DAFTAR PUSTAKA

Abreu, I.A. & D.E. Cabelli. 2010. Superoxide dismutases-a review of the metal-associated mechanistic variations. Biochim. Biophys. Acta - Proteins Proteomics 1804: 263–274.

Aguirre-Guzman, G., J.G. Sanchez-Martinez, A.I. Campa-Cordova, A. Luna-Gonzalez & F. Ascencio. 2009. Penaeid Shrimp Immune System. Thai J. Vet. Med. 39 (3): 205-215.

Akira, S., K. Takeda & T. Kaisho. 2001. Toll-like receptors: critical proteins linking innate and acquired immunity. Sci Technol. 2: 675–80.

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. Mar. Drugs 9: 2106-2130.

Ale, M.T., J.D. Mikkelsen & A.S. Meyer. 2012. Designed optimization of a single-step extraction of fucose-containing sulfated polysaccharides from *Sargassum* sp. J. Appl. Phycol. 24: 715–723.

Amend, D.F. & J.R. Nelson. 1977. Variation in the susceptibility of sockeye salmon *Oncorhynchus nerka* to infectious haemopoietic necrosis virus. J. Fish Biol. 11: 567–573.

Amparyup, P., W. Charoensapsri & A. Tassanakajon. 2009. Two prophenoloxidases are important for the survival of *Vibrio harveyi* challenged shrimp *Penaeus monodon*. Dev Comp Immunol. 33: 247–256.

Amparyup, P., J. Sutthangkul, W. Charoensapsri & A. Tassanakajon. 2012. Pattern recognition protein binds to lipopolysaccharide and β-1,3-glucan and activates shrimp prophenoloxidase system. J. Biol. Chem. 287: 10060–10069

Andersson, I. & A. Backlund. 2008. Structure and function of Rubisco. Plant Physiology and Biochemistry 46: 275-291

Apines-Amar, M.J.S. & E.C. Amar. 2015. 3. Use of immunostimulants in shrimp culture: An update. *In* C.M.A. Caipang, M.B.I. Bacano-Maningas & F.F. Fagutao (Eds.). Biotechnological Advances in Shrimp Health Management in the Philippines, 2015: 45-71.

Aprilyanto, V & L. Sembiring. 2016. Filogenetika Molekuler. Teori dan Aplikasi. Innosain, Yogyakarta. 208 p.

Ayuningtyas. 2016. Pemberian ekstrak alginat dari *Padina* sp. secara oral untuk meningkatkan parameter imun non- spesifik dan ekspresi gen imun pada udang vaname (*Litopenaeus vannamei*). Tesis. Universitas Gadjah Mada, Yogyakarta.

Azad, I.S., A. Panigrahi, C. Gopal, S. Paulpandi, C. Mahima & P. Ravichandran. 2005. Routes of immunostimulation vis-a-vis survival and growth of Penaeus monodon postlarvae. Aquaculture. 248: 227-234.

Bachere, E., D. Destoumieux & P. Bulet. 2000. Penaeidins, antimicrobial peptides of shrimp, a comparison with other effectors of innate immune. Aquaculture. 191: 71-88.

Bai, N., M. Gu, W. Zhang ,W. Xu & K. Mai. 2014. Effects of β-glucan derivatives on the immunity of white shrimp *Litopenaeus vannamei* and its resistance against white spot syndrome virus infection. Aquaculture 426–427: 63-73

Bailey-Brock, J.H. & S.M. Moss. 1992. Penaeid taxonomy, biology and zoogeography. IN: Marine Shrimp Culture: principles and practices. Editors; A.W. Fast & L.J. Lester. Developments in Aquaculture and Fisheries Science, 23. Elsevier Publishers: 9-28.

Bakunina, I.I., O.I. Nedashkovskaia, S.A. Alekseeva, E.P. Ivanova, L.A. Romanenko, N.M. Gorshkova, V.V. Isakov, T.N. Zviagintseva & V.V. Mikhaĭlov. 2002. Degradation of fucoidan by the marine proteobacterium *Pseudoalteromonas citrea* (translated). Microbiology. 71: 41–47.

Barillas-Mury, C. 2007. CLIP proteases and *Plasmodium* melanization in *Anopheles gambiae*. Trends Parasitol. 23: 297-299.

Bartlett, J.M.S. & D. Stirling. 2003. A short history of the polymerase chain reaction.

Methods Mol. Biol. 226: 3–6.

Bast, F., S. Bhushan, P. Rani & A.A. John. 2016. New record of *Sargassum zhangii* (Sargassaceae, Fucales) in India based on nuclear and mitochondrial DNA barcodes. Webbia 7792: 1–6.

Baum, B.D. & L. Ave. 2008. Reading a Phylogenetic tree : The meaning of monophyletic groups what an evolutionary tree represents the lexicon of phylogenetic inference how to read an evolutionary tree. Nat. Educ. 1(1): 190.

Beauchamp, C. & I. Fridovich. 1971. Superoxide dismutase: improved assay and an assay applicable to acrylamide gels, Anal Biochem 44: 276-287.

Berteau, O & Mulloy B. 2003. Sulfated fucans, fresh perspectives: structures, functions, and biological properties of sulfated fucans and an overview of enzymes active toward this class of polysaccharides. Glycobiology 13: 29R-40R.

Baxter, R., N. Hastings, A. Law & E.J. Glass. 2004. Introduction and movement of *Penaues vannamei* and *Penaues stylirostris* in Asia and the Pacific, FAO Regional Office for Asia and the Pacific.

Boisson-Vidal, C., F. Chaubet, L. Chevolot, C. Sinquin, J. Theveniaux, J. Millet, C. Sternberg, B. Mulloy & A.M. Fischer. 2000. Relationship between antithrombotic activities of fucans and their structure. Drug Development Research 51: 216-224.

Boone, L. 1931. Anomuran, macruran Crustacea from Panama and Canal Zone. Bulletin of the American Museum of Natural History 63(2): 137-189.

Borges, A., M. Rosa, G. Recchia, J. Queiroz-Silva, E. Bressan & E., Veasey. 2009. CTAB methods for DNA extraction of sweetpotato for microsatellite analysis. Sci. Agric. 66: 529–534.

Bowie, A. & L.A.J. O'Neill. 2000. The interleukin-1 receptor/Toll-like receptor superfamily: signal generators for pro-inflammatory interleukins and microbial products. J. Leukoc. Biol. 67: 508–514.

Bradford, M.M. 1976. A rapid and sensitive method for the quantitation of microgram quantities of protein utilizing the principle of protein-dye biding. Analytical Biochemistry 72: 248-254

Budhiyanti, S.A., S. Raharjo, D.W. Marseno & I.Y.B. Lelana. 2012. Antioxidant activity of brown algae *Sargassum* species extract from the coastline of Java Island. Am. J. Agric. Biol. Sci. 7: 337–346.

Buggé, D.M., H. Hégaret, G.H. Wikfors & B. Allam. 2007. Oxidative burst in hard clam *(Mercenaria mercenaria)* haemocytes. Fish Shellfish Immunol. 23: 188-196.

Bustin, S.A. 2000. Absolute quantification of mRNA using real-time reverse transcription polymerase chain reaction assays. J. Mol. 25: 169–93.

Camacho, O., L. Mattio, S. Draisma, S. Fredericq & G. Diaz-Pulido. 2015. Morphological and molecular assessment of *Sargassum* (Fucales, Phaeophyceae) from Caribbean Colombia, including the proposal of *Sargassum giganteum* sp. nov., *Sargassum schnetteri* comb. nov. and *Sargassum section* Cladophyllum sect. nov. Syst. Biodivers. 13: 105–130.

Campa-Córdova, A.I., N.Y. Hernández-Saavedra, R. De Philippis & F. Ascencio. 2002a. Generation of superoxide anion and SOD activity in haemocytes and muscle of American white shrimp (*Litopenaeus vannamei*) as a response to β-glucan and sulphated polysaccharide. Fish Shellfish Immunol. 12: 353–366.

Campa-Córdova, A.I., N.Y. Hernández-Saavedra & F. Ascencio. 2002b. Superoxide dismutase as modulator of immune function in American white shrimp (*Litopenaeus vannamei*). Comp. Biochem. Physiol. Part C 133: 557–565.

Cerenius, L. & K. Söderhäll. 2004. The prophenoloxidase-activating system in invertebrate. Immunological Reviews 198: 72–82

Cerenius, L., B.L. Lee & K. Söderhäll. 2008. The proPO-system: pros and cons for its role in invertebrate immunity. Trends Immunol. 29: 263–271.

Chai, P.C., X.L. Song, G.F. Chen, H. Xu & J. Huang. 2016. Dietary supplementation of probiotic *Bacillus* PC465 isolated from the gut of *Fenneropenaeus chinensis* improves the health status and resistance of *Litopenaeus vannamei* against white spot syndrome virus. Fish Shellfish Immunol. 54: 602–611.

Chaweepack, T., S. Chaweepack, B. Muenthaisong, L., Ruangpan, K., Nagata & K. Kamei. 2014. Effect of galangal (*Alpinia galanga* Linn.) extract on the expression of immune-related genes and *Vibrio harveyi* resistance in Pacific white shrimp (*Litopenaeus vannamei*). Aquac. Int. 23: 385–399.

Chayaburakul, K., G. Nash, P. Pratanpipat, S. Sriurairatana & B. Withyachumnarnkul. 2004. Multiple pathogens found in growth-retarded black tiger shrimp *Penaeus monodon* cultivated in Thailand. Dis. Aquat. Org. 60: 89–96.

Chen, Y.Y., S. Kitikiew, S.T. Yeh & J.C. Chen. 2016a. White shrimp *Litopenaeus vannamei* that have received fucoidan exhibit a defense against *Vibrio alginolyticus* and WSSV despite their recovery of immune parameters to background levels. Fish Shellfish Immunol. 59: 414-426.

Chen, Y.Y., J.C. Chen, Y.H. Kuo, Y.C. Lin, Y.H. Chang, H.Y. Gong & C.L. Huang.

