The Effect of Different Probiotic Sources on Vannamei Shrimp (Litopenaeus vannamei) Cultivation with Biofloc System

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Abstract

An important component in the application of biofloc is the presence of probiotic bacteria as a floc-forming agent. This study aimed to analyze the differences in the yield of vannamei shrimp in a biofloc system using commercial probiotics and independent probiotics on a laboratory scale. The study design was a completely randomized design with 3 treatments and 4 replications, including independent probiotics (IP), commercial probiotics (CP), and control (C). PM utilized an independent formula with starter bacteria Lactobacillus casei and PK contained bacteria Bacillus sp., Pseudomonas sp., Nitrosomonas sp., Aerobacter sp., Nitrobacter sp. Probiotics were fermented 24 hours before their application to the maintenance medium. A total of 15 shrimp/aquarium measuring 3.29 ± 0.48 g were reared for 27 days after the floc was first formed. The results showed that the growth and feed conversion ratio of vannamei shrimp in the biofloc system was higher than that of the control (P<0.05). The growth and feed conversion ratio between probiotic treatments did not show significantly different results (P>0.05). Survival in treatment and control groups was not significantly different (P>0.05). The observed floc volumes which increased during the rearing of vannamei shrimp were up to 6.50-7.50 mL/L. Several types of organisms found in the flock included nematodes, phytoplankton, copepods, and protozoa. The observed water quality was the same in each treatment except for higher dissolved oxygen and ammonia in the control. This study recommends the use of independent probiotics in vannamei shrimp culture based on biofloc technology.

INTRODUCTION

Vannamei shrimp is a commodity with high economic value and market demand increasing every year because vannamei shrimp has a soft texture and distinctive taste (FAO, 2020). The intensification of vannamei shrimp cultivation which is increasingly being carried out causes problems, such as high operational costs, shrimp culture waste that pollutes the environment, and the problem of water needs as a cultivation medium (Amir et al., 2018). One
technology considered to be able to overcome these problems is biofloc technology. This technology has experienced rapid development, has been applied to various commodities that can increase feed efficiency by up to 10-20%, and is supported by optimal water quality (Pantjara et al., 2010). Biofloc technology is considered environmentally friendly because it can utilize aquaculture waste in rich protein feed sources that are good for shrimp (Burford et al., 2004).

The principle of biofloc is to recycle the nutrients from the excretion of shrimp and the rest of the feed by heterotroph bacteria into bacterial biomass that can be utilized by the shrimp so that the water quality is better and maintained. Bioflocs consist of various microbial communities such as protozoa, bacteria, and zooplankton containing vitamins, amino acids methionin, enzymes, and minerals that can be used as food supplements to help shrimp digestion so that bioflocs will save the use of shrimp feed in a pond. One of the important elements in the application of biofloc is the presence of probiotic bacteria. Probiotic bacteria play a role in the process of recycling nutrient waste to be utilized by shrimp cultured in a biofloc system (Masithah et al., 2016).

Probiotics are microbial agents that can provide beneficial effects for the host because they can increase the nutritional value of feed, improve the performance of the immune response to disease, and improve the quality of the culture environment (Verschuere et al., 2000). The advantages of probiotics can stimulate the growth of cultured organisms, increase feed effectiveness (Hamka et al., 2021a), improve immune performance (Hamka et al., 2021b), maintain optimal water quality, increase feed conversion ratio, inhibit pathogenic bacteria growth (Hamka et al., 2021b; Aly et al., 2008; Kesarwadi-Watson et al., 2008; Nayak, 2010). Research on the use of various types of probiotics in biofloc systems has been carried out. The results show that different types of probiotics produce different outputs. Commercial probiotics can increase growth and feed conversion ratio in biofloc-based freshwater fish farming (Suprianto et al., 2019; Kurniaji et al., 2021). The use of commercial probiotics in vannamei shrimp bioflocs has also been widely carried out and can have a positive effect on the growth of vannamei shrimp (Setyono et al., 2019).

