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EFFECT OF ADDITIONING PHOSPHORUS TO CULTIVATION MEDIA ON THE GROWTH RATE OF VANAME SHRIMP (*Litopenaues vannamei*) FRENCH AT SALINITY 0 PPT

Pengaruh Penambahan Fosfor Pada Media Budidaya Terhadap Laju Pertumbuhan Udang Vaname (*Litopenaues Vannamei*) Perancis Pada Salinitas 0 ppt

Ismail, Andre Rachmat Scabra*, Muhammad Marzuki

Mataram University Aquaculture Study Program

Pendidikan Street Number 37, Mataram City, West Nusa Tenggara Province

*Coresponding author : andrescabra@unram.ac.id

ABSTRACT

The aquaculture commodity that is widely developed in Indonesia is vannamei shrimp *Litopenaeus vannamei* because vannamei shrimp have promising prospects and profits (Babu et al., 2014). One effort to maintain and increase vaname shrimp production is to utilize existing cultivation land, including land in fresh waters. Vaname shrimp is one of the shrimp that has quite good tolerance in the high salinity range, namely between 0.5-40 ‰ (Wyban et al, 1992). The aim of this research was to determine the effect of phosphorus (P) on the growth of vannamei shrimp in rearing media with a salinity of 0 ppt. With the right dose of phosphorus, growth of vannamei shrimp reared in media with a salinity of 0 ppt can occur optimally. The method used was a Completely Randomized Design (CRD) consisting of 4 treatments and 3 replications, namely the addition of phosphorus through media with various different doses; 0 ppm, 15 ppm, 30 ppm, and 45 ppm. The addition of the mineral Ca 50 ppm and P 45 ppm had a real effect on the growth rate of vaname shrimp, with the highest absolute length growth value of 5.8 cm and absolute weight growth of 1.07 gr found in P4 (Treatment Four).

ABSTRAK

Komoditas budidaya perikanan yang banyak dikembangkan di Indonesia adalah udang vannamei *Litopenaeus vannamei* karena udang vannamei mempunyai prospek dan keuntungan yang menjanjikan (Babu et al., 2014). Salah satu upaya untuk mempertahankan dan meningkatkan produksi udang vaname adalah dengan memanfaatkan lahan budidaya yang ada, termasuk lahan di perairan tawar. Udang vaname merupakan salah satu udang yang mempunyai toleransi cukup baik pada kisaran salinitas tinggi yaitu antara 0,5-40‰ (Wyban et al, 1992). Tujuan penelitian ini adalah untuk mengetahui pengaruh fosfor (P) terhadap pertumbuhan udang vaname pada media pemeliharaan salinitas 0 ppt. Dengan dosis fosfor yang tepat, pertumbuhan udang vaname yang dipelihara pada media salinitas 0 ppt dapat terjadi secara optimal. Metode yang digunakan adalah Rancangan Acak Lengkap (RAL) yang terdiri dari 4 perlakuan dan 3 ulangan yaitu penambahan fosfor melalui media dengan berbagai dosis berbeda; 0 ppm,

15 ppm, 30 ppm, dan 45 ppm. Penambahan mineral Ca 50 ppm dan P 45 ppm memberikan pengaruh nyata terhadap laju pertumbuhan udang vaname, dengan nilai pertumbuhan panjang absolut tertinggi sebesar 5,8 cm dan pertumbuhan bobot absolut sebesar 1,07 gr terdapat pada P4 (Perlakuan Keempat).

Kata Kunci	*Fosfor, udang vannamei, media salinitas rendah*
Keywords	*Phosphorus, vannamei shrimp, low salinity media*
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INTRODUCTION

One of the cultivation potentials that is being widely developed in Indonesia is the vaname shrimp *Litopenaeus vannamei*. This is because these shrimp have promising prospects and profits (Babu et al., 2014). This shrimp is very popular and has quite high economic value, and is even a favorite in Indonesia. Indonesia was ranked 4th in the world with total white shrimp exports of 140,000 tonnes in 2007, in 2008 Indonesia's ranking rose to 3rd in the world behind China and Thailand. Indonesia's total exports reached 168,000 tons, an increase of 21%. In 2009, Indonesia's exports also experienced an extraordinary increase reaching 240,250 tons.

