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The Effect of the Addition of Vitamin E and Vitamin K on Growth and Survival of Giant Prawn *(Macrobrachium rosenbergii)* Larvae

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Abstract. Giant prawn (Macrobrachium rosenbergii) is a potential fishery commodity. Recently, the commercial aquaculture of giant prawn has developed quite rapidly, especially in the rearing sector, due to its high economic value and accessible cultivation technology application. Low survival and growth are the causes of delays in the cultivation of giant prawns. The quality of the food for giant prawns is important to support the survival of the prawns during aquaculture activities. This study looks at how adding vitamins E and K to artificial food affects the growth and survival of giant prawn larvae from the Galah Prawn Seed Center (BBUG) in Klungkung, Bali. The results show that vitamin E had the highest influence on the growth and survival of giant prawn larvae, with 35.55% survival and a 4.727 growth index. Meanwhile, vitamin K in the prawn feed has no effect due to poor water quality and high mortality. The range of measured water quality was temperature (26-31°C), pH (7.5-7.8), and salinity (5-20 ppt). In general, this study shows that vitamin E had a positive effect on the growth and survival of giant prawn larvae.

Keywords: Giant prawn growth; vitamin E; vitamin K; survival rate

I. INTRODUCTION

Giant prawn *(Macrobrachium rosenbergii)* is a very promising fishery commodity and rapid development. Giant prawns have a fairly high economic value in the rearing sector and great demand because of the available and easy-to-apply cultivation technology. The body size of giant prawns *(Macrobrachium rosenbergii)* is larger than other freshwater prawns; apart from that, giant prawns are also more resistant to disease and are very popular with consumers both at home and abroad [11]. However, there is one problem in giant prawn cultivation, namely, maintaining life in the larval phase remains an issue during the rearing process. Moreover, low survival has long been the cause of delays in the cultivation of giant prawns *(Macrobrachium rosenbergii)*. The susceptibility of the larvae to disease and the slow growth of the shrimp in the enlargement phase in the ponds are thought to be the result of poor brood management.

The feed has an important role in sustaining life in aquaculture activities. In general, giant prawns are given artificial feed with a composition of 40% protein, 5% fat, and 20% carbohydrates [6]. The composition of artificial feed needs to be improved because, in general, artificial feed for shrimp only has nutrients (carbohydrates, protein, and fat) without vitamins. So, efforts to improve the nutritional composition of additional feed need to be made to increase the production of cultivated products [1]. One of the nutrients in feed needed by fish and other cultivated commodities is vitamins. Vitamins are organic compounds that act as cofactors in several metabolic reactions. In general, vitamins E and K play an important role in endurance, stress relief, preventing blood clots, and mineral absorption. Therefore, the addition of vitamins E and K to giant prawn larvae can improve the recovery of life and growth of giant prawn larvae [5].

The purpose of this study was to determine the effect of adding vitamins E and K to feed on the growth and maintenance of giant prawns *(Macrobrachium rosenbergii*) and to determine the effect of adding vitamins E and K on the quality of aquaculture water. Therefore, this

research is expected to be useful for the community, especially giant prawn cultivators, regarding the benefits of giving vitamins E and K on the growth and maintenance of giant prawn larvae.

II. METHODS

Time and Location

This research was conducted for 3 months, from January to March 2023. The data were obtained at BBUG Klungkung Regency.

Research Methods

The method used in this study was the experimental method and a Completely Randomized Design. A completely randomized design is a method that places treatments into experimental units carried out completely randomly, then all media and parameters must be the same, even though the treatments are different [12].

This study used 3 treatments, namely: the group without the addition of vitamins (control); with the addition of 300mg of vitamin E; and with the addition of 300mg of vitamin K. The research was carried out using a basin as a container and water with a salinity of 5 ppt as a medium for the maintenance of giant prawn larvae. Four basins were used and had a diameter of 23 cm and a height of 15 cm, filled with approximately 1 liter of water, with 50 giant prawn larvae aged 1 week, size 2mm in each basin. During the study, giant prawn larvae were given artificial feed that made with flour, milk, and eggs at 3gr at once for 3 times. Each treatment consisted of 3 repetitions for 3 weeks. Water quality measurements were carried out during the rearing period of giant prawn larvae in each basin with different treatments. The water quality parameters measured included temperature (^{0}C), pH, and salinity (ppm).

