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PRODUCTIVITY OF WHITE SHRIMP (*Litopenaeus vannamei*) WITH THE ADDITION OF PROBIOTICS AND PREBIOTICS

Produktivitas Udang Vaname (*Litopenaeus vannamei*) dengan Penambahan Probiotik dan Prebiotik

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ABSTRACT

Vaname shrimp remains a prime commodity due to several advantages, including the ability to thrive in a salinity range of 0.5-31 ppt, with a stocking density of 100-300 individuals/m², a faster growth cycle of 90-100 days, and a high appetite leading to rapid growth. Currently, the technology for culturing vaname shrimp has advanced with the implementation of intensive systems that utilize high stocking densities, although this impacts water quality. One approach to maintaining good water quality, especially in reducing organic waste, is the use of prebiotics and probiotics. Further studies are needed to determine the productivity of vaname shrimp with the addition of probiotics and prebiotics in shrimp culture. This research employed a survey method with parameters observed including productivity and water quality. Productivity encompassed stocking density, Average Body Weight (ABW), Average Daily Growth (ADG), population, biomass, Food Conversion Rate (FCR), Survival Rate (SR), and size. Water quality parameters measured included salinity, temperature, pH, DO using a Multitester, alkalinity, TOM, Ca, Mg, Total Hardness using titration, PO_4, NH_4, NO_3, NO_2 using a test kit, the number of green algae, blue-green algae, diatoms, euglena, and dinoflagellates using a hemocytometer, zooplankton, and protozoa using a Sedgewick Rafter, total bacteria, total vibrio, and the number of yellow, green, and black vibrio using Total Plate Count (TPC). Data analysis used descriptive methods. The results showed that the harvest exceeded the company's target, and the SR and FCR values were categorized as good in vaname shrimp cultivation. Water quality measurements indicated that conditions were still optimal for vaname shrimp culture.

Keywords: Aquaculture, Prebiotic, Probiotic, Vannamei Shrimp

ABSTRAK

Udang vaname saat ini masih menjadi komoditas unggulan dikarenakan beberapa keunggulan yang dimiliki antara lain mampu hidup di kisaran salinitas 0,5-31 ppt, dengan kisaran padat tebar 100-300 ekor/m^2, dengan waktu pemeliharaan satu siklus lebih cepat yakni 90-100 hari dan memiliki selera makan yang tinggi sehingga cepat mengalami pertumbuhan. Saat ini,

teknologi pembesaran udang vaname semakin berkembang dengan adanya teknologi intensif yang menerapkan padat tebar yang tinggi namun hal ini berpengaruh terhadap kualitas air. Salah satu usaha yang dapat dilakukan untuk mempertahankan kualitas air yang baik terutama dalam mereduksi limbah bahan organik adalah menggunakan prebiotik dan probiotik. Studi lanjut perlu dilakukan untuk mengetahui produktivitas udang vaname dengan penambahan probiotik dan prebiotik pada pemeliharaan udang. Penelitian ini menggunakan metode survey dengan parameter penelitian yang diamati produktivitas dan kualitas air. Produktivitas meliputi padat tebar, *Average Body Weight* (ABW), *Average Daily Growth* (ADG), populasi, biomassa, *Food Convention Rate* (FCR), *Survival Rate* (SR) dan *Size*. Parameter kualitas air yang diamati meliputi, salinitas, suhu, pH, DO yang diukur menggunakan Multitester, Alkalinitas, TOM, Ca, Mg, Total *Hardness*, menggunakan titrasi, PO_4, NH_4, NO_3, NO_2 menggunakan test kit, jumlah plankton alga hijau, alga hijau biru, diatom, euglena, dinoflagellata, menggunakan haemocytometer, zooplankton, protozoa menggunakan Sedgewick Rafter, total bakteri, total vibrio, serta jumlah vibrio kuning, hijau dan hitam menggunakan *Total Plate Count* (TPC). Analisis data menggunakan metode deskriptif. Hasil penelitian menunjukkan hasil panen sudah melebihi target dari perusahaan, nilai SR dan FCR termasuk dalam kategori baik dalam kegiatan pembesaran udang vaname. Hasil pengukuran kualitas air menunjukkan masih tergolong optimum bagi pembesaran udang vaname.