One effort to maintain and increase vaname shrimp production is to utilize existing cultivation land, including land in fresh waters. White vaname shrimp is a type of shrimp that has a fairly good tolerance for low salinity. Vannamei shrimp are hyper-hypo osmoregulators, namely organisms that are able to live in a wide salinity range between 0.5-40 ‰ (Wyban et al, 1992).

The main problem currently faced is the low survival rate of vannamei post larvae even though various methods of acclimation to low salinity have been developed. Apart from the low survival rate, a problem that is often faced is the low survival rate during the acclimation process. This can affect the moulting process in shrimp. The problem that often occurs in the moulting process of vaname shrimp is the slowing down of the skin hardening process which will have an impact on the growth rate. Shrimp will grow well if the moulting process goes well (Zaidi and Wartono, 2009). This problem can also affect the growth rate during the maintenance period of white vaname shrimp. The osmoregulation process which releases a lot of energy is one of the factors that influences the growth rate of shrimp. Therefore, efforts are needed to overcome the problem of delayed growth of shrimp kept at low salinity, namely by adding (Calcium) Ca and (Phosphorus) P to the rearing media.

Calcium (Ca) and phosphorus (P) are important minerals from 20 types of minerals identified as playing an important role in the shrimp body (Akiyama et al., 1991). Calcium and phosphorus are the main components of inorganic feed material. Quantitatively, the main function of Ca and P is mainly in the formation of hard tissue such as bones, exoskeleton and skeleton. In shrimp, it mainly plays a role in the formation of skin and carapace, which are the main elements that make up the carapace of giant prawns, called exuvia, so that a lack or excess of Ca and P will affect the molting process in white shrimp. Ca is a very important mineral, especially in osmoregulation, muscle contraction and a cofactor in several enzymatic processes. Meanwhile, P is a mineral that plays many roles

in metabolic processes such as an essential part of phospholipids, amino acids, phosphoproteins, adenosine triphosphate (ATP). Phosphorus is very important for the life of aquatic organisms because it functions in the storage and transfer of energy in cells and functions in the genetic system (Cole, 1983). Therefore, it is important to carry out research by adding phosphorus (P) to the maintenance medium with a salinity of 0 ppt.

The aim of this research was to determine the effect of phosphorus (P) on the growth of vannamei shrimp in rearing media with a salinity of 0 ppt. With the right dose of phosphorus, growth of vannamei shrimp reared in media with a salinity of 0 ppt can occur optimally.

METODE PENELITIAN

Research design

This research was conducted using an experimental method using a Completely Randomized Design (CRD). The aspect studied was the effect of adding calcium with the same dose and phosphorus powder with different doses in the rearing container with 4 treatments and 3 repetitions, so that 12 experimental units were obtained.

Treatment 1:50 ppm calcium with a phosphorus dose of 0 ppm
Treatment 2:50 ppm calcium with a phosphorus dose of 15 ppm
Treatment 3:50 ppm calcium with a phosphorus dose of 30 ppm
Treatment 4:50 ppm calcium with a phosphorus dose of 45 ppm

Research procedure

The container used for maintenance is a container with a volume of 25 L. The cultivation container is placed according to the predetermined treatment sequence and filled with fresh water. Each container is given aeration to supply oxygen in the cultivation media and is marked with each treatment. The biota used is vaname shrimp fry measuring PL20 obtained from PT. Superior Seeds, North Lombok Regency. Before maintenance, the test animals were first acclimatized in a tank containing sea water. In the shrimp rearing media, the salinity will be reduced to 0 ppt, the acclimatization process will last for one to two weeks. Shrimp were stocked in 12 containers with a volume of 25 liters. In 1 container the fish are spread at a density of 20 fish/20 liters of water.

