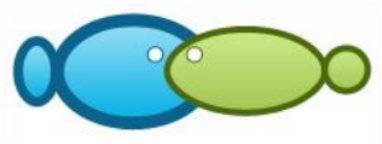
Growth of shrimp infected by Vibrio, fed with formulated feed with inclusions of Dunaliella salina and Tetraselmis chuii extracts

by Ita Widowati

Submission date: 28-Jul-2022 10:18AM (UTC+0700)
Submission ID: 1876043007
File name: C-6-IW-Growth-AACL.pdf (452.48K)
Word count: 3275
Character count: 17901



Growth of shrimp infected by *Vibrio*, fed with formulated feed with inclusions of *Dunaliella salina* and *Tetraselmis chuii* extracts

[1]Ita Widowati, [1]Muhammad Zainuri, [2]Hermien P. Kusumaningrum, [3]Yann Hardivillier, [3]Vincent Leignel, [4]Nathalie Bourgougnon, [3]Jean-Luc Mouget

[1] Department of Marine Science, Faculty of Fisheries and Marine Science, Diponegoro University, Tembalang, Semarang, Indonesia; [2] Department of Biology, Faculty of Science and Mathematics, Diponegoro University, Tembalang, Semarang, Indonesia; [3] Laboratoire du Mer Molécule et Santé, Le Mans Université, Le Mans, France; [4] Laboratoire de Chimie Biologie Marine, Université Bretagne Sud, Vannes, France. Corresponding author: I. Widowati, ita.widowati@live.undip.ac.id

Abstract. In the development of shrimp *Litopenaeus vannamei* farming, the main problem is disease susceptibility. To control diseases, preventive actions are one of the most important strategies. The general objective of this study was to obtain bioactive compounds of microalgae *Tetraselmis chuii* and *Dunaliella salina* that have the potential to increase growth and resistance to disease in shrimp. The methods used in this research were: extraction of microalgae, supplementation of microalgae extract into shrimp feed, and microalgae application test as feed supplement for shrimp as an enhancer of growth. The results showed that feed containing two microalgae extracts showed a higher crude protein content than the control. Shrimp fed for 28 days with feed containing *T. chuii* extract (2.193%. day^{-1}) showed a higher Specific Growth Rate than those administered feed with *D. salina extract* (1.437 %. day^{-1}).
Key Words: antibacterial activity, *Litopenaeus vannamei*, Specific Growth Rate, *Vibrio harveyi*.

Introduction. Shrimp species that can be found in Indonesia are *Metapenaeus affinis, Metapenaeus brevicornis, Metapenaeus ensis, Metapenaeus barbata, Penaeus monodon, Parapenaeopsis hardwickii, Parapenaeopsis sculptilis*, and others (Anna 2017). Shrimps have high economic value in Indonesia. The shrimp production is decreasing, while the demand for shrimp in the world market is increasing. The production in 2020 was predicted to reach 213000 tons (Anna 2017).

Great losses in shrimp cultures can occur due to deteriorated and stressful environment quality, leading to outbreaks of viral diseases, like white spot syndrome virus (WSSV), and bacterial diseases caused by *Vibrio alginolyticus* and *V. harveyi*, and others (Huynh et al 2011; Kannaripan et al 2009).

Vibrio is a genus of pathogen Gram-negative bacteria, usually found in water (Lightner 1996; Myers et al 2003; Thompson et al 2003). Vibriosis causes mortality in larvae, post larvae, juvenile, sub-adult and adult shrimps. The mortality can reach 100% in some cases (Sunaryanto & Mariyam 1987).

Thus, prevention of disease outbreaks and enhancement of immunity are of primary concern (Huynh et al 2011). Microalgae have many benefits because of their high protein content (Avagyan 2008), and can be added as a supplement in feed. Apart of being a nutrient enhancer in feed, several species of microalgae have anti-microbial, antioxidant and other bioactivities that can improve the health status of different organisms (Charoonnart et al 2018).

