Brandt, A. Kliem, L. Vitved, S. Hansen & K. Skjodt. 2010. Evolutionary conservation of mannan-binding lectin (MBL) in bony fish: Identification, characterization and expression analysis of three bona fide collectin homologues of MBL in the rainbow trout (*Onchorhynchus mykiss*). *Fish & Shellfish Immunology* 29: 910-920.
- Karthikeyan, R., S.T. Somasundaram, T. Manivasagam, T. Balasubramanian, P. Anantharaman. 2010. Hepatoprotective activity of brown alga *Padina boergesenii* against CCl₄ induced oxidative damage in Wistar rats. *Asian Pacific J. of Tropical Medicine* 696-701.
- Kato, Y., M. Nakao, M. Shimizu, H. Warishi & T. Yano. 2004. Purification and functional assessment of C3a, C4a and C5a of the common carp (*Cyprinus carpio*) complement. *Developmental & Comparative Immunology* 28: 901-910.



UNIVERSITAS
GADJAH MADA

KEMENTERIAN

RESPON IMUN NON-SPEKIFIK LELE DUMBO (*Clarias sp.*) YANG DIBERI FUCOIDAN DARI RUMPUT LAUT COKELAT

(*Padina sp.*) SECARA ORAL

CAHYONO PURBOMARTONO, Dr.Ir. Alim Isnansetyo, M.Sc

Universitas Gadjah Mada, 2019 | Diunduh dari <http://etd.repository.ugm.ac.id/>

Kelautan & Perikanan. 2017. Program lele bioflok. <https://kkp.go.id/djpb/artikel/3113-subsektor-perikanan-budidaya-sepanjang-tahun-2017-menunjukkan-kinerja-positif> (Diakses 12 September 2018).

Kerrigan, A.M. & G.D. Brown. 2009. C-type lectins and phagocytosis. *Immunology* (Online) 214(7): 562-75. www.ncbi.nlm.nih.gov. Diakses 30 Nopember 2013.

Khairuman, Sihombing & A. Khairul. 2008. *Budidaya lele dumbo di kolam terpal*. Agomedia Pustaka. Jakarta.

Kim, K.W., S.S. Kim, Khosravi, S. Rahimnejad & K.J. Lee. 2014. Evaluation of *Sargassum fusiforme* and *Ecklonia cava* as dietary additives for olive flounder (*Paralichthys olivaceus*). *Turkish J. of Fisheries & Aquatic Sciences* 14: 321-330.

Kim, E.J., S.Y. Park, Y.J. Lee & J.H.Y. Park. 2010. Fucoidan present in brown algae induces apoptosis of human colon cancer cells. *BMC Gastroenterology* 10:96.

Kim, W.J., H.G. Kim, H.R. Oh, K.B. Lee, Y.K. Lee & Y.I. Park. 2007. Purification and anticoagulant activity of a fucoidan from Korean *Undaria pinnatifida* sporophyll. *Algae* 22(3):247-252.

Kima, M.H. & H.G. Joo. 2008. Immunostimulatory effects of fucoidan on bone marrow derived dendritic cells. *Immunology Letters* 115: 138-143.

Klein, N.J. 2005. Mannose-binding lectin: do we need it. *Molecular Immunology* 42: 919-24.

Kollner, B., B. Wasserrab, G. Kotterba & U. Fishcer. 2002. Evaluation of immune functions of rainbow trout (*Oncorhynchus mykiss*), how can environmental influences be detected. *Toxicology Letters* 131: 83-95.

Koppang, E.O., U. Fischer, L. Moore, M.A. Tranulis, J.M. Dijkstra, B. Kollner, L. Aune, E. Jirillo & I. Hordvik. 2010. Salmonid T cells assemble in the thymus, spleen and in novel interbranchial lymphoid tissue. *J. Anatomy* 217: 728-739.

Kurita, O., T. Fujiwara & E. Yamazaki. 2008. Characterization of The pectin extracted from citrus peel in the presence of citric acid. *Carbohydrate Polymers* 74:725-730.

Kusdarwati, R., Kismiyati, H.K. Sudarno & Y.T.P. 2017. Isolation and Identification of *Aeromonas hydrophila* and *Saprolegnia* sp on catfish (*Clarias gariepinus*) in floating cages in bozem moro Krembangan Surabaya . IOP Conference Serial Earth Environment Science.

Kwak, J.Y. 2014. Fucoidan as a marine anticancer agent in preclinical development. *Marine Drugs* 12: 851-870.

Kylin, H. 1913. Biochemistry of sea algae. *H. Z. Physiology Chemistry* 83: 171-197.

Laing, K.J. & C.J. Secombes. 2004. Chemokines. *Developmental & Comparative Immunology* 28: 443-460.