Research Parameters

Data analysis was performed using the Kruskal-Wallis test followed by the Mann-Whitney test. The parameters measured include the survival rate parameter and larval stage index parameter.

Survival rate

The survival rate parameters of giant prawn larvae were determined by counting the number of prawn larvae at the beginning and the end of the study. This aims to find out how many shrimp larvae survived during the study. Survival during the study was calculated based on the difference between the number of shrimps at the beginning of the study and the number of shrimps that died during the study, divided by the number of shrimps at the start of the study and then multiplied by 100 [3]. The formula for calculating survival (SR) is as follows:

$$SR = \frac{(N1 - N2)}{N1}\ x\ 100$$

SR: Survival rate
N1: Number of stocks
N2: Number of deaths

Larval stage index

Measurement of larval stage index parameters was guided by bringing samples of shrimp larvae to the Fisheries Laboratory of Udayana University and observing them under a microscope with 10x magnification. Shrimp larvae experience 11 stages of growth starting from after hatching to post-larvae, which can be measured using larval stage index (LSI) [15]:

$$LSI = \frac{(n1xa) + (n2xb) + (n3xc) + \cdots}{N}$$

LSI: Larvae Stage Index
n1, n2, n3: the number of larvae seen at the same stage
a, b, c: larval stage
N: total number of larvae

III. RESULT AND DISCUSSION

Survival Rate and Larvae Stage Index

Based on the research that has been done, giant prawn larvae with regular feed (control) get an SR of 32%, and on feed mixed with vitamin E get an SR of 35.33% (Figure 1). Meanwhile, giant prawn larvae that were given feed mixed with vitamin K did not get results (SR=0).

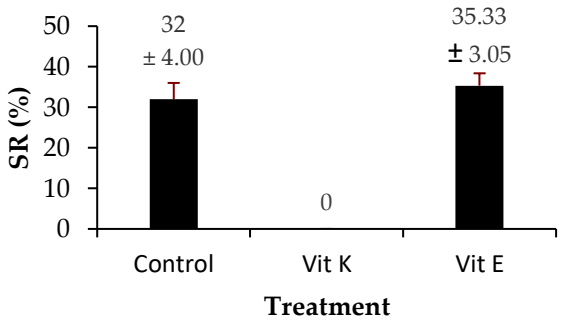

Figure 1. Survival of giant prawn larvae with different treatments for 30 days of rearing

The death of giant prawn larvae that were given regular feed and those that were fed with additional vitamin E began on the day when the shrimp larvae experienced molting, and the temperature started to decrease because the molting shrimp could not withstand low temperatures. Meanwhile, shrimp larvae treated with vitamin K-

supplemented feed died on the second day when feeding because the salinity in the rearing container increased

The survival of giant prawn larvae decreased in each treatment. In the first week, the survival of giant prawn larvae on regular feed and supplemental vitamin E decreased slightly. In contrast, the treatment with vitamin K and a combination of vitamins E and K decreased quite drastically. In the second and third weeks, the survival of giant prawn larvae on regular feed and additional vitamin E decreased again. In contrast, in the second and third week, the treatment with vitamin K had no larvae in the rearing medium. The weekly SR chart can be seen in Figure 2.

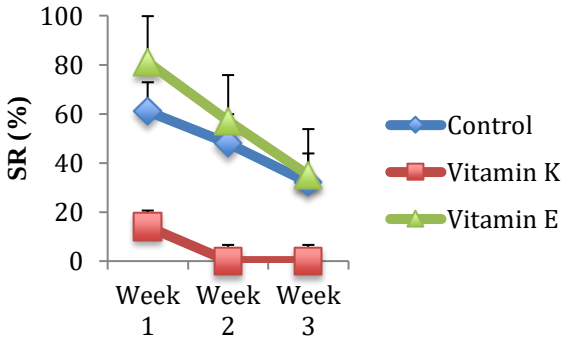

Figure 2. SR weekly chart

The results of the calculation of the Larvae Stage Index (LSI) on giant prawn larvae show results that tend to be the same as the survival of giant prawn larvae. The results of LSI calculations for treatment with control feed and feed added with vitamin E were 4.636 and 4.727. Meanwhile, the treatment that added vitamin K did not get results (LSI = 0). This is due to the giant prawn larvae in the research media dying before the day of observation of the LSI. The Larvae Stage Index graph of giant prawn larvae during the study period can be seen in Figure 3.