Kata Kunci: Pembesaran, Prebiotik, Probiotik, Udang Vaname

INTRODUCTION

White Shrimp or what is known by the public as vaname comes from Central America. White shrimp is a superior commodity that causes high market demand, high prices so that cultivation is growing rapidly (Fatimah et al., 2022). Vaname shrimp is a priority export commodity because vaname shrimp has many advantages such as being able to survive in a salinity range of 0.5-31 ppt, with a stocking density range of 100-300 tails/m2., with a faster one-cycle maintenance time of 90-100 days and has a high appetite so that it grows quickly (Shilman et al., 2023).

Currently, vaname shrimp farming technology is increasingly developing with intensive technology that applies high stocking densities. This can be an opportunity to develop a vaname shrimp farming business. One of the impacts of the intensification of vaname shrimp cultivation is a decrease in water quality. Decreased water quality can interfere with the growth of vaname shrimp and cause low survival rates of vaname shrimp (Yunarty & Renitasari, 2022). One effort that can be made to maintain good water quality, especially in reducing organic waste, is to use prebiotics and probiotics. Probiotics help decompose organic materials, such as leftover feed and shrimp feces, which can pollute water and endanger shrimp health (Citria, 2018). Meanwhile, the provision of prebiotics can increase fish digestibility. Prebiotics act as "food" for good bacteria (probiotics) in the digestive tract of fish. Prebiotics themselves are nutrients that cannot be digested by humans, but can be fermented by good bacteria (probiotics) in the intestines. Prebiotics act as "food" for probiotic bacteria, helping them to grow and reproduce (Sari et al., 2018).

The use of probiotics in ponds is believed to be able to improve water quality and inhibit the growth of pathogenic microorganisms, thereby creating healthy and sustainable pond conditions (Dewi et al., 2023). The provision of probiotics in maintenance water was carried out by Burhanuddin et al. (2016). The administration of probiotics in the maintenance of whiteleg shrimp greatly affects the chemical quality of water and the survival of whiteleg shrimp which can even reach 100%. This is because the administration of probiotics fights bad bacteria in the digestive tract by competing for space and food, so that their numbers are reduced. Probiotics help the body fight disease by increasing the body's resistance, including

increasing the number of antibodies and white blood cells.

In addition to probiotics, there are prebiotics which, when given to shrimp, can increase growth, survival rate, feed efficiency, and the composition of beneficial bacteria. Based on these benefits, a study is needed to determine the productivity of whiteleg shrimp with the addition of probiotics and prebiotics in shrimp maintenance.

METHODS

Time and Place

The method used in this study uses a survey method, which is a research method that aims to obtain a general description of data described by a sample (Maidiana, 2021). The research location is at PT. Sejahtera Indah Perkasa, Bangka City, Bangka Belitung Islands which was carried out from October to December 2023. There are four vaname shrimp rearing ponds observed. The pond is round, measuring 1900 m^2, with a circle diameter of 50 m and a bund height of 2.5 m.

Land Preparation and Vaname Shrimp Maintenance Media

The initial stage in preparing the cultivation container is cleaning the cultivation facilities and infrastructure. Furthermore, HDPE repairs, bund repairs, and installation of facilities and infrastructure are carried out. The installation of the facilities and infrastructure in question is the installation of pendulums, nanobubbles, aeration hoses, water wheels, outlet pipes, siphon pipes, overflow pipes, and ancos. The number of water wheels used in one pond is six. Two water wheels with a power of one HP and four water wheels with a power of two HP. The final stage is the process of drying the pond which is carried out for 2-3 days by utilizing sunlight.

The process of preparing the vaname shrimp maintenance media begins with filling the water, then the water is sterilized using UV and TCCA 90% with a dose of 15 ppm. The final stage is mixing the ingredients for plankton growth consisting of minerals, probiotics and dolomite. The ingredients and doses of plankton formation based on the company's SOP can be seen in Table 1.