Lange, S., S.H. Bambir, A.W. Dodds, T. Bowden, I. Bricknell & S. Espelid. 2006. Complement component C3 transcription in Atlantic halibut (*Hippoglossus hippoglossus* L.) larvae. *Fish & Shellfish Immunology* 20:285-294.

Lange, S., S. Bambir, A.W. Dodds & B. Magnadottir. 2004. An immunohistochemical study on complement component C3 in juvenile Atlantic halibut (*Hippoglossus hippoglossus* L.). *Developmental & Comparative Immunology* 28:593-601.

Lee, M. C., Y. C. Chen & T. C. Peng. 2012. Two-stage culture method for optimized polysaccharide production in *Spirulina platensis*. *J. of the Science of Food & Agriculture* 92:1562-1569.

Lei, G., C. He, X. Liu, H. Su, X. Gao, Y. Li & W. Liu. 2012. The innate immune-related genes in catfish. *Int. J. Molecular Science* 13: 14172-14202.



UNIVERSITAS
GADJAH MADA

RESPON IMUN NON-SPEKIFIK LELE DUMBO (*Clarias sp.*) YANG DIBERI FUCOIDAN DARI RUMPUT LAUT COKELAT

(*Padina sp.*) SECARA ORAL

CAHYONO PURBOMARTONO, Dr.Ir. Alim Isnansetyo, M.Sc

Universitas Gadjah Mada, 2019 | Diunduh dari <http://etd.repository.ugm.ac.id/>

- Lesmanawati, W. 2006. Potensi mahkota dewa *Phaleria macrocarpa* sebagai antibakteri dan imunostimulan pada ikan patin *Pangasius hypophthalmus*.
- Li, B., F. Lu, X. Wei & R. Zhao. 2008. Fucoidan: Structure and Bioactivity. 1671-1695.
- Li, J.H., J.Z. Shao, L.X. Xiang & Y. Wen. 2007. Cloning, characterization and expression analysis of pufferfish interleukin-4 cDNA: the first evidence of Th2-type cytokine in fish. *Molecular Immunology* 44: 2078–2086.
- Li, B., X.J. Wei, L. Zhao & H. Zhang. 2006. Structure of fucoidan and the relationship between activity and structure. *Natural Product Research Development* 18:1052-1056.
- Li, J., R. Peters, S. Lapatra, M. Vazzana & J.O. Sunyer. 2004. Anaphylatoxin-like molecules generated during complement activation induce a dramatic enhancement of particle uptake in rainbow trout phagocytes. *Developmental & Comparative Immunology* 28:1005-1021.
- Linn, B. 2007. Immunostimulants connecting innate and adaptive immunity in Atlantic salmon (*Salmo salar*). Master Thesis in Biology. Department of Marine Biotechnology Norwegian College of Fishery Science University of Tromso.
- Littler D.S. & M.M. Littler. 2003. South pacific reef plants. A diver's guide to the plant life of south pacific coral reefs. Offshore Graphic Inc., Washington DC.
- Lu, A., X. Hua, J. Xue, J. Zhu, Y. Wang & G. Zhou. 2012. Gene expression profiling in the skin of zebrafish infected with *Citrobacter freundii*. *Fish & Shellfish Immunology* 32(2): 273–283.
- Lukisetyowati, I. & Kurniasih. 2011. Kelangsungan hidup ikan mas (*Cyprinus carpio*) yang diberi pakan ekstrak bawang putih (*Alium sativum*) dan diinfeksi *A. hydrophila*. *J. Perikanan & Kelautan* 16(1):144-160.
- Lutfia, F.N. 2015. Karakterisasi dan uji aktivitas sitotoksik fucoidan dari alga cokelat *Sargassum cristaefolium*, *Turbinaria conoides* dan *Padina fraseri* terhadap sel kanker kolon WiDr, sel kanker payudara MCF-7 dan sel normal vero. Tesis. UGM Yogyakarta.
- Maftuch & S. Dalimunthe. 2013. Penyakit hewan akuakultur. Malang: UB Press.
- Magnadottir, B. 2006. Innate immunity of fish (overview). *Fish & Shellfish Immunology* 20:137-151.
- Maier, V.H., K. V. Dorn, B. K. Gudmundsdottir & G. H. Gudmundsson. 2008. Characterisation of cathelicidin gene family members in divergent fish species. *Molecular Immunology* 45(14):3723–3730.
- Mak, W., N. Hamida, T. Liua, J. Lu & W.L. White. 2013. Fucoidan from New Zealand *Undaria pinnatifida*: monthly variations and determination of antioxidant activities. *Carbohydrate Polymers* 95:606– 614.
- Mak, W.W.F. 2012. Extraction, characterization and antioxidant activity of fucoidan from New Zealand *Undaria pinnatifida* (Harvey) Suringar. Master Degree Thesis.104.
- Malle, D., E.G. Fransina & F. Jansen. 2014. Ekstraksi dan identifikasi polisakarida bersulfat dari sayur karang *Gracilaria sp.* *Indonesia J. Chememical Research* 1:83-87.
- Manivannan, K., K. Devi, G. Thirumaran & P. Anantharaman. 2009. Mineral composition of marine macroalge from Mandapam coastal regions; Southeast coast of India. *Am-Euras J. Botany* 2:42-51.
- Manoppo, H., Sukenda, D. Djokosetiyanto, M.F. Sukadi & E. Harris. 2011. Peningkatan respons imun non-spesifik, resistensi, dan pertumbuhan udang vaname (*Litopenaeus vannamei*) melalui pemberian pakan nukleotida. *J. Akuakultur Indonesia* 10(1): 1–7.



