JURNAL PERIKANAN
UNIVERSITAS GADJAH MADA
Terakreditasi Ristekdikti No: 158/E/KPT/2021

ISSN: 2502-5066 (Online)
ISSN: 0853-6384 (Print)
Vol. 25 (1), 41-49
DOI 10.22146/jfs.76272

Applications of Epipelic Diatoms and Probiotics for Pacific White Shrimp Nursery (*Litopenaeus vannamei*)

Wardi Wardi*[1], Sinar Pagi Sektiana[2] & Bambang Suprakto[3]

[1]Aquaculture, Aceh Marine and Fisheries Polytechnic, Aceh Besar Regency, Aceh, Indonesia
[2]Aquaculture, Fisheries Expert Polytechnic Jakarta, South Jakarta, Jakarta, Indonesia
[3]Fishery Resource Utilization, Fisheries Expert Polytechnic Jakarta, South Jakarta, Jakarta, Indonesia
*Corresponding Author, email: wardiladong@gmail.com

Submitted: 14 July 2022; **Revised:** 04 January 2023; **Accepted :** 03 June 2023

ABSTRACT Pacific white shrimp (*Litopennaeus vannamei*) is a type of shrimp that is very easy to cultivate because it has several advantages, it is resistant to disease and has a high survival rate, and productivity can reach 13.6 tons/ha. Very high density because it can use feed and space more efficiently. This is what makes many farmers in Indonesia cultivate it. Despite the many advantages, there are still many obstacles faced by cultivators who experience failure and losses. The failure was caused by poor water quality during cuture and the emergence of disease attacks that caused slow growth decreased production and resulted in huge losses for farmers. To overcome these problems, it is necessary to improve the water quality of the cultivation media used. Water quality improvement was carried out by the application of probiotics for the vannamei nursery. The purpose of this study was to evaluate the optimal dose/cell count on water quality and shrimp growth and evaluate the developmental level of pathogenic bacteria treated with Epipelic Diatoms (DE) and Probiotic. The method used was an experimental method using a completely randomized design (CRD) with 4 treatments and 3 replications. The treatments tested were A (pure seawater), B (100% DE), C (100% PB), D (100% DE+100% PB). The seeds used were PL 6 vannamei shrimp with an average weight of 0.175 g and an average length of 5.5. The results showed that the combination of DE and PB had a significant effect ($p<0.05$) on water quality and the growth and survival of post-vannamei larvae.

Keywords: Growth; post larvae; survival; vannamei shrimp; water quality

INTRODUCTION

Pacific white shrimp (*Litopennaeus vannamei*) is a type of shrimp that is easily cultivated in Indonesia, because it has many advantages, including disease resistance and high productivity, productivity can reach more than 13.6 tons/ha (Supono, 2006). In addition, vannamei shrimp can be cutured in high densities because they can utilize feed and space more efficiently (Fuady *et al*., 2013). This is what makes many farmers in Indonesia cultivate it. Despite having many advantages, there are still some obstacles experienced by cultivators that cause failure and losses. The failure was caused by poor water quality during cuture (Purnamasari *et al*., 2019) and pond farmers often experience several problems, one of which is disease attacks that can cause slow shrimp growth, decreased aquaculture production to cause death and result in large losses for cultivators (Nurlaila *et al*., 2016; Purnamasari *et al*., 2019).

The application of good shrimp culture standards through aquaculture environmental management approaches (Fuady *et al*., 2013) and the provision of quality fry have become a reference for increasing the success of aquaculture (Lasima *et al*., 2012). The application of environmental management starts from the preparation period for cuture such as sterilization, use of probiotics and the growth of plankton and has become one of the standard operating procedures for aquaculture activities (Akmal *et al*., 2021). Meanwhile, the provision of quality fry is carried out by selecting disease-free, uniform and stress-free fry (Ramadhanthie *et al*., 2021).

Some of the problems that occur in vannamei shrimp farmers, of which is the death of seeds at the beginning of maintenance (Chumpol *et al*., 2017). So far, to reduce mortality at the beginning of rearing, acclimatization is done as an effort to reduce fry stress due to moving from a controlled environment (hatchery) to an pond environment (Shumway & Parsons, 2016), another alternative is to nurse them first before stocking them. enlargement pond. This nursery activity has been practised in tiger prawn cultivation and is starting to become a new segment in vannamei shrimp farming activities because it can shorten the life span of rearing in ponds, in addition to that, larger seed sizes are expected to increase survival and speed up growth (Prabowo *et al*., 2019).

The advantages of nursery technology in shrimp culture provide benefits, including the efficiency of feed use, increasing the vitality of shrimp tolans and shortening the rearing period in rearing which is 85-90 days to achieve an average weight of 25-27 g/head and can increase production and survival at magnification reaches 70%-89%. Besides that, it ensures the availability of juvenie seeds with the suitability of the growing cropping pattern (Mangampa & Suwoyo, 2016).

Problems in the nursery that need to be considered for survival and rapid growth, during a nursery that is less than optimal survival, reaches 60-70% as a result of water quality and the nursery media ecosystem is not adequate. As an alternative technique for nursery vannamei shrimp by maintaining water quality and maintaining the nursery media ecosystem. The presence of plankton in the waters

can be used as an indicator of the fertility level of water (Makmur & Fahrur, 2011). The presence of plankton is very beneficial because of its contribution as food for shrimp, biomass in autotrophic-heterotrophic shrimp systems is 17% higher and FCR is 18% lower than in fully heterotrophic systems (de Abreu *et al.*, 2019). Several types of plankton are favoured by shrimp larvae and post-larvae because they have high concentrations of amino acids and are very important for the growth and survival of shrimp (Marinho *et al.*, 2017).

In general, diatom plankton (Bacillariophyceae) are widely used in shrimp farming activities, both hatchery and rearing because of their high nutritional content and can contribute to essential amino acids and are easy to digest (Das & Sarwar, 1998), on the other hand, although there is not much information about the use of diatoms. epipelic in shrimp farming activities but as a type of plankton that lives on the bottom of the water and attaches to the substrate (Kurnia, 2020), epipelic diatoms are very helpful for the cultivation of species that live domestically such as shrimp (Supono, 2008). Under natural conditions, diatoms interact with other organisms, especially bacterial species. When the interaction of bacteria is positive, bacteria can promote the growth of microalgae cells through the production of growth-promoting factors, such as vitamins and acetic acid, or the regeneration of inorganic nutrients. Microalgae synthesize tissues that can be a source of carbon assimilation for bacteria. However, microalgae can produce antibacterial compounds that inhibit bacterial growth and vice versa. Diatoms produce chemical compounds with many types of bio-activity, such as anti-bacterial activity. For example, Skeletonema cost and Phaeodactylum tricornutum, produce secondary metabolites that have an effect on pathogenic bacteria (Molina-Cárdenas & del Pilar Sánchez-Saavedra, 2017).