2016b. Lipopolysaccharide and β-1,3-glucan-binding protein (LGBP) bind to seaweed polysaccharides and activate the prophenoloxidase system in white shrimp *Litopenaeus vannamei*. Dev Comp Immunol. 55: 144–151.

Chen, Y.Y., J.C. Chen, Y.C. Lin, D.F. Putra, S. Kitikiew, C.C. Li, J.F. Hsieh, C.H. Liou & S.T. Yeh. 2014. Shrimp that have received carrageenan via immersion and diet exhibit immunocompetence in phagocytosis despite a post-plateau in immune parameters. Fish Shellfish Immunol. 36: 352–366.

Chen, Y.Y., J.C. Chen, Y.C. Lin, S.T. Yeh & C.L. Huang. 2015. White shrimp *Litopenaeus vannamei* that have received *Gracilaria tenuistipitata* extract show early recovery of immune parameters after ammonia stressing. Marine Drugs 13:3606-3624.

Cheng, W., C. Liu, S.T. Yeh & J.C. Chen. 2004. The immune stimulatory effect of sodium alginate on the white shrimp *Litopenaeus vannamei* and its resistance against *Vibrio alginolyticus*. Fish Shellfish Immunol. 17: 41–51.

Cheng, W., C.H. Liu, C.M. Kuo & J.C. Chen. 2005a. Dietary administration of sodium alginate enhances the immune ability of white shrimp *Litopenaeus vannamei* and its resistance against *Vibrio alginolyticus*. Fish Shellfish Immunol. 18: 1–12.

Cheng, W., L.U. Wang & J.C. Chen. 2005b. Effect of water temperature on the immune response of white shrimp *Litopenaeus vannamei* to *Vibrio alginolyticus*. Aquaculture. 250: 592–601.

Chizhov, A.O., A. Dell & H.R. Morris, 1999. A study of fucoidan from the brown seaweed Chorda Filum. Carbohydr. Res. 320: 108-119.

Chotigeat, W., S. Tongsupa, K. Supamataya & A. Phongdara. 2004. Effect of fucoidan on disease resistance of black tiger shrimp. Aquaculture 233: 23–30.

Chou, P.H., H.S. Chang, I.T. Chen, H.Y. Lin, Y.M. Chen, H.L. Yang & K.C. Wang, 2009. The putative invertebrate adaptive immune protein *Litopenaeus vannamei* Dscam (LvDscam) is the first reported Dscam to lack a transmembrane domain and cytoplasmic tail. Dev. Comp. Immunol. 33: 1258–1267.

Chou, P.H., H.S. Chang, I.T. Chen, C.W. Lee, H.Y. Hung, Han-Ching & K.C. Wang, 2011. *Penaeus monodon* Dscam (PmDscam) has a highly diverse cytoplasmic tail and is the first membrane-bound shrimp Dscam to be reported. Fish Shellfish Immunol. 30, 1109–1123.

Cock, J., T. Gitterle, M. Salazar & M. Rye. 2009. Breeding for disease resistance of Penaeid shrimps. Aquaculture. 286: 1-11.

Cowley, J.A., C.M. Dimmock, K.M. Spann & P.J. Walker. 2012. Family Roniviridae. *In*: King, A.M.Q., M.J. Adams, E.B. Carstens, & E.J. Lefkowitz (Eds.). Virus Taxonomy: Ninth Report of the International Committee on Taxonomy of Viruses: 829–834.

Daniel, R., O. Berteau, J. Jozefonvicz & N. Goasdoue. 1999. Degradation of algal (*Ascophyllum nodosum*) fucoidan by an enzymatic activity contained in digestive glands of the marine mollusc *Pecten maximus*. Carbohydr. Res. 322: 291–297.

Dawson, E.Y. 1954. Marine Plants in the Vicinity of the Institut Oceanographie de

Nha Trang, Viet Nam. Pacific Sci. 8: 373–469. doi: 101259121

Dechamma, M.M., M. Rajeish, B. Maiti, M.K. Mani & I. Karunasagar. 2015. Expression of Toll-like receptors (TLR), in lymphoid organ of black tiger shrimp (*Penaeus monodon*) in response to *Vibrio harveyi* infection. Aquac Reports. 1: 1–4.

Deepika, A., K. Sreedharan, A. Paria, M. Makesh & K.V. Rajendran. 2014. Toll-pathway in tiger shrimp (*Penaeus monodon*) responds to white spot syndrome virus infection: Evidence through molecular characterisation and expression profiles of MyD88, TRAF6 and TLR genes. Fish Shellfish Immunol. 41: 441–454.

Dhar, A.K., R.M. Bowers, K.S. Licon, G. Veazey & B. Read. 2009. Validation of reference genes for quantitative measurement of immune gene expression in shrimp. Mol. Immunol. 46: 1688–1695.

Dhargalkar, V.K. & D. Kavlekar. 2004. Seaweeds A Field Manual, first edition. National Institute of Oceanography, Dona Paula, Goa, New Delhi. 36 p.

Defoirdt, T., N. Boon, P. Bossier & W. Verstraete. 2004. Disruption of bacterial quorum sensing: An unexplored strategy to fight infections in aquaculture. Aquaculture. 240: 69-88.

Defoirdt, T., P. Sorgeloos & P. Bossier. 2011 Alternatives to antibiotics for the control of bacterial disease in aquaculture. Current Opinion in Microbiology 14: 251-258.

de-la-Re-Vega, E., K.D. Garcia-Orozco, S.A. Calderon-Arredondo, M.A. Romo-Figueroa, M.A. Islas-Osuna, G.M. Yepiz-Plascencia & R.R. Sotelo-Mundo. 2004. Recombinant expression of marine shrimp lysozyme in *Escherichia coli*. J. Biotechnol. 7: 298-304.

Destoumieux, D., P. Bulet, D. Loew, A. Van Dorsselaer, J. Rodriguez & E. Bachere. 1997. Penaeidins, a new family of antimicrobial peptides isolated from penaeids shrimp (Decapoda). J. Biol. Chem. 272: 28398-28406.

Destomieux, D., P. Bulet, J.M. Strub & E. Bachere. 1999. Recombinant expression and range of activity of penaeidins, antimicrobial peptides from penaeid shrimp. Eur. J. Biochem. 266: 335-346.

Direktorat Jenderal Perikanan Budidaya. 2015. Rancangan Renstra Direktorat Jenderal Perikanan Budidaya (DJPB), Kementerian kelautan dan Perikanan Tahun 2015 – 2019.

Dodgson, K.S. & R.G.. Price. 1962. A note on the determination of the ester sulphate content of sulphated polysaccharides. Biochem. J. 84:106-110

Doh-ura, K., T. Kuge, M. Uomoto, K. Nishizawa, Y. Kawasaki & M. Iha. 2007. Prophylactic effect of dietary seaweed fucoidan against enteral prion infection. Antimicrobial Agents and Chemoterapy. 51: 2274–2277.

Doyle, J.J. & J.L. Doyle. 1987. A rapid DNA isolation procedure for small quantities of fresh leaf tissue. Phytochemical Bulletin19:.11-15

Doyle, J.L. & Doyle, J.J., 1990. Isolation of plant DNA from fresh tissue. Focus (Madison). 12:1

Duan, Y., Y. Zhang, H. Dong, X. Zheng, Y. Wang, H. Li, Q. Liu & J. Zhang. 2017. Effect of dietary poly-b-hydroxybutyrate (PHB) on growth performance,

intestinal health status and body composition of Pacific white shrimp *Litopenaeus vannamei* (Boone, 1931). Fish Shellfish Immunol: 30, 1109–1123.

Durand, S.V. & D.V. Lightner. 2002. Quantitative real time PCR for the measurement of white spot syndrome virus in shrimp. J. Fish Dis. 25: 381–389.

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*, immunosuppressed by cadmium chloride (*Short communication*). Veterinary Immunology and Immunopathology. 162:168–173.

Elizondo-Gonzalez, R., L.E. Cruz-Suarez, D. Ricque-Marie, E. Mendoza-Gamboa, C. Rodriguez-Padilla & L. M. Trejo-Avila. 2012. *In vitro* characterization of the antiviral activity of fucoidan from *Cladosiphon okamuranus* against Newcastle Disease Virus. Virology Journal. 9:307.

Eluvakkal, T., S.R. Sivakumar & K. Arunkumar. 2010. Fucoidan in some Indian brown seaweeds found along the coast gulf of Mannar. International Journal of Botany. 6: 176-181.

Escobedo-Bonilla C. M. 2013. Application of RNA interference (RNAi) against viral infections in Shrimp: A review. Journal of Antivirals and Antiretrovirals. S9: 1-12

Escobedo-Bonilla, C.M., V. Alday-Sanz, M. Wille, P. Sorgeloos & M.B. Pensaert. 2008. Review A review on the morphology, molecular characterization, morphogenesis and pathogenesis of white spot syndrome virus. J. Fish Dis. 31: 1–18.

Evans, K.M., Wortley, A.H., Mann & D.G. 2007. An assessment of potential diatom "barcode" genes (*cox*1, *rbc*l, 18S and ITS rDNA) and their effectiveness in determining relationships in *Sellaphora* (Bacillariophyta). Protist 158: 349–364.

Fast, A.W. 1991. Development of appropriate and economically viable shrimp pond growout technology in the United States. pp. 197-240. In: P.F. DeLoach, W.J. Dougherty and M.A. Davidson (eds). Elsevier Science Publishers, Amsterdam, The Netherlands.

Firdaus, M. & M. Astawan. 2010. Prevention of endothelial dysfunction in streptozotocin-induced diabetic rats by *Sargassum echinocarpum* extract. Med J Indones. 19: 32–35.

Flegel, T.W. 2006. Detection of major penaeid shrimp viruses in Asia, a historical perspective with emphasis on Thailand. Aquaculture. 258: 1–33.

Flegel, T.W., D.V. Lightner, C.H.U.F. Lo & L. Owens. 2008. Shrimp Disease Control : Past, Present and Future. Dis Asian Aquac. 4: 355–378.