Material and Method

Collection of shrimp. The shrimp used in this study is white shrimp (*Litopenaeus vannamei*) weighing on average 6 g, being 1.5 months old, and having 10 cm in length, obtained from the Agency of Jepara Brackish Water Cultivation Fisheries (BBPBAP), Jepara, Indonesia. White shrimp were maintained in large tanks with a volume of 8000 L from April to June 2018 at the BBPBAP and Aquaculture Laboratory Unisnu Jepara, Indonesia. The tanks were equipped with aeration and water circulation systems, with natural photoperiods. A room temperature of 27-30°C was maintained. Acclimatization was carried out for 15 days. During the acclimatization process, *ad libitum* commercial feed pellets were administered. Shrimp were then divided randomly into the 20 experimental aquariums of 150 L, each containing 20 individuals. The treatment was carried out for 28 days, with 3 replications. The infection of shrimp was carried out by injecting 1 mL of 10^6 mL^{-1} *Vibrio harveyi* solution into the third segment of the abdomen of the shrimp that had been acclimatized. The *V. harveyi* were obtained from BBPBAP Jepara.

Extraction of microalgae. Biomass deposits were isolated and washing was carried out. The biomass was drained and the wet weight of the cell biomass was weighed and was dried for 3-4 days at a cold room temperature of 16-18°C. The dry samples were subjected to a fine crushing until they became a powder. Maceration was carried out with a ratio of 1:3 (w/v) powder sample and methanol solvent. The samples in powder form were weighed and 100 g were soaked in 300 mL of methanol solvent. All parts of the microalgae powder were immersed in the solvent in an Erlenmeyer container (Ye et al 2009). Maceration was carried out by incubating at 16°C, in dark conditions for 24 hours. After 24 hours of incubation, centrifugation at 1500 xg was carried out for 10 minutes. The supernatant was separated and the natant was macerated again using the same technique. Maceration was repeated 3 times. The three supernatants were mixed and evaporated using a rotary evaporator. Evaporation was carried out at a temperature of less than 40°C, agitation of 100 xg, and pressure of 500 mm Hg. The result of the evaporation process is a polar microalgae extract in concentrated liquid form. This extract is thick and dark in color. The evaporated extract is then compressed using freeze-drying until the extract becomes solid. The solid extract preparations were weighed. The extract was finely ground so that it became a powder.

Antibacterial activity. Antibacterial activity was performed by using the agar diffusion method. *D. salina* and *T. chuii extract* were tested against *Vibrio harveyi* cultures (Lalitha 2009). A 0.1 mL *V. harveyi* was spread on the agar medium. The extract solution was dropped on a paper disk and then placed on a petri dish containing agar and bacteria. The petri dish was then incubated at 37ºC for 48 hours. Antibacterial activity was measured in the form of inhibitory zones.

Feed formulation. Standard feed was formulated using basic ingredients, without additives: 55% fish meal, 18% shrimp head flour, 10% fine bran, 3% fish oil, 3% vitamin mix, 3% mineral mix, 8% carboxymethyl cellulose (CMC) and water. The ingredients were mixed and stirred, then dried using an oven at 27°C during 30 hours.

The basic feed was supplemented with *D. salina* and *T. chuii* extracts. Extracts were weighed, dissolved and diluted using aquades to get a concentration of 1, 1.5, 3 and 5 g kg^{-1} of basic feed. The solution of each extract was added by spraying to the basic feed and dried at 16°C. In order to make a coating of basic feed, Progol (2 g kg^{-1} of feed), multivitamin 1 g kg^{-1} of feed and fish oil 3% per kg of feed were mixed and added by spraying and dried again at 16°C. The dry feed was packed in a dry jar and silica was placed in the jar to maintain low moisture. The feed was stored in a cold storage showcase at 10-15°C.

The proximate analyses of formulated feed included crude protein determination by the Kjeldahl method, dry fat content by the Soxhlet method, fat content by the Folch method, ash content by heating the sample at 600°C, crude fiber using the method of

dissolving samples with acids, strong bases and heating, and moisture content by heating the feed in an oven at 105-110°C (Takeuchi 1988).

The amount of feed administered to shrimp was 5% of biomass per day. Feeding was carried out 4 times per day, at 06.00 am, 12.00 am, 04.00 pm, and 09.00 pm.

The experiment used closed system techniques. The water was completely replaced every day. Water quality parameters measured were temperature, salinity, dissolved oxygen and pH using a water quality checker. Parameter measurements were carried out 4 times a day.