Navicula is a benthic diatom with a dry weight of 430-490 g/kg protein, and 230-260 g/kg lipids, i.e 30-150 g EPA g/kg and 20-30 g DHA g/kg. Another study contains fat from 4.3 to 31.7% and protein from 12.7 to 13.31%. Several studies using epipelic diatoms (navicula) with a density of 5x10 cells/Ml with additions every 5 days) in the biofloc system in nurseries gave good results regarding the contribution of these diatom nutrients to the growth of vannamei postlarvae. Benthic diatoms produce fucose, xylose, mannose, galactose, glucose and glucan as storage of intraslurry compounds. This intracellular polymeric substance is important as an adhesive composition for the attachment of bacterial symbiosis. Another beneficial effect of microalgae-bacterial interactions is the excretion of environmental carbon sources or other products by microalgae which have a simulated effect on bacteria, including increased bacterial biofilm formation. This beneficial effect depends on the microalgae and bacterial species density (de Abreu et al., 2019).

The relationship between diatoms and bacteria is mutually beneficial and works together in building biofilms. The contribution of each partner requires the establishment and maintenance of cultures of axenic organisms. The formation of diatom extracellular polymeric substances (EPS) is influenced by related bacterial commodities. The effectiveness of this purification method does not depend on the diatom species itself, but on the community depending on the bacteria (Windler *et al.*, 2012).

Disease control strategies in shrimp culture that are widely used and give good results are through biological control, one of which is the application of probiotics. This is done with the consideration that probiotic bacteria have advantages, including the organisms used are safer than chemicals that do not accumulate in the food chain, can reduce repeated use in reproduction, target organisms rarely become resistant to probiotic agents and are used for joint control. simultaneously controlling pathogens in

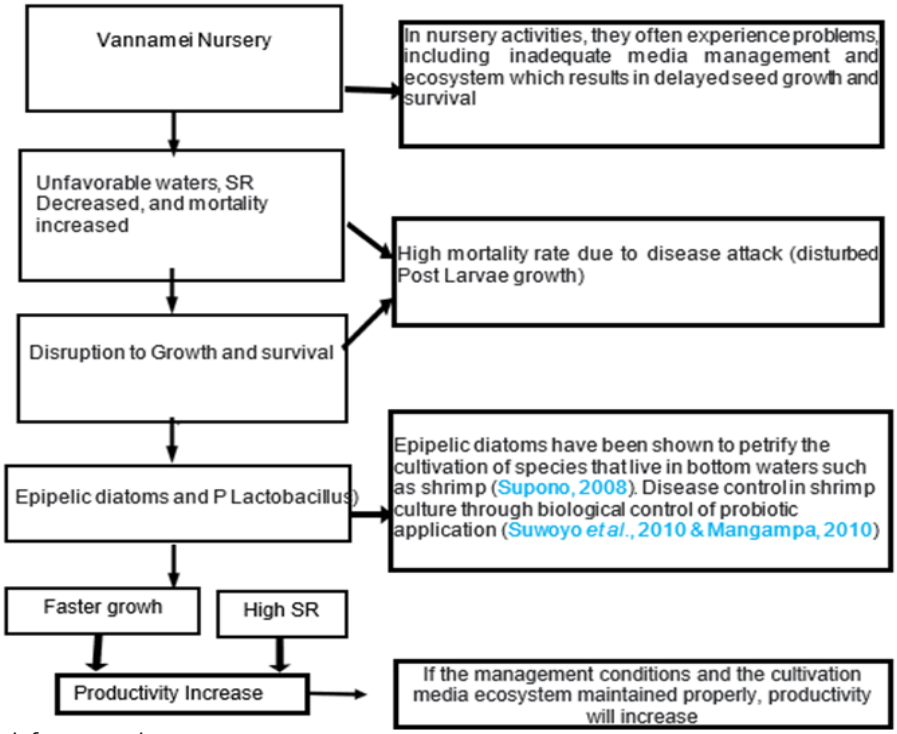

Figure 1. Research framework.

the host and the environment stimulates shrimp immunity and is an agent of water quality improvement through its ability to reduce pollutants (Suwoyo & Mangampa, 2010).

Microphytobenthic species always interact with bacteria, both in biodiversity and in culture conditions. This interaction is known to have a positive effect (*Alteromonas* sp. and Muricuda sp.) or a negative effect (*Pseudomonas* sp. and *Halomonas* sp.) on the growth performance of microalgae. The bacterial phyla of the heterotrophic are generally associated with diatom cultures. Some bacteria can increase the growth of microalgae through synergistic interaction. One of the most interacting is the release of growth-promoting bacteria such as vitamins needed by microalgae (cobalamin, thiamine, and biotin) (Jauffrais *et al*., 2017).

MATERIALS AND METHODS

Materials

The research was conducted from March to April 2022. It is located at the Brackish Water Cultivation Fisheries Center (BPBAP) at the batee end of Aceh province. The tools and materials used in this study are Blower 250 kW, aeration stones size 2 cm, aeration hoses, box fibre 50 litres, coni caltank volume 500 litres, basin, jars, toples, digital scales, block milimetre, DO meter, hand refractory meter, serok larva, dipper, fries PI 6, diatoms, probiotics, sea water, artificial feed and artemia (natural Pkn).

Experimental design

This study uses the experimental method of completely randomized design (CRD) with a design according to Harsojuwono *et al*. (2011) linear model of completely randomized design (CRD) as follows:

$$Y = \mu + \zeta + \varepsilon$$

Information:
μ: Expected mean (mean),
ζ: Effect of treatment actor for non-factorial research or actor combination of treatments for factorial research (=α+β+αβ, if studied, consists of two actors),
Ɛ: Effect of error (experimental error).

The design used in this study was a completely randomized design (CRD) which consisted of 4 treatments with 3 replications as follows:
Treatment A = Control treatment media,
Treatment B = 100% epipelic diatom,
Treatment C = 100% probiotic,
Treatment D = Epipelic diatoms and probiotics (100% + 100%).