Flores-Miranda, M. del C., A. Luna-González, D.V. Cortés-Espinosa, P. Álvarez-Ruiz, E. Cortés-Jacinto, F.J. Valdez-González, R. Escamilla-Montes & H.A. González-Ocampo. 2015. Effects of diets with fermented duckweed (*Lemna* sp.) on growth performance and gene expression in the Pacific white shrimp, *Litopenaeus vannamei*. Aquac. Int. 23: 547–561.

Fofonoff, P.W., G.M. Ruiz, B. Steves, C. Simkanin & J.T. Carlton. 2019.

National Exotic Marine and Estuarine Species Information System. <http://invasions.si.edu/nemesis/>. Access Date: 15-Jan -2019.

Gallo, C., F. Schiavon & L. Ballarin. 2011. Insight on cellular and humoral components of innate immunity in *Squilla mantis* (Crustacea, Stomatopoda). Fish Shellfish Immunol. 31: 423–431.

García, J.C., A. Reyes, M. Salazar & C.B. Granja. 2009. Differential gene expression in White Spot Syndrome Virus (WSSV)-infected naïve and previously challenged Pacific white shrimp Penaeus (*Litopenaeus vannamei*). Aquaculture. 289: 253–258

García-Triana, A., T. Zenteno-Savín, A.B. Peregrino-Uriarte & G. Yepiz-Plascencia. 2010. Hypoxia, reoxygenation and cytosolic manganese superoxide dismutase (cMnSOD) silencing in *Litopenaeus vannamei*: Effects on cMnSOD transcripts, superoxide dismutase activity and superoxide anion production capacity. Dev Comp Immunol. 34: 1230–1235.

Gómez-Anduro, G.A., C.V. Barillas-Mury, A.B. Peregrino-Uriarte, L. Gupta, T. Gollas-Galván, J. Hernández-López & G. Yepiz-Plascencia. 2006. The cytosolic manganese superoxide dismutase from the shrimp *Litopenaeus vannamei* : molecular cloning and expression. Dev Comp Immunol. 30: 893–900.

Gómez-Anduro, G.A., F. Ascencio-Valle, A.B. Peregrino-Uriarte, A. Cámpa-Córdova & G. Yepiz-Plascencia. 2012. Cytosolic manganese superoxide dismutase genes from the white shrimp *Litopenaeus vannamei* are differentially expressed in response to lipopolysaccharides, white spot virus and during ontogeny. Comp. Biochem. Physiol. - B Biochem. Mol. Biol. 162: 120–125.

Gross, P.S., T.C. Bartlett, C.I. Browdy, R.W. Chapman & G.W. Warr. 2001. Immune gene discovery by expressed sequence tag analysis of hemocytes and hepatopancreas in the pacific white shrimp, *Litopenaeus vannamei,* and the Atlantic white shrimp, *L. setiferus.* Dev. Comp. Immunol. 25: 565-577.

Guiry, M.D. in Guiry, M.D. & G.M. Guiry. 2018. AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org> diakses tanggal 13 November 2018.

Hammond, J.B. & N.J. Kruger. 1988. The Bradford method for protein quantitation. Methods Mol Biol. 3: 25–32.

Handoyo, D. & A. Rudiretna 2001. Prinsip umum dan pelaksanaan Polymerase Chain Reaction (PCR). Unitas 9: 17–29.

Hayashi, K., T. Nakano, M. Hashimoto, K. Kanekiyo, and T. Hayashi. 2008. Defensive effects of a fucoidan from brown alga *Undaria pinnatifida* against herpes simplex virus infection. International Immunopharmacology 8: 109–116.

Hebert, P.D.N., A. Cywinska, S.L. Ball & J.R. deWaard. 2003. Biological identifications through DNA barcodes. Proc. R. Soc. B Biol. Sci. 270: 313–321.

Hebert, P.D.N., M.Y. Stoeckle, T.S. Zemlak & C.M. Francis. 2004. Identification of birds through DNA barcodes. PLoS Biol. 2 (10): e312

Heinzelmann, M., H.C. Polk & F.N. Miller. 1998. Modulation of lipopolysaccharide-induced monocyte activation by heparin-binding protein and fucoidan. Infection and Immunity. 66: 5842–5847.

Hellio, C., A. Bado-Nilles, B. Gagnaire, T. Renault & H. Thomas-Guyon. 2007. Demonstration of a true phenoloxidase activity and activation of a ProPO cascade in Pacific oyster, *Crassostrea gigas* (Thunberg) *in vitro*. Fish Shellfish Immunol. 22: 433-440.

Holmblad, T. & K. Soderhäll. 1999. Cell adhesion molecules and antioxidative enzyme in a crustacean, possible role in immunology. Aquaculture. 172: 111-123.

Hoarau, G., J.A. Coyer, W.T. Stam & J.L. Olsen. 2007. A fast and inexpensive DNA extraction/purification protocol for brown macroalgae: Technical article. Mol. Ecol. Notes 7: 191–193.

Hose, J.E., G.G. Martin, V.A. Nguyen, J. Lucas & T. Rosenstein. 1987. Biological Bulletin,. Biol. Bull. 173: 178–187.

Huang, X., H. Zhou & H. Zhang. 2006. The effect of *Sargassum fusiforme* polysaccharide extracts on vibriosis resistance and immune activity of the shrimp, *Fenneropenaeus chinensis*. Fish Shellfish Immunol. 20:750–757.

Huynh, M. & N. Serediak. 2006. Algae Identification Field Guide. Agriculture and Agri-Food Canada. 40p

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 Immunol. 31: 286–293.

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 Immunol. 32:551–564.

Isnansetyo, A., A. Arif, Triyanto & N. Kasanah. 2012. Immunomodulating Activity of fucoidan from *Padina* sp. in Tilapia. *In*: A. Sudaryono, M. Hasan, & G.P. Budi (*Eds.*). Proceeeding of International Conference of Aquaculture Indonesia 2012. Masyarakat Akuakultur Indonesia. Semarang, November, 23-24. 304.

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*). Aquacult Int. 24 (2): 465–477.

Isnansetyo, A., H.M. Irpani, T.A. Wulansari & N. Kasanah. 2014. Oral administration of alginate from a tropical brown seaweed , *Sargassum* sp. to enhance non-spesific defense in walking catfish (*Clarias* sp.). Aquacult Indo 15: 73–80.

Isnansetyo, A., F.N.L. Lutfia, M. Nursid, Trijoko & R.A. Susidarti. 2017. Cytotoxicity of fucoidan from three tropical brown algae against breast and colon cancer cell lines. Pharmacogn. J. 9: 14–20.

Janeway, C.A. & R. Medzhitov. 2000. Viral interference with IL-1 and Toll signaling. Proc. Natl. Acad. Sci. U.S.A. 97: 10682–10683.

Ji, P.-F., C.-L.Yao & Z.-Y. Wang. 2009. Immune response and gene expression in

shrimp (*Litopenaeus vannamei*) hemocytes and hepatopancreas against some pathogen-associated molecular patterns. Fish Shellfish Immunol. 27: 563–570.

Jiravanichpaisal, P., B.L. Lee & K. Söderhäll, 2006. Cell-mediated immunity in arthropods: Hematopoiesis, coagulation, melanization and opsonization. Immunobiology. 211 (4): 213–236.

Jiravanichpaisal, P., N. Puanglarp, S., Petkon, S., Donnuea, I., Söderhäll & K. Söderhäll. 2007. Expression of immune-related genes in larval stages of the giant tiger shrimp, *Penaeus monodon*. Fish Shellfish Immunol. 23: 815–824.

Johansson, M.W., P. Keyser, K. Sritunyalucksana & K. Soderhäll. 2000. Crustacean haemocytes and haematopoiesis. Aquaculture. 191: 45–52.

Johansson, M.W. & K. Soderhäll 1989. A cell adhesion factor from cray fish haemocyte has degranulating activity towards cray fish granular cells. Insect Biochem. 19: 183–190.

Karunasagar, I., M.G. Vinod, B.O.B. Kennedy, A. Vijay, A. Deepanjali, K.R. Umesh & I. Karunasagar. 2005. Biocontrol of bacterial pathogens in aquaculture with emphasis on phage therapy. In P. Walker, R. Lester and M.G. Bondad-Reantaso (eds). Diseases in Asian Aquaculture 5: 535-542. Fish Health Section, Asian Fisheries Society, Manila.

Kawamoto H, Y. Miki, T, Kimura, K. Tanaka, T. Nakagawa, M. Kawamukai & H. Matsuda. 2006. Effects of fucoidan from Mozuku on human stomach cell lines. Food Science and Technology Research. 12: 218–222.

Kementerian Kelautan dan Perikanan (KKP). 2018. Produktivitas Perikanan Indonesia, pada Forum Merdeka Barat, Kementerian Komunikasi dan Informatika. Jakarta, 19 Januari 2018.

Kher, C.P., F.P. Doerder, J. Cooper, P. Ikonomi, U. Achilles-Day, F.C. Küpper & D.H. Lynn. 2011. Barcoding Tetrahymena: Discriminating species and identifying unknowns using the cytochrome c oxidase subunit I (cox-1) barcode. Protist 162: 2–13

Khimmakthong, U., P. Deachamag, A. Phongdara & W. Chotigeat. 2011. Stimulating the immune response of *Litopenaeus vannamei* using the phagocytosis activating protein (PAP) gene. Fish Shellfish Immunol. 31, 415–422.

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

Kim, E.J., S.Y. Park, J.Y. 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., S.M. Kim, 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: 247–252.

Kitikiew, S., J. Chen, D. F. Putra, Y. Lin, S. Yeh & C. Liou. 2013. Fucoidan effectively provokes the innate immunity of white shrimp *Litopenaeus vannamei* and its resistance against experimental *Vibrio alginolyticus* infection. Fish & Shellfish Immunology 34: 280-290

Kondo, M., T. Itami, Y. Takahashi, R. Fujii & S. Tomonaga. 1998. Ultrastructural and cytochemical characteristics of phagocytes in kuruma prawn. Fish Pathol. 33: 421-427.

Križman, M., J. Jakše, D. Baričevič & B. Javornik. 2006. Robust CTAB-activated charcoal protocol for plant DNA extraction. Terra. 87: 427–433.