Various types of commercial probiotics can now be easily found. The content of bacteria and nutrients facilitates shrimp cultivation for cultivators. The development of commercial probiotics on the market makes people innovate to make independent probiotics. This kind of probiotic is made by the community because the price is relatively affordable when compared to commercial ones, it is easy to manufacture, and the ingredients obtained are derived from herbal plants from the surrounding environment. The use of independent probiotics in the biofloc system is expected to facilitate cultivators in their application in the field. In addition, the use of independent probiotics can reduce production costs because farmers generally use technology with low input costs (Putri et al., 2020). The effectiveness of independent probiotics use has not been tested together with commercial probiotics in the vannamei shrimp biofloc system.

This study aimed to analyze the differences in the yield of vannamei shrimp in a biofloc system using commercial probiotics and independent probiotics carried out on a laboratory scale.

**METHODOLOGY**

**Ethical Approval**

There are no animals harmed or improperly treated during the research. The test animals in this study were treated properly according to the optimal environment, starting from handling...
technique, water quality, availability of feed, etc.

**Place and Time**

This research was conducted in June-July 2022 at the Teaching Factory (TEFA) Fisheries Cultivation Engineering Study Program, Polytechnic of Marine and Fisheries Bone, Bone Regency, South Sulawesi.

**Research Materials**

The research material used was vannamei shrimp measuring 3.29 ± 0.48 g, which was obtained from the training pond of the Bone Marine and Fisheries Polytechnic after 35 days of intensive rearing (DOC 35) in plastic ponds. The container used for maintenance was an aquarium measuring 70×50×50 cm which could accommodate 100 L of water. The water used came from sea waters around Waetuwo Urban Village, Bone Regency. Bacterial cultures were sampled from the maintenance media using Tryptone Soya Agar/TSA (HiMedia Laboratories Pvt. Ltd, India) and TCBS media (HiMedia Laboratories Pvt. Ltd, India), which were prepared with sterile aquadest (Onemed, Indonesia). The other tools used were: digital scale with an accuracy of 0.01 g, fishnet, jar, imhoff cone, aerator, DO meter (YSI Pro20, USA), pH meter (Eutech, USA), refractometer (Bright Scientific Co., Japan), thermometer (YSI Pro20, USA), ammonia, nitrate, nitrite, and phosphate test kits (Merck KgaA, Germany).

The probiotics used were commercial probiotics and independent probiotics. The commercial probiotic used was Super NB™ (PT CP Prima Tbk, Indonesia) which contained several types of bacteria, namely Bacillus sp., Pseudomonas sp., Nitrosomonas sp., Aerobacter sp., Nitrobacter sp. The independent probiotics used were Yakult™ (PT. Yakult Indonesia Persada, Indonesia) which contained Lactobacillus casei bacteria, and Fermipan™ (S.I.L, France) containing Saccharomyces cerevisiae. Before use, probiotics were fermented for 24 hours. The materials used for the manufacture of probiotic fermentation as an independent probiotic can be seen in the following table.

<table>
<thead>
<tr>
<th>Table 1. Composition of ingredients for fermentation in the independent probiotic.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Independent Probiotic (PM)</strong></td>
</tr>
<tr>
<td>Material Type</td>
</tr>
<tr>
<td>Brackish water</td>
</tr>
<tr>
<td>Molasses</td>
</tr>
<tr>
<td>Yakult™</td>
</tr>
<tr>
<td>Fermipan™</td>
</tr>
<tr>
<td>Ginger</td>
</tr>
<tr>
<td>Turmeric</td>
</tr>
<tr>
<td>Curcuma</td>
</tr>
</tbody>
</table>

The addition of ginger, turmeric, and temulawak as fermenters for probiotic production according to the research before in fish. The fermenter also plays a role in increasing feed absorption and triggering fish appetite (Mansyur and Tangko, 2008). This material is a good immunostimulant for the body's resistance to fish (Hariani and Purnomo, 2017).

**Research Design**

This study used a completely randomized design (CRD) with 3 treatments and 4 replications. Each treatment unit was placed randomly and conditioned homogeneously. The treatment in this study is as follows; Independent Probiotics (IP): vannamei shrimp reared in a biofloc system using probiotic fermentation made with an independent formula, Commercial...
Probiotics (CP): vannamei shrimp reared in a biofloc system using commercial probiotic fermentation, Control (C): vannamei shrimp reared without using a biofloc system.