Growth. Absolute growth was measured as follows (Takeuchi 1988):

Absolute weight gain = initial shrimp weight - final shrimp weight

Specific growth rate was determined with the following equation (Zonneveld et al 1991):

$$SGR=[(\ln Wt-\ln W_o)/T] \times 100$$

Where: SGR - specific growth rate (% per day); Wt - total weight at the end of experiment (g); Wo - total weight at the beginning of experiment (g); T - experiment time (days).

Results and Discussion

Antibacterial activity. The antibacterial activity indicated by the inhibition zone diameter of *T. chuii* and *D. salina* extracts against *Vibrio harveyi* at 100 ppm were 13.95 mm and 11.65 mm, respectively (Figure 1), and classified as strong (Davis & Stout 1971).

The antibacterial activities of *T. chuii* and *D. salina* were tested against *V. harveyi*, being potential bio-control agents (Widowati et al 2018). In addition to the antibacterial activity, these microalgae have antiradical scavenging properties (Widowati et al 2017).

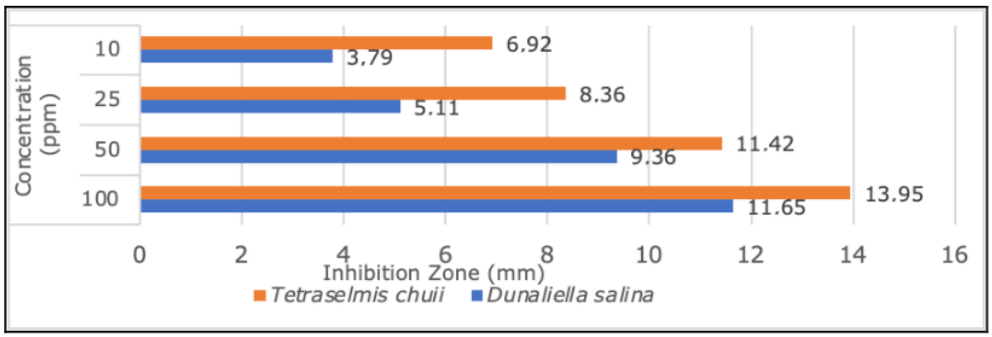


Figure 1. Antibacterial activity showed by the inhibition zone diameter of *Dunaliella salina* and *Tetraselmis chuii* extracts against *Vibrio harveyi.*

Proximate analysis. In the present study, the microalgae were added as feed supplements in the standard feed. The proximate analysis of the basic feed enriched with the microalgae extracts in all concentrations showed a higher content of crude protein and lipid than those of control (Table 1).

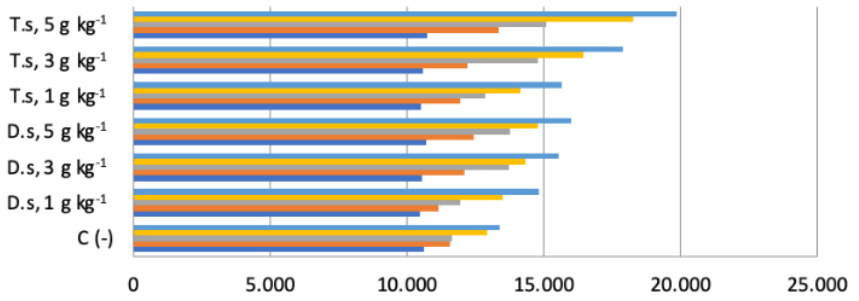
Table 1

Proximal analysis of shrimp feed containing *Dunaliella salina* and *Tetraselmis chuii* extracts

Composition	*Control*	*D.s 1 g kg^{-1}*	*D.s 3 g kg^{-1}*	*D.s 5 g kg^{-1}*	*T.c 1 g kg^{-1}*	*T.c 3 g kg^{-1}*	*T.c 5 g kg^{-1}*
Crude protein	40.03	40.58	40.62	40.78	40.77	40.81	40.96
Lipid	06.26	6.6	6.4	6.7	5.4	6.5	6.7
Ash	12.58	12.25	12.34	12.58	13.31	12.16	12.62
Fiber	3	2.48	2.67	2.4	2.16	2.32	2.3
NNFE	38.13	38.09	37.97	37.54	38.36	38.21	37.42