Research Parameters

Survival Rate (SR)

The degree of survival is the ratio of the number of fish that survive from the beginning to the end of the study. DKH is calculated based on the formula (Heinsbroek 1989) in (Amrillah, et al., 2015) which is as follows:

$$SR=Nt/No \times 100\ \%$$

Note :
SR = Survival Rate Vaname Shrimp; Nt = Number of white vaname shrimp alive at the end of the study (individual); No = Number of white vaname shrimp living at the start of the study (individual).

Absolute Weight Growth (AWG)

Absolute weight growth is the rate of increase in shrimp weight from the beginning of the study to the end of the study. According to Effendi (1997) in Pratama (2017), absolute weight growth (Wm) can be calculated using the following formula:

$$Wm = Wt - Wo$$

Note :
Wm = Absolute weight growth (gr); Wt = Average weight of shrimp at the end of rearing (gr); Wo = Average weight of shrimp at the beginning of rearing (gr)

Absolute Length Growth (ALG)

Absolute length growth is the rate of growth in shrimp length during the study. The absolute increase in length can be calculated using the Effendie (1979) formula, namely:

$$Pm = Lt\text{-}Lo.$$

Note:
ALG = Absolute lenght growth (cm); Lt = Final length r (cm); Lo = Initial length (cm)

Feed Convertion Ratio (FCR)

Feed conversion ratio (RKP) is the ratio of the amount of feed given during the research to the amount of shrimp growth during the research. According to Zonneveld et al (1991) in Ali (2015) that the shrimp feed conversion ratio (RKP) can be calculated using the following formula:

$$FCR = \frac{\sum F\ feed\ given - \sum F\ remaining\ feed}{(Bt+Bm)-Bo}$$

Note :
FCR = Feed konvertion ratio (FCR); ΣF = Amount of feed (gram); Bt = Shrimp biomass at the end of the study (gram); Bm = Dead shrimp biomass (gram); Bo = Shrimp biomass at the start of the study (gram)

Calcium Levels in Water

Calcium levels are the level of Ca mineral concentration in the maintenance media during biota maintenance. Scabra et al., (2021), tested calcium levels in the media using a titration method according to Widigdo (2000) with the following formula:

$$\text{Hardness } Ca^{2+} = \frac{\text{ml titran x m titran x 100,1 x 1000}}{\text{ml sample}}$$

Water Quality Parameters

Water quality is one of the parameters that is quite important in the process of maintaining aquatic biota, because the better the environment for maintaining biota, the better the survival rate of the biota being maintained. According to Yustianti (2013), environmental factors must be optimal for the physiological processes of vaname shrimp. Water quality parameters measured include temperature, DO, ammonia, salinity, pH.

Table 1. Water Quality Parameters

No	Parameters	Unit	Test Tools/Methods
1	Temperatur	^oC	DO meter
2	*Disolved Oxygen*	mg/L	DO meter
3	Salinity	g/L	Refraktometer
4	pH	-	pH meter
5	Ammonia	mg/L	Hanna Ammonia checker

Data Analysis

Data from the research results will be analyzed using Analysis of Variance (ANOVA) with SPSS at a significance level of 5% to determine the effect of the treatment in the research. If the data shows a real effect, then further analysis is carried out using the Duncan test.

RESULT ADN DISCUSSION

***Survival Rate* (SR)**

Based on the results of the ANOVA test with a 95% confidence interval. The TKH value does not have a real influence, so it must be analyzed descriptively. The results of calculating the survival value of vannamei shrimp are presented in Figure 1. The lowest DKH until the end of rearing for 45 days was in treatment one (P1) as a control with a survival value of 27.5%. Meanwhile, the highest survival value up to day 45 was in treatment two (P2) with a survival value of 35%.