Kubista, M., J. M. Andrade, M. Bengtsson, A. Forootan, J. Jonák, K. Lind, R. Sindelka, R. Sjöback, B. Sjögreen, L. Strömbom, A. Ståhlberg & N. Zoric. 2006. The real-time polymerase chain reaction (rev.). Molecular Aspects of Medicine. 27: 95–125.

Kucera H. & G.W. Saunders. 2008. Assigning morphological variants of *Fucus* (Fucales, Phaeophyceae) in Canadian waters to recognized species using DNA barcoding. Botany 86: 1065-1079.

Kumar, S., K. Tamura & M. Nei. 2004. MEGA3: integrated software for molecular evolutionary genetics analysis and sequence alignment. Briefings Bioinform 5: 150–163.

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

Kusaykin, M.I., A.O. Chizhov, A.A. Grachev, S.A. Alekseeva, I.Y. Bakunina, O.I. Nedashkovskaya, V.V. Sova & T.N. Zvyagintseva. 2006. Comparative study of specificity of fucoidanases from marine microorganisms and invertebrates. J. Appl. Phycol. 18: 369-373.

Lahaye, M. 1991. Marine algae as sources of fibers: Determination of soluble and insoluble dietary fiber contents in some 'sea vegetables'. J. Sci. Food Agric. 54: 587–594.

Lane, C.E., S.C. Lindstrom & G.W. Saunders. 2007. A molecular assessment of northeast Pacific *Alaria* species (Laminariales, Phaeophyceae) with reference to the utility of DNA barcoding. Mol. Phylogenet. Evol. 44: 634–648.

Lee, M.H., T. Osaki, J.Y. Lee, M.J. Baek, R. Zhang, J.W. Park, S. Kawabata, K. Soderhäll & B.L. Lee. 2004. Peptidoglycan recognition proteins involved in 1,3-β-D-glucan-dependent prophenoloxidase activation system of insect. J. Biol. Chem. 279: 3218-3227.

Le Gall, L. & G.W. Saunders. 2010. DNA barcoding is a powerful tool to uncover algal diversity: A case study of the phyllophoraceae (Gigartinales, Rhodophyta) in the Canadian flora1. J. Phycol. 46: 374–389.

Leliaert, F., H. Verbruggen, P. Vanormelingen, F. Steen, J.M. López-Bautista, G.C. Zuccarello & O. De Clerck. 2014. DNA-based species delimitation in algae. Eur. J. Phycol. 49: 179–196.

Lee, S.Y. & K. Söderhäll. 2002. Early events in crustacean innate immunity. Fish Shellfish Immunol. 12: 421–437.

Lee, W.J. & K.S. Bae. 2002. Phylogenetic relationship among several genera of Dictyotaceae (Dictyotales, Phaeophyceae) based on 18S rRNA and partial *rbc* L gene sequences. Marine Biology 140: 1107–1115.

Leu, J.H., S.J. Lin, J.Y. Huang, T.C. Chen & C.F. Lo. 2013. A model for apoptotic interaction between white spot syndrome virus and shrimp. Fish Shellfish Immunol. 34: 1011–1017

Li B., F. Lu, X. Wei & R. Zhao. 2008. Fucoidan: structure and bioactivity. Molecules. 13: 1671-1695.

Li C, Y. Chen, S. Weng, S. Li, H. Zuo, X. Yu, H. Li, J. He & X. Xu. 2014. Presence of tube isoforms in *Litopenaeus vannamei* suggests various regulatory patterns of signal transduction in invertebrate NF-kB pathway. Dev Comp Immunol. 42: 174-185.

Li, F. & J. Xiang. 2013. Recent advances in researches on the innate immunity of shrimp in China (Rev.). Dev Comp Immunol. 39: 11–26.

Li, H., Y. Chen, M. Li, S. Wang, H. Zuo, X. Xu, S. Weng, J. He & C. Li. 2015. A C-type lectin (LvCTL4) from *Litopenaeus vannamei* is a downstream molecule of the NF-κB signaling pathway and participates in antibacterial immune response. Fish Shellfish Immunol. 43: 257–263

Li, M., C. Li, C. Ma, H. Li, H. Zuo, S. Weng, X. Chen, D. Zeng, J. He & X. Xu. 2014. Identification of a C-type lectin with antiviral and antibacterial activity from pacific white shrimp *Litopenaeus vannamei*. Dev. Comp. Immunol. 46: 231–240.

Lightner, D.V. 1996. A Handbook of Pathology and Diagnostic Procedures for Disease of Cultured Penaeid Shrimp. World Aquaculture Society, Baton Rouge, Louisiana.

Lightner, D.V. 2011. Virus diseases of farmed shrimp in the Western Hemisphere (the Americas): A review. J. Invertebr. Pathol. 106: 110–130.

Lightner, D.V. & R.M. Redman. 1998. Shrimp diseases and current diagnostic methods. Aquaculture. 164: 201–220.

Lightner, D.V., R.M. Redman, C.R. Pantoja, K.F.J. Tang, B.L. Noble, P. Schofield, L.L. Mohney, L.M. Nunan & S.A. Navarro. 2012. Historic emergence, impact and current status of shrimp pathogens in the Americas. J. Invertebr. Pathol. 110: 174–183.

Lin, Y.C., F.F. Lee, C.L. Wu & J.C. Chen 2010. Molecular cloning and characterization of a cytosolic manganese superoxide dismutase (cytMnSOD) and mitochondrial manganese superoxide dismutase (mtMnSOD) from the kuruma shrimp *Marsupenaeus japonicus*. Fish Shellfish Immunol. 28: 143–150.

Lin, Y.C, J.C. Chen, W.Z.W. Morni, D.F. Putra, C.L.Huang, C.C. Li. & J.F. Hsieh. 2013. Vaccination enhances early immune responses in white shrimp *Litopenaeus vannamei* after secondary exposure to *Vibrio alginolyticus*. PLoS ONE 8 (7): e69722.

Lin Y.C., S.T. Yeh, C.C. Li, L.L. Chen, A.C. Cheng & J.C. Chen. 2012. An immersion of *Gracilaria tenuistipitata* extract improves the immunity and survival of white shrimp *Litopenaeus vannamei* challenged with white spot syndrome virus. Fish & Shellfish Immunol. 31: 1239-1246.

Liu, C.H., S.T. Yeh, S.Y. Cheng & J.C. Chen. 2004. The immune response of the white shrimp *Litopenaeus vannamei* and its susceptibility to *Vibrio* infection in relation with the moult cycle. Fish Shellfish Immunol 16: 151-161.

Liu, C.H., S.P. Yeh, C.M. Kuo, C. Winton & C.H. Chou. 2006. The effect of sodium alginate on the immune response of tiger shrimp via dietary administration: Activity and gene transcription. Fish Shellfish Immunol. 21: 442–452.

Liu, K.F., C.H. Chiu, Y.L. Shiu, W. Cheng & C.H. Liu. 2010. Effects of the probiotic, *Bacillus subtilis* E20, on the survival, development, stress tolerance, and immune status of white shrimp, *Litopenaeus vannamei* larvae. Fish Shellfish Immunol. 28: 837–844.

Livak, K.J. & T.D. Schmittgen. 2001. Analysis of relative gene expression data using real-time quantitative PCR and the $2^{-\Delta\Delta CT}$ method. Methods. 25: 402–408.

Lo, C.F., T. Aoki, J.R. Bonami, T. Flegel, J.H. Leu, D.V. Lightner, G. Stentiford, K. Söderhäll, P.J. Walker, H.C. Wang, X. Xun, F. Yang & J.M. Vlak, 2012. Nimaviridae. *In*: A.M.Q. King, M.J. Adams, E.B. Carstens & E.J. Lefkowitz, (Eds.). Virus Taxonomy: Ninth Report of the International Committee on Taxonomy of Viruses. Elsevier, New York:. 229–234.

Lomelí-Ortega, C.O. & S.F. Martínez-Díaz. 2014. Phage therapy against *Vibrio parahaemolyticus* infection in the whiteleg shrimp (*Litopenaeus vannamei*) larvae. Aquaculture. 434: 208-211.

Lutfia, F.N. 2015. Karakterisasi dan uji aktivitas sitotoksik fukoidan 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. Universitas Gadjah Mada, Yogyakarta.

Ma, T.H.T., S.H.K. Tiu, J.G. He & S.M. Chan. 2007. Molecular cloning of a C-type lectin (LvLT) from the shrimp *Litopenaeus vannamei*: Early gene down-regulation after WSSV infection. Fish Shellfish Immunol. 23: 430–437.

Maftuch, E. Prasetio, A. Sudianto, M. Rozik, R. Nurdiyani, E. Sanusi, H. Nursyam, F. Fariedah, Marsoedi & Murachman. 2013. Improvement of innate immune responses and defense activity in tiger shrimp (*Penaeus monodon* Fab.) by intramuscular administration of the outer membrane protein *Vibrio alginolyticus*. SpringerPlus. 2:432

Maeda, T., T. Kawai, M. Nakaoka & N. Yotsukura. 2013. Effective DNA extraction method for fragment analysis using capillary sequencer of the kelp, *Saccharina* sp. J. Appl. Phycol. 25: 337–347.

Marshall, S.H. & G. Arenas. 2003. Antimicrobial peptides: A natural alternative to chemical antibiotics and a potential for applied biotechnology. Electron. J. Biotechnol. 6: 271-284.

Maningas, M.B.B., H. Kondo & I. Hirono. 2013. Molecular mechanisms of the shrimp clotting system. Fish Shellfish Immunol. 34: 968–972.

Martin, G.G. & B. Graves. 2005. Fine structure and classification of shrimp haemocytes. J. Morphol. 185: 339-348.

Marudhupandi, T. & T.T.A. Kumar. 2013. Effect of fucoidan from *Turbinaria ornata* against marine ornamental fish pathogens. Journal of Coastal Life Medicine 1 (4): 282-286

Masukoa, T., A. Minami, N. Iwasaki, T. Majima, S. Nishimura & Y.C. Lee. 2005. Carbohydrate analysis by a phenol–sulfuric acid method in microplate format. Analytical Biochemistry 339: 69–72.