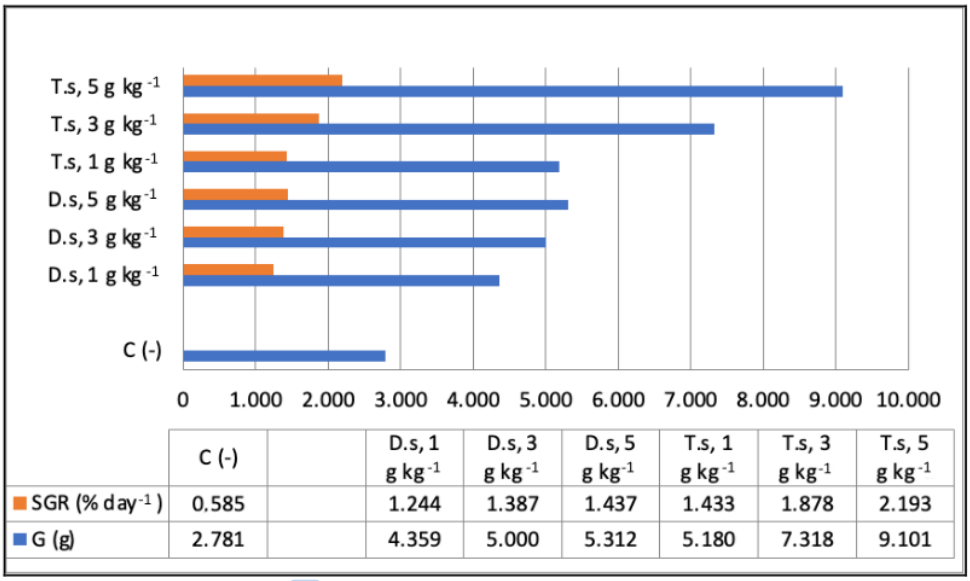
Note: NNFE - Non Nitrogen Free Extract; D.s - *Dunaliella salina*; T.c - *Tetraselmis chuii*.

Growth. Growth and specific growth rate of shrimp administered feed with the two microalgae added in all concentrations showed better results than those administered control feed (Figures 2 & 3).



	C (-)	D.s, 1 g kg^{-1}	D.s, 3 g kg^{-1}	D.s, 5 g kg^{-1}	T.s, 1 g kg^{-1}	T.s, 3 g kg^{-1}	T.s, 5 g kg^{-1}
Day 28	13.394	14.816	15.533	16.012	15.671	17.889	19.839
Day 21	12.942	13.502	14.317	14.800	14.136	16.436	18.274
Day 14	11.641	11.952	13.733	13.767	12.853	14.783	15.087
Day 7	11.575	11.152	12.100	12.433	11.952	12.227	13.342
Day-0	10.613	10.457	10.533	10.700	10.491	10.572	10.738

Figure 2. Growth of shrimp (g) fed by formulated feed with *Dunaliella salina (D.s)* and *Tetraselmis chuii* (*T.s*) extracts; C - control.



	C (-)		D.s, 1 g kg^{-1}	D.s, 3 g kg^{-1}	D.s, 5 g kg^{-1}	T.s, 1 g kg^{-1}	T.s, 3 g kg^{-1}	T.s, 5 g kg^{-1}
SGR (% day^{-1})	0.585		1.244	1.387	1.437	1.433	1.878	2.193
G (g)	2.781		4.359	5.000	5.312	5.180	7.318	9.101

Figure 3. Growth (G) and Specific Growth Rate (SGR) of shrimp fed by formulated feed with *Dunaliella salina* (D.s) and *Tetraselmis chuii* (T.s) extracts; C - control.

Vibrio caused many outbreaks in shrimp cultures (Jayasree et al 2006). 14 species have been reported in penaeid shrimp culture systems: *Vibrio harveyi, V. splendidus, V. parahaemolyticus, V. alginolyticus, V. anguillarum, V. vulnificus, V. campbelli, V. fischeri, V. damsella, V. pelagicus, V. orientalis, V. ordalii, V. mediterrani, V. logei*. Govahi et al (2014) found a common species, *Vibrio alginolyticus* and reported two others species, *V. proteolyticus* and *V. mimicus,* in Iran. In Central Java, Widowati, et al (2018) identified *Vibrio alginolyticus* and *V. harveyi* as vibriosis-causing agents in a shrimp pond.