UNIVERSITAS
GADJAH MADA

RESPON IMUN NON-SPEKIFIK LELE DUMBO (*Clarias sp.*) YANG DIBERI FUCOIDAN DARI RUMPUT LAUT COKELAT

(*Padina sp.*) SECARA ORAL

CAHYONO PURBOMARTONO, Dr.Ir. Alim Isnansetyo, M.Sc

Universitas Gadjah Mada, 2019 | Diunduh dari <http://etd.repository.ugm.ac.id/>

- Marel, M., M. Adamek, S.F. Gonzalez, P. Frost, J.H. Rombout, G.F. Wiegertjes, H.F. Savelkoul & U.D. Steinhagen. 2012. Molecular cloning and expression of two beta-defensin and two mucin genes in common carp (*Cyprinus carpio* L.) and their up-regulation after beta-glucan feeding. *Fish & Shellfish Immunology* 32: 494-501.
- Marina, S. P. Emokey, N. Mihaela, V. Aurel, B.G. Florinel, C.C. Gheorghe, N. Vlad, V. Constantin, S. Popescu, S. C. Dana, 2017. Seasonal Changes of Phagocytic Activity Enhanced by an Acoholic Mint Extract in Cultured Rainbow Trout. *Indian Journal of Pharmaceutical Education and Research* 52(4)
- Marudhupandi, T., T. Kumar, S. Lakshmanasenthil, G. Suja & T. Vinothkumar. 2014. Invitro anticancer activity of fucoidan from *Turbinaria conoides* against A549 cell lines. *International J. of Biological Macromolecule* 72:919-923.
- Maruyama, H., H. Tamauchib, M. Iizuka & T. Nakano. 2006. The role of NK cells in antitumor activity of dietary fucoidan from *Undaria pinnatifida* sporophylls (Mekabu). *Planta Medicine* 72:1415-1417.
- Mastan, S.A. 2015. Use of immunostimulants in aquaculture disease management. 2(4):277-280.
- Masuko, T., A. Minami, N. Iwasaki, T. Majima, S. Nishimura & Y. Lee. 2005. Carbohydrate analysis by a phenol sulfuric acid method in microplate. *Analytical Biochemistry* 339: 69-72.
- Matsushita, M., A. Matsushita & Y. Endo. 2004. Origin of the classical complement pathway: lamprey orthologue of mammalian C1q acts as a lectin. *Proceedings of the National Academy of Sciences of the United States of America* 101(27): 10127-10131.
- Mogensen, T.H. & S.R. Paludan. 2005. Reading the viral signature by toll-like receptors and other pattern recognition receptors. *J. Molecular. Medicine* 83:180-192.
- Modra, H., Z. Svobodova & J. Kolarova. 1998. Comparison of differential leukocyte counts in fish of economic and indicator importance. *Acta Veteriner* 67: 215-226.
- Mulero, I., E. J. Noga, J. Meseguer, A. Garcia-Ayala & V. Mulero. 2008. The antimicrobial peptides piscidins are stored in the granules of professional phagocytic granulocytes of fish and are delivered to the bacteria-containing phagosome upon phagocytosis. *Developmental & Comparative Immunology* 32: 1531-1538.
- Mulero, I., A. Garcia-Ayala, J. Meseguer & V. Mulero. 2007. Maternal transfer of immunity and ontogeny of autologous immunocompetence of fish: A mini review. *Aquaculture* 268: 244-250.
- Mulia, D.S., S. Wahyuningsih, H. Maryanto & C. Purbomartono. 2015. Uji lapang pakan bervaksin *Aeromonas hydrophila* pada lele dumbo di daerah Cilacap. *Techno* 16(2): 85-97.
- Na, Y. Seul, J.W. Kim, S. Kim, J. Park, S. Lee S, S. Kim, A. Synytsya & Y. Park. 2010. Purification, characterization and immunostimulating activity of water soluble polysaccharides isolated from *Capsosiphon fulvescen*. *International Immunopharmacology* 10:364-370.
- Nakao, M., T. Kajiya, Y. Sato, T. Somamoto, Y.K. Unoki, M. Matsushita, M. Nakata, T. Fujita & T. Yano. 2013. Lectin pathway of bony fish complement: Identification of two homologs of the mannose-binding lectin associated with MASP2 in the common carp (*Cyprinus carpio*). *J. Immunology* 177:5471-5479.
- Nawi, F. & M.Z. Saad. 2016. Major components of fish immunity: A review. *Pertanika J. Tropical Agriculture Science* 39(4):393-420.
- Nikoskelainen, S., S. Verho, S. Jarvinen, J. Madetoja, T. Wiklund & E.M. Lilius. 2007. Multiple whole bacterial antigens in polyvalent vaccine may result in inhibition of specific