Mattio, L. & C.E. Payri. 2010. Assessment of five markers as potential barcodes for identifying *Sargassum* subgenus *Sargassum* species (Phaeophyceae, Fucales). Cryptogamie, Algologie 31 (4): 467-485

Mattio, L., C.E. Payri & M. Verlaque. 2009. Taxonomic revision and geographic distribution of the subgenus *Sargassum* (Fucales, Phaeophyceae) in the western and central pacific islands based on morphological and molecular analyses. J. Phycol. 45: 1213–1227.

McCandless E.L & J.S. Craigie. 1979. Sulfated polysaccharides in red and brown algae. Annual Review of Plant Physiology. 30: 41-67.

McCauley, L.A.R & J.D. Wehr. 2007. Taxonomic reappraisal of the freshwater brown algae *Bodanella, Ectocarpus, Heribaudiella*, and *Pleurocladia* (Phaeophyceae) on the basis of rbcL sequences and morphological characters. Phycologia 46 (4): 429–439

McDevit, D.C. & G. W. Saunders. 2009. On the utility of DNA barcoding for species differentiation among brown macroalgae (Phaeophyceae) including a novel extraction protocol. Phycological Research 57: 131–141.

Meng-Yi, C., H.U.B. Kuang-Yu, H. Chih-Cheng & S. Yen-Ling. 2005. More than one type of transglutaminase in invertebrates? A second type of transglutaminase is involved in shrimp coagulation. Dev. Comp. Immunol. 29: 1003-1016.

Miandare, H.K., P. Yarahmadi & M. Abbasian. 2016. Immune related transcriptional responses and performance of *Litopenaeus vannamei* post-larvae fed on dietary probiotic PrimaLac®. Fish Shellfish Immunol. 55: 671-678.

Mir, I.N., N.P. Sahu, A.K. Pal & M. Makesh. 2017. Synergistic effect of L-methionine and fucoidan rich extract in eliciting growth and non-specific immune response of *Labeo rohita* fingerlings against *Aeromonas hydrophila*. Aquaculture 479: 396–403.

Moon, C.H., J.W. Do, S.J. Cha, W.J. Yoon, S.B. Kim, M.S. Ko, M.A. Park, J.W. Kim, S.K. Sohn, J.H. Lee & J.W. Park. 2003. Highly conserved sequences of three major virion proteins of a Korean isolate of white spot syndrome virus (WSSV). Dis. Aquat. Organ. 53: 11–13.

Morya V.K., J. Kim & E.K. Kim. 2012. Algal fucoidan: Structural and size-dependent bioactivities and their perspectives. Appl Microbiol Biotechnol 93: 71–82.

Moss, S.M., D.R. Moss, S.M. Arce, D.V. Lightner & J.M. Lotz. 2012. The role of selective breeding and biosecurity in the prevention of disease in penaeid shrimp aquaculture. Journal of Invertebrate Pathology. 110: 247-250.

Musthaq, S.K.S & J. Kwang. 2015. Reprint of “Evolution of specific immunity in shrimp – A vaccination perspective against white spot syndrome virus. Dev. Comp. Immunol. 48: 342−353

Mylonakis, E. & Aballay, A. 2005. Worms and flies as genetically tractable animal models to study host-pathogen interactions. Infect. Immun. 73: 3833-3841.

Nappi, A.J. & E. Ottaviani. 2000. Cytotoxicity and cytotoxic molecules in invertebrates. BioEssays. 22: 469-480.

Nathan, C. & M.U. Shiloh. 2000. Reactive oxygen and nitrogen intermediates in the relationship between mammalian hosts and microbial pathogens. Proc. Natl. Acad. Sci. U.S.A. 97: 8841-8848.

Nayak, S., S.K. Singh, N. Ramaiah & R.A. Sreepada. 2010. Identification of upregulated immune-related genes in *Vibrio harveyi* challenged *Penaeus monodon* postlarvae. Fish Shellfish Immunol. 29: 544–549.

Neves, C.A., E.A. Santos & A.C.D. Bainy. 2000. Reduced superoxide dismutase activity in *Palaemonetes argentinus* (Decapoda, Paleminedae), infected by *Probopyrus ringueleti* (Isopoda, Bopyridae). Dis. Aquat. Org. 39: 155-158.

Niu, J., X. Chen, X. Lu, S.G. Jiang, H.Z. Lin, Y.J. Liu, Z. Huang, J. Wang, Y. Wang & L.X. Tian. 2015. Effects of different levels of dietary wakame (*Undaria pinnatifida*) on growth, immunity and intestinal structure of juvenile *Penaeus monodon*. Aquaculture. 435: 78–85.

Nolan, T., R.E. Hands & S.A. Bustin. 2006. Quantification of mRNA using real-time RT-PCR. Nature Protocols 1(3):1559-1582.

Oak, J.H., Y. Suh & I.K. Lee, I.K., 2002. Phylogenetic Relationships of *Sargassum* subgenus *Bactrophycus* (Sargassaceae, Phaeophyceae) inferred from rDNA ITS Sequences. Algae 17: 235–247.

OIE, 2018. OIE-Listed diseases, infections and infestations in force in 2018. <www.oie.int/animal-health-in-the-world/oie-listed-diseases-2018/>

Omran, A.R. 2005. The epidemiologic transition: A theory of the epidemiology of population change (Reprinted from The Milbank Memorial Fund Quarterly, vol 49, pg 509-38, 1971). Milbank Q. 83: 731–757.

Onofri, A. & E. Pannacci. 2014. Spreadsheet tools for biometry classes in crop science programmes. Commun. Biometry Crop Sci. 9: 3–13.

Ottaviani, E. & C. Franceschi. 1997. The invertebrate phagocytic immunocyte: Clues to a common evolution of immune and neuroendocrine systems. Immunol. Today 18: 169–174.

Pearson, W.R. 2013. An introduction to sequence similarity ("homology") searching. Curr. Protoc. Bioinform. Suplement 42: 3.1.1-3.1.8.

Peng, J., P. Wei, X. Chen, D. Zeng & X. Chen. 2016. Identification of cold responsive genes in Pacific white shrimp (*Litopenaeus vannamei*) by suppression subtractive hybridization. Gene 575, 667–674.

Penny, D., M.D. Hendy, &M.A. Steel.1992. Progress with methods for constructing evolutionary trees. Trends Ecol. Evol. 7, 73–79.

Pereira, M.S., B. Molloy & P.A.S. Mourão. 1999. Structure and Anticoagulant Activity of Sulfated Fucans. J. Biol. Chem. 274: 7656-7667.

Perry, J.J.P., D.S. Shin, E.D. Getzoff & J.A. Tainer. 2010. The structural biochemistry of the superoxide dismutases. Biochim. Biophys. Acta - Proteins Proteomics. 1804: 245–262.

Phillips, N., 1995. Biogeography of *Sargassum* (Phaeophyta) in the Pacific basin. Taxon. Econ. Seaweeds: 107-144.

Pirttilä, A.M., M. Hirsikorpi, T. Kämäräinen, L. Jaakola & A Hohtola. 2001. DNA Isolation Methods for Medicinal and Aromatic Plants. Plant Mol. Biol. Report. 19: 273a-273f.

Poettinger, T. & C.D. Schubart. 2014. Molecular diversity of freshwater crabs from Sulawesi and the sequential colonization of ancient lakes. Hydrobiologia. 739: 73–84.

Poong, S.W., P.E. Lim, S.M. Phang, H. Sunarpi, J.A. West & J.A. Kawai. 2014. A molecular-assisted floristic survey of crustose brown algae (Phaeophyceae) from Malaysia and Lombok Island, Indonesia based on *rbc*L and partial cox1 genes. J. Appl. Phycol. 26: 1231–1242.

Porebski, S., L.G. Bailey & B.R. Baum. 1997. Modification of a CTAB DNA extraction protocol for plants containing high polysaccharide and polyphenol components. Plant Mol. Biol. Report. 15: 8–15.

Pountney, D.C. 2015. Performance of the black tiger prawn (*Penaeus monodon*) fed fucoidan under sub-optimal conditions. Dissertation, University of Tasmania. 231 p.

Rahman, M.M. 2007. Differences in virulence between white spot syndrome virus (WSSV) isolates and testing of some control strategies in WSSV infected shrimp. Doctoral Dissertation. Ghent University, Belgium.

Rahman, M.M., M. Corteel, J.J. Dantas-Lima, M. Wille, V. Alday-Sanz, M.B. Pensaert, P. Sorgeloos & H.J. Nauwynck. 2007. Impact of daily fluctuations of optimum (27 °C) and high water temperature (33 °C) on *Penaeus vannamei* juveniles infected with white spot syndrome virus (WSSV). Aquaculture. 269: 107–113.

Rahman, M.M., M. Corteel, C.M. Escobedo-Bonilla, M. Wille, V. Alday-Sanz, M.B. Pensaert, P. Sorgeloos & H.J. Nauwynck. 2008. Virulence of white spot syndrome virus (WSSV) isolates may be correlated with the degree of replication in gills of *Penaeus vannamei* juveniles. Dis. Aquat. Organ. 79: 191–198.

Radulovici, A.E., P. Archambault & F. Dufresne. 2010. DNA barcodes for marine biodiversity: Moving fast forward? Diversity. 2: 450–472.

Rajalakshmi, S. 2017. Different types of PCR techniques and its applications. International Journal of Pharmaceutical, Chemical, and Biological Sciences: 7, 285–292.

Ramberg J.E., E.D. Nelson & R.A. Sinnott. 2010. Immunomodulatory dietary polysaccharides: a systematic review of the literature. *Nutrition Journal*. 9: 54.

Ramakrishnan, M.A. 2016. Determination of 50% endpoint titer using a simple formula. World Journal of Virology. 5(2): 85-86.

Reed, L.J. & H.A. Muench. 1938. A simple method of estimating fifty percent endpoints. A. J. Trop. Med. Hyg. 27: 493–497.