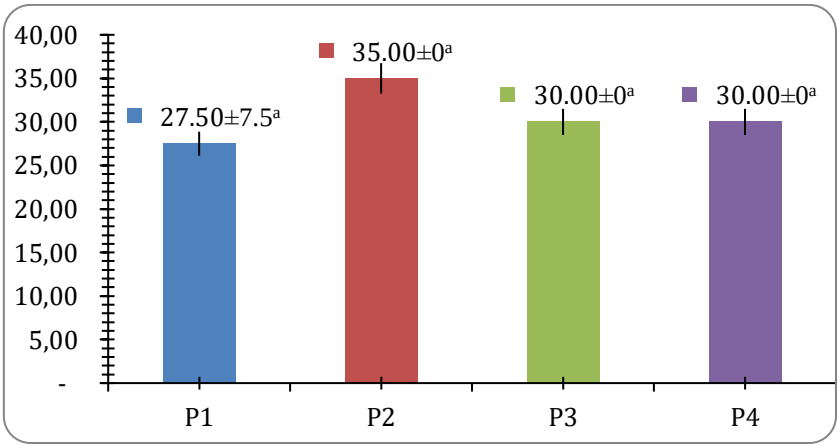

Figure 1. Graph of white shrimp survival rate

Note: P1= Dosis Ca 50 ppm + P 0 ppm; P2= Dosis Ca 50 ppm + P 15 ppm; P3= Dosis Ca 50 ppm + P 30 ppm; P4= Dosis Ca 50 ppm + P 45 ppm

Based on the research results, the TKH value of vaname shrimp during 45 days of rearing can be seen in Figure 1. It can be seen that the addition of minerals in the form of Calcium and Phosphorus does not have a real effect on the survival rate of vaname shrimp. However, the average survival rate of shrimp in treatment P2 (50 ppm calcium + 15 ppm phosphorus) with a survival percentage of 35% was relatively higher than other treatments. The low survival rate of vannamei shrimp during rearing is because vannamei shrimp have quite high cannibalism. The aggressive and territorial nature of shrimp will attack smaller flocks or when molting or cannibalism (Ali, 2007). This problem results in low shrimp production. The minerals Ca and P play a role in the process of carapace formation (molting) and maintenance of the skeleton system and also play a role in the physiological processes of the body of shrimp organisms.

Absolute Weight Growth (AWG)

Based on the ANOVA test with a 95% confidence interval, the PMB values were significantly different, so a further test was carried out with Duncan. The results of the PMB test are presented in Figure 2. Based on the graph displayed, it shows the effect of giving minerals in the form of Calcium (Ca) and Phosphorus (P) in various concentrations, namely P1 (50 ppm calcium + 0 ppm phosphorus), P2 (50 ppm calcium + 15 ppm phosphorus), P3 (50 ppm calcium + 30 ppm phosphorus), P4 (50 ppm calcium + 45 ppm

phosphorus) on the weight of vaname shrimp for 45 days. The highest vannamei shrimp weight up to day 45 was found in P4 with (50 ppm calcium + 45 ppm phosphorus) with an average shrimp weight value of 1.07 ± 0.07 gr. Meanwhile, the lowest weight of vaname shrimp up to day 45 was found in P1 as a control (50 ppm calcium + 0 ppm phosphorus) with an average weight value of 0.68 ± 0.25 gr.