- Nikolakopoulou, K. & I.K. Zarkadis. 2006. Molecular cloning and characterisation of two homologues of mannose-binding lectin in rainbow trout. *Fish & Shellfish Immunology* 21: 305-314.
- Nishino, T., Y. Aizu & T. Nagumo. 1991. The influence of sulfate content and molecular weight of a fucan sulfate from the brown seaweed *Ecklonia kurome* on its antithrombin activity. *Thrombosis Research* 64: 723-731.
- Nugrahajati, P., Wargiyanto, & M. Krisnawati. 2013. *Rahasia Sukses Bisnis Dan Budidaya Lele Unggulan*. Yogyakarta : Lily Publisher.
- Nurjannah, R.D.D., S.B. Prayitno & A.M. Lusiastuti. 2013. Pengaruh ekstrak daun sirsak (*Annona muricata*) terhadap profil darah dan kelulushidupan ikan mas (*Cyprinus carpio*) yang diinfeksi bakteri *Aeromonas hydrophila*. *J. Aquaculture Management Technology* 2(4):72-83.
- Ode, I. dan J. Wasahua. 2014. Jenis-jenis alga cokelat potensial di perairan pantai desa Hutumuri Pulau Ambon. *J. Ilmiah agribisnis & Perikanan* 7(2).
- Olsen, M.M., P.W. Kania, R.D. Heinecke, K. Skjoedt, K.J. Rasmussen & K. Buchmann. 2011. Cellular and humoral factors involved in the response of rainbow trout gills to *Ichthyophthirius multifiliis* infections: Molecular and immunohistochemical studies. *Fish & Shellfish Immunology* 30: 859-869.
- O'Neill, A.N. 1954. Degradative studies on fucoidan. *J. American Chemical Society* 76: 5074-5076.
- Palaksha, K.J., G.W. Shin, Y. R. Kim & T. S. Jung. 2008. Evaluation of non-specific immune components from the skin mucus of olive flounder (*Paralichthys olivaceus*). *Fish & Shellfish Immunology* 24(4): 479-488.
- Pali, D., C.B. Andreasen, D.F. Frank, B.M. Menzel & J.A. Roth. 2005. Gradient separation and cytochemical characterisation of neutrophils from kidney of fathead minnow (*Pimephales promelas* Rafinesque, 1820). *Fish & Shellfish Immunology* 18: 263-267.
- Papanastasiou, A.D. & I.K. Zarkadis. 2006. The gamma subunit of the eighth complement component (C8) in rainbow trout. *Developmental & Comparative Immunology* 30:485-491.
- Park, C.I., I. Hirono & T. Aoki. 2005. Molecular characterization of the Japanese flounder *Paralichthys olivaceus* CD33 and evolution of the CD3 cluster. *Developmental & Comparative Immunology* 29: 123-133.
- Patankar, M. S., S. Oehninger & T. Barnett. 1993. A revised structure for fucoidan may explain some of its biological activities. *J. Biol. Chem.* 268: 21770-21776.
- Pereira, L. 2011. A review of the nutrient composition of selected edible seaweeds. *In: Seaweed*, edited by Pomin V.H., Nova Science Publishers, Inc., New York 15-47.
- Petry, V. & A. Gaspari. 2006. Toll-like receptors and dermatology. *International J. of Dermatology* 558-570.
- Pham, M.A., K.J. Lee, B.J. Lee, S. Lim, S. Kim, Y.D. Lee, M.S. Heo & K.W. Lee. 2006. Effects of dietary *Hizikia fusiformis* on growth and immune responses in juvenile Olive Flounder (*Paralichthys olivaceus*). *Asian-Australia J. Animal Science* 12 : 1769-1775.
- Pinheiro, A.C., A.I. Bourbon, M.A. Cerqueira, E. Maricato, C. Nunes, M.A. Coimbra & A.A. Vicente. 2015. Chitosan/fucoidan multilayer nanocapsules as a vehicle for controlled release of bioactive compounds. *Carbohydrate Polymers* 115:1-9.