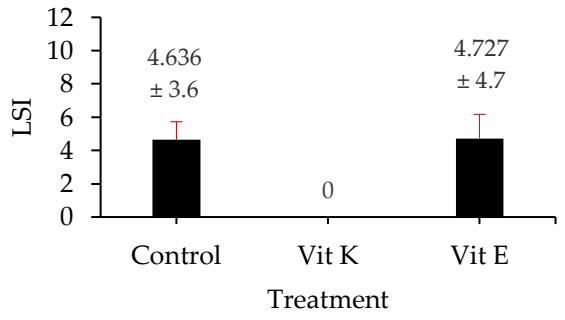

Figure 3. LSI graph of giant prawn larvae with different treatments for 30 days of rearing

Referring to the results of the Kruskal-Wallis test in Table 1, for SR that the average regular feed treatment was 32, the average Vit K value was 0.000, the average Vit E value was 35.33, and the Vit E and K average values were 0.000. In addition, the value of Sig. of 0.019, the value is <0.05 so it can be concluded that with a 95% confidence level, the results of the initial hypothesis (H0) were rejected and the alternative hypothesis (H1) was accepted, which means that there is an average difference between treatment groups, so it can be decided that there is an effect of vitamins E and K on SR.

Table 1
Kruskal-Wallis test result

	Treatment	Mean	Sig.
SR	Control	32 %	0,019
	Vit K	0,000	
	Vit E	35,33 %	
LSI	Control	4.636	0,000
	Vit K	0.000	
	Vit E	4.727	

Based on the table above, information is obtained that the average value of ordinary feed treatment is 4.636, the average value of Vit K is 0.000, the average value of Vit E is 4.272, and the average value of Vit E and K is 0.000. In addition, based on the Kruskal-Wallis test, the value of Sig. of 0.000, the value is <0.05 so it can be concluded that with a 95% confidence level, the results of the initial hypothesis (H0) were rejected and the alternative hypothesis (H1) was accepted, which means that there is an average difference between treatment groups, so it can be decided that there is an effect of vitamins E and K on LSI.

Table 2
Mann-Whitney test result

Treatment	Average difference	Sig.
Control and Vit. E (SR)	3.33	0.216
Control and Vit. E (LSI)	3.364	0.715

Referring to the results of the Mann-Whitney follow-up test in Table 2 for SR, the average difference in the control with the addition of vitamin E was 3.33. Then the Sig value is obtained. of 0.216, the value is > 0.05 so it can be concluded that with a 95% confidence level, the results of the initial hypothesis (H0) are accepted and the alternative hypothesis (H1) is rejected, which means that there is no average difference between treatment groups, so it can be decided that there is no effect of vitamin E on SR.

In the larval stage, giant prawns are susceptible to disease and low temperatures. With the addition of vitamin E, the immune system of giant prawn larvae becomes high, so mortality in containers treated with vitamin E is low.

This is because the addition of vitamin E to artificial feed provides benefits to giant prawn larvae, such as helping to cope with stress, maintaining endurance, and acting as an antioxidant [9].

Whereas the treatment with vitamin K did not get results because the salinity in the study with the addition of vitamin K was not optimal. Shrimp larvae reared in containers treated with vitamin K experienced high mortality because the salinity in the rearing containers reached 20 ppt. In addition to water quality, giant prawn larvae on vitamin K treatment experienced high mortality. Vitamin K does not affect giant prawn larvae. The addition of vitamin K to giant prawns will be optimal at the juvenile stage. This is because in the larval stage, giant prawns are not ready to receive vitamin K, whereas during this stage, the giant prawn larvae will experience poisoning and destruction of red blood cells [16].