**Work Procedure**

The research container was an aquarium cleaned using a brush and detergent. Then, the aquarium was filled with water sterilized using 15 ppm of chlorine™ (Tjiwi Kimia, Indonesia) and given strong aeration for 7 days to remove residual chlorine. Each aquarium was equipped with an aeration system and filled with 100 L of water. To ensure that the water was sterile, bacterial sampling was carried out using TCBS and TSA. The bacteria sampling procedure followed the method of Kurniaji et al. (2020). The probiotics used were firstly cultured using several materials according to Table 1. Fermentation was carried out for 24 hours before the growth of biofloc on the maintenance media. Biofloc was grown by adding the material gradually to all aquariums according to Table 2. The water was left aerated for 10 days for floc formation (Sumitro et al., 2020). Feed pellets were used as a source of N to grow flocks with a C:N ratio of 15 according to the modified method of Husain et al. (2014). After the floc was formed, the number of shrimps included in the aquarium was 15 shrimps/aquarium. During 27 days of rearing, the shrimps were fed with a feeding rate of 10% using commercial pellet feed of the Irawan™ brand containing 30% protein in the morning, afternoon, and evening.

Measurements of water quality parameters according to the method of Yassien et al. (2019) included temperature using thermometer, pH using pH meter, salinity using refractometer and DO using DO meter, those which were carried out every morning and evening. Measurements of ammonia, nitrate, nitrite, and phosphate using test kit were carried out at the beginning, middle, and end of the study. Every 7 days, growth sampling was in the form of floc volume, and flock observations were carried out under a microscope.

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Amount</th>
<th>Time of Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>100 L</td>
<td>Initial Time of Research</td>
</tr>
<tr>
<td>Coarse Salt</td>
<td>100 g</td>
<td>Initial Time of Research</td>
</tr>
<tr>
<td>Probiotic (due to treatment)</td>
<td>3 mL</td>
<td>During The Research</td>
</tr>
<tr>
<td>Molasses</td>
<td>10 mL</td>
<td>During The Research</td>
</tr>
<tr>
<td>Calcium Oxide</td>
<td>5 g</td>
<td>Initial Time of Research</td>
</tr>
<tr>
<td>Tapioca Flour</td>
<td>10 g</td>
<td>During The Research</td>
</tr>
<tr>
<td>Shrimp Pellet</td>
<td>10 g</td>
<td>Initial Time of Research</td>
</tr>
</tbody>
</table>

**Note:** initial time is the application of material at the time of starting the research (day 1), during the research is the application of materials during of study.

Parameters observed included shrimp weight gain, daily growth rate, absolute growth rate, survival, feed conversion ratio, flock volume, flock condition, and water quality. Measurement of flock volume referred to Avnimelech (2012) using an imhoff cone. Flock observation refers to the method of Rajkumar et al. (2015) using a microscope. Daily growth rate (DGR) was calculated using a formula based on Kurniaji et al. (2018) as follows:

\[
\text{DGR} = \frac{\ln Wt - \ln Wo}{t} \times 100
\]

Where:

- \( \text{DGR} \) = daily growth rate (%)
- \( Wt \) = final weight (g)
- \( Wo \) = initial weight (g)
- \( t \) = maintenance time (days)

The absolute growth rate was obtained from the difference between the
final and initial weight of the shrimp. The equation used to measure the absolute growth rate (AGR) was based on Effendie (1997) as follows:

\[
AGR = Wt - Wo
\]

Where:
- \( AGR \) = absolute growth rate (g)
- \( Wt \) = final weight (g)
- \( Wo \) = initial weight (g)

Survival was the number of live shrimps at the end of rearing. The equation used to calculate the survival rate (SR) referred to Effendie (1997) as follows:

\[
SR = \frac{N_t}{N_o} \times 100
\]