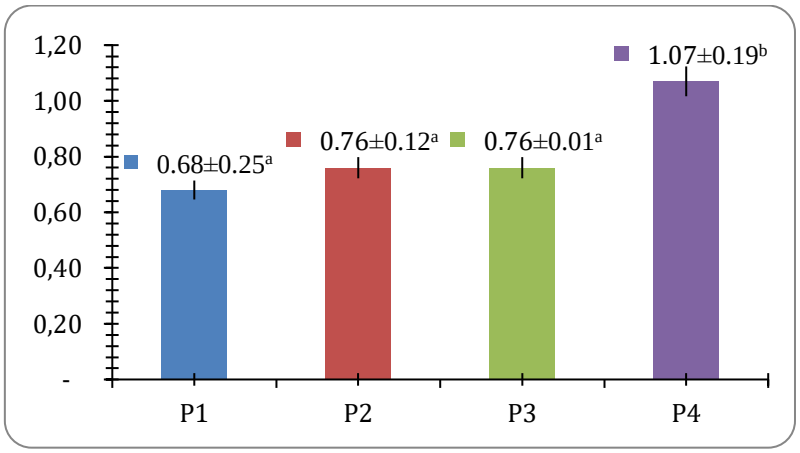

Figure 2. Vannamei shrimp weight growth graph

Note: P1= Dosis Ca 50 ppm + P 0 ppm; P2= Dosis Ca 50 ppm + P 15 ppm; P3= Dosis Ca 50 ppm + P 30 ppm; P4= Dosis Ca 50 ppm + P 45 ppm.

Based on research results, the weight of vaname shrimp during 45 days of rearing increased along with the length of time they were reared for treatment. In Figure 2, it can be seen that the average weight of vaname shrimp is highest, namely at P4 (50 ppm calcium + 45 ppm phosphorus) with a value of 1.07 ± 0.19, at P2 and P3 the weight growth rate is the same as 0. .76. Meanwhile, the lowest value is P1 (50 ppm calcium + 0 ppm phosphorus) with a value of 0.68 ± 0.25. This shows that the addition of calcium and phosphorus minerals has a real influence on weight gain in vaname shrimp. The main function of this mineral is to increase and accelerate the process of carapace formation (molting) and play a role as a physiological process in shrimp. Lall (2002).

Minerals are needed by aquatic biota for optimal growth performance. Ca and P are minerals that are synergistic with each other (Zainuddin, 2001) and are in the form of hydroxyapatite in forming bone crystals (Ye et al., 2006).

Absolute Length Growth (ALG)

Based on the ANOVA test with a 95% confidence interval, the absolute length growth values were significantly different, so a further test was carried out with Duncan. The results of the PPM test are presented in graphical form in Figure 3. The graph displayed shows the effect of giving minerals in the form of Calcium (Ca) and Phosphorus (P) in various concentrations, namely P1 (50 ppm calcium + 0 ppm phosphorus), P2 (50 ppm calcium + 15 ppm phosphorus), P3 (50 ppm calcium + 30 ppm phosphorus), P4 (50 ppm calcium + 45 ppm phosphorus) on the length of vaname shrimp for 45 days. The highest length of vannamei shrimp up to day 45 was found in P4 with (50 ppm calcium + 45 ppm phosphorus) with an average shrimp length value of 5.86 ± 0.07 cm. Meanwhile, the lowest length of vaname shrimp up to day 45 was found in P1 as a control (50 ppm calcium + 0 ppm phosphorus) with an average length value of 4.58 ± 0.13 gr.

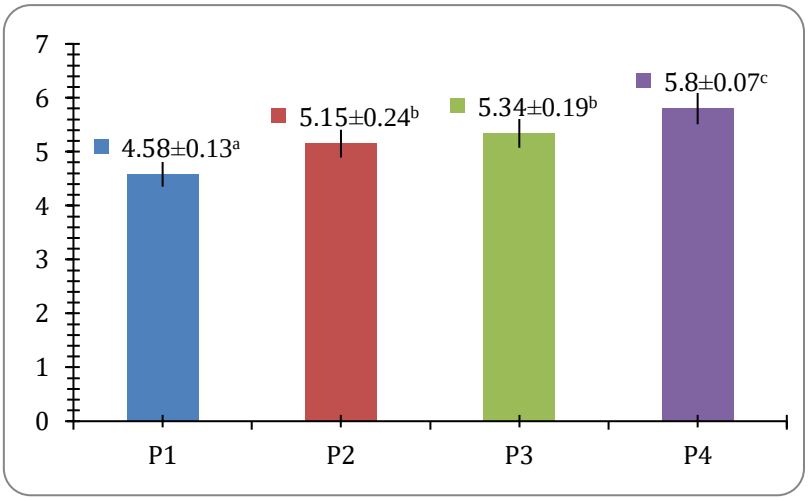

Figure 3. Graph of white shrimp length growth

Note: P1= Dosis Ca 50 ppm + P 0 ppm; P2= Dosis Ca 50 ppm + P 15 ppm; P3= Dosis Ca 50 ppm + P 30 ppm; P4= Dosis Ca 50 ppm + P 45 ppm.