Epipelic diatom culture

To culture epipelic diatoms (Suriadnyani *et al*., 2017) can be done by first taking diatom seeds from the waters or vannamei shrimp ponds. Taking diatom commodities from vannamei shrimp rearing ponds that are more than 2 months old are used as seeds, cultured in a closed room with low light intensity. The dominant diatoms were transferred to an indoor room with high light intensity and cultured on 50 ml of culture medium without stirring. Applying fertilizer to the media after Diatoms Epipelic appears on the walls of the culture media. The walls were cleaned by sterile hands to harvest DE and were ready to be cultured at larger volumes. After DE has developed and then stored in the natural feed LAB for preparation of test materials. The number of cells required is 5 ml (5.000.000 cells/mL) for each container given every 3 days.

Probiotic preparation

The probiotics usedwere probiotics containing *Lactobacillus* sp with a total of 50.000.000 cells/mL (10^6 cfu/mL) with *Saccharomyces* sp. with a cell content of 100.000 cells/ml (10^5 cfu/mL). Probiotics were given every day as much as 5 ml per container with a total of 2.5 x 10^8 cfu/mL bacteria.

Seed preparation

As many as 3000 shrimp seeds were used from the household-scale hatchery unit belonging to SUPM Ladong Aceh at the PL 6 stage. This adaptation process was carried out for 15 minutes. Seeds in plastic bags filled with oxygen were put in a temporary storage tank for adaptation. The plastic gasket was opened and filled with water little by little until the seeds in the bag come out on their own and swim into the holding container. The seeds that have been adapted are ready to be stocked in 250 research containers per container.

Research container preparation

The research container in the form of a fibreglass box with a volume of 50 litres and a holding tank with a volume of 500 litres was first sterilized using a 60% chlorine solution at a dose of 30 mg/L for 30-60 minutes (Boyd & Tucker, 2012). After soaking, followed by soaking sodium thiosulfate 15 mg/L for 10-15 minutes to remove chlorine residue. The containers were rinsed again using fresh water and then arranged according to the results of the research design as well as the installation of aeration installations into each container. 50 litres of sterile sea-water was put into each research container and allowed to stand for 24 hours and aeration was turned on. The addition of epiphilic diatoms and probiotics according to the applied treatment was carried out for 5-7 days before stocking the fry.

Test parameters

Seed weight

Measurement of weight growth data (g) is based on the formula (Effendie, 1997). Absolute weight gain (PMG) = Wt-Wo, Where:
PMB : Heavy absolute increase,
Wt : Final weight,
Wo : Initial weight.

Seed length

Measurement of absolute length data (mm) was measured using millimetre block paper and based on the formula presented (Fuady & Nitisupardjo, 2013).
Absolute Length Gain = Lt-Lo, Where:
PPM : Increase in Length,
Lt : Final Length,
Lo : Initial Length.

Life sustainability

The survival rate of post-larvae of Vannamei shrimp is calculated using the formula (Fuady & Nitisupardjo, 2013).

as follows:

$$SR = \frac{N_t}{N_0} \times 100\%$$

Information:
SR = Survival rate (%),
Nt = Number of live shrimps at the end of the experiment (tails),
N0 = Number of live shrimps at the beginning of rearing (tails).

Water quality measurement

Measurements of water quality parameters such as temperature, dissolved oxygen, salinity and pH were carried out every day. To maintain water quality conditions, siphoning was carried out every day or according to media water conditions which were carried out after one hour of feeding. While testing for ammonia, nitrate, nitrite phosphate, and alkalinity were carried out 3 times during the study, namely at the beginning, middle and end of the study using a chlorine meter at the Disease Lab of the Brackish Water Cultivation Fisheries Center (BPBAP) at the end of the batee, Aceh province.

Table 1. Analytical methods for observing water quality.

No	Parameter	Unit	Measuring instrument
1	Temperature	°C	Thermometer
2	Dissolved oxygen	PPM	DO meter
3	Salinity	ppt	Hendre fractometer
4	pH	-	PH meter
5	Nitrates (NO_3)	mg	Hanna's Nitrate Photometer
6	Nitrite (NO_2)	mg	test kits
7	Ammonia (NH_3)	mg	MediumRange-Colorimeter Hanna HI715
8	Phosphate	mg	High Range Phosphate Colorimeter HI-717
9	Alkalinity	(mg/L)	Hydroponic pH meter

Bacteria count test

Examination of the total number of bacteria for all treatments 3 times during the study was carried out at the beginning, middle, and end of the study. Sample testing was carried out by takingg 50 ml of water from each trietment bacterial sample examined was the type of vibrio which was carried out at the BPBAP Ujung Batee Disease Lab. The results of the examination of the sample take 1-2 days.

Data analysis/ variable test

Data analysis was carried out using analysis of diversity or F test (ANOVA). This test was conducted to determine the effect of treatment (Free Variable) on the measured Vannamei shrimp larvae or the F test. If the F test was significantly different or very significantly different, then continued with the Least Significant Difference (LSD) test, which was to determine the difference between each treatment.

RESULTS AND DISCUSSION

Survival rate (SR)

The results of observations during the study showed that the highest survival was found in the DEP treatment (Epipelic Diatoms and Probiotics), followed by DE and P treatments which tended to be the same, then the lowest followed by the control treatment. These results can be seen in Figure 2.

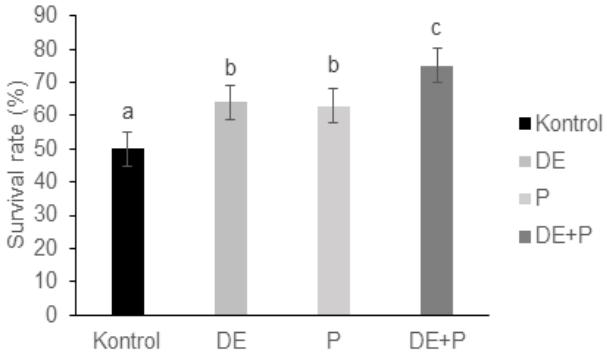

Figure 2. Survival in each treatment.

The results of the research conducted for 20 days obtained the highest average namely in treatment D of 75.2%, followed by treatment B which was 64% and C at 62.4% and A at 49.6%. These results indicate that treatment D got the highest SR value compared to the other treatment values.