Where:
- \( SR \) = survival rate (%)
- \( N_t \) = final number of fish (tails)
- \( N_o \) = initial number of fish (tails)

Feed conversion ratio was the ratio of feed amount needed to produce shrimp weight. The equation used to calculate the feed conversion ratio was based on Zonneveld et al. (1991) as follows:

\[
FCR = \frac{F}{(Wt + D) - Wo}
\]

Where:
- \( FCR \) = feed conversion ratio
- \( F \) = amount of feed (g)
- \( Wt \) = final shrimps' biomass (g)
- \( D \) = dead shrimps (g)
- \( Wo \) = initial shrimps' biomass (g)

Data Analysis

Data on growth, survival, feed conversion ratio, bacterial population, and floc volume were statistically analyzed by the ANOVA method (Kolmogorov-Smirnov) and Duncan test using the SPSS Version 16.0 program. The data from the observation of flocks and water quality were analyzed descriptively and quantitatively.

RESULTS AND DISCUSSION

Weight Gain

The weight gain of vannamei shrimp was measured at each observation time, namely on days 1, 7, 14, 21, and 27. The measurement results showed an increase in individual weight at each observation time (Figure 1).

![Graph showing weight gain of vannamei shrimp during 27 days of rearing](image)

The results of the ANOVA test showed that the weight gain of vannamei shrimp per individual on the 1st day of observation was not significantly different between treatments (\( P>0.05 \)) and the weight of each treatment was 3.31±0.27 g, 3.28±0.69 g and 3.23±0.31 g, where the shrimp used were uniform at the beginning of the treatment. This is by the statement of Karimah et al. (2018) that measuring growth performance requires a uniform size of the test organism. The weight gain observed was significantly different (\( P<0.05 \)) on days 7, 21 and 27.

The weight of shrimp on IP (independent probiotic) and CP (commercial probiotic) was significantly different from C (control). The results of this study showed that the treatment with probiotics in the biofloc system was able to...
significantly increase the growth of vannamei shrimp. This is by the results of research by Pantjara et al. (2010) that the application of biofloc in shrimp farming intensively can increase growth. The activity of probiotic bacteria in the waste cycle process becomes a food source that can trigger better shrimp growth (Avnimelech, 2012).

The treatment of commercial and independent types of probiotics had no significant effect on the weight gain of vannamei shrimp at each observation time. This shows that the two types of probiotics used could increase the growth of shrimp. The commercial probiotics used contained Bacillus sp. which played a role in growth. According to Lestari et al. (2021), the addition of Bacillus sp. in biofloc can accelerate catfish growth and feed efficiency. Bacillus sp can work on the digestive system and produce exogenous enzymes that can improve digestive performance (Ekasari et al., 2010).

Probiotics Nitrosomonas sp, Aerobacter sp., and Nitrobacter sp. were nitrifying bacteria that improved water quality in the biofloc system and supported growth (Suprapto, 2012). The independent probiotic used was derived from L. casei bacteria which was added with fermipan containing S. cerevisiae. According to Putri et al. (2015), probiotic EM-4 containing L. casei and S. cerevisiae can play a role in the biofloc system and increase the growth of cultured organisms, so that the commercial and independent probiotics play a role in the growth of shrimp.

**Daily Growth Rate and Absolute Growth Rate**

The daily growth rate and absolute growth rate were observed to be different between the treatment and control. The results of observations of the daily growth rate and absolute growth rate of vannamei shrimp can be seen in Figure 2.

The results of the ANOVA test showed that the daily growth rate and absolute growth rate were significantly different between treatments. Duncan’s further test showed that the daily growth rate of IP (independent probiotic) was not significantly different from CP (commercial probiotic) and C (control). In addition, CP (commercial probiotic) was significantly different from C. The absolute growth rate of IP (independent probiotic) was not significantly different from CP (commercial probiotic) but significantly different from C (P<0.05). This study showed that the use of probiotics, both commercial and independent, was able to increase the growth of vannamei shrimp. Probiotics Bacillus sp., Pseudomonas sp., Nitrosomonas sp., Aerobacter sp., Nitrobacter sp., and Lactobacillus sp were bacteria that played a role in the biofloc system.
Bacillus sp. could work on the digestive system, whereas bacteria Nitrosonomas sp., Aerobacter sp., and Nitrobacter sp. were nitrifying bacteria that improved water quality. Lactobacillus sp is an aerobic heterotrophic bacterium that plays a role in floc formation (Suprapto, 2012). Biofloc is a cultivation system focusing on more effective nutrient inputs requiring a nutrient recycling process carried out by heterotrophic bacteria. Several types of heterotrophic bacteria are bacteria Bacillus sp and Lactobacillus sp. (Widanarni et al., 2012).