Some microalgae are known for their beneficial bioactivities, like *D. salina* and *T. chuii*, and are often used as indicators in biocontrol (Widowati et al 2018). Gonzalez-Davis et al (2012) observed that *Dunaliella tertiolecta* and *Skeletonema costatum* showed antibacterial activities in aqueous extracts and are nontoxic to brine shrimp (*Artemia franciscana*) nauplii. The addition of microalgae had a positive effect in rearing fish larvae (Kokou et al 2012). *Dunaliella* extract showed beneficial effects when used as shrimp feed supplements (Supamattaya et al 2005).

The main constituent of the crude extract of *D. salina* has unique chemical compounds, namely 3,3,5-Trimethylheptane (M.W. 142.2) and n-Hexadecane (M.W.226.2) (Krishnakumar et al 2013). These secondary metabolites pay are a new avenue for future research to pinpoint the chemical constituents that possess antimicrobial activities (Krishnakumar et al 2013). High contents of LC-PUFAs docosahexaenoic acid (DHA) and arachidonic acid (AA) in algal feed improved the survival rates of *L. vannamei* shrimp (Nonwachai et al 2010). Microalgae *Skeletonema costatum* are not only capable of producing antibacterial compounds against *Vibrio*, but can also help shrimp nutrition (Gonzalez-Davis et al 2012). Thus, some microalgae can be added as beneficial supplements in the feed of shrimp.

Conclusions. The results showed that feed containing two microalgae extracts showed a higher crude protein content than the control. Shrimp fed during 28 days with feed containing *Tetraselmis chuii* extract (2.193% day^{-1}) showed a higher SGR than shrimp administered feed with *Dunaliella salina* extract (1.437 % day^{-1}).

Acknowledgements. The authors wish to thank the Directorate of Research and Community Service, Ministry of Research and Technology and Higher Education,

Indonesian Government, for funding this research through the Basic Research Program 2018.

Conflict of Interest. The authors declare that there is no conflict of interest.

References

Anna Z., 2017 Indonesian shrimp resource accounting for sustainable stock management. Biodiversitas Journal of Biological Diversity 18(1):248-256.

Avagyan A. B., 2008 A contribution to global sustainable development: inclusion of microalgae and their biomass in production and bio bycles. Clean Technologies and Environmental Policy 10:313-317.

Charoonnart P., Purton S., Saksmerprome V., 2018 Applications of microalgal biotechnology for disease control in aquaculture. Biology (Basel) 7(2):24, 14 p.

Davis W. W., Stout T. R., 1971 Disc plate method of microbiological antibiotic assay: II. Novel procedure offering improved accuracy. Applied Microbiology 22(4):666-670.

Gonzalez-Davis O., Ponce-Rivas E., Sanchez-Saavedra M. D. P., Munoz-Marquez M. E., Gerwick W. H., 2012 Bioprospection of microalgae and cyanobacteria as biocontrol agents against *Vibrio campbellii* and their use in white shrimp *Litopenaeus vannamei* culture. Journal of the World Aquaculture Society 43(3):387-399.

Govahi M., Afsharnasb M., Motalbei Moghanjighi A. A., Haghighi A., 2014 Multiple infections in shrimp *Litopenaeus vannamei* broodstock in commercial hatcheries in Khouzestan Province. Iranian Journal of Fisheries Science 13(4):869-885.

Huynh T. G., Yeh S. T., Lin Y. C., Shyu J. F., Chen L. L., Chen J. C., 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(2):286-293.

Jayasree I., Janakiram P., Madhavi R., 2006 Characterization of *Vibrio* spp. associated with diseased shrimp from culture ponds of Andhra Pradesh (India). Journal of the World Aquaculture Society 37(4):523-532.

Kannapiran E., Ravindran J., Chandrasekar R., Kalaiarasi A., 2009 Studies on luminous, *Vibrio harveyi* associated with shrimp culture system rearing *Penaeus monodon*. Journal of Environmental Biology 30(5):791-795.