According to Yuniarso (2006), Survival rate s the ratio between the number of individuals living at the end of the maintenance period and the number of individuals living at the beginning of the maintenance period in the same population. Factors that affect the high percentage of survival are biotic and abiotic factors such as competitors, population density, age disease, the ability of organisms to adapt and the consequences of human handling. The effect of Navicula is very clear on the post-larvae of vannamei shrimp, namely increasing productivity per m^3 of land. This is because these diatoms produce essential fatty acids that are beneficial for the growth of post-larval shrimp (de Abreu *et al.*, 2019).

Absolute weight growth

Observations showed that the absolute average growth of vannamei shrimp reared for 20 days showed a significant difference (Figure 3). The results of the ANOVA test showed that the absolute growth was significantly different ($P<0.05$).

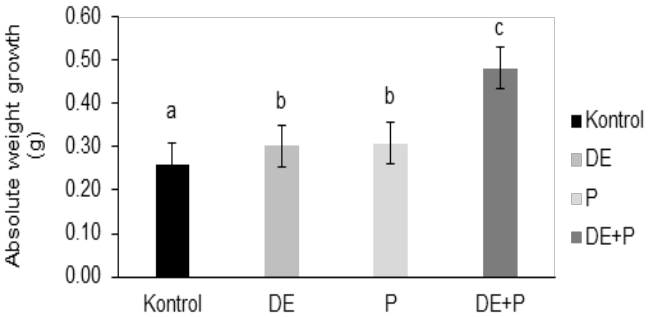

Figure 3. Absolute weight growth in each treatment.

The results of the study showed that the highest absolute weight growth value was found in treatment D, namely

the combination of DE and P with an average growth of 0.48 g and the lowest growth value was found in treatment A, which weighed 0.26 g.

This result is supported by the results of previous research that the application of Lactobacillus can increase the growth and survival of vannamei shrimp. In addition, Lactobacillus can suppress disease-causing bacteria which can slow the growth of white vannamei shrimp (Syadillah *et al*., 2020) and epipelic diatoms, for example, Navicula given to nurseries can contribute nutrients to the growth of white vannamei larvae (de Abreu *et al*., 2019).

Absolute length growth

Observations showed that the absolute length growth was significantly different (Figure 4) ($p<0.05$). The Duncan test results showed that treatment D was the highest followed by treatments B, C and the lowest was treatment A.

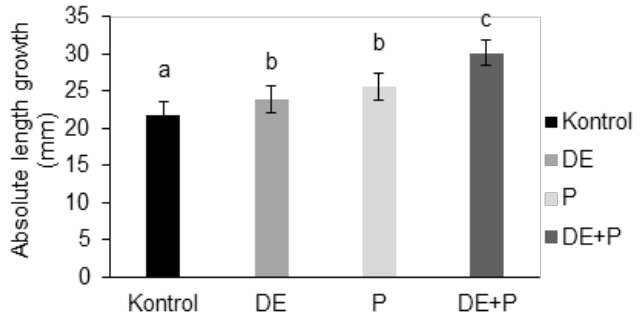

Figure 4. Absolute length growth in each treatment.

Based on the data in Figure (2.4) shows that the highest average absolute individual length growth of vannamei shrimp (*Litopenaeus vannamei*) was achieved by DE+P treatment of 30.2 mm, followed by P treatment of 25.57 mm. Then followed by DE treatment of 23.9 mm. Meanwhile, the lowest absolute length growth was the control treatment at 21.83 mm. This study is the first to show that administration of probiotics, epipelic diatoms and their combination enhances length growth.

Water quality

Temperature

The results of temperature measurements during the study were carried out in the morning and evening, there was no difference between treatments, which was in the same range every day (Figure 5).

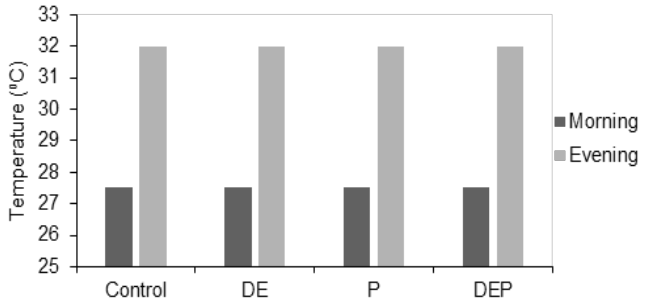

Figure 5. The temperature in the morning and evening for each treatment.

The results of the measurement of the temperature of the maintenance media during the study in the morning ranged from 27.5-28.5 °C and in the afternoon ranged from 31.9- 32.4 °C. the temperature obtained in each treatment during the study was still at the optimal temperature for vannamei shrimp. According to (Supono, 2018) vannameii shrimp have a wide temperature tolerance, so many are cultivated in tropical and subtropical countries. Vannamei shrimp can live at a temperature of 23-30 °C but grows optimally at a temperature of 27-30 °C. Likewise (Suwoyo *et al*., 2018), the temperature for optimal growth ranges from 29-30 °C while the temperature that causes death is <26-28 °C, shrimp will die if the temperature is below 15 °C or above 33 °C within 24 hours or more.

Dissolved oxygen (DO)

The results of measurements of dissolved oxygen in each treatment did not show any difference, in each treatment the average value of dissolved oxygen was 5.3-5.5 mg/L in the morning and in the afternoon in the range of 4.0-4.5 mg/L (Figure 6).

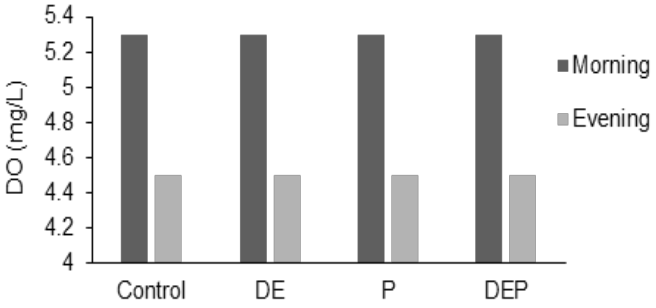

Figure 6. DO morning and evening for each treatment.

According to (Suwoyo *et al*., 2018), the optimal dissolved oxygen content for shrimp culture, which is >3, is said to be in the category suitable for the growth of white shrimp. The water quality that is very important to support the life of shrimp is oxygen because dissolved oxygen supports the aerobic decomposition of organic matter and nitrification by bacteria. In this study, the dissolved oxygen content in the vannamei shrimp rearing medium had a DO content >5 mg/L, so it was categorized in the appropriate category for vannamei shrimp culture.

Degree of acidity (pH)

The results of pH measurements in all treatments in the morning and evening did not show any difference, namely in the range of 7.4-7.6 in the morning, while the pH range in the afternoon ranged from 7.9-8.6 (Figure 7).

