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The Effect Of Different Stocking With Vitamin C Supplementation Feed On The Growth And Survival Of Tilapia (*Oreochromis niloticus*)

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Article Information

Article history :
Received: March 21, 2025
Accepted: May 17, 2025
Available online: May 31, 2025

Keywords: *Stocking Density, Vitamin C, Tilapia, Growth, Water Quality.*

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Abstract

Tilapia (*Oreochromis niloticus*) is a freshwater fish with significant economic value. Proper stocking density and vitamin C supplementation are important to maintain fish health and improve productivity by reducing competition for feed and oxygen. The purpose of this research was to determine the best stocking density through vitamin C supplementation as seen from the growth data and survival of tilapia during 30 days of maintenance. The research method that used is experimental with Completely Randomized Design. The research consisted of a stocking density treatment of 15 fish/container, 25 fish/container, and 35 fish/container. Each treatment will be given 3 repetitions. Vitamin C supplementation is given in the feed with a dose of 150 mg/kg of feed. The cultivation container used has a volume of 15 L of water as a cultivation medium. Growth and survival data will be analyzed using SPSS and water quality data as supporting data will be analyzed using Ms. Excel and presented descriptively quantitatively. The results of the research showed that the highest length, weight, and survival values were in treatment A (15 fish/container) with a length growth of 2.43 cm and a weight of 2.42 grams and a survival rate of 86.63%. The results of the ANOVA analysis showed that the stocking density treatment had a significant effect on the length of tilapia, but did not have a significant effect on the weight and survival of the fish. The water quality conditions were still at the optimal standard quality values for tilapia maintenance in all treatments.

DOI:https://doi.org/10.62521/01d0f118

Introduction

Tilapia is one of the freshwater fish commodities that has important economic value. This fish is popular among fish farmers because it has promising prospects in the future with several advantages, such as rapid growth with high productivity and a fairly high salinity tolerance (Fransisca and Muhsoni, 2021). Additionally, the texture of the meat, taste, white meat color, and few bones with good nutritional content, as well as its affordable price make tilapia a source of protein and there is a high demand in the community. Cultivation activities can

provide good production results if managed properly (Mendrofa and Zebua, 2025). The important keys in fish farming activities are feed management, health management, and water quality management. Feed is one of the important factors in cultivation activities because almost 70% of production costs are used for purchasing fish feed (Mulia *et al*., 2023).

Fish health management consists of preventing and treating fish from diseases, so certain treatments are needed, such as adding vitamin C to fish feed to increase fish immunity. Water quality management is closely related to fish health. It is essential to maintain water quality because water serves as the primary living medium for fish. Therefore, various water parameters must be carefully monitored and controlled to ensure optimal fish growth, survival, and overall health.

Vitamins are organic compounds that are very much needed for body metabolism. According to Lovel (1984), fish have a limited composition to synthesize vitamin C and depend on the composition of the feed, so fish need vitamin C intake in the feed mixture to increase growth and reduce stress, following the opinion of Sukmawati *et al*., (1999), vitamin C can be used for protection from disease attacks. According to Gunawan *et al*., (2014), the addition of vitamin C as much as 100 mg/kg and 150 mg/kg in feed effectively accelerates growth and maintains the survival of tilapia (*Oreochromis niloticus*). This research employed a dietary supplementation of vitamin C at a dosage of 150 mg/kg feed under varying stocking densities to evaluate the influence of stocking density on the growth performance of Nile tilapia (*Oreochromis niloticus*).

The stocking density of tilapia will increase yield under optimum environmental conditions and sufficient feeding (Hepher and Pruginin, 1981), (Yuliati, *et al*., 2003), and (Diansari, Arini, & Elfitasari, 2013). This is related to the environmental carrying capacity, namely the ability of the water area to support fish life optimally over a long period. Factors that affect carrying capacity include water quality, feed, and fish size. During the maintenance process, fish farmers frequently complain about the best density of fish seeds. Therefore, it is necessary to take steps and apply appropriate technology to add economic value to fish farming efforts.

Materials and methods

The research was conducted in the wet pond laboratory of the Faculty of Marine and Fisheries, Udayana University for 30 days of maintenance. This research used 9 containers with a volume of 15 L, and tilapia with a size

of ±7 cm were used with different stocking densities in each treatment, as well as commercial feed containing 30% protein for the test.