Kokou F., Makridis P., Kentouri M., Divanach P., 2012 Antibacterial activity in microalgae cultures. Aquaculture Research 43:1520-1527.

Krishnakumar S., Bai V. D. M., Rajan A. R., 2013 Evaluation of bioactive metabolites from halophilic microalgae *Dunaliella salina* by GC-MS analysis. International Journal of Pharmaceutical Sciences 5(4):296-303.

Lalitha M. K., 2009 Manual on antimicrobial susceptibility testing (Under the auspices of Indian Association of Medical Microbiologists). American Society for Microbiology, Washington DC, 47 p.Lightner D. V., 1996 A handbook of shrimp pathology and diagnostic procedures for disease of cultured penaeid shrimp. World Aquaculture Society, Baton Rouge, LA, 35 p.

Myers M. L, Panicker G, Bej A. K., 2003 PCR detection of a newly emerged pandemic *Vibrio parahaemolyticus* O3:K6 pathogen in pure cultures and seeded waters from the Gulf of Mexico. Applied and Environmental Microbiology 69(4):2194-2200.

Nonwachai T., Purivirojkul W., Limsuwan C., Chuchird N., Velasco M., Dhar A. K., 2010 Growth, nonspecific immune characteristics, and survival upon challenge with *Vibrio harveyi* in Pacific white shrimp (*Litopenaeus vannamei*) raised on diets containing algal meal. Fish & Shellfish Immunology 29(2):298-304.

Sunaryanto A., Mariyam A., 1987 Occurrence of a pathogenic bacteria causing luminescence in penaeid larvae in Indonesia hatcheries. Bulletin of the Brackishwater Aquaculture Development Centre 8:64-70.

Supamattaya K., Kiriratnikom S., Boonyaratpalin M., Borowitzka L., 2005 Effect of a *Dunaliella* extract on growth performance, health condition, immune response and

disease resistance in black tiger shrimp (*Penaeus monodon*). Aquaculture 248(1):207-216.
Takeuchi T., 1988 Laboratory work-chemical evaluation of dietary nutrients. In: Fish Nutrition and Mariculture. Watanabe T. (ed), JICA Kanagawa International Fisheries Training Centre, Tokyo, pp. 179-233.
Thompson F. L., Thompson C. C., Hoste B., Vandemeulebroecke K., Guillan M., Swings J., 2003 *Vibrio fortis* sp. nov. and *Vibrio hepatarius* sp. nov., isolated from aquatic animals and the marine environment. International Journal of Systematic and Evolutionary Microbiology 53(5):1495-1501.
Widowati I., Zainuri M., Kusumaningrum H. P., Maesaroh Y., Hardivillier Y., Leignel V., Bourgougnon N., Mouget J. L., 2018 Identification of agents causing vibriosis in *Litopenaeus vannamei* shrimp culture in Kendal, Central Java, Indonesia and application of microalgae *Dunaliella salina* and *Tetraselmis chui* as bio-control agents against vibriosis. AACL Bioflux 11(1):101-107.
Widowati I., Zainuri M., Kusumaningrum H. P., Susilowati R., Hardivillier Y., Leignel V., Bourgougnon N., Mouget J. L., 2017 Antioxidant activity of three microalgae *Dunaliella salina*, *Tetraselmis chuii* and *Isochrysis galbana* clone Tahiti. IOP Conference Series: Earth and Environmental Science 55:012067, 6 p.
Ye H., Zhou C., Sun Y., Zhang X., Liu J., Hu Q., Zeng X., 2009 Antioxidant activities in vitro of ethanol extract from brown seaweed *Sargassum pallidum*. European Food Research and Technology 230:101, 9 p.
Zonneveld N. E., Huisman E. A., Boon J. H., 1991 Fish farming principles. Translation. PT Gramedia Pustaka Utama, Jakarta, 381 p.