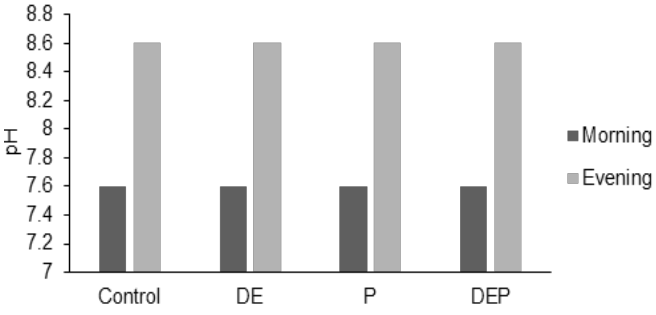

Figure 7. pH in the morning and evening for each treatment.

The degree of acidity (pH) in the morning and evening is still within tolerance for the life of vannamei shrimp. This pH range can be said to support the vannamei shrimp cultivation business. The optimal range of pH values in

vannamei shrimp culture ranges from 7.5 to 8.5. In this range, shrimp can experience optimal growth. The pH concentration of the water affects the shrimp's appetite and chemical reactions in the water. In addition, a pH that is below the tolerance range causes difficulty in changing the skin where the skin becomes soft and survival is low. (Supriatna *et al*., 2020).

Salinity

Salinity in this study was determined as a benchmark for research water media, according to the results of trials at an early stage, which was the growth medium for *Navicula* sp. ie at 20 ppt salinity. This is the reference for all treatment media in the trial set to 20 ppt. Salinity playsan important role in the regulation of osmoregulation. Vannamei shrimp can grow optimally in the 15-25 ppt salinity range, even some studies at 5 ppt salinity are still suitable for growth (Suwoyo & Mangampa, 2010).

Total ammonia nitrogen (TAN)

The results of ANOVA for ammonia data in media water showed that there was a significant difference between treatments ($p<0.05$). Duncan's test showed treatment D with the lowest TAN value followed by C and B then treatment A with the highest TAN value.

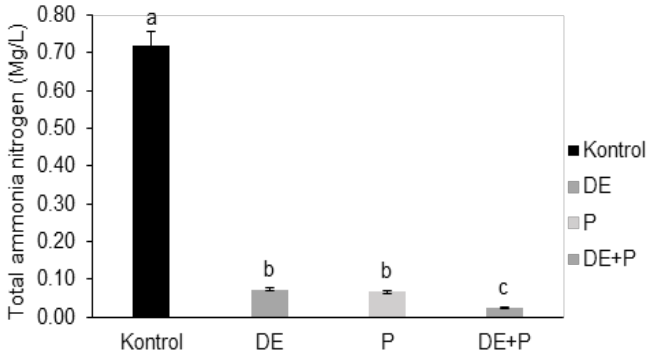

Figure 8. Total ammonia nitrogen (TAN).

Ammonia concentration in pond waters that exceeds the standard will inhibit the growth of shrimp. For the shrimp to grow well enough, the ammonia in the water should not be more than 0.1 mg/L. The pH value determines the concentration of undissociated ammonia. The direct effect of high ammonia levels is not yet lethal, but damage to the gill tissue and gill sheet will swell so that the function of the gills as a respiratory organ will be disrupted in binding oxygen by hemocyanin. In addition, high levels of ammonia can also increase the susceptibility of shrimp to disease (Maimunah & Kilawati, 2015).

Nitrite

The results of ANOVA for nitrite-N data in media water showed that there was a significant difference between treatments ($p<0.05$). Duncan's test showed treatments D and C with the lowest TAN value followed by B and then treatment A with the highest TAN value.

Nitrite is the result of the breakdown of ammonia by the aerobic bacteria Nitrosomonas. The optimal nitrite content for vannamei shrimp culture is 0.01-0.05 mg/L (Suwoyo *et al*., 2018). The decrease in nitrite compounds is thought to occur after the application of bacteria to the treatment and keeping the concentration below the quality standard (Herdianti *et al*., 2015). The abundance of nitrifying bacteria (bacteria that help process ammonia into nitrite and nitrate) is sufficient to produce a conducive and safe aquatic environment-contaminants (Pujihastuti, 2011). However, for acute toxicity of brackish water salinity, a much higher concentration of 178 ppm is required for LC96 (Ramírez-Rochín *et al*., 2017).

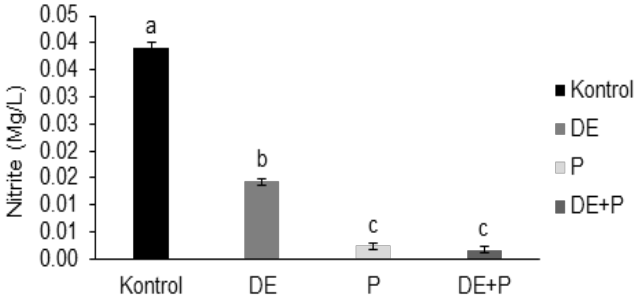

Figure 9. Nitrite content

Nitrate

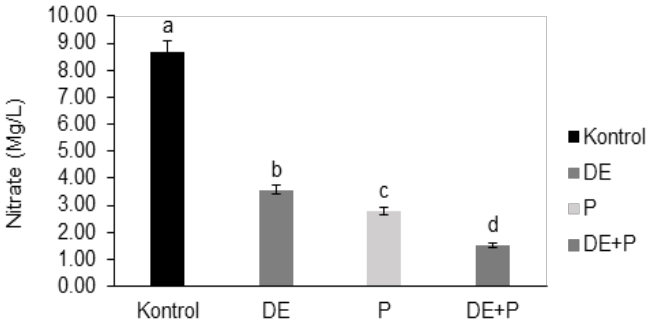

Figure 10. Nitrate content.

The concentration of nitrate in the control treatment was very high compared to the DE, P, and DEP treatments, namely the control treatment at 8.67 mg/L, DE treatment at 3.57 mg/L, and P treatment at 2.77 mg/L, while the lowest nitrate was treatment DE+P ranged from 1.53 mg/L.