The research method in this research is experimental using a Completely Randomized Design (CRD) which is a type of experimental design where treatments are given randomly to all experimental units. There was no significant effect of the medium or place of the experiment on the observed response because the environment was homogeneous (Mattjik & Sumertajaya, 2000). This research used three treatments and three repetitions, consisting of:

Treatment A : Tilapia with a vitamin C dose of 150 mg/kg feed and a stocking density of 15 fish/container.

Treatment B : Tilapia with a vitamin C dose of 150 mg/kg feed and a stocking density of 25 fish/container.

Treatment C : Tilapia with a vitamin C dose of 150 mg/kg feed and a stocking density of 35 fish/container.

According to Effendi (1997), growth is the increase in weight and length of fish which can be calculated using the following formula:

Absolute weight gain: Wt-W0.....(1)

Where:

Wt : Final Weight (gram)

W0 : Initial Weight (gram)

Absolute length growth: Lt-Lo.....(2)

Where:

Lt : Final length (cm)

Lo : Initial length (cm)

Survival Rate (SR) is the percentage of fish survival that can be calculated using a formula. Survival in this research was obtained at the end of the research. The survival formula according to Effendi (1997) is as follows:

$$Survival\ rate = \frac{N_t}{N_0} x100 \ldots.(3)$$

Where:

SR : Fish survival rate (%)

Nt : Number of harvested fish (fish)

N0 : Number of initial fish (fish)

Water quality measurements were carried out every morning during the research, namely 30 days of maintenance to control the development of water quality during the research. The water quality parameters measured were Dissolved Oxygen (DO), pH, and temperature.

The data obtained will be analyzed using the One Way ANOVA (Analysis of

Variance) method with the Statistical Product and Service Solution (SPSS) program. When the analysis shows a real difference between treatments, the Duncan Test will be performed at a 95% confidence level to determine the best treatment.

Results and Discussion

Length Growth

Based on the results of the research that has been conducted from the three treatments, it shows that from the different stocking densities, the highest fish length growth value was in treatment A with a vitamin C dose of 150 mg/kg feed and a stocking density of 15 fish/container, which was 2.43 cm. The lowest length growth value was in Treatment C using a stocking density of 35 fish/container of 1.38 cm. This is supported by the SPSS test which shows a significant difference in each treatment (**Figure 1**).

The results of this research indicate that a stocking density of 15 fish/container gives the best results in length growth in tilapia (O. *niloticus*) it was found that there was a significant difference seen from the difference in notation in each treatment which was influenced by the stocking density in fish. According to Komalasari *et al*., (2017), the effect of stocking density greatly affects the length growth in fish. This shows that the denser the stocking, the slower the length growth. The research conducted showed that vitamin C affects the length of growth of fish. According to Batubara *et al*., (2023), vitamin C given in commercial feed mixtures has a real effect on the length growth of fish, because giving vitamin C helps increase calcium levels in fish.

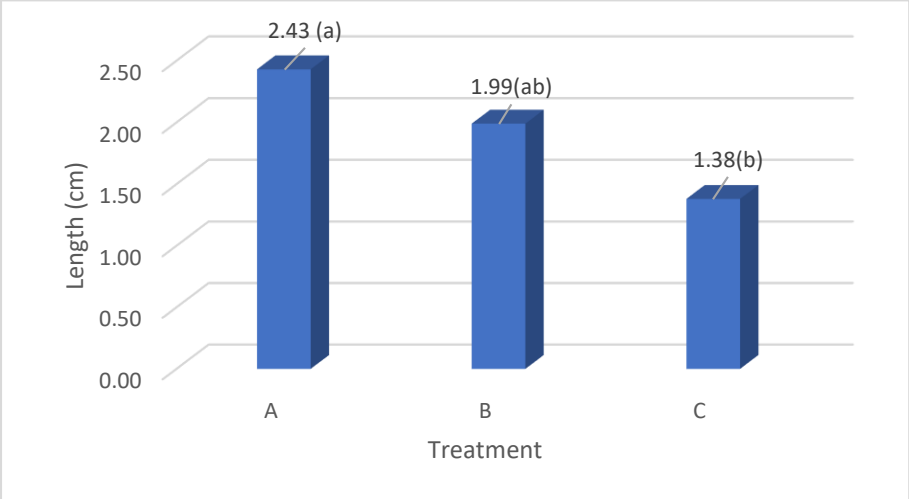

Figure 1. Results of Fish Length Growth
Description: Differences in notation indicate statistically significant effects

Fish Weight Growth

Based on the research results that experienced weight gain every week, the highest absolute weight growth value was in Treatment A, which was 2.42 grams and the lowest was in Treatment C, which was 1.60 grams (Figure 2).