RESPON IMUN NON-SPEKIFIK LELE DUMBO (*Clarias sp.*) YANG DIBERI FUCOIDAN DARI RUMPUT LAUT COKELAT

(*Padina sp.*) SECARA ORAL

CAHYONO PURBOMARTONO, Dr.Ir. Alim Isnansetyo, M.Sc

Universitas Gadjah Mada, 2019 | Diunduh dari <http://etd.repository.ugm.ac.id/>

UNIVERSITAS
GADJAH MADA

- Plouffe, D.A., P.C. Hanington, J.G. Walsh, E.C. Wilson & M. Belosevic. 2006. Comparison of select innate immune mechanisms of fish and mammals. *Xenotrans Plantation* 12: 266-277.
- Ponce, N.M., C.A. Pujol, E.B. Damonte, M.L. Flores & C.A. Stortz. 2003. Fucoidans from the brown seaweed *Adenocystis utricularis*: Extraction methods, antiviral activity and structural studies. *Carbohydr. Res.* 338:153-165.
- Prabu, D.L., N.P. Sahu, A.K. Pal, S. Dasgupta & A. Narendra. 2014. Immunomodulation and interferon gamma gene expression in sutchi cat fish, *Pangasianodon hypophthalmus*: Effect of dietary fucoidan rich seaweed extract (FRSE) on pre and post challenge period. *Aquaculture Research* 1–20.
- Pretsch, Erno, P. Bulhman & M. Badertscher. 2009. Structure determination of organic compounds, tables of spectral data. Berlin Springer.
- Przybylska, D.A. 2012. Mucosal immune response in common carp (*Cyprinus carpio* L.) host pathogen interactions in relation to β -glucan stimulation. PhD thesis National Food Institute Biological Quality Research Group Technical University of Denmark.
- Qiu, L., H. Zhang & K. Yang. 2009. Molecular cloning and mRNA expression analysis of interleukin-8 gene in Japanese sea perch (*Lateolabrax japonicus*). *Molecular Biology Reports* 36: 1099-105.
- Rachmat, R., T. Murniasih, A. Rasyid & F. Untari. 1999. Penelitian produk alam laut uji anti degeneratif alga laut. Puslitbang Oseanologi LIPI, Jakarta.
- Rairakhwada, A.K. Dina, Z.P. Pal, N.P. Bhatena, A. Sahu, Jha & S.C. Mukherjee. 2007. Dietary microbial levan enhances cellular non-specific immunity and survival of common carp (*Cyprinus carpio*) juveniles. *Fish & Shellfish Immunology* 22: 477-486.
- Rajamani, K., T. Balasubramanian, S. S Thirugnanasambandan. 2018. Bioassay-guided isolation of triterpene from brown alga *Padina boergesenii* possess anti-inflammatory and anti-angiogenic potential with kinetic inhibition of β -carotene linoleate system. *LWT - Food Science & Technology* 93:549–555
- Rajendran, P., A.S. Parasuraman & M. Dinakaran. 2016. Polysaccharides from marine macroalga, *Padina gymnospora* improve the non-specific and specific immune responses of *Cyprinus carpio* and protect it from different pathogens. *Fish & Shellfish Immunology* 58:220-228.
- Rakers, S., M. Gebert, S. Uppalapati, W. Meyer, P. Maderson, A.F. Sell, C. Kruse & R. Paus. 2010. Fish matters: the relevance of fish skin biology to investigative dermatology. *Experimental Dermatology* 19: 313-324.
- Rani V. 2014. Biodiversity and immunomodulatory properties of brown seaweeds of gulf. 11001:1-190.
- Ranjam, P., J.B. Bowzard, J.W. Schwerzmann, V. Jeisy-Scott, T. Fujita & S. Sambhara. 2009. Cytoplasmic nucleic acid sensors in antiviral immunity. *Trends Molecular Medicine* 15:359-368.
- Reverter, M., N.T. Bontemps, D. Lecchini, B. Banaigs & P. Sasal. 2018. Biological and Ecological Roles of External Fish Mucus: A Review. *Fishes* 3 (41)
- Rioux, L.E., S.L. Turgeon & M. Beaulieu. 2007. Characterization of polysaccharides extracted from brown seaweeds. *Carbohydrate Polymers* 69: 530-537.
- Robert, R.J., 2012. *Fish Pathology*. Wiley-Blackwell, Iowa.
- Roshanfekar, R., M.R. Tabande & M. Alishahi. 2014. Investigation of the bacterial effects of *Aeromonas hydrophila* along with Freund adjuvant on the expression of lysozyme-c

gene in common carp (*Cyprinus carpio*). International J. of Biosciences 4(12): 314-322.