In addition, there was no difference in growth between vannamei shrimp reared in a biofloc system with commercial probiotics and independent probiotics. The types of probiotic bacteria used in both treatments were bacteria that played a role in floc formation so these probiotic bacteria had the potential to increase the growth of vannamei shrimp. The use of Bacillus sp. on shrimp culture with biofloc technology has been evaluated by Adipu et al. (2019). The results showed that these bacteria were able to improve the growth performance of shrimp. Likewise, the use of L. casei bacteria was evaluated by Putri et al. (2015) which showed positive results on the growth of cultured organisms. Other bacteria were heterotrophic bacteria those which played a role in recycling wastewater so that they could be utilized by shrimp. Manan et al. (2020) stated that biofloc is an aggregation of algae, bacteria, protozoa, and organic particles such as uneaten feed. Heterotrophic bacteria such as Pseudomonas sp. are commonly found in biofloc.

Survival Rate

The results of the ANOVA test showed that the observed survival rates were not significantly different between the treatment and control (P>0.05). The results of observations on the survival of vannamei shrimp can be seen in Figure 3.

![Figure 3. Vannamei shrimp survival after 27 days of rearing (same letter notation shows results that are not significantly different between treatments). Description: IP (independent probiotic), CP (commercial probiotic), C (control).](image)

Based on the results of the study, probiotic treatment on biofloc media did not affect the viability of vannamei shrimp. The survival rate of vannamei shrimp was not significantly different, presumably due to the absence of pathogenic bacterial infection in culture media. Manan et al. (2020) stated that biofloc media contaminated with pathogenic bacteria such as Vibrio sp. can reduce the survival rate of vannamei shrimp. Although numerically the results of statistical tests were not significantly different, there was a tendency for higher survival in shrimp reared in biofloc systems. According to Chethurajupalli and Tambireddy (2022), the application of biofloc can increase the viability of vannamei shrimp which is higher than the control or without biofloc.

Shrimp survival without biofloc was 62% and in biofloc >70%. The ability of
biofloc to increase survival and growth has long been reported by several studies (Xu dan Pan, 2012; Shilta et al., 2020; Panigrahi et al., 2020). The presence of probiotic bacteria can help improve digestive performance, improve air quality, and suppress bacterial pathogens so that shrimp can grow properly (Long et al., 2015). This is due to the ability of the biofloc system to form an optimal environment for the growth and survival of white shrimp.

Feed Conversion Ratio

The observed feed conversion ratio was significantly different between the treatment and control (P<0.05). The shrimp feed conversion ratio in PM (independent probiotic) treatment was not significantly different from PK (commercial probiotic) (P>0.05) but significantly different from K (control) (P<0.05).

![Feed Conversion Ratio graph](image)

Figure 4. Vannamei shrimp feed conversion ratio (differences in letter notation indicate significant differences between treatments). Description: IP (independent probiotic), CP (commercial probiotic), C (control).

The results of observations of feed conversion ratios showed that the use of probiotic bacteria in biofloc was able to increase the effectiveness of feed utilization. This had an impact on increasingly optimal growth. Similar results were found by Adipu et al. (2019), stating that the application of biofloc technology in shrimp farming can reduce the value of the feed conversion ratio and increase growth. Several previous studies also found that the vannamei shrimp feed conversion ratio was better in the biofloc system (Xu and Pan, 2012; Emerenciano et al., 2013; Krummenauer et al., 2014). This effective use of feed is thought to be due to the presence of probiotic bacteria that can work on the shrimp digestive system so that feed digestibility is better. Ridho and Subagiyo (2013) stated that the low feed conversion ratio is caused by the performance of probiotic bacteria to produce extracellular enzymes that increase food digestibility in the shrimp intestines. *Bacillus* sp. are probiotic bacteria that can work on the digestive system thereby increasing nutrient digestibility (De et al., 2018).