Table 1. Mixture of Plankton Forming Materials

Type	Material	Dose (ppm)	Information
Mineral	Tohor	1	Dissolved in 50 L of fresh water
	Dolomite	0.5	
	Azomite	0.1	
	Zeolite	0.2	
	Molasses	0.1	
	Metasilicate	0.1	
Probiotic	Feed	0.03	Dissolved with 50 L of fresh water and
	Sugar	1	fermented for 24 hours using aeration
	Sodium	0.1	
	Tiptopp pond	0.05	
Tohor	Tohor	23	Directly spread
Dolomite	Dolomite	23	Directly spread

Probiotic and Prebiotic Culture

Probiotic and prebiotic cultures are carried out every morning using the ingredients and doses listed in Table 1. Probiotic culture is carried out by dissolving all probiotic ingredients with 50 L of fresh water, then fermenting for 24 hours and aerating in a drum. Prebiotic culture is carried out by dissolving all ingredients with 50 L of fresh water, then tightly closing for 24

hours. The ingredients for making probiotics and prebiotics based on the company's SOP can be seen in the table below.

Table 2. Ingredients and Dosage for Making Probiotics and Prebiotics

Type	Material	Dose (ppm)	Information
Probiotic	Yeast	0.05	All ingredients are dissolved in 50 L of fresh water
	Tiptopp	0.05	and fermented using aeration for 24 hours
Prebiotic	Wheat flour	1.3	All ingredients are dissolved in 50 L of fresh water
	Sugar	0.9	and tightly closed for 24 hours

Yeast functions to increase pH (Oktaviana et al., 2015). The carbohydrate and protein content in wheat flour is expected to provide nutrients for bacterial growth (Suharyono et al., 2019). Sugar acts as a carbon source to provide nutrients for bacteria (Salma & Ratni, 2022). Tiptopp containing Bacillus sp. bacteria functions to suppress *Vibrio* sp. This is in accordance with the opinion of Mustafa et al. (2019) which states that the ability of probiotics to suppress the number of *Vibrio* sp. bacteria is influenced by the combination of bacteria contained in the probiotics used such as *Bacillus* sp., *Pseudomonas* sp., *Nitrosomonas* sp., *Aerobacter* sp. and *Nitrobacter* sp.

Probiotic and Prebiotic Administration in Maintenance Media

Probiotic and prebiotic distribution is carried out in the morning after feeding and morning siphoning. Probiotic distribution is carried out once every 3 days while prebiotic distribution is carried out once a day for 2 days. The order of distribution with a ratio of 1:2 is probiotic-prebiotic-prebiotic. This distribution is done by spreading it right in front of the current generated by the water wheel.

Feeding and Feed Enrichment

Feeding greatly affects the growth and development of shrimp. The feeding methods used are the blind feeding method and the demand feeding method. The feeding program and method can be seen in Table 3.

Table 3. Feeding Program

DOC	Frequency of Administration	Feeding Time	Feeding Method
1-30	5 Times a Day	08.00 WIB, 11.00 WIB, 14.00 WIB, 17.00 WIB, 20.00 WIB	Blind feeding
31-harvest	7 Times a Day	07.00 WIB, 09.30 WIB, 12.00 WIB, 14.30 WIB, 17.00 WIB, 19.30 WIB, 22.00 WIB	Demand feeding

The blind feeding method in this study was carried out with the assumption that every 100,000 fry were given 2 kg of feed, this statement is in accordance with Ritonga et al. (2021), which states that the provision of vaname shrimp feed is calculated with the assumption that 100,000 fry are given 1-3 kg of feed. Every day the feed will be added by 0.2-0.6 per 100,000 fry or 0.5-1.5 kg of feed in one day, calculated from DOC 2 to DOC 30.

The demand feeding method starts from DOC 31 until harvest. This method is carried out by checking the anco as an indicator of feed reduction if in one feeding hour there is remaining feed in the anco, then in the next feeding hour the feed will be reduced. The calculation of feed reduction based on the remaining feed in the anco can be seen in Table 4.