The research results showed that the length of vaname shrimp during 45 days of rearing increased along with the length of rearing for all treatments. In Figure 3, it can be seen that the highest average length of vaname shrimp was 5.86 ± 0.07 cm in P4 (50 ppm calcium + 45 ppm phosphorus), while the lowest was in the control with an average length of 4.58 ± 0.13 cm. Based on the results of statistical analysis of variance, it was found that the effect of giving calcium and phosphorus minerals in various concentrations in the media on the length of vaname shrimp in this study was significantly different.

The addition of calcium and phosphorus minerals had a better effect than the control without the addition of phosphorus minerals. This is because the mineral phosphorus functions to simplify and expedite the metabolic system in the vaname shrimp's body. P is a mineral that plays many roles in metabolic processes such as an essential part of phospholipids, amino acids, phosphoproteins, adenosine triphosphate (ATP) and plays many roles in intermediate metabolism (Davis and Gatlin III 1991).

***Feed Convertion Ratio* (FCR)**

Based on the results of the ANOVA test with a 95% confidence interval. The feed conversion ratio value showed a real effect, so further tests were carried out with Duncan. The feed conversion ratio test results are presented in graphical form in Figure 4. The lowest feed conversion ratio for vaname shrimp up to day 45 was found in P4 (50 ppm calcium + 45 ppm phosphorus) with a feed conversion ratio value of 0.80. Meanwhile, the highest value up to day 45 was found in P2 (50 ppm calcium + 15 ppm phosphorus) with a feed conversion ratio value of 1.03.

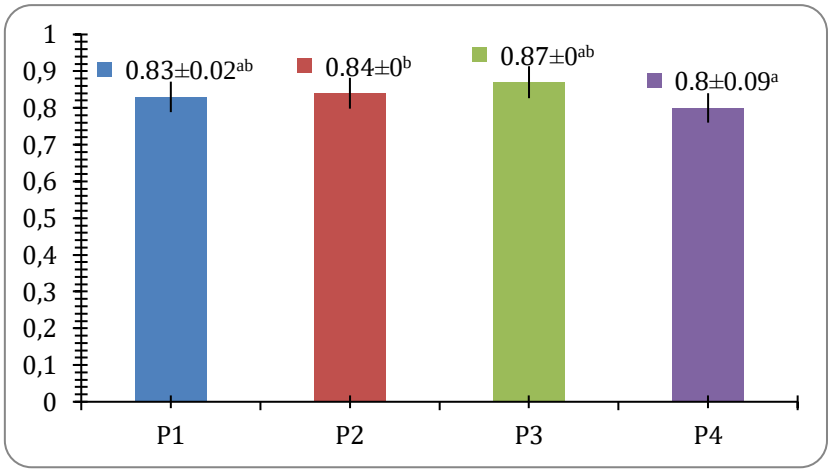

Figure 4. Feed Conversion Ratio Graph

Note: P1= Dosis Ca 50 ppm + P 0 ppm; P2= Dosis Ca 50 ppm + P 15 ppm; P3= Dosis Ca 50 ppm + P 30 ppm; P4= Dosis Ca 50 ppm + P 45 ppm

Based on the results of research conducted and statistical analysis tests, it shows that the addition of phosphorus minerals has a real influence on the feed conversion ratio (RKP) in vaname shrimp. The feed conversion ratio is the amount of feed needed to produce 1 kg of meat for cultivated shrimp. The research results graph shows that the highest feed conversion ratio was in the two P2 treatments (50 ppm calcium + 15 ppm phosphorus) with a feed conversion value of 1.03, followed by the three P3 treatments (50 ppm calcium + 30 ppm phosphorus) with a feed conversion ratio value of 0.91, in treatment one P1 (50 ppm calcium + 0 ppm phosphorus) the feed conversion value was 0.82, and the lowest feed conversion ratio value was found in treatment four P4 (50 ppm calcium + 45 ppm phosphorus) with conversion value feed of 0.80.