Rio, D.C. 2014. Reverse transcription–polymerase chain reaction. Cold Spring Harb. Protoc. 11: 1207–1216

Robalino, J., C.L. Browdy, S. Prior, A. Metz, P. Parnell, P. Gross & G. Warr. 2004. Induction of antiviral immunity by double-stranded RNA in a marine invertebrate. J. Virol. 78: 10442-10448.

Roch, P. 1999. Defense mechanisms and disease prevention in farmed marine invertebrates. Aquaculture. 172: 125-145.

Rojtinnakorn, J., I. Hirono, T. Itami, Y. Takahashi & T. Aoki. 2002. Gene expression in haemocytes of kuruma prawn, *Penaeus japonicus,* in response to infection with WSSV by EST approach. Fish Shellfish Immunol. 13: 69-83.

Roux, M.M., A. Pain, K.R. Klimpel & A.K. Dhar. 2002. The lipopolysaccharide and β-1,3-glucan binding protein gene is upregulated in white spot virus-infected shrimp *(Penaeus stylirostris).* J. Virol. 76: 7140-7149.

Rožić, S., J. Puizina, I. Šamanić & A. Žuljević. 2012. Molecular identification of the brown algae, *Cystoseira* spp . (Phaeophycae, Fucales) from the Adriatic Sea – preliminary results. Acta Adriatica. 53: 447–456.

Rudtanatip, T., N. Boonsri, S. Asuvapongpatana, B. Withyachumnarnkul & K., Wongprasert. 2017. A sulfated galactans supplemented diet enhances the expression of immune genes and protects against *Vibrio parahaemolyticus* infection in shrimp. Fish Shellfish Immunol. 65: 186–197

Runsaeng, P., S. Thepnarong, O. Rattanaporn & P. Utarabhand. 2015. Cloning and the mRNA expression of a C-type lectin with one carbohydrate recognition domain from *Fenneropenaeus merguiensis* in response to pathogenic inoculation. Mol. Cell. Probes. 29: 365–375.

Sadek, S., R. Rafael, M. Shakouri, G. Rafomanana, F.L. Ribeiro & J. Clay. 2002. Shrimp Aquaculture in Africa and the Middle East: The Current Reality and Trends for the Future. Report prepared under the World Bank, NACA, WWF and FAO Consortium Program on Shrimp Farming and the Environment. Work in Progress for Public Discussion. Published by the Consortium. 42p.

Saiki, R.K., D.H. Gelfand, S. Stoffel, S.J. Scharf, R. Higuchi, G.T. Horn, K.B. Mullis & H.A. Erlich. 1987. PCR The Polymerase Chain Reaction Polymerase Chain Reaction Amplification of a Short DNA Stretch by Repeated Cycles of In Vitro DNA Polymerization Primer-directed enzymatic amplification of DNA with a thermostable DNA polymerase. Methods Enzymol. 239: 487–491.

Sakai, T., T. Kawai & I. Kato. 2004. Isolation and characterization of a fucoidan-degrading marine bacterial strain and its fucoidanase. Mar. Biotechnol. 6: 335–346.

Saksmerprome, V., P. Charoonnart, W. Gangnonngiw & B. Withyachumnarnkul. 2009. A novel and inexpensive application of RNAi technology to protect shrimp from viral disease. Journal of Virological Methods. 162: 213-217.

Saunders, G.W. & D.C. McDevit. 2012. Methods for DNA barcoding photosynthetic protists emphasizing the macroalgae and diatoms *in* W. J. Kress & D. L. Erickson (Eds.), DNA Barcodes: Methods and Protocols, Methods in Molecular Biology. 858: 311–338.

Saunders, G.W. & T.E. Moore. 2013. Refinements for the amplification and sequencing of red algal DNA barcode and RedToL phylogenetic markers: A summary of current primers, profiles and strategies. Algae 28: 31–43.

Schleder, D.D., L.G.B. Peruch, M.A. Poli, T.H. Ferreira, C.P. Silva, E.R. Andreatta, L. Hayashi, F. do Nascimento Vieira. 2018. Effect of brown seaweeds on Pacific white shrimp growth performance, gut morphology, digestive enzymes activity and resistance to white spot virus. Aquaculture. 495: 359–365.

Schmittgen, T.D. & K.J. Livak. 2008. Analyzing real-time PCR data by the comparative C_T method. Nature Protocols 3 (6): 1101-1108

Shapiro-Ilan, D.I., J.R. Fuxa, L.A. Lacey, D.W. Onstad, & H.K. Kaya. 2005. Definitions of pathogenicity and virulence in invertebrate pathology. J. Invertebr. Pathol. 88: 1–7.

Shekhar, M.S., A. Gomathi, N.K. Dubey, K., Vinaya Kumar & K.K. Vijayan. 2017. Effect of immune gene silencing in WSSV infected tiger shrimp *Penaeus monodon*. Fish Shellfish Immunol. 70: 252–259.

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 Sci. 51: 394-397.

Sinurat, E., E. Saepudin, R. Peranginangin & S. Hudiyono. 2016. Immuno-stimulatory activity of brown seaweed-derived fucoidans at different molecular weights and purity levels towards white spot syndrome virus (WSSV) in shrimp *Litopenaeus vannamei*. J App Pharm Sci. 6 (10): 082-091.

Sivagnanavelmurugan, M., G.K. Ramnath, B.J. Thaddaeus, A. Palavesam & G. Immanuel. 2015. Effect of *Sargassum wightii* fucoidan on growth and disease resistance to *Vibrio parahaemolyticus* in *Penaeus monodon* post-larvae. Aquac Nutr. 21: 960–969.

Sivagnanavelmurugan, M., B.J. Thaddaeus, A. Palavesam & G. Immanuel. 2014. Dietary effect of *Sargassum wightii* fucoidan to enhance growth, prophenoloxidase gene expression of *Penaeus monodon* and immune resistance to *Vibrio parahaemolyticus*. Fish Shellfish Immunol. 39: 439–449.

Sivakamavalli, J. & B. Vaseeharan. 2014. Purification, characterization and functional role of lectin from green tiger shrimp *Penaeus semisulcatus*. Int. J. Biol. Macromol. 67: 64–70.

Soderhäll, I., E. Bangyeekhun, S. Mayo & K. Soderhäll. 2003. Hemocyte production and maturation in an invertebrate animal; proliferation and gene expression in hematopoietic stem cells of *Pacifastacus leniusculus.* Dev. Comp. Immunol. 27: 661-672.

Sohpal, V.K., A. Dey & A. Singh. 2010. MEGA biocentric software for sequence and phylogenetic analysis: A review. Int. J. Bioinform. Res. Appl. 6: 230–240.

Song, Y.L. & C.C. Huang. 2000. Aplications of immunostimulant to prevent shrimp diseases. *In* M. Fingerman & R. Negabhusanam (Eds). Resent advances in marine biotechnology. 1st ed. Playmouth: Science Publishers Inc.: 173-187

Song, Y.L., C.I. Yu, T.W. Lien, C.C. Huang & M.N. Lin. 2003. Haemolymph parameters of Pacific white shrimp (*Litopenaeus vannamei*) infected with Taura syndrome virus. Fish Shellfish Immunol. 14: 317–331.

Soylu, E.N. & A. Gönülol. 2012. Morphological and 18S rRNA analysis of coccoid green algae isolated from lakes of Kızılırmak Delta. Turk J Biol 36: 247–254.

Sritunyalucksana, K., S.Y. Lee & K. Soderhäll. 2002. A β-1,3-glucan binding protein from the black tiger shrimp, *Penaeus monodon*. Dev. Comp. Immunol. 26: 237-245.

Sritunyalucksana, K., T. Utairungsee, R. Sirikharin, J. Srisala. 2013. Reprint of: Virus-binding proteins and their roles in shrimp innate immunity. Fish Shellfish Immunol. 34: 1018–1024.

Stormo, G.D. 2009. An introduction to sequence similarity ("Homology") searching. Curr. Protoc. Bioinforma. Suplement 27: 1–7.

Stuart, L.M. & R.A. Ezekowitz. 2008. Phagocytosis and comparative innate immunity: learning on the fly. Nat Rev Immunol. 8: 131–141.

Subaidah, S. 2013. Respons pertumbuhan dan imunitas udang vanamei *Litopenaeus vannamei* terhadap pemberian hormon pertumbuhan rekombinan ikan kerapu kertang. Disertasi. Institut Pertanian Bogor, Bogor.

Subaidah, S., O. Carman O, K. Sumantadinata, Sukenda & Alimuddin. 2012. Growth response and genes expression of white shrimp *Litopenaeus vannamei* immersed in recombinant giant grouper growth hormone solution. J Ris Akuakultur. 7: 359–369.

Subramanian, D., Y.H. Jang, D.H. Kim, B.J. Kang & M.S. Heo. 2013. Dietary effect of *Rubus coreanus* ethanolic extract on immune gene expression in white leg shrimp, *Penaeus vannamei*. Fish Shellfish Immunol. 35: 808–814.

Sudaryono, A., A.H.C. Haditomo & A. Isnansetyo. 2015. Evaluation of dietary supplementation of aqueous extract of brown algae *Sargassum cristaefolium* on growth performance and feed utilization of juvenile white shrimp *Litopenaeus vannamei*. AACL Bioflux 8: 142–149.

Sudha, P.M., C. V. Mohan, K.M. Shankar & A. Hegde. 1998. Relationship between White Spot Syndrome Virus infection and clinical manifestation in Indian cultured penaeid shrimp. Aquaculture. 167: 95–101

Suet, T., M. Amelia & A.A. Amirul. 2018. Data on partial polyhydroxyalkanoate synthase genes (*phaC*) mined from *Aaptos aaptos* marine sponge-associated bacteria metagenome. Data Br. 16: 75–80.

Sulit, V.T, M.E.T. Aldon, I.T. Tendencia, A.M.J. Ortiz, S.B. Alayon& A.S. Ledesma. 2005. Regional Technical Consultation on the Aquaculture of *Penaeus vannamei* and other Exotic Shrimps in Southeast Asia. Manila, Phillippines, 1-2 March 2005, Aquaculture Department, Sotheast Asian Fisheries Development Center (SEAFDEC).