Based on the Mann-Whitney follow-up test in Table 4.2 for LSI, the average difference in control with the addition of vitamin E was 3.364 with a Sig. 0.715, the value is > 0.05, so it can be concluded that with a confidence level of 95%, the results of the initial hypothesis (H0) are accepted and the alternative hypothesis (H1) is rejected, which means that there is no average difference between treatment groups, so it can be decided that there is no effect of vitamin E on LSI.

The treatment of shrimp larvae that were given additional vitamin E had higher results than the treatment with ordinary feed because the feed that was added with vitamin E had higher nutrition, and these nutrients could increase the immunity of giant prawn larvae during rearing. This was reinforced by the statement [9], which stated that the addition of vitamin E could provide a good growth rate for shrimp fry. The addition of vitamin E can also avoid larval abnormalities and accelerate the molting process of giant prawn larvae [10]. In the treatment with added vitamin K, no results were obtained because the giant prawn larvae died before the LSI observation began.

Water Quality

Water quality measurements carried out during the study included temperature, pH, and salinity. The media temperature during the study for each treatment was 26 °C-31 °C. The pH of each treatment had different results, for the treatment on ordinary feed the pH ranged from 7.5-7.6, for the treatment on vitamin E it had a pH of 7.7-7.8, for the treatment on vitamin K it obtained a pH of 7.7-7.8 and for the combination treatment of vitamins E and vitamin K, it obtained a pH of 7.7. In measuring salinity, the control had a salinity of 5-10 ppt, in the vitamin E treatment, the salinity was 5 ppt, and in the vitamin K treatment, the salinity was 5-20 ppt. The results of temperature and pH measurements in this study were normal, but for salinity was not normal for fish farming. The results of water quality calculations can be seen in Table 3.

Table 3
Water quality data

Parameters	Value of Water Quality		
	Control	Vitamin E	Vitamin K
Temperature (°C)	26-31	26-31	26-31
pH	7.5-7.6	7.7-7.8	7.7-7.8
Salinity (ppt)	5-10	5	5-20

The giant prawn larvae in the study experienced high mortality when the temperature of the container decreased to 26 °C, especially when the giant prawn larvae were molting. Temperature is an environmental factor that greatly influences the growth, development, and survival of shrimp [8]. Low temperatures can cause stress and susceptibility of shrimp larvae to disease because at low temperatures, shrimp larvae have low immunity, which also causes the death of shrimp larvae [13].

The pH value obtained in the study ranged from 7.5 to 7.7. This value is included in the optimal value for survival and growth of giant prawn larvae [14]. Salinity levels obtained in this study were 5-20 ppt. Proper salinity for giant prawn cultivation. is between 5-15 ppt [7]. In this study, salinity is thought to have an important role in the low survival and growth of giant prawns, especially on fed with the addition of vitamins. In the control treatment that added vitamin K to the larval rearing container, the average salinity value was 20 ppt. The addition of vitamin K did not result in optimal LSI and larval growth. This salinity value is thought to cause high mortality of shrimp larvae. Increased salinity in the vitamin K maintenance container because vitamin K contains sodium. Sodium can increase the salinity in the container when the feed given to giant prawn larvae remains and is mixed with the rearing medium for quite a long time. With an increase in salinity in the container, shrimp larvae will experience ionic stress due to excessive sodium [4]. High salinity values cause high mortality because shrimp larvae reared at a salinity of more than 15 will experience slow growth and even high mortality, so the survival of shrimp larvae is low [2]. The correlation between addition of vitamin E has a positive impact on the LSI shrimp larvae, and their growth increases, while vitamin E has little effect on water quality. The combination of vitamins E and K will have a positive impact if the salinity in the rearing container is reduced, as vitamin K itself can increase the salinity of the water quality.

IV. CONCLUSION

Based on the results, it can be concluded that the addition of vitamin E to the growth and LSI of giant prawn larvae has a positive impact because vitamin E causes minimal effects that help stabilize the growth and LSI of the larvae. The addition of vitamin K to the larvae does not have a positive correlation because the addition of vitamin K to the container increases the salinity beyond normal levels, which causes larval mortality. The addition of vitamins E and K has a perfect negative correlation because while the addition of both vitamins enhances the growth and LSI of the larvae, special attention must be given to the salinity of the rearing container to avoid the increase in salinity caused by vitamin K.

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