The feed conversion value shows the efficiency of utilization of nutrients in feed by cultivated biota. The lower the feed conversion value produced, the better the efficiency of feed utilization. This is supported by Sulawesty et al (2014) who state that the feed conversion ratio shows the efficiency of feeding. A lower value indicates that the feed provided can be utilized properly by cultivated biota.

Calcium Levels in Water

Calcium levels in water are measured using an ammonia kit. The value of calcium levels in water will be described descriptively. A graph of the calcium content values in water is shown in Figure 5. Based on the image presented, it shows that the highest Ca levels were found in treatment four and the lowest Ca levels were found in treatment one.

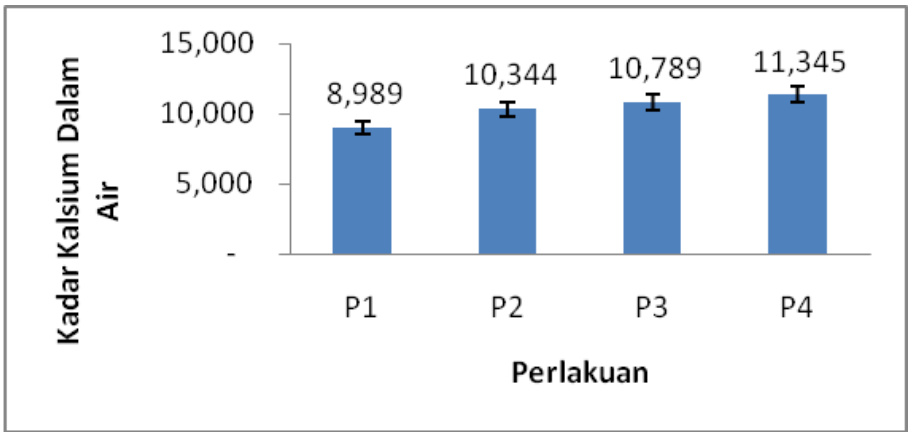

Figure 5. Graph of Calcium Levels in Water

Note: P1= Dosis Ca 50 ppm + P 0 ppm; P2= Dosis Ca 50 ppm + P 15 ppm; P3= Dosis Ca 50 ppm + P 30 ppm; P4= Dosis Ca 50 ppm + P 45 ppm.

Based on the results of research on Calcium (Ca) levels in white shrimp rearing media, it appears that the highest Calcium content in the media was seen in treatment P4 (50 ppm calcium + 45 ppm phosphorus) 11.345, P3 (50 ppm calcium + 30 ppm phosphorus) 10.789, P2 (50 ppm calcium + 15 ppm phosphorus) was 10.344, and the lowest calcium content was seen in P1 (50 ppm calcium + 0 ppm phosphorus) with a calcium content of 8.898. The high calcium content in treatment four was directly proportional to the growth rate of vaname shrimp in that treatment. The addition of calcium to the rearing media had a significant influence on the growth rate of vaname shrimp during 45 days of rearing. The Ca mineral functions in the formation of skin and carapace. Ca is a very important mineral, especially in the transmission of nerve impulses, osmoregulation, muscle contraction and a cofactor in several enzymatic processes. (Zubay, 1983 in Davis and Gatlin III, 1991). Calcium (Ca) and phosphorus (P) are important minerals from 20 types of minerals identified as playing an important role in the shrimp body (Akiyama et al., 1991).

Water Quality

The water quality parameter values in the media were measured during the research to determine the suitability of the waters as a suitable medium for rearing vaname shrimp during rearing. Water quality parameter values are described descriptively. Some of the qualities measured during the research include temperature, pH, Do, and ammonia. Water quality data is presented in tabular form.