Table 4. Feed Reduction Based on Anco Score

Anco Control Results		Feed Reduction (%)
H	H	Still
H	S	10-30
S	S	30-50
H	B	50-fasting
S	B	50-fasting
B	B	Fasting

Description:
H: Finished
S: Little left or ≤ 10 feed grains
B: Lots left or ≥ 10 feed grains

The anco score and anco checking time can be seen in table 5.

Table 5. Anco Dosage and Control Program

DOC	Anco (%)	Check Time (Hours)
20-30	0.8	2.5
31-34	1	2.5
35-59	1	2
60-69	3	1.5
70-79	3	1
80-Harvest	3	0.75

High stocking density affects the amount of feed given, the higher the stocking density, the more feed will be given. To meet the nutritional needs required for shrimp, it is necessary to add vitamins and minerals to the vaname shrimp feed, such as super aqua, chemo attractant and hepatop. The function of using super aqua is to reduce stress on shrimp, increase shrimp immunity and provide minerals. According to Taqwa et al. (2021), the benefits of minerals are to help shrimp molt and harden new shells. The use of chemo attractant can increase shrimp immunity through beta glucan and natural antibiotics from garlic extract. Allicin contained in garlic can significantly increase leukocyte cells in fish blood, so garlic can be used as an efficient immunostimulant (Simorangkir et al., 2020). The use of hepatop containing vitamins and minerals functions as an immunostimulant which functions to maintain endurance, increase growth and survival (Budiyati et al., 2022).

The following is a mixture of feed used in this study which aims to increase the growth of vaname shrimp (Table 6).

Table 6. Vaname Shrimp Feed Mix

Time of Administration (WIB)	Mixed ingredients	Amount* (g)	Water* (ml)
07.00	-	-	-
09.00 and 12.00	Hepatop	3	25
14.30	Chemo Attraktant	3	25
17.00, 19.30 and 22.00	Super Aqua	3	100

Description: *Quantity for 1 kg of feed

Research Parameters

1. Productivity

The data observed in this study were productivity which included stocking density, Average Body Weight (ABW), Average Daily Growth (ADG), population, biomass, Food Convention Rate (FCR), Survival Rate (SR) and Size. Stocking density, average shrimp weight (ABW), average daily weight gain of shrimp in a certain period of time (ADG), population, shrimp biomass, Survival of vaname shrimp at the end of maintenance (SR), feed conversion ratio (FCR), and number of shrimp per 1 kg (size) were calculated using the following formula:

1. Stocking Density (Linayati et al., 2019)

$$\text{Stocking Density} = \frac{\text{Number of fry}}{\text{Pond area}}$$

2. Avarage Body Weight (ABW) (Wahyudi et al., 2022)

$$\text{ABW} = \frac{\text{Shrimp weighing scale(g)}}{\text{Number of shrimp (tails)}}$$

3. Avarage Daily Growth (ADG) (Wahyudi et al., 2022)

$$\text{ADG} = \frac{\text{ABW sampling I (g)} - \text{ABW sampling II (g)}}{\text{Sampling period (days)}}$$

4. Population (Effendi, 2000)

$$\text{Population} = \frac{\text{Biomass}}{\text{ABW}}$$

5. Biomass (Fajri, 2016)

$$\text{Biomass} = \text{Population (tails) x ABW (g)}$$

6. Survival Rate (SR) (Wahyudi et al., 2022)

$$\text{ABW} = \frac{\text{Number of live shrimp}}{\text{Number of shrimps spread}} \text{x } 100\%$$

7. Feed Convertion Ratio (FCR) (Kayandi et al., 2022)

$$\text{FCR} = \frac{\text{Amount of feed used up}}{\text{Biomass}} \text{x land area}$$

8. Size

$$\text{Size} = \frac{1000 \text{ (g)}}{\text{ABW}}$$

2. Water Quality

Vaname shrimp farming business activities require water quality management, one of which is monitoring water quality parameters. The purpose of this monitoring is to monitor the condition of the water during the cultivation process. The water quality parameters observed include, salinity, temperature, pH, DO measured using a Multitester, Alkalinity, TOM, Total Hardness, using titration, PO_4, NH_4, NO_3, NO_2 using a test kit, the number of green algae plankton, blue green algae, diatoms, euglena, dinoflagellates, using a haemocytometer, zooplankton, protozoa using Sedgewick Rafter, total bacteria, total vibrio, and the number of yellow, green and black vibrio using Total Plate Count (TPC).