Sun, J., L. Wang, B. Wang, Z. Guo, M. Liu, K. Jiang, R. Tao & G. Zhang. 2008. Purification and characterization of a natural lectin from the plasma of the shrimp *Fenneropenaeus chinensis*. Fish Shellfish Immunol. 25, 290–297.

Sun, J., L. Wang, B. Wang, Z. Guo, M. Liu, K. Jiang & Z. Luo. 2007. Purification and characterisation of a natural lectin from the serum of the shrimp *Litopenaeus vannamei.* Fish & Shellfish Immunology 23: 292-299.

Supungul, P., S. Klinbunga, R. Pichyangkura, S. Jitrapakdee, I. Hirono, T. Aoki & A. Tassanakajon. 2002. Identification of immune-related genes in hemocytes of black tiger shrimp *(Penaeus monodon)*. Mar. Biotechnol. 4: 487-494.

Syed Musthaq, S.K. & J. Kwang. 2015. Reprint of "Evolution of specific immunity in shrimp - A vaccination perspective against white spot syndrome virus." Dev. Comp. Immunol. 48: 342–353

Synytsya, A., W.J. Kim, S.M. Kim, R. Pohl, A. Synytsya & F. Kvasnicka. 2010. Structure and antitumor activity of fucoidan isolated from sporophyll of Korean brown seaweed *Undaria pinnatifida*. Carbohydrate Polymers. 81: 41–48.

Takeda, K., T. Kaisho T & S. Akira. 2003. Toll-like receptors. Annu Rev Immunol.

21: 335–376.

Tamura, K., M. Nei, & S. Kumar. 2004. Prospects for inferring very large phylogenies by using the neighbor-joining method. PNAS 101: 11030–11035.

Tanekhy, M. & J. Fall. 2015. Expression of innate immunity genes in kuruma shrimp *Marsupenaeus japonicus* after in vivo stimulation with garlic extract (allicin). Vet. Med. (Praha). 60: 39–47.

Tangprasittipap, A., J. Srisala, S. Chouwdee, M. Somboon, N. Chuchird, C. Limsuwan, T. Srisuvan, T.W. Flegel & K. Sritunyalucksana. 2013. The microsporidian Enterocytozoon hepatopenaei is not the cause of white feces syndrome in whiteleg shrimp *Penaeus (Litopenaeus) vannamei*. BMC Vet. Res. 9, 139.

Taslihan, A., B. Sumiarto & K.H. Nitimulyo. 2014. The prevalence and risk factors of white spot syndrome virus in tiger shrimp at traditional ponds. Jurnal Veteriner 15(3): 298–305.

Tassanakajon, A., K. Somboonwiwat, P. Supungul & S. Tang. 2013. Discovery of immune molecules and their crucial functions in shrimp immunity. Fish & Shell fish Immunology 34:954-967.

Tendencia, E.A., R.H. Bosma & J.A.J. Verreth. 2011. White spot syndrome virus (WSSV) risk factors associated with shrimp farming practices in polyculture and monoculture farms in the Philippines. Aquaculture. 311: 87–93.

Teruya, T., T. Konishi, S. Uechi, H. Tamaki & M. Tako. 2007. Anti-proliferative activity of oversulfated fucoidan from commercially cultured *Cladosiphon okamuranus* TOKIDA in U937 cells. International Journal of Biological Macromolecules. 41: 221–226

Teruya T., S. Takeda, Y. Tamaki & M. Tako. 2010. Fucoidan isolated from *Laminaria angustata* var longissima induced macrophage activation. Bioscience Biotechnology Biochemistry. 74: 1960-1962.

Thiru, P. R.J. Rundell. 2008. Creating Phylogenetic Trees with. Philos. Trans. R. Soc. Lond. B. Biol. Sci. 363: 3401–3412.

Thanigaivel, S., N. Chandrasekaran, A. Mukherjee & T. John. 2016. Seaweeds as an alternative therapeutic source for aquatic disease management. Aquaculture. 464: 529-536.

Thitamadee, S., K. Sritunyalucksana, A. Prachumwat, T.W. Flegel, J. Srisala, O. Itsathitphaisarn & P. Jaroenlak. 2016. Review of current disease threats for cultivated penaeid shrimp in Asia. Aquaculture. 452: 69–87.

Traifalgar, R.F., 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* postlarvae. Aquaculture Sci. 57 (2): 167-174.

Traifalgar, R.F., H. Kira, H.T. Tung, F.R. Michael, A. Laining, S. Yokoyama, M. Ishikawa, S. Koshio, A.E. Serrano & V. Corre. 2010. Influence of dietary fucoidan supplementation on growth and immunological response of juvenile *Marsupenaeus japonicus*. J. World Aquac. Soc. 41: 235–244

Traifalgar R.F., S. Koshio, M. Ishikawa, A.E. Serrano & V.L. Corre. 2012. Fucoidan supplementation improves metamorphic survival and enhances Vibriosis resistance of *Penaeus japonicus* larvae. Journal of Fisheries and Aquaculture 3 (1): 33-36.

Tran, L., L. Nunan, R.M. Redman, L.L. Mohney, C.R. Pantoja, K. Fitzsimmons & D.V. Lightner. 2013. Determination of the infectious nature of the agent of acute hepatopancreatic necrosis syndrome affecting penaeid shrimp. Dis. Aquat. Org. 105: 45–55.

Trejo-Avila, L.M., M.E. Morales-Martınez, D. Ricque-Marie, L.E. Cruz-Suarez, P. Zapata-Benavides, K. Moran-Santibanez & C. Rodrı´guez-Padilla. 2014. *In vitro* anti-canine distemper virus activity of fucoidan extracted from the brown alga *Cladosiphon okamuranus*. VirusDis. 25 (4): 474–480

Udompetcharaporn, A., K. Junkunlo, S. Senapin, S. Roytrakul, T.W. Flegel & K. Sritunyalucksana. 2014. Identification and characterization of a QM protein as a possible peptidoglycan recognition protein (PGRP) from the giant tiger shrimp *Penaeus monodon*. Dev. Comp. Immunol. 46: 146–154.

Valli, J.S. & B. Vaseeharan. 2012. CDNA cloning, characterization and expression of lipopolysaccharide and β-1,3-glucan binding protein (LGBP) gene from the Indian white shrimp *Fenneropenaeus indicus*. Comp. Biochem. Physiol. - A Mol. Integr. Physiol. 163: 74–81.

Vargas-Albores, F., J. Hernandez-Lopez, T. Gollas-Galvan, K. Montano-Pérez, F. Jiménez-Vega & G. Yepiz-Plascencia. 1998. Activation of shrimp cellular defense functions by microbial products. In T.W. Flegel (ed). Advances in shrimp biotechnology. National center for genetic engineering and biotechnology, Bangkok: 161-166.

Van de Braak, C.B.T., M.H.A. Botterblom, W. Liu, N. Taverne, W.P.W. Van der Knaap & J.H.W.M. Rombout. 2002. The role of the haematopoietic tissue in haemocyte production and maturation of the black tiger shrimp *(Penaeus monodon)*. Fish Shellfish Immunollogy. 12: 253-272.

Varela-Álvarez, E., N. Andreakis, A. Lago-Lestón, G.A. Pearson, E.A. Serrão, G. Procaccini, C.M. Duarte & N. Marbá. 2006. Genomic DNA isolation from green and brown algae (*Caulerpales* and *Fucales*) for microsatellite library construction. J. Phycol. 42: 741–745

Vazquez, L., J. Alpuche, G. Maldonado, C. Agundis, A. Pereyra-Morales & E. Zenteno. 2009. Review: Immunity mechanisms in crustaceans. Innate Immun. 15: 179–188.

Verma, A.K., S. Gupta, S.P. Singh, & N.S. Nagpure. 2017. An update on mechanism of entry of white spot syndrome virus into shrimps. Fish Shellfish Immunol. 67: 141–146.

Wang, L., B. Zhi, W. Wu & X. Zhang. 2008. Requirement for shrimp caspase in apoptosis against virus infection. Dev. Comp. Immunol. 32: 706–715.

Wang, L., L. Wang, D. Zhang, F. Li, M. Wang, M. Huang, H. Zhang & L. Song. 2013. A novel C-type lectin from crab *Eriocheir sinensis* functions as pattern recognition receptor enhancing cellular encapsulation. Fish Shellfish Immunol. 34: 832–842.

Wang P.H., D.H. Wan, Z.H. Gu, X.X. Deng, S.P. Weng, X.Q. Yu & J.G. He. 2011. *Litopenaeus vannamei* tumour necrosis factor receptor-associated factor 6

(TRAF6) responds to *Vibrio alginolyticus* and white spot syndrome virus (WSSV) infection and activates antimicrobial peptide genes. Dev Comp Immunol. 35: 105-114

Wang, P.H., T. Huang, X. Zhang & J.G. He. 2014. Antiviral defense in shrimp: From innate immunity to viral infection. Antiviral Res. 108: 129–141.

Wang, P.H., J.P. Liang, Z.H Gu, D.H Wan, S.P Weng, X.Q Yu & J.G He. 2012. Molecular cloning, characterization and expression analysis of two novel Tolls (*LvToll*2 and *LvToll*3) and three putative Spätzle-like Toll ligands (LvSpz1–3) from *Litopenaeus vannamei*. Developmental and Comparative Immunology 36: 359–371.

Wang, R., S.Y. Lee, L. Cerenius & K. Soderhäll. 2001a. Propertis of the prophenoloxidase activating enzyme of the freshwater crayfish, *Pacifastacus leniuscalus.* Eur. J. Biochem. 268: 895-902.

Wang, R., Z. Liang, M. Hal & K. Soderhäll. 2001b. A transglutaminase involved in the coagulation system of the freshwater crayfish, *Pacifastacus leniusculus,* tissue localization and cDNA cloning. Fish Shellfish Immunol. 11: 623-637.