The feed conversion ratio between commercial and independent probiotic treatments showed results that were not significantly different. Although the feed conversion ratio data showed a higher trend in commercial probiotics. Agustama et al. (2021) stated that the probiotic *Bacillus* sp. mixed in the feed showed a better performance than *L. casei* in the growth performance of vannamei shrimp. In addition to the presence of bacteria acting on the digestive system, the low feed conversion ratio is also thought to be due to the presence of floc which is an additional food for shrimp. According to Ju et al. (2008), biofloc provides additional protein, fat, minerals, vitamins, and other bioactive compounds such as...
carotenoids, bromophenols, chlorophyll, phytosterols, and amino sugars.

**Floc Volume**
The observed floc volume increased from the 1st day to the 27th day of observation. Floc volume was not significantly different between treatments during the 27-day vannamei shrimp rearing period (P>0.05). The results of the observation of floc volume can be seen in the following figure.

Figure 5. Floc volume during 27 days of maintenance.

The flock volume increased gradually from the beginning to the end of the observation. Maximum floc volume was observed up to 6.50 mL/L in independent probiotic aquariums and 7.50 mL/L in commercial probiotics. The floc volumes observed in all treatments were still in the optimal range for the growth of vannamei shrimp. According to Avnimelech (2012), the maximum floc volume for shrimp growth is 50 mL/L. Flock volume greater than 50 mL will cause depletion of dissolved oxygen and interfere with shrimp growth. Efforts to maintain the volume of floc to remain in the optimal range are to add water to dilute the floc content.

Figure 6. Measurement of floc volume using an Imhoff cone.

**Floc Observation**
The observation of the flocks showed that there were differences in the density of the flocks at each time of observation. This was in line with the increasing floc volume during the vannamei shrimp rearing period. The floc observed under the microscope was formed from various elements of organisms and organic matter. Observations showed the presence of copepods, nematodes, protozoa and several types of phytoplankton (unidentified). This is in accordance with Rajkumar et al. (2015) who found that there were several types of organisms in the vannamei shrimp floc which were dominated by zooplankton and phytoplankton, including tintinids, copepods, spirulina, ciliates and nematodes.
This community is generally present in the maintenance media of the biofloc system and will decrease with shrimp rearing. Shrimp take advantage of the presence of plankton as a food source. Plankton contains nutrients that are important for shrimp (Moss et al., 2001). Chethurajupalli and Tambireddy (2022) also reported the presence of rotifers, copepods, nematodes, and ciliated protozoa in the biofloc system. Biofloc consists of 98% flagellates, 1.5% rotifers and 0.5% amoeba (Ju et al., 2008). This is similar to the report of Manan et al. (2017) who stated the presence of nematodes, gastrotrichs, euplotes, protozoa, rotifers, and copepods in the vannamei shrimp biofloc system (Figure 7).

![Figure 7](image_url)

**Figure 7.** Observations of flocks under a microscope with a magnification of 10×/0.25. The condition of the flock on the 7th day (D), the condition of the flock on the 14th day (E), the condition of the flock on the 21st day (F), and the condition of the flock on the 27th day (G). Microorganisms in the flock: nematodes (I), phytoplankton (J), copepods (K), protozoa (L).

**Water Quality**

Water quality measurement data includes temperature, salinity, dissolved oxygen, pH, ammonia, nitrite, nitrate, and phosphate. The water quality during the study was still within the standard range except nitrate and nitrite according to Boyd and Gautier (2000). Temperature and salinity are below MMF standards (2016) because maintenance is carried out indoors and water comes from brackish waters which are commonly used in the surrounding area. The other parameters are in accordance with the standard.