Data Analysis

The data obtained will be presented in the form of a table and then analyzed descriptively. Descriptive analysis is data analysis by describing or depicting the data that has been collected (Sugiyono, 2015).

RESULT

In a cultivation activity, a company has a target in carrying out cultivation. The success of a cultivation can be seen from the results of the cultivation carried out. The following is productivity data during the study.

Table 7. Productivity Data

Production Performance	Pond E7	Pond E8	Pond E9	Pond E10
Number of stocking (fish)	245,000	245,000	245,000	245,000
Density (fish/m^2)	129	129	129	129
Harvest biomass (kg)	2,641.84	2,484.98	2,701.38	2,823.12
Cumulative feed (kg)	3,318	3,541	3,330	3,468
Population (fish)	197,187	216,417	227,591	205,071
ABW (g)	13.40	11.48	11.87	13.76
Size (fish)	75	87	84	73
FCR	1.2	1.4	1.2	1.2
SR (%)	80.48	88.33	92.89	83.70
DOC	71	73	72	73
Harvest Target (Tons/cycle)	2.3	2.3	2.3	2.3

Table 8. Water Quality of Maintenance Media

Parameter	Unit	SOP	Measurement Results	Optimum Value (Reference)
Salinity	ppt	26 - 30	24.54 – 37.21	26-32[a]
Temperature	^oC	29-29.64	27.46 - 31.14	29-32[a]
pH	ppt	7 – 8.25	5.37 - 8.5	7.5 – 8.5[a]
DO	mg/l	7-9	4.93-10.97	>4[a]
Alkalinity	ppm	≥ 120	88 - 173	100 – 150[a]
TOM	mg/l	< 90	82.16– 140	< 90[f]
PO_4	mg/l	0.5 – 1.0	0 – 3	≤ 0.01[a]
NH_4	mg/l	≤ 0.5	0 – 3.3	< 0.5[c]
NO_2	mg/l	≤ 0.2	0 – 3	<0.06[b]
NO_3	mg/l	≤ 35	4 - 15	0.06-1.0[e]
Total Hardness	mg/l	> 2000	1435 - 7900	1300-2500[d]
Number of Plankton	cells/ml	-	77.5 – 2,967,500	-
GA	cells/ml	50-90%	72.20 – 100	-
BGA	cells/ml	< 10%	0.09 – 17.58	-
Diatom	cells/ml	< 25%	0.09 – 14.06	-
Euglena	cells/ml	< 5%	0.10 – 4.36	-
Dino	cells/ml	< 5%	0.10 – 19.35	-
Protozoa	cells/ml	< 5%	0.09 - 7.69	-
Zoo	cells/ml	< 1%	0.09 -1.38	-
Vibrio Yellow	CFU/ml	< 1000	0 - 970	-
Vibrio Green	CFU/ml	< 100	0 - 910	-
Vibrio Black	CFU/ml	0	0	-
Total Bacteria	CFU/ml	> 10 x TVC	0 - 990	≤ 1x10
Total Vibrio	CFU/ml	< 3000	1.4 - 118.3	-
Vibrio	CFU//ml	< 5%	0 - 54%	-

Notes: PERMEN-KP/2016[a], Suhendar et al. (2020)[b], Agrianti et al. (2022)[c], Alfionita (2022)[d], Adibrata et al. (2022)[e], SNI (2014)[f]

DISCUSSION

The harvest carried out at PT Sejahtera Indah Perkasa was a total harvest at DOC 70-73 because the selling price of shrimp experienced a significant increase in price, harvesting at DOC 70 was carried out in order to reduce operational costs and prevent the emergence of diseases that could harm the company. The stocking density in vaname shrimp cultivation activities with an intensive system at PT Sejahtera Indah Perkasa is 129 tails/m^2. In intensive system cultivation, vaname shrimp cultivation can be carried out with a high stocking density, namely between 100-300 tails per square meter (Minanur et al., 2024).