Nitrate is the oxidation of nitrite by Nitrobacter bacteria in the nitrification process between nitrate and nitrogen in the denitrification process. According to (Suwoyo *et al*., 2018), the optimal nitrate concentration for white vannamei shrimp is in the range of 0.4-0.8 mg/L. However, the actual level to reach conditions that are harmful to shrimp health is at values above 177 mg/L (Furtado *et al*., 2015). Probiotic bacteria can potentially kill pathogenic bacteria and inhibit the denitrification process of nitrate and nitrite formation which can pollute the environment (Yuka *et al*., 2021)

Phosphate

The concentration of phosphate in the control treatment was very high compared to the DE, P, and DEP controls. The lowest phosphate was obtained by the combination of epipelic and probiotics. In the control treatment, the value of phosphate concentration was 2.4 mg/L, DE treatment was 0.71 mg/L and P treatment was 0.52 mg/L, while DE+P was 0.4 mg/L.

According to (Lestari, 2021), phosphate is one of the nutrients for the growth of phytoplankton and plants. The optimum phosphate concentration for phytoplankton

growth ranged from 0.09-1.80 mg/L. Meanwhile, phosphate waters have a maximum concentration of 0.021-0.05 mg/L.

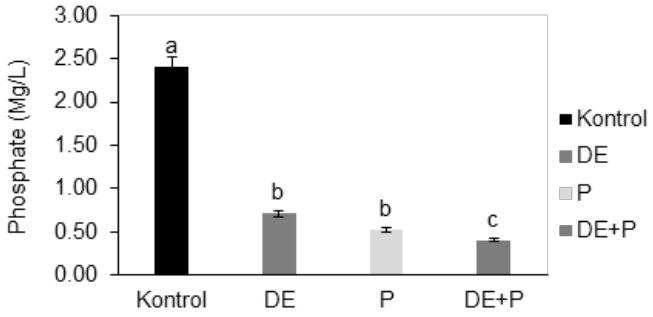

Figure 11. Phosphate content.

Alkalinity

The waters at the study site have a normal alkalinity content of seawater. The lowest alkalinity was in the DE+P combination treatment. For the control treatments, DE and P were not significantly different.

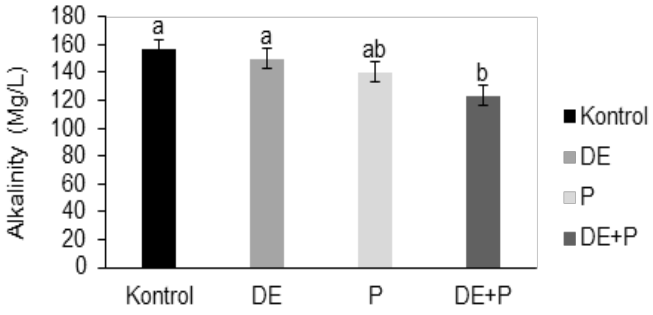

Figure 12. Alkalinity content.

Based on SNI 01-7246-2006, the water alkalinity value requirement for vannamei shrimp rearing ranges from 100-150 mg/L. Optimal alkalinity for vannamei shrimp cultivation activities ranges from 90-150 mg/L. Alkalinity or total alkalinity is the total concentration of basic elements contained in water or equivalent to calcium carbonate ($CaCO_3$) (Maimunah & Kilawati, 2015).

Vibrio test

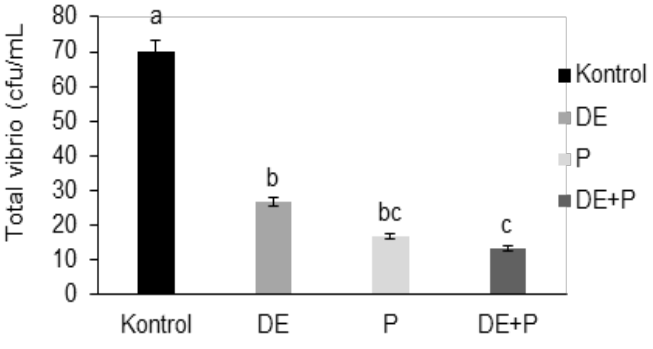

Figure 13. Vibrio test.

The total vibrio from the test results, the lowest value was found in the diatom + probiotic combination treatment followed by DE and P treatment. While the highest vibrio was found in the control treatment. Vibrio in the control treatment ranged from 70 cfu/mL, the DE treatment was 27 cfu/mL, and the P treatment was 17 cfu/mL, while the DEP was 13 cfu/mL.

The growth of bacterial species in aquaculture activities is influenced by the composition of nutrients and bacteria present in the waters. Some types of bacteria exist that require certain environmental conditions to grow and thrive. Several other types of bacteria even act as competitors for other types of bacteria. The low percentage of the appearance of the vibrio group of bacteria in the treatment was influenced by the performance of probiotics and lost to the nutrient competition (Sukenda *et al*., 2006). *Lactobacillus* sp. can suppress vibriosis in tiger prawns and vannamei shrimp (Karthik *et al*., 2014).

CONCLUSION

The application of epipelic diatoms and probiotics in treatment D with a dose of 5 mL each can provide the highest survival and growth of vannamei shrimp each survival of 75.2%, absolute weight growth of 0.48 g and absolute length reaching 30.20mm. Following treatment C using probiotics at a dose of 5 mL, survival was 63.2%, absolute weight was 0.31 g, absolute length was 25.57 mm, and treatment B was using epipelic diatoms at a dose of 5 mL, survival was 64%, absolute weight was 0. 30 g, absolute length (23.90 mm). Whereas in the control treatment (A) the survival was 47%, the absolute weight was 0.26 g and the absolute length was 21.83 mm.

The application of epipelic diatoms and probiotics each 5 mL (treatment D) on water quality had a significant effect on the TAN value of 0.1 mg/L, nitrite 0.01-0.02 mg/L, nitrate 1.53 mg/L and phosphate 0.37-0.47 mg/L. Followed by treatment C using 5 mL of probiotics and treatment B by administering 5 mL of epipelic diatoms. Meanwhile, treatment A (control) had the highest TAN, nitrite, nitrate and phosphate content. All treatments A, B, C and D had no significant effect on temperature, pH and DO.

Application of epipelic diatoms and probiotics each 5 mL (treatment D) had a significant effect with the lowest Vibrio content value of 13 cfu/mL, followed by treatment C with 5 mL of probiotics containing virio content of 17 cfu/mL and treatment B giving diatoms epipelik 5 mL with a vibrio content of 27 cfu/mL, while treatment A had the highest vibrio content, namely 70 cfu/mL.