Different weight gain results are influenced by different stocking densities, because the denser the stocking level, the greater the feed consumption requirements. According to Xu *et al*., (2022), the research conducted showed that the stocking density level affects the amount of feed consumption. There is a relationship between the density of stocking in the pond and the amount of feed needed to meet the fish needs.

The ANOVA test conducted with the Duncan test showed that the difference in stocking density did not have a significant effect on the growth of tilapia weight during the research. This explains that the stocking density of 35 fish/container still gives results that are not significantly different from the growth of tilapia weight. The provision of vitamin C affects weight growth, namely helping in the metabolic process of the fish's body. The effect of giving a dose of vitamin C is very beneficial for fish growth because vitamin C is very easily digested by the digestive tract. This greatly helps the metabolic process in the fish's body. According to Sumitro and Afandi (2021), vitamin C has a role in helping the metabolic function in the fish's body. Vitamin C supplementation has an important role in the performance of fish weight growth because vitamin C plays a role in the performance of the fish's intestines. According to Ibrahim *et al*., (2020), vitamin C supplementation in fish has an important role in increasing growth hormones and helping the intestines absorb nutrients in feed.

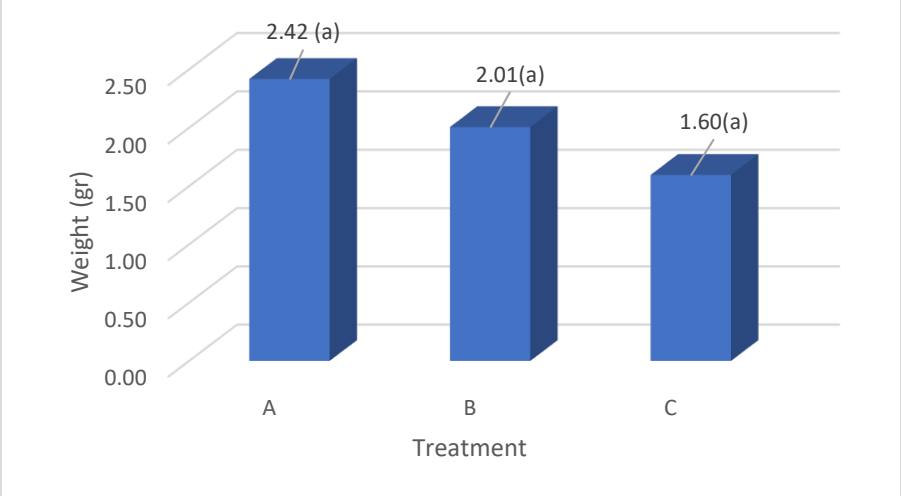

Figure 2. Results of fish weight growth during the research
Description: Differences in notation indicate statistically significant effects

Survival Rate (SR)

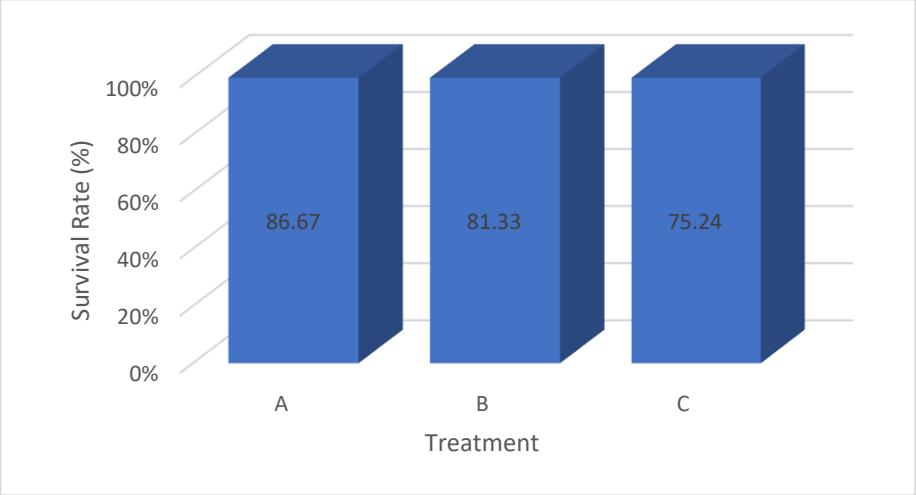

Figure 3. Results of fish survival during the research

The results of the research showed that the survival rate values during the research gave different results. The highest survival rates obtained in Treatment A was 86.67%, Treatment B was 81.33%, and Treatment C was 75.25%. (Figure 3). The highest survival rate was in Treatment A because this treatment had a lower stocking density compared to other treatments.