Probiotic administration is beneficial for shrimp growth. Probiotic bacteria are microorganisms that do not cause disease (non-pathogenic) and have a positive impact on the organisms being cultivated. These benefits include improving the quality of the environment where the organism lives, increasing the absorption of nutrients from the feed consumed, and increasing the host's immune response to various diseases (Widanarni et al., 2014). Probiotics in cultivation can be given through water and feed, both live feed (rotifers, Artemia) and artificial feed (Tuiyo et al., 2022).

Based on research conducted by Ramdhani et al. (2018), the provision of prebiotics in feed has an effect on the growth of vaname shrimp. Oligosaccharides in prebiotics play an important role in increasing nutrient absorption in the intestine, which then supports optimal growth. Some of the benefits produced by probiotics and prebiotics can be seen in the results of FCR, SR and harvest targets in the study which are still relatively good and even exceed the company's production target.

The SR target at PT Sejahtera Indah Perkasa at DOC 70 and above is 80%. The SR value during the total harvest in the first cycle of cultivation reached 80.48% in pond E7, 88.33% in pond E8, 92.89% in pond E9 and pond E10 of 83.70%. From these data, it can be seen that the SR value for the first cycle was declared successful in carrying out cultivation activities. According to Yuniarty (2022), the SR value is said to be good for shrimp cultivation, which is more than 70%. Several studies that have been conducted by providing probiotics for the maintenance of vaname shrimp have had an impact, namely increasing the SR of vaname shrimp (Jannah et al., 2018; Agustama et al., 2021).

FCR is the efficiency of feed use which is calculated by comparing the amount of feed given with the results of shrimp harvest biomass. The FCR target at PT Sejahtera Indah Perkasa at DOC 70 is 1.2. While the highest FCR value is 1.4 in pond E8 and the lowest FCR value is 1.2 in ponds E7, E9 and E10. The FCR value in ponds E7, E9 and E10 has reached the company's target, while for pond E8 with an FCR value of 1.4, this is not in accordance with the company's target, but the FCR value is still relatively good, the FCR value in vaname shrimp ponds ranges from 1.4 - 1.8 (Arsad et al., 2017). The presence of probiotic bacteria and increased natural microflora, especially in the small intestine, will increase the host's digestive ability by producing digestive enzymes. This has a positive impact on the Feed Conversion Ratio (FCR) because more feed content is hydrolyzed, so that the feed can be utilized by fish more effectively (Sari et al., 2018). The presence of prebiotics themselves acts as food for the microflora that live in the intestines (Kusmiyati, 2020). These prebiotics will accelerate the development of beneficial bacteria that inhabit the digestive tract (Oktaviana & Febriani, 2023) so that this will have a positive effect on digestibility.

In the measurement of water quality parameters carried out, the results of the measurement of salinity, temperature, pH, DO, alkalinity and PO_4 parameters were in accordance with PERMEN-KP/2016. checking the TOM parameters in accordance with SNI (2014) and NO_2 in accordance with the statement of Suhendar et al. (2020). The opinion of Agrianti et al. (2022), regarding NH_4 in accordance with the established SOP but the results of the check did not reach the maximum limit. The results of the Ca, Mg and T Hardness checks were in accordance with the SOP and the opinion of Alfionita (2022). The results of the NO_3

check did not match the statement of Adibrata et al. (2022), where the results of the check were too high.

The pH, phosphate, nitrite and TOM parameters have a level of correlation with other parameters. The Phosphate parameter is related to the parameters of dissolved oxygen, brightness, alkalinity, nitrite, and organic matter. In the aquatic ecosystem itself, phosphate acts as a limiting factor for aquatic productivity. The content of organic matter in ponds (TOM) is closely related to several other factors such as acidity (pH), salt content (salinity), phosphate content, and nitrite content. The more turbid the pond water, the more organic matter it contains. These organic materials come from the remains of living things, dirt, mud, and leftover feed that settles at the bottom of the pond (Ariadi et al., 2021).

CONCLUSION

The provision of probiotics and prebiotics in the enlargement of vaname shrimp has an impact on the results of FCR, SR and the resulting production targets. The results of FCR, SR and production targets are in accordance with the targets in the company.

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