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Analysis of the Effect of Time Difference in Blue Light Illumination on Growth and Behavior in Tilapia *(Oreochromis niloticus)*

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Abstract

Freshwater and marine fish farming faces challenges as the need for tilapia *(Oreochromis niloticus)* is one of the many fishery commodities, easy to find and widely cultivated in Indonesia. Tilapia can be cultivated in various places such as ponds, reservoirs, rice fields, ponds, rivers and even in waters that have higher salt levels than brackish freshwater. Experimental research experiment design, factorial design *(complete randomized design)* The experiment carried out in this study was the use of blue light color with different times as many as 3 treatments each repeated 3 times: Treatment A = 10 watt blue light without time change Treatment B = 10 watt blue light with 4 hours Treatment C = 10 watt blue light with 6 hours. Statistical data analysis using the ANOVA test was carried out using the help of the SPSS 16.0 program. The analysis aimed to find out the influence of blue light colour on the behaviour and growth of tilapia seeds. Based on the results of the study, it can be concluded that, Treatment of different irradiation times (0 hours, 4 hours, and 6 hours) has a significant influence on the absolute weight growth of tilapia. Treatment with a 6-hour radiation time per day showed the best weight growth compared to other treatments.

Keywords: aquaculture, artificial lighting, fish physiology, growth performance, photoperiod

INTRODUCTION

Tilapia *(Oreochromis niloticus)* is one of the leading fishery commodities that is widely cultivated and easy to find in various regions of Indonesia. Its delicious taste and body shape with minimal fine spines make this fish one of the favorite sources of animal protein by the public. Tilapia cultivation can be carried out in various media such as ponds, ponds, rivers, reservoirs, rice fields, to brackish waters that have higher salinity than freshwater. Tilapia that is still small in size is generally more resistant to changes in environmental conditions compared to large ones, (Khairuman & Amri, 2005).

Fish growth is the process of increasing body size, both in weight, length, and volume, which occurs over time due to the addition of body tissues. Fish growth is influenced by internal and external factors. Internal factors include age, genetics, ability to utilize feed, and the body's resistance to disease, while external factors are related to environmental conditions such as water quality, temperature, space of movement, light intensity, and feed availability (Biswas et al., 2006; El-Sayed & Kawanna, 2004; Volpato & Barreto, 2001). Optimal environmental conditions will support the metabolic process and fish eating activities so that growth can take place optimally. Therefore, the management of environmental factors is one of the important aspects in the success of tilapia cultivation.

The use of blue lights with different lighting durations aimed to evaluate the behavioral response and growth of tilapia (*Oreochromis niloticus*). Artificial lighting in aquaculture systems is known to be able to affect fish activities, especially gathering behavior, feeding activities, and feed utilization efficiency that is directly related to fish growth (Luchiari & Freire, 2009). In addition, manipulation of the light spectrum in aquaculture media can improve the physiological response of fish through more optimal environmental regulation (Villamizar et al., 2009). Tilapia cultivation in Indonesia is generally carried out in ponds because it is easier to manage feed, monitor water quality, control diseases, and harvest

processes. The success of aquaculture is greatly influenced by the environmental conditions of the maintenance and the application of technology that supports optimal fish growth (El-Sayed & Kawanna, 2004). Therefore, the use of blue light with variations in irradiation duration is expected to be one of the technological alternatives to increase tilapia growth in aquaculture systems.

The use of light lamps in fish farming aims to regulate behavior and improve the physiological response of fish to the maintenance environment. One of the most widely used light colors is blue light because it is able to increase fish activities, such as gathering behavior and feeding activities, so that it can support optimal fish growth (Abd El-Hack et al., 2022). In modern aquaculture systems, light manipulation began to be developed as a supporting technology to improve the growth efficiency, survival, and biological response of farmed fish (Qu et al., 2022). Tilapia cultivation (*Oreochromis niloticus*) is one of the freshwater fisheries commodities that has high economic value, but still faces obstacles to high production costs, especially in the use of feed. Therefore, the use of artificial light is expected to be one of the technological alternatives to increase tilapia cultivation productivity through a more optimal maintenance environment (Noureldin et al., 2021).