Wang, W., J. Lu, C. Wang, C., Wang, H., Zhang, H. & C. Li. 2013. Effects of *Sargassum fusiforme* polysaccharides on antioxidant activities and intestinal functions in mice. International Journal of Biological Macromolecules 58: 127-132.

Wang, X.W. & J.X. Wang. 2012. Diversity and multiple functions of lectins in shrimp immunity. Dev. Comp. Immunol. 39, 27–38.

Wang, X.W., W.T. Xu, X.W. Zhang, X.F. Zhao, X.Q. Yu & J.X. Wang. 2009. A C-type lectin is involved in the innate immune response of Chinese white shrimp. Fish Shellfish Immunol. 27: 556–562.

Wang, Y.C., P.S Chang & H.Y Chen. 2007. Tissue expressions of nine genes important to immune defence of the Pacific white shrimp *Litopenaeus vannamei.* Fish Shellfish Immunol. 23: 1161-1177

Wang, Y.C., P.S. Chang & H.Y. Chen. 2008. Differential time-series expression of immune-related genes of Pacific white shrimp *Litopenaeus vannamei* in response to dietary inclusion of β-1,3-glucan. Fish Shellfish Immunol. 24: 113–121.

Wang, Y.C. 2007. Expression of immune-related genes in the Pacific white shrimp. PhD Thesis. Institute of Marine Biology, National Sun Yat-sen University, Kaohsiung, Taiwan.

Wang, Y.G., M.D. Hassan, M. Shariff, S.M. Zamri & X. Chen. 1999. Histopathology and cytopathology of white spot syndrome virus (WSSV) in cultured *Penaeus monodon* from peninsular Malaysia with emphasis on pathogenesis and the mechanism of white spot formation. Dis. Aquat. Organ. 39: 1–11.

Watanuki, H., G. Chakraborty, H. Korenaga, T. Kono, R.B. Shivappa & M. Sakai. 2009. Immunostimulatory effects of natural human interferon-alpha (huIFN-a) on carps *Cyprinus carpio* L. Veterinary Immunology and Immunopathology 131: 273–277

Watthanasurorot A, K. Soderhall & P.A. Jiravanichpaisal. 2012 Mammalian like interleukin-1 receptor-associated kinase 4 (IRAK-4), a TIR signaling mediator

in intestinal innate immunity of black tiger shrimp (*Penaeus monodon*). Biochem Biophys Res Commun. 417: 623-629

Watthanasurorot, A., P. Jiravanichpaisal, H. Liu, I. Soderhall & K. Soderhall. 2011. Bacteria-induced Dscam isoforms of the crustacean, *Pacifastacus leniusculus*. PloS Pathog. 7 (6): e1002062.

Wei, X., X. Liu, J. Yang, J. Fang, H. Qiao, & Y. Zhang. 2012. Two C-type lectins from shrimp *Litopenaeus vannamei* that might be involved in immune response against bacteria and virus. Fish Shellfish Immunol. 32: 132–140.

Widowati, I., A.B. Susanto, M. Puspita, V. Stiger-pouvreau & N. Bourgougnon. 2014. Potentiality of using spreading *Sargassum* species from Indonesia as an interesting source of antibacterial and radical scavenging compounds: A preliminary study. Int J Mar Aquat Res Conserv Co-exist 1: 63–67.

Witvrouw, M. & E. De Clercq. 1997. Sulfated polysaccharides extracted from sea algae as potential antiviral drugs. Gen. Pharmacol. 29: 497–511.

Wongprasert, K., T. Rudtanatip & J. Praiboon. 2014. Immunostimulatory activity of sulfated galactans isolated from the red seaweed *Gracilaria fisheri* and development of resistance against white spot syndrome virus (WSSV) in shrimp. Fish Shellfish Immunol. 36: 52–60.

Wongsasak, U., S. Chaijamrus, S. Kumkhong & S. Boonanuntanasarn. 2015. Effects of dietary supplementation with β-glucan and synbiotics on immune gene expression and immune parameters under ammonia stress in Pacific white shrimp. Aquaculture. 436: 179–187.

Wyban, J.A. & J.N. Sweeney, 1989. Intensive shrimp growout trials in a round pond. Aquaculture. 76: 215–225.

Wyban, J.A. & J.N. Sweeney. 1991. Intensive shrimp production technology. The Oceanic Institute Shrimp manual. ISBN 0-9617016-3-3. 143 p.

Xu, Y.H., W.J. Bi, X.W. Wang, Y.R. Zhao, X.F. Zhao & J.X. Wang. 2014. Two novel C-type lectins with a low-density lipoprotein receptor class A domain have antiviral function in the shrimp *Marsupenaeus japonicus*. Dev. Comp. Immunol. 42: 323–332.

Yaemkasem, S., V. Boonyawiwat, J. Kasornchandra & C. Poolkhet. 2017. Risk factors associated with white spot syndrome virus outbreaks in marine shrimp farms in Rayong Province, Thailand. Dis. Aquat. Organ. 124: 193–199.

Yang, C., C. Lu, S., Chen, W., Liao & S., Chen. 2015. Immune gene expression for diverse haemocytes derived from pacific white shrimp, *Litopenaeus vannamei*. Fish Shellfish Immunol. 44, 265–271

Yang, D.Y., B. Eng, J.C. Dudar, S.R. Saunders & J.S. Waye. 1997. Removal of PCR inhibitors using silica-based spin columns: Application to ancient bones. J. Can. Soc. Forensic Sci. 30: 1–5.

Yang LS, Z.X.Yin, J.X. Liao, X.D. Huang, C.J. Guo & S.P. Weng. 2007. A Toll receptor in shrimp. Mol Immunol. 44: 1999–2008

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 Immunol. 41: 264-270

Yeh, M.S., C.J. Huang, J.H. Leu, Y.C. Lee & I.H. Tsai. 1999. Molecular cloning and characterization of a hemolymph clottable protein from tiger shrimp *(Penaeus monodon)*. Eur. J. Biochem. 266: 624-633.

Yeh, S.T. & J.C. Chen. 2008. Immunomodulation by carrageenans in the white shrimp *Litopenaeus vannamei* and its resistance against *Vibrio alginolyticus*. Aquaculture 276: 22–28.

Yeh, S.T., Y.C. Lin, C.L. Huang & J.C. Chen. 2010. White shrimp *Litopenaeus vannamei* that received the hot-water extract of *Gracilaria tenuistipitata* showed protective innate immunity and up-regulation of gene expressions after low-salinity stress. Fish Shellfish Immunol. 28: 887–894.

Yoo, C.Y., W.J. Kim, S.Y. Kim, S.M. Kim, M.K. Chung, J.W. Park, H.H. Suh, K.B. Lee & W.I. Park. 2007. Immunomodulating activity of a fucoidan isolated from korean *Undaria pinnatifida* Sporophyll. Algae. 22: 333-338.

Yoon, H.S., J.Y. Lee, S.M. Boo & D. Bhattacharya. 2001. Phylogeny of Alariaceae, Laminariaceae, and Lessoniaceae (Phaeophyceae) based on plastid-encoded RuBisCo spacer and nuclear-encoded ITS sequence comparisons. Mol. Phylogenet. Evol. 21: 231–243

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 vanname*. Fish Shellfish Immunol. 54: 46–53.

Zachleder, V. 1984. Optimization of nucleic acids assay in green and blue-green algae: extraction procedures and the light-activated diphenylamine reaction for DNA. Arch. Hydrobiol. Suppl. 67: 313–328.

Zayed, A., K. Muffler, T. Hahn, S. Finkelmeier, A. Burger-Kentischer & R. Ulber. 2016. Physicochemical and biological characterization of fucoidan from *Fucus vesiculosus* purified by dye affinity chromatography. Mar. Drugs 14: 1–15.

Zhang, M., J. Ma, K. Lei & X. Xu. 2010. Molecular cloning and characterization of a class II ADP ribosylation factor from the shrimp *Marsupenaeus japonicus*. Fish Shellfish Immunol. 28: 128-133.

Zhang, Q., Q. Liu, S. Liu, H. Yang, S. Liu, L. Zhu, B. Yang, J. Jin, L. Ding, X. Wang, Y. Liang, Q. Wang & J. Huang. 2014. A new nodavirus is associated with covert mortality disease of shrimp. J. Gen. Virol. 95: 2700–2709.

Zhang, S., J. Li, X. Wu, W. Zhong, J. Xian, S. Liao, Y. Miao & A. Wang. 2013. Effects of different dietary lipid level on the growth, survival and immune-relating genes expression in Pacific white shrimp, *Litopenaeus vannamei*. Fish Shellfish Immunol. 34: 1131–8.

Zhang, Y., L. Qiu, L. Song, H. Zhang, J. Zhao, L. Wang, Y. Yu, C. Li, F. Li, K. Xing & B. Huang. 2009. Cloning and characterization of a novel C-type lectin gene from shrimp *Litopenaeus vannamei*. Fish Shellfish Immunol. 26: 183–192.

Zhang, Z.F., M. Shao & K.H. Kang. 2006. Classification of haematopoietic cells and haemocytes in Chinese prawn *Fenneropenaeus chinensis.* Fish Shellfish Immunol. 21: 159-169.

Zhao, Z.Y., Z.X. Yin, X.P. Xu, S.P. Weng, X.Y. Rao, Z.X. Dai, Y.W. Luo, G. Yang, Z.S. Li, H.J. Guan, S.D. Li, S.M. Chan, X.Q. Yu & J.G. He. 2009. A novel C-

type lectin from the shrimp *Litopenaeus vannamei* possesses anti-white spot syndrome virus activity. J. Virol. 83: 347–356.

Zhi, B., W. Tang & X. Zhang. 2011. Enhancement of shrimp antiviral immune response through caspase-dependent apoptosis by small molecules. Mar. Biotechnol. 13: 575–583.

Zokaeifar, H., J L. Balcázar, C.R. Saad, M.S. Kamarudin, K. Sijam, A. Arshad & N. Nejat. 2012. Effects of *Bacillus subtilis* on the growth performance, digestive enzymes, immune gene expression and disease resistance of white shrimp, *Litopenaeus vannamei*. Fish Shellfish Immunol. 33: 683-689.