Received: 22 April 2020. Accepted: 29 May 2020. Published online: 13 April 2021.
Authors:
Ita Widowati, Diponegoro University, Faculty of Fisheries and Marine Science, Department of Marine Science, Indonesia, Jalan Prof. Soedarto SH, Tembalang, 50275 Semarang, Indonesia, e-mail: ita.widowati@live.undip.ac.id ita_jusup@yahoo.co.id
Muhammad Zainuri, Diponegoro University, Faculty of Fisheries and Marine Science, Department of Oceanography, Indonesia, Jalan Prof. Soedarto SH, Tembalang, 50275 Semarang, Indonesia, e-mail: muhammad.zainuri@yahoo.co.id
Hemin Pancasakti Kusumaningrum, Diponegoro University, Faculty of Sciences and Mathematic, Department of Biology, Indonesia, Jl. Prof Soedarto SH, Tembalang, 50275 Semarang, Indonesia, e-mail: herminsakti@gmail.com
Yann Hardivillier, Le Mans Université, Faculté des Sciences et Techniques, Laboratoire du Mer Molécule et Santé (MMS), EA 2160 FR CNRS 3473 IUML, Avenue Olivier Messiaen, 72085 Le Mans, Cedex 9, France, e-mail: yann.hardivillier@univ-lemans.fr
Vincent Leignel, Le Mans Université, Faculté des Sciences et Techniques, Laboratoire du Mer Molécule et Santé (MMS), EA 2160 FR CNRS 3473 IUML, Avenue Olivier Messiaen, 72085 Le Mans, Cedex 9, France, e-mail: vincent.leignel@univ-lemans.fr
Nathalie Bourgougnon, Université de Bretagne-Sud, Laboratoire de Biotechnologie et Chimie Marines (LBCM), Campus de Tohannic, 56017 Vannes, France, e-mail: nathalie.bourgougnon@univ-ubs.fr
Jean-Luc Mouget, Le Mans Université, Faculté des Sciences et Techniques, Laboratoire du Mer Molécule et Santé (MMS), EA 2160 FR CNRS 3473 IUML, Avenue Olivier Messiaen, 72085 Le Mans, Cedex 9, France, e-mail: jean-luc.mouget@univ-lemans.fr

How to cite this article:
Widowati I., Zainuri M., Kusumaningrum H. P., Hardivillier Y., Leignel V., Bourgougnon N., Mouget J. L., 2021 Growth of shrimp infected by *Vibrio*, fed with formulated feed with inclusions of *Dunaliella salina* and *Tetraselmis chuii* extracts. AACL Bioflux 14(2):981-987.

Growth of shrimp infected by Vibrio, fed with formulated feed with inclusions of Dunaliella salina and Tetraselmis chuii extracts

ORIGINALITY REPORT

10%	%	10%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Princess Angelie S. Casas, Kong-Wah Sing, Ping-Shin Lee, Olga M. Nuñeza, Reagan Joseph T. Villanueva, John-James Wilson. "DNA barcodes for dragonflies and damselflies (Odonata) of Mindanao, Philippines", Mitochondrial DNA Part A, 2017 Publication	1%
2	Carina Miranda Tayag, Yong-Chin Lin, Chang-Che Li, Chyng-Hwa Liou, Jiann-Chu Chen. "Administration of the hot-water extract of Spirulina platensis enhanced the immune response of white shrimp Litopenaeus vannamei and its resistance against Vibrio alginolyticus", Fish & Shellfish Immunology, 2010 Publication	1%
3	S Mellisa, S A E Rahimi, U Umiati. "The effect of different live feeds on the growth and survival of comet goldfish Carrasius auratus	1%

auratu larvae", IOP Conference Series: Earth and Environmental Science, 2018
Publication

---

4 Kishore Kumar Krishnani. "Finfish-Based Bioaugmentation Technology for Enhancing Shrimp Grower's Income and Livelihood", Agricultural Research, 2021 — 1 %
Publication

---

5 Triwulan, K A Priadana, J J Ekaputri, R Bayuaji. "Physical and Chemical Character of Fly Ash of Coal Fired Power Plant in Java", IOP Conference Series: Materials Science and Engineering, 2017 — 1 %
Publication

---

6 GonzÃ¡lez-Davis, Oscar, Elizabeth Ponce-Rivas, M. Del Pilar SÃ¡nchez-Saavedra, MarÃa-Enriqueta MuÃ±oz-MÃ¡rquez, and William H. Gerwick. "Bioprospection of Microalgae and Cyanobacteria as Biocontrol Agents Against Vibrio campbellii and Their Use in White Shrimp Litopenaeus vannamei Culture", Journal of the World Aquaculture Society, 2012. — 1 %
Publication