REFERENCES

Akmal, Y., R. Humairani, M. Muliari & I. Zulfahmi. 2021. Peningkatan nilai ekonomi pada kelompok pembudidaya udang vannamei (*Litopenaeus vannamei*) Laut Mina Budidaya Kabupaten Bireuen, Aceh. Jurnal SOLMA. 10 (2): 275-286. https://doi.org/10.22236/solma.v10i2.6437

Boyd, C.E & C.S. Tucker. 2012. Pond aquaculture water quality management. Springer Science & Business Media. https://doi.org/10.1007/978-1-4615-5407-3

Chumpol, S., D. Kantachote, T. Nitoda & H. Kanzaki. 2017. The roles of probiotic purple nonsulfur bacteria to control water quality and prevent acute hepatopancreatic necrosis disease (AHPND) for enhancement growth with higher survival in white shrimp (*Litopenaeus vannamei*) during cultivation. Aquaculture. 473: 327-336. http://dx.doi.org/10.1016/j.aquaculture.2017.\02.033

Das, N.G & S.M.M. Sarwar. 1998. Nutritional analysis of two diatoms *Skeletonema* sp. and *Chaetoceros* sp. as diet for *Penaeus monodon* in hatchery. Indian Journal of Fisheries. 45 (2): 193-196. https://epubs.icar.org.in/index.php/IJF/article/view/8745

de Abreu, J.L., L.O. BritoM, P.C.M. de Lima, S.M.B.C. da Silva, W. Severi & A.O. Gálvez. 2019. Effects of addition of *Navicula* sp. (diatom) in different densities to post-larvae of shrimp *Litopenaeus vannamei* reared in a BFT system: Growth, survival, productivity and fatty acid profile. Aquaculture Research. 50 (8): 2231-2239. https://doi.org/10.1111/are.14104

Effendie, M.I. 1997. Biologi perikanan. Yayasan Pustaka Nusatama. Yogyakarta, 163.

Fuady, M.F., H. Haeruddin & M. Nitisupardjo. 2013. Pengaruh pengelolaan kualitas air terhadap tingkat kelulushidupan dan laju pertumbuhan udang vannamei (*Litopenaeus vannamei*) di PT. Indokor Bangun Desa, Yogyakarta. Management of Aquatic Resources Journal (MAQUARES). 2 (4): 155-162. https://doi.org/10.14710/marj.v2i4.4279

Furtado, P.S., B.R. Campos, F.P. Serra, M. Klosterhoff, L.A. Romano & W. Wasielesky. 2015. Effects of nitrate toxicity in the Pacific white shrimp, *Litopenaeus vannamei*, reared with biofloc technology (BFT). Aquaculture International. 23 (1): 315-327. http://dx.doi.org/10.1007/s10499-014-9817-z

Harsojuwono, B. A., Arnata, I. W., & Puspawati, G. 2011. Rancangan Percobaan.

Herdianti, L., S. Soewardi & S. Hariyadi. 2015. Efektivitas penggunaan bakteri untuk perbaikan kualitas air media budi daya udang vannamei (*Litopenaeus vannamei*) super intensif. Jurnal Ilmu Pertanian Indonesia. 20 (3): 265-271. https://doi.org/10.18343/jipi.20.3.265

Jauffrais, T., H. Agogué, M.-P. Gemin, L. Beaugeard & V. Martin-Jézéquel. 2017. Effect of bacteria on growth and biochemical composition of two benthic diatoms *Halamphora coffeaeformis* and *Entomoneis paludosa*. Journal of Experimental Marine Biology and Ecology. 495: 65-74. https://doi.org/10.1016/j.jembe.2017.06.004

Karthik, R., A.J. Hussain & R. Muthezhilan. 2014. Effectiveness of *Lactobacillus* sp. (AMET1506) as probiotic against vibriosis in *Penaeus monodon* and *Litopenaeus vannamei* shrimp aquaculture. Bioscience Biotechnology Research Asia. 11: 297-305. http://dx.doi.org/10.13005/bbra/1423

Kurnia, D. 2020. Kandungan kimia dari *Navicula* sp. dan bioaktivitasnya. Indonesia Natural Research Pharmaceutical Journal. 5 (1): 65-69. https://doi.org/10.52447/inspj.v5i1.4049

Lasima, W., M. Syamsun & D. Kadarisman. 2012. Tingkat penerapan manajemen mutu pada UMKM pembenihan udang di Jawa Timur. MANAJEMEN IKM: Jurnal Manajemen Pengembangan Industri Kecil Menengah. 7 (2): 143-151. https://doi.org/10.29244/mikm.7.2.143-151

Lestari, I. 2021. Dampak Limbah Organik Tambak Udang Vannamei Super Intensif Terhadap Tingkat Eutrofikasi Perairan Pantai Desa Palajau Kecamatan Arungkeke Kabupaten Jeneponto. http://repository.unhas.ac.id/id/eprint/4561

Maimunah, Y & Y. Kilawati. (2015). Kualitas lingkungan tambak intensif *Litopenaeus vannamei* dalam kaitannya dengan prevalensi penyakit white spot syndrome virus. Research Journal of Life Science. 2 (1): 50-59. https://doi.org/10.21776/ub.rjls.2015.002.01.7

Makmur, R & M. Fahrur. 2011. Hubungan antara kualitas air dan plankton di tambak Kabupaten Tanjung Jabung Barat Provinsi Jambi. Prosiding Forum Inovasi Teknologi Akuakultur. 2 (1): 961-968.

Mangampa, M & H.S. Suwoyo. 2016. Budidaya udang vannamei (*Litopenaeus vannamei*) teknologi intensif menggunakan benih tokolan. Jurnal Riset Akuakultur. 5 (3): 351-361. http://dx.doi.org/10.15578/jra.5.3.2010.351-361

Marinho, Y.F., L.O. Brito, C.V.F da Silva-Campos, W. Severi, H.A. Andrade & A.O. Galvez. 2017. Effect of the addition of *Chaetoceros calcitrans*, *Navicula* sp. and *Phaeodactylum tricornutum* (diatoms) on phytoplankton composition and growth of *Litopenaeus vannamei* (Boone) postlarvae reared in a biofloc system. Aquaculture Research. 48 (8): 4155-4164. https://doi.org/10.1111/are.13235

Molina-Cárdenas, C.A & M. del Pilar Sánchez-Saavedra. 2017. Inhibitory effect of benthic diatom species on three aquacullture pathogenic vibrios. Algal Research. 27: 131-139. https://doi.org/10.1016/j.algal.2017.09.004

Nurlaila, N., I. Dewiyanti & S. Wijaya. 2016. Identifikasi dan prevalensi ektoparasit pada udang vannamei (*Litopenaeus vannamei*) di Kabupaten Aceh Besar. Syiah Kuala University. Jurnal Ilmiah Mahasiswa Kelautan Perikanan Unsyiah.