Stocking density affects the survival rate of tilapia. The higher the stocking density, the less space for fish to move and the more competition for food there will be. However, the survival rate between these three treatments is still relatively high, namely above 70%, due to the factor of giving a dose of vitamin C which helps in increasing the immunity of fish. According to Wijayanti *et al*., (2023), giving a dose of vitamin C of 150 mg/kg of feed can help in increasing the immune response which increases immunity in fish. One of the factors causing a decrease in the immune response in fish is stress which can increase mortality or death in fish. The treatment that can be done in this case is to provide vitamin C which can help increase the immune response and reduce stress in fish. According to Islam *et al*., (2019), giving vitamin C can play a role in reducing stress which results in high mortality in fish which affects the level of immunity in the fish's body. This is very helpful in increasing survival or survival rates for fish farming.

Water Quality

The results of the research that has been conducted show that DO in all treatments is in the optimal range for tilapia maintenance, namely 3.45-4.1 ppm; temperature value 24.6-25.5℃; and pH value 6.5-7.38. Differences in

Table 1. Water Quality Measurement

Treatment	Treatment A	Treatment B	Treatment C
DO (ppm)	3.51-4.1	3.48-4	3.45-3.9
Temperature (^{0}C)	24.8-25.5	24.6-25.4	24.7-25.3
pH	7.1-7.32	6.5-7.28	6.7-7.28

stocking density can affect the amount of dissolved oxygen because the denser the stocking, the more competition there will be in the use of oxygen for respiration.

Based on Table 1, it is clear that Treatment C (stocking density 35 fish/container) has a lower DO value than Treatment B and Treatment A. However, all water quality parameter values are still in the optimum range for tilapia maintenance. Low dissolved oxygen content will result in fish death. According to Verma *et al*., (2022), the loss of oxygen content in the cultivation medium will result in fish death.

Research has shown that it has a DO ranged from 3.45 to 4.1, which is relatively stable for fish farming based on the research carried out. According to Saselah *et al*., (2023), the oxygen range of less than 3 is a range that is not good for cultivation media, in this research the oxygen content is still stable due to several factors, namely the presence of a good aeration system. As a result, dissolved oxygen can be tolerated. Fluctuations in temperature and pH concentration in the research were influenced by the environment, and the placement of the container during the research. The results of temperature measurements in the research ranged from 24.6 to 25.5 ^{o}C. While the pH concentration during the research ranged from 6.5 to 7.32. The Temperature and pH Concentration values in this research are still relatively stable and can support fish growth during cultivation. The results of water quality measurements during the research can be seen in Table1.

According to Niawati *et al*., (2022), the safe temperature for cultivation media is between 24-33^{o}C. While the safe pH concentration for cultivation is between 6.5-9. This means that the water quality in the tilapia cultivation media in this research is relatively safe and stable. Temperature differences, DO, and pH concentration in cultivation media can usually be influenced by several factors, such as rainfall and light intensity. According to Panggabean *et al*., (2016), the influence of rainfall and light intensity will affect the temperature, dissolved oxygen (DO), and pH concentration in a pond or cultivation media.

Conclusion

Different stocking densities significantly affected the absolute length growth of tilapia but did not significantly affect the absolute weight growth and survival of tilapia supplemented with 150 mg/kg of feed. The highest length, weight, and survival values were obtained in Treatment A (stocking density of 15 fish/container). Based on the analysis results, a stocking density of 35 fish/container of tilapia seeds with 150 mg/kg of feed vitamin C supplementation is recommended for application in cultivation activities. According to the ANOVA test, tilapia weight and survival did not differ significantly. Therefore, compared to the stocking density of 15 fish/m^2 and 25 fish/m^2, 35 fish/container is expected to lead to higher production results in aquaculture activities.

Acknowledgements

The author would like to express gratitude to the Faculty of Marine and Fisheries, Udayana University, for providing the facilities and support that enabled this research to be carried out.

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