---

7 Hesam Kamyab, Shreeshivadasan Chelliapan, Chew Tin Lee, Tayebeh Khademi et al. "Improved production of lipid contents by cultivating Chlorella pyrenoidosa in — 1 %

heterogeneous organic substrates", Clean Technologies and Environmental Policy, 2019
Publication

8	Truong-Giang Huynh, Su-Tuen Yeh, Yong-Chin Lin, Jeng-Feng Shyu, Li-Li Chen, Jiann-Chu Chen. "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, 2011 Publication	1 %

9	Violeta Medina-Beltrán, Antonio Luna-González, Jesús A. Fierro-Coronado, Ángel I. Campa-Córdova et al. "Echinacea purpurea and Uncaria tomentosa reduce the prevalence of WSSV in witheleg shrimp (Litopenaeus vannamei) cultured under laboratory conditions", Aquaculture, 2012 Publication	1 %

10	Patai Charoonnart, Saul Purton, Vanvimon Saksmerprome. "Applications of Microalgal Biotechnology for Disease Control in Aquaculture", Biology, 2018 Publication	<1 %

11	Sunee Wanlem, Kidchakan Supamattaya, Chutima Tantikitti, Poonsuk Prasertsan,	<1 %

Potchanapond Graidist. "Expression and applications of recombinant crustacean hyperglycemic hormone from eyestalks of white shrimp (Litopenaeus vannamei) against bacterial infection", Fish & Shellfish Immunology, 2011
Publication

---

12 Khatoon, Helena, Sanjoy Banerjee, Gregory Tan Guan Yuan, Noorazilah Haris, Mhd Ikhwanuddin, Mohd Azmi Ambak, and Azizah Endut. "Biofloc as a potential natural feed for shrimp postlarvae", International Biodeterioration & Biodegradation, 2016.
Publication

<1 %

---

13 Nina Meilisza, Dedi Jusadi, Muhammad Zairin, I Made Artika, Nur Bambang Priyo Utomo, Tutik Kadarini, Muhammad Agus Suprayudi. " Digestibility, growth and pigmentation of astaxanthin, canthaxanthin or lutein diets in Lake Kurumoi rainbowfish, (Allen) cultured species ", Aquaculture Research, 2017
Publication

<1 %

---

14 Supamattaya, K.. "Effect of a Dunaliella extract on growth performance, health condition, immune response and disease resistance in black tiger shrimp (Penaeus monodon)", Aquaculture, 20050729
Publication

<1 %

15	Sonia Araceli Soto - Rodriguez, Paola Magallón - Servín, Melissa López - Vela, Mario Nieves Soto. " Inhibitory effect of marine microalgae used in shrimp hatcheries on responsible for acute hepatopancreatic necrosis disease ", Aquaculture Research, 2021 Publication	<1 %
16	José Vladimir Trejo-Flores, Antonio Luna-González, Píndaro Álvarez-Ruíz, Ruth Escamilla-Montes et al. "Protective effect of Aloe vera in Litopenaeus vannamei challenged with Vibrio parahaemolyticus and white spot syndrome virus", Aquaculture, 2016 Publication	<1 %
17	Mastan, S.A., and S.K. Aktharunnisa Begum. "Vibriosis in Farm Reared White Shrimp, Litopenaeus Vannamei in Andhra Pradesh-Natural Occurrence and Artificial Challenge", International Journal of Applied Sciences and Biotechnology, 2016. Publication	<1 %
18	P. Rajasulochana, G. Satyanarayana. "A probiotic based product using multi-strain Bacillus species and predictive models for shrimp growth following probiotic intervention", Aquaculture, 2022	<1 %

Publication

Exclude quotes	On	Exclude matches	Off
Exclude bibliography	On		

Growth of shrimp infected by Vibrio, fed with formulated feed with inclusions of Dunaliella salina and Tetraselmis chuii extracts

GRADEMARK REPORT

FINAL GRADE

/0

GENERAL COMMENTS

Instructor

PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7