- Russell, S. & J.S. Lumsden. 2005. Function and heterogeneity of fish lectins. Veterinary Immunology & Immunopathology 108:111-120.
- Rustidja. 2004. Pembenihan ikan-ikan tropis. Fakultas Perikanan Universitas Brawidjaya Malang. Malang.
- Saanin. 1984. Taksonomi dan kunci identifikasi ikan volume I dan II. Bina Rupa Aksara. Jakarta.
- Sakai, M., K. Taniguchi, K. Mamoto, H. Ogawa, M. Tabata. 2001. Immunostimulant effects of nucleotide isolated from yeast RNA on crap, *Cyprinus carpio* L. J. Fish Disease 24: 433-438.
- Salerno, G., N. Parrinello, P. Roch & M. Cammarata. 2007. cDNA sequence and tissue expression of an antimicrobial peptide, dicentracin; a new component of the morone cidin family isolated from head kidney leukocytes of sea bass, *Dicentrarchus labrax*. Comparative Biochemistry Physiology B Biochemistry Molecular Biology 146: 521-529.
- Sarathi, M., V.P.I. Ahmed, C. Venkatesan, G. Balasubramanian, J. Prabavathy & A.S.S. Hameed. 2007. Comparative study on immune response of *Fenneropenaeus indicus* to *Vibrio alginolyticus* and white spot syndrome virus. Aquaculture 271:8-20.
- Savan, R., T. Kono, D. Igawa & M. Sakai. 2005. A novel tumor necrosis factor (TNF) gene present in tandem with the TNF-alpha gene on the same chromosome in teleosts. Immunogenetics 57:140-150.
- Seppola, M., A.N., Larsen, K. Steiro, B. Robertsen & I. Jensen. 2008. Characterisation and expression analysis of the interleukin genes, IL-1 β , IL-8 and IL-10, in Atlantic cod (*Gadus morhua* L.). Molecular Immunology 45: 887-897.
- Setyawan, A., A. Isnansetyo A., Murwantoko, S. Indarjulianto & C.R. Handayani, 2018. Comparative immune response of dietary fucoidan from three Indonesian brown algae in white shrimp *Litopenaeus vannamei*. AACL Bioflux 11(6): 1707-1723
- Shetty, N., J.W. Tang & J. Andrews. 2009. Infectious disease: pathogenesis, prevention, and case studies. John Wiley & Sons Ltd. London.
- Shimei, L., P. Yu, L. Lin & L. Li. 2011. Effects of dietary β -1,3-glucan, chitosan or raffinose on the growth, innate immunity and resistance of koi (*Cyprinus carpio koi*). Fish & Shellfish Immunology 31:788-94.
- Shimizu, J., U. Wada-Funada, H. Mano, Y. Matahira, M. Kawaguchi & M. Wada. 2005. Proportion of murine cytotoxic T cells is increased by high molecular-weight fucoidan extracted from *Okinawa mozuku* (*Cladosiphon okamuranus*). J. Health Science 51: 394-397.
- Sinurat, E. dan R. Kusumawati. 2017. Optimasi metode ekstraksi fucoidan kasar dari rumput laut cokelat *Sargassum binderi* Sonder. JPB Kelautan & Perikanan 12 (2): 125-134.
- Sinurat, E. & R. Peranginangin. 2015. Purification and characterization of fucoidan from brown seaweed *Sargassum binderi* sonder. Squalen Bulletin of Marine & Fisheries Postharvest & Biotechnology 10(2):79-87.
- Song, J.W., J.W. Jang, S.S. Kim, D.H. Oh, J.H. Cha & K.J. Lee. 2012. Effect of dietary supplementation with alga (*Hizikia fusiformis* and *Ecklonia cava*) on the non-specific immune responses of parrot fish *Oplegnathus fasciatus*. Korean J. of Fisheries & Aquatic Sciences 44:332-338.
- Sritunyalucksana, K., P. Sithisarn, B. Withayachumnarnkul & T.W. Flegel. 1999. Activation of

pro-PO, agglutinin and antibacterial activity in haemolymph of the black tiger prawn by immunostimulant. *Fish & Shellfish Immunology* 9: 21-30.