Table 2. Water Quality Test Results During Research

No	Parameters	P1	P2	P3	P4	Optimum Value
1	Ph	8,4 - 8,6	8,27 - 8,6	8,34 - 8,6	8,2 – 8,4	7,4 – 8,9°C (Hasniar, 2013)
2	Temperatur	27,4 - 29,7	27,5 – 29,7	27,5 – 29,7	27,5 – 29,6	27,5 – 31°C (Hamzah, 2004)
3	Do	5,8 – 7,1	5,8 – 7,1	5,8 – 7,6	5,7 – 6,7	5 ppm (Hamzah, 2004)
4	Amonia	0,02 – 0,09	0,07 – 0,14	0,04 – 0,09	0,14 – 0,21	<0,10 (Budiardi, 2008)

Water quality is a parameter that really determines the survival of the shrimp biota that is kept. Makmur et al. (2018) one of the factors that determines the success of cultivating shrimp production is water quality management, because shrimp are aquatic animals whose entire life, health and growth depend on the quality of water as their living medium.

During the research, the water quality measured was pH, temperature, dissolved oxygen and ammonia levels. Based on the results of water quality measurements during the 45 day research period, it is known that the water quality in all treatments showed quite optimal values. Water temperature affects the physiological and psychological health of shrimp, the speed of chemical and biochemical reactions of shrimp and also influences the speed of shrimp metabolism (Hasniar, 2013). The research results showed that the temperature range for the maintenance media during the research was 27.5-29.6. The optimum temperature range for growing vaname shrimp is 28-31°C (Arsad et al., 2017) and grows well at temperatures of 23-30°C (Makmur et al., 2018)

The pH value of water plays an important role in the life of shrimp, because it can influence the speed of chemical reactions in the water and the biochemistry in the shrimp's body (Hasniar, 2013). The results of the research showed that the pH of the water in the white shrimp rearing media during the research was in the range of 8.4-8.6. This is in accordance with the opinion of Sustainable et al. (2018), a good pH for shrimp cultivation is 7.4-8.9.

Oxygen is a limiting factor, so that if its availability in water is not sufficient for the needs of cultivated biota, then all biota activities will be hampered (Rakhfid et al., 2018). Dissolved oxygen in waters is needed by aquatic organisms to support their life and growth (Scabra & Budiardi, 2020). Oxygen is needed by shrimp in the respiration process which can produce energy (Muzaki, 2004). The research results showed that dissolved oxygen in the rearing water from all treatments was still within the tolerance limits appropriate for the life of vaname shrimp, namely in the range of 5.8-7.6 mg/l. This is in accordance with the opinion of (Lestari, 2018) which states that good dissolved oxygen conditions for shrimp cultivation are at least 3 mg/l.

Ammonia in waters comes from the decomposition process of organic materials which contain lots of nitrogen compounds (protein) originating from leftover feed and fertilization (Hasniar, 2013). The results of the research showed that the ammonia levels in all treatments were still within normal limits that could be tolerated for the growth of vaname shrimp. In accordance with the opinion of Mangampa and Suwono (2010) that NH3 concentrations of more than 1.0 mg/l can cause shrimp death. In the research conducted, the value of ammonia levels in all treatments ranged from 0.4-021. The concentration of ammonia in waters is influenced by other water quality parameters. The concentration of ammonia-nitrogen will increase with increasing pH and temperature and decreasing salinity which will result in shrimp poisoning with ammonia (Hasniar, 2013).

CONCLUSION

Conclusion

The addition of the mineral Ca 50 ppm and P 45 ppm had a real effect on the growth rate of vaname shrimp, with the highest absolute length growth value of 5.8 cm and absolute weight growth of 1.07 gr found in P4 (Treatment Four).

Suggesting

Based on research conducted, the addition of Ca and P minerals has a real influence on the growth rate of vaname shrimp. It is recommended to use a Ca dose of 50 ppm and P 45 ppm for rearing vaname shrimp at a salinity of 0 ppt.

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