Light is one of the environmental factors that plays an important role in supporting the biological activities of fish, including eating behavior, growth, reproduction, and other physiological responses. The intensity, color, and duration of irradiation can affect the ability of fish to adapt to the maintenance environment (Henry et al., 2025; Silva et al., 2014). Fish that have a high sensitivity to light generally show a positive phototacosis response, which is moving closer to a specific light source. The response is influenced by the wavelength of light received by the fish's vision system so that each color of light can have a different influence on the behavior and activity of the fish (Villamizar et al., 2009).

The use of blue light in fish farming is known to have a positive influence on fish activities, especially in improving feeding response and lowering stress levels during rearing (Yi et al., 2022). In addition, lighting manipulation using light emitting diode (LED) lamp technology is starting to be widely applied because it is more efficient, energy-efficient, and able to produce a more stable light spectrum than conventional lamps (Noureldin et al., 2021). Therefore, light regulation in the cultivation system can be used as one of the strategies to increase tilapia growth and productivity optimally.

As an environmental factor from outside the fish's body, light plays an important role in influencing various aspects of fish life, including its physiological, reproductive, and growth functions (Henry et al., 2025). In cultivation practice, artificial light through lamps can be used as a substitute for sunlight (Yi et al., 2022). One of the strategies carried out by cultivators is to regulate artificial lighting during the fish rearing period, (Noureldin et al., 2021). Light spectrum manipulation is carried out using light emitting diode (LED) lamp technology which has a number of advantages over fluorescent lamps, such as higher energy efficiency, longer service life, and less environmental impact because it is mercury-free (Aras et al., 2015).

Tilapia is a diurnal fish that is active during the day, therefore it is necessary to determine the right light spectrum so that the sensitivity of the eyes becomes better (Aras et al., 2015). Based on research (Noureldin et al., 2021) Using a 10-watt lamp shows that tilapia will move and gather under the light of blue lights, and tend to avoid yellow and red lights, while the type of light color that Tilapia likes the most is blue. Research results (Wang et al., 2023) using a 10 watt TL lamp where the behavior of tilapia is more responsive to the treatment of blue light and also produces the highest absolute growth in blue lights.

The use of lamplight on the growth rate of freshwater fish in the cultivation process is still minimal. Light is one of the environmental factors that until now has not attracted

cultivators to develop it. Cultivators still use traditional methods and are more interested in using a mixture of artificial feed with natural ingredients to increase the growth rate of fish. In fact, light is known to affect the physiological condition of fish directly and can be used as a substitute for natural light.

The use of light needs to be studied because fish are one of the animals that have the ability to distinguish the warma of light used to determine mate preferences during mating, safe dwelling preferences, food preferences, and recognition The presence of predators can affect fish behavior, including in responding to light stimuli (McFarland & Loew, 1983). A number of studies have proven that variations in light color have a significant effect on various physiological aspects of fish, such as fecundity rate, survival rate, growth, and other biological responses. However, until now there are still minimal studies that specifically discuss the effect of light color differences on tilapia growth in aquaculture systems. Therefore, it is important to conduct research on the use of light colors in the tilapia cultivation process.

METHODS

This study aims to analyze the effect of the use of blue light with different irradiation lengths on the growth of tilapia (*Oreochromis niloticus*) seeds. The research was carried out at the Bukit Harapan Tourism Pool, Bonto Parangang Village, Parangloe District, Gowa Regency. The research method used is an experimental method with a *completely randomized design (CRD*) because the research medium is homogeneous. The experimental method is used to determine the effect of certain treatments on the research object in a controlled and systematic manner (Montgomery, 2017). This study consisted of three treatments with three repeats, namely treatment A using a 10-watt blue light without a time, treatment B using a 10-watt blue light with a 4-hour illumination time, and treatment C using a 10-watt blue light with a 6-hour irradiation duration.