- Srivastava, P.K. & A.K. Pandey. 2015. Role of immunostimulant in immune responses of fish and shellfish. *Biochemistry Cell Arch* 15:47-73.
- Stratev, D., H. Daskalov & I. Vashin. 2015. Characterisation and determination of antimicrobial resistance of β -haemolytic *Aeromonas* spp. isolated from common carp (*Cyprinus carpio* L.). *Revue Médical Vétérinaire* 166(1-2): 54-61.
- Synytsya, A., W.J. Kim, S.M. Kim, I.R. Poh, F. Kvasnicka, J. Copikova & Y.I. Park. 2010. Structure & antitumour activity of fucoidan isolated from sporophyll of Korean brown seaweed *Undaria pinnatifida*. *Carbohydrate Polymers* 81(1):41-8.
- Takahashi, J.B. & E.C. Urbinati. 2014. Fish Immunology. The modification and manipulation of the innate immune system: Brazilian studies *An Acad Bras Cienc* 86(3).
- Takahashi, K., N. Okamoto, M. Maita, J.S. Rohovec & Y. Ikeda. 1992. Progression of erythrocytic inclusion body syndrome in artificially infected coho salmon. *Fish Pathology* 27:89-95.
- Tasumi, S., W.J. Yang, T. Usami, S. Tsutsui, T. Ohira, I. Kawazoe, M.N. Wilder, K. Aida & Y. Suzuki. 2004. Characteristic and primary structure of a galectin in the skin mucus of the Japanese eel (*Anguilla japonica*). *Development Comparative Immunology* 28: 325-335.
- Teruya, T., H. Takemoto, T. Konishi & Tako. 2009. Structural characteristics and in vitro macrophage activation of acetyl fucoidan from *Cladosiphon okamuranus*. *Glycoconjugate J.* 26:1019-1028.
- Traifalgar, R.F., H. Kira, T.H. Thanh, M.F. Raafat, A. Laining. 2010. Influence of dietary fucoidan supplementation on growth and immunological response of juvenile *Marsupenaeus japonicus*. *Journal of the World Aquaculture Society* 41: 235-244.
- Traifalgar, F.R., A.E. Serrano, V. Corre, H. Kira, H.T. Tung, F.R. Michael, M.A. Kader, A. Laining, S. Yokoyama, M. Ishikawa & S. Koshio. 2009. Evaluation of dietary fucoidan supplementation effects on growth performance and vibriosis resistance of *Penaeus monodon* post larvae. *Aquaculture Science* 57:167-174.
- Tsutsumi, A., R. Takahashi & T. Sumida. 2005. Mannose binding lectin: genetics and autoimmune disease. *Autoimmunity Reviews* 4:364-372.
- Tuller, J., C. De Santis & D.R. Jerry. 2014. Dietary influence of fucoidan supplementation on growth of *Lates calcarifer* (Bloch). *Aquaculture* 45: 749-754.
- Tuller J, Santis CD, Jerry DR. 2012. Dietary influence of Fucoidan supplementation on growth of *Lates calcarifer* (Bloch). *Aquaculture Research*. 1-6.
- Uma, A., G. Rebecca, S. Meena & K. Saravanabava. 2010. PCR detection of putative aerolysin and hemolysin genes in an *Aeromonas hydrophila* isolate from infected koi carp (*Cyprinus carpio*). *Tamil J. Veterinary Animal Science* 6: 31-33.
- Uribe, C., H. Folch, R. Enriquez & G. Moran. 2011. Innate and adaptive immunity in teleost fish: a review. *Veterinary Medicina* 56:486-503.
- Uthayakumar, V., V. Ramasubramanian, D. Santhilkumar, P.R. Sreedevi & S. Munirasu. 2012. Specific and non-specific immune response and disease resistance of *Solanum torvium* leaf soluble fractions in freshwater carp *Cyprinus carpio*. *International Research J. of Pharmacy* 3 (6):1-6.
- Utomo, N.B.P., F. Rahmatia & M. Setiawati. 2013. Penggunaan *Spirulina platensis* sebagai suplemen bahan baku pakan ikan nila *Oreochromis niloticus*. *J. Akuakultur Indonesia* 11(1):49-53.