Measurements of temperature, salinity, and pH showed the same results in the treatment and control. The measurement of dissolved oxygen was observed to be different in the treatment and control. This indicates that there was a higher utilization of dissolved oxygen in the treatment than in the control. According to Chethurajupalli and Tambireddy (2022), dissolved oxygen in biofloc media is lower than without biofloc. This is due to the high activity of heterotrophic bacteria that utilize oxygen to remodel organic matter. The rate of nitrification and respiration of microorganisms results in an increase in carbon dioxide levels in the floc and a decrease in dissolved oxygen levels. Ammonia, nitrite, nitrate, and phosphate levels were also observed to be no different in the biofloc and control media. The difference lay in the range of ammonia levels of independent and commercial probiotics which were lower at the beginning of the observation.

According to Tong et al. (2020), the input ratio of C:N 12-15 helps heterotrophic bacteria to decompose more ammonia in the biofloc system. The activity of nitrifying bacteria is able to keep ammonia at low levels (Anand et al., 2014). Previous studies also found that low ammonia was found in biofloc media (Rajkumar et al., 2015; Bossier and Ekasari, 2017). The results of measuring water quality in all treatment units during

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the rearing of vannamei shrimp are as follows.

### Table 3. Results of water quality measurements during vannamei shrimp rearing.

<table>
<thead>
<tr>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Salinity (ppt)</td>
<td>18.00-25.00</td>
<td>18.00-25.00</td>
<td>18.00-25.00</td>
<td>15 – 25</td>
<td>26 – 32</td>
</tr>
<tr>
<td>Dissolved Oxygen (ppm)</td>
<td>5.70-6.90</td>
<td>5.58-6.20</td>
<td>6.12-6.88</td>
<td>&gt;5</td>
<td>&gt; 4</td>
</tr>
<tr>
<td>Ammonia (NH₃) (ppm)</td>
<td>0.00-0.80</td>
<td>0.00-0.80</td>
<td>0.40-0.80</td>
<td>&lt; 0.1</td>
<td>&lt; 0.1</td>
</tr>
<tr>
<td>Nitrite (NO₂) (ppm)</td>
<td>0.15-0.50</td>
<td>0.15-0.50</td>
<td>0.15-0.50</td>
<td>0.05</td>
<td>&lt; 1.0</td>
</tr>
<tr>
<td>Nitrate (NO₃) (ppm)</td>
<td>2.30-5.60</td>
<td>2.30-5.60</td>
<td>2.30-5.60</td>
<td>0.3</td>
<td>&lt; 0.5</td>
</tr>
<tr>
<td>Phosphat (PO₄) (ppm)</td>
<td>0.25-1.50</td>
<td>0.25-0.50</td>
<td>0.25-0.50</td>
<td>&lt; 0.3</td>
<td>&lt; 0.1-5</td>
</tr>
</tbody>
</table>

The results of this study provide information that independent probiotics have the potential to be used because of various advantages, namely the growth and feed conversion ratio produced were no different from biofloc using commercial probiotics. In addition, independent probiotics use ingredients derived from herbal plants in the surrounding environment, making it easier for cultivators to produce. The use of independent probiotics in the biofloc system is expected to make it easier for cultivators to apply them and not incur large costs to procure the ingredients.

**CONCLUSION**

The results showed that there was no difference in growth performance, feed conversion ratio, viability, floc volume, and water quality on biofloc media from commercial and independent probiotic treatments. This study recommends for use of independent probiotics because it can produce the same result performance as commercial probiotics. Vannamei shrimp reared in the biofloc system showed better growth and feed conversion ratios compared to those without biofloc.

**CONFLICT OF INTEREST**

There is no conflict of interest among all authors upon writing and publishing the manuscript.

**AUTHOR CONTRIBUTION**

The contribution of each author is the following: Ardana Kurniaji, Diana Putri Renitasari, and Siti Aisyah Saridu were collecting, analyzing data, and drafting the manuscript. Yunarty and Anton participated in the conception of experimental design.

**ACKNOWLEDGMENT**

Thank you to Polytechnic of Marine and Fisheries of Bone students who have helped carry out this research.

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