The research stages include the preparation of containers and maintenance media, the preparation of tilapia seeds, feeding, and the regulation of light treatment in each research container. The observed variable is fish growth which includes an increase in the length and weight of the fish. Weight measurement is carried out through weighing the total weight of fish, while length measurement is carried out periodically using a measuring device. Research data is recorded every day, then input and processed using Microsoft Excel. Data analysis was carried out using *the Analysis of Variance* (ANOVA) test with the help of the SPSS version 16.0 program to determine the effect of treatment on tilapia seed growth. If the results of the analysis show a significant difference, it is followed by a *further Least Significant Difference* (LSD) test to determine the difference between treatments (Quinn & Keough, 2002).

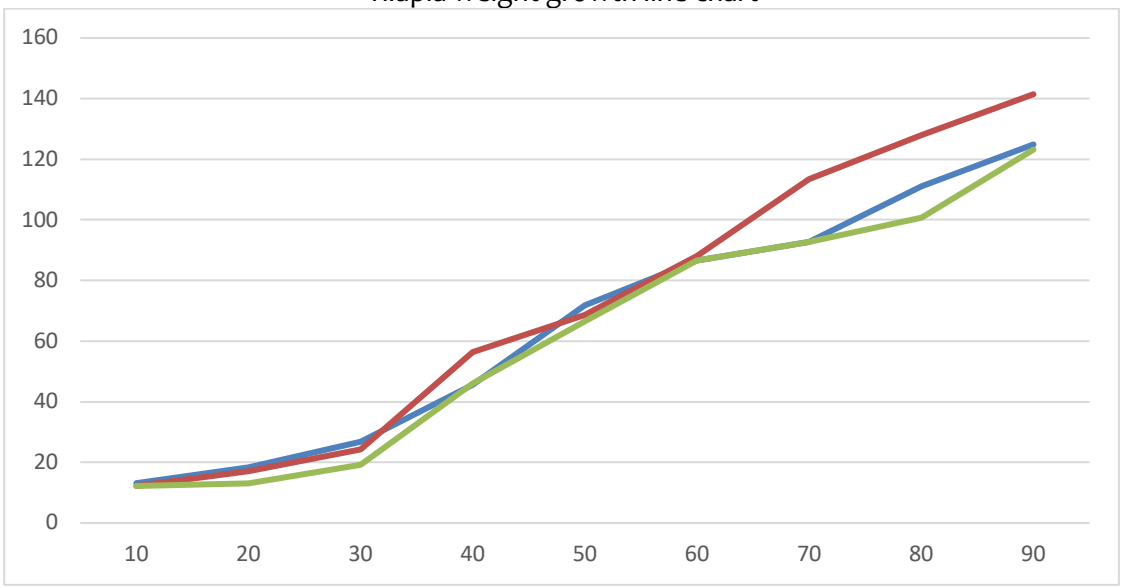
RESULTS AND DISCUSSION

This section presents the results of a study on the effect of long blue light irradiation on the absolute weight growth of tilapia during the maintenance period. Fish growth is one of the indicators of cultivation success which is influenced by environmental factors, feed, and light intensity. Therefore, this study was conducted to determine the effect of different irradiation age differences on the growth of farmed tilapia.

From the results of the research that has been carried out, it can be seen that in each research treatment starting from 0 hours, 4 hours or 6 hours, there is an increase in weight.

The pattern of weight gain between the three treatments was also almost the same. This can be seen in the image below:

Figure 1.
Tilapia weight growth line chart



Source: research data processing results

The use of light lamps in fishery activities is widely used for fishing activities. The principle is to illuminate the prey or food of the fish so that the fish gathers which allows the fish to be more easily caught (McFarland & Loew, 1983). This principle is the basis for the use of lamps for fish farming activities with the aim that it is easier for fish to find their food and is expected to affect the increase in the weight of fish that are raised or cultivated.

In this study, the results were obtained that illumination of lamps with different intensities was able