UNIVERSITAS
GADJAH MADA

RESPON IMUN NON-SPEKIFIK LELE DUMBO (*Clarias sp.*) YANG DIBERI FUCOIDAN DARI RUMPUT LAUT COKELAT

(*Padina sp.*) SECARA ORAL

CAHYONO PURBOMARTONO, Dr.Ir. Alim Isnansetyo, M.Sc

Universitas Gadjah Mada, 2019 | Diunduh dari <http://etd.repository.ugm.ac.id/>

- Valle, F.A., R.S. Coffigny & A.P. Trujillo. 2004. Effects of different stressors in haematological variables in cultured *Oreochromis aureus* S. *Comparative Biochemistry and Physiology, Part C* 139: 245–250.
- Villarroel, F., A. Bastias, A. Casado, R. Amthauer & M. I. Concha. 2007. Apolipoprotein A-I, an antimicrobial protein in *Oncorhynchus mykiss*: evaluation of its expression in primary defence barriers and plasma levels in sick and healthy fish. *Fish & Shellfish Immunology* 23:197-209.
- Wahjuningrum, D., E.H. Solikhah, T. Budiardi & M. Setiawati. 2010. Pengendalian infeksi *Aeromonas hydrophila* pada ikan lele dumbo (*Clarias sp.*) dengan campuran meniran (*Phyllanthus niruri*) dan bawang putih (*Allium sativum*) dalam pakan. *J. Akuakultur Indonesia* 9(2): 93-103.
- Wang, C. & Y. Chen. 2016. Extraction and characterization of fucoidan from six brown macroalgae 24(2):319-328.
- Wang, Q., Y. Song, Y. He, D. Ren, F. Kow & Z. Qiao. 2014. Structural characterisation of algae *Costaria costata* fucoidan and its effects on CCl₄ -induced liver injury. *Carbohydrate Polymers* 107:247-254.
- Wang, Y., A.C. Zhang, Z. Ni, A. Herrera & B. Walcheck. 2010. Activity and other mechanisms of soluble L-selectin production during death receptor-induced leukocyte apoptosis. *J. Immunology* 184:4447-4454.
- Wang, T., J.W. Holland, N. Bols & C.J. Secombes. 2005. Cloning and expression of the first non-mammalian interleukin-11 gene in rainbow trout *Oncorhynchus mykiss*. *FEBS J.* 272:1136-1147.
- Waryono, T. 2001. Biogeografi alga makro (rumput) laut di kawasan pesisir Indonesia. Makalah dalam Seminar Ikatan Geografi Indonesia (IGI).
- Wu, X., G. Ragupathi, K. Panageas, F. Hong & P.O. Livingston. 2013. Accelerated tumor growth mediated by sub-lytic levels of antibody-induced complement activation is associated with activation of the PI3K/AKT survival pathway. *Clinical Cancer Research*.
- Wynne, M. J. 1998. A study of *Padina antillarum* (Kützting) piccone and a comparison with *P. tetrastromatica* Hauck (Dictyotales, Phaeophyta). *Cryptogamie Algologie* 4: 271-89.
- Yang, Q., R. Yang, Q.C. Zhou, J. Chen & X.P. Liang. 2014. Effect of fucoidan on growth and digestive enzyme activities of the yellow catfish, *Pelteobagrus fulvidraco*. *China J Animal Nutrition* 26(7):1880-1887.
- Yang, Q., R. Yang, M. Li, Q. Zhou, X. Liang & Z.C. Elmada. 2014. Effects of dietary fucoidan on the blood constituents, anti-oxidation and innate immunity of juvenile yellow catfish (*Pelteobagrus fulvidraco*). *Fish & Shellfish Immunology* 41: 264-270.
- Yang, M.X., C.H. Ma, J.T. Sun, Q.Q. Shao, W.J. Gao & Y. Zhang. 2008. Fucoidan stimulation induces a functional maturation of human monocyte-derived dendritic cells. *International Immunopharmacology* 8(13-14):1754-60.
- Yin G., G. Jeney, T. Raocz, X. Pao & Z. Jeney. 2006. Effect of two chinese herbs (*Astragalus radix* and *Scutellaria radix*) on non-specific immune response of tilapia, *Oreochromis niloticus*. *Aquaculture* 253:39-47.
- Yoshiura, Y., I. Kiryu, A. Fujiwara, H. Suetake, Y. Suzuki & T. Nakanishi. 2003. Identification and characterization of *Fugu orthologues* of mammalian interleukin-12 subunits. *Immunogenetics* 55: 296-306.
- 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.



UNIVERSITAS
GADJAH MADA

RESPON IMUN NON-SPEKIFIK LELE DUMBO (*Clarias sp.*) YANG DIBERI FUCOIDAN DARI RUMPUT LAUT COKELAT

(*Padina sp.*) SECARA ORAL

CAHYONO PURBOMARTONO, Dr.Ir. Alim Isnansetyo, M.Sc

Universitas Gadjah Mada, 2019 | Diunduh dari <http://etd.repository.ugm.ac.id/>

- Yunanto, A., R.T. Firdaus & E. Suhartono. 2014. Salivary antioxidative index in newborns at risk of sepsis as novel parameter for early-onset neonatal sepsis. 3(1):63-66.
- Zhang, W., T.Oda, Q. Yu & J.O. Jin. 2015. Fucoidan from *Macrocystis pyrifera* has powerful immune-modulatory effects compared to three other fucoidans. *Marine Drugs* 13:1084-1104.
- Zhao, X., S.Z. Dong, L.P. Sun, P. Li & B.F. Li. 2011. The scavenging activities and mechanism on oxygen free radicals of polysaccharides from *Laminaria japonica*. *J. Fish China* 35(4):531-538.
- Zhu, L.Y., L. Nie, G. Zhu, L.X. Xiang & J. Z. Shao. 2013. Advances in research of fish immune relevant genes: a comparative overview of innate and adaptive immunity in teleosts. *Developmental and Comparative Immunology*. In press.