Prabowo, W.T., S. Subaidah & R.W.P. Nawawi. 2019. Aplikasi sistem pada pendederan udang vannamei dengan kepadatan tinggi untuk meningkatkan tingkat kelangsungan hidup. Jurnal Perekayasaan Budidaya Air Payau dan Laut. 14: 15-20.

Pujihastuti, Y.P. 2011. Nitrification and denitrification in pond. Jurnal Akuakultur Indonesia. 10 (1): 89-98. https://doi.org/10.19027/jai.10.89-98

Purnamasari, I., M. Saad, M. Ali, M. Muntalim & M.H. Ardiansya. 2019. Upaya pengembangan usaha budidaya udang vanname (*Litopenaeus vannamei*) di Desa Sidokumpul Kecamatan Lamongan Kabupaten Lamongan. Grouper: Jurnal Ilmiah Fakultas Perikanan Universitas Islam Lamongan. 10 (1): 18-22. https://doi.org/10.30736/grouper.v10i1.48

Ramadhanthie, R., M.G.E Kristiany & D. Rukmono. 2021. Kajian teknis dan analisis finansial pembenihan udang vannamei (*Litopenaeus vannamei*) di CV. Pasific Harvest Shrimp Hatchery, Banyuwangi, Jawa Timur. Buletin Jalanidhitah Sarva Jivitam. 2 (1): 13-22. http://dx.doi.org/10.15578/bjsj.v2i1.8807

Ramírez-Rochín, J., M.G. Frías-Espericueta, J.F. Fierro-Sañudo, S.G. Alarcón-Silvas, M.G. Fregoso-López & F. Páez-Osuna. 2017. Acute toxicity of nitrite on white

shrimp Litopenaeus vannamei (Boone) juveniles in low-salinity water. Aquaculture Research. 48 (5): 2337-2343. https://doi.org/10.1111/are.13069

Shumway, S.E & G.J. Parsons. 2016. Scallops: biology, ecology, aquaculture, and fisheries. Elsevier. https://doi.org/10.1016/S0167-9309(06)80024-4

Sukenda, S., P. Hadi & E. Harris. 2006. Pengaruh Pemberian Sukrosa Sebagai Sumber Karbon Dan Probiotik Terhadap Dinamika Populasi Bakteri Dan Kualitas Air Media Budidaya Udang Vannamei, *Litopenaeus vannamei*. http://repository.ipb.ac.id/handle/123456789/56105

Supono, S. 2006. The productivity of white shrimp at intensif fishpond in Tulang Bawang Lampung. Saintek Perikanan: Indonesian Journal of Fisheries Science and Technology. 2 (1): 48-53. https://doi.org/10.14710/ijfst.2.1.48-53

Supono, S. 2008. analisis diatom epipelic sebagai indikator kualitas lingkungan tambak untuk budidaya udang. Program Pasca Sarjana Universitas Diponegoro.

Supono, S. 2018. Manajemen Kualitas Air untuk Budidaya Udang. Aura.

Supriatna, M., M. Mahmudi & M. Musa. 2020. Model ph dan hubungannya dengan parameter kualitas air pada tambak intensif udang vannamei (*Litopenaeus vannamei*) di Banyuwangi Jawa Timur. JFMR (Journal of Fisheries and Marine Research). 4 (3): 368-374. http://dx.doi.org/10.21776/ub.jfmr.2020.004.03.8

Suriadnyani, N.N., N.L.T Aryani & K. Mastantra. 2017. Kultur massal diatom sebagai sediaan pakan alami pada pembenihan udang windu (*Penaeus monodon*). Buletin Teknik Litkayasa Akuakultur. 6 (1): 35-38. http://dx.doi.org/10.15578/blta.6.1.2007.35-38

Suwoyo, H.S & M. Mangampa. 2010. Aplikasi probiotik dengan konsentrasi berbeda pada pemeliharaan udang vannamei (*Litopenaeus vannamei*). Prosiding Forum Inovasi Teknologi Akuakultur. 239.-247. http://ejournal-balitbang.kkp.go.id/index.php/fita/article/view/6386

Suwoyo, H.S. 2009. Tingkat konsumsi oksigen sedimen pada dasar tambak intensif udang vannamei (*Litopenaeus vannamei*). Institut Pertanian Bogor. Bogor. http://perpustakaan.kkp.go.id/union/index.php?p=show_detail&id=14854

Suwoyo, H.S., M. Fahrur & R. Syah. 2018. Pengaruh jumlah titik aerasi pada budidaya udang vannamei, *Litopenaeus vannamei*. Jurnal Ilmu dan Teknologi Kelautan Tropis. 10 (3): 727-738. https://doi.org/10.29244/jitkt.v10i3.24999

Syadillah, A., S. Hilyana & M. Marzuki. 2020. Pengaruh penambahan bakteri (*Lactobacillus* sp.) dengan konsentrasi berbeda terhadap pertumbuhan udang vannamei (*Litopenaeus vannamei*). Jurnal Perikanan Unram. 10 (1): 8-19. https://doi.org/10.29303/jp.v10i1.146

Windler, M., A. Gruber & P.G. Kroth. 2012. Purification of benthic diatoms from associated bacteria using the antibiotic imipenem. Journal of Endocytobiosis and Cell Research. 22: 62-65. http://nbn-resolving.de/urn:nbn:de:bsz:352-219682

Yuka, R.A., A. Setyawan & S. Supono. 2021. Identifikasi bakteri bioremediasi pendegradasi total ammonia nitrogen (TAN). Jurnal Kelautan: Indonesian Journal of Marine Science and Technology. 14 (1): 20-29. https://doi.org/10.21107/jk.v14i1.8499

Yuniarso, T. 2006. Peningkatan kelangsungan hidup, pertumbuhan, dan daya tahan udang windu (*Penaeus monodon* fab.) stadium pl 7 - pl 20 setelah pemberian silase artemia yang telah diperkaya dengan silase ikan.

How to cite this article Wardi, W., S.P. Sektiana & B. Suprakto. 2023. Applications of Epipelic Diatoms and Probiotics for Pacific White Shrimp Nursery (*Litopenaeus vannamei*). Jurnal Perikanan Universitas Gadjah Mada. 25 (1): 41-49. DOI https://doi.org/10.22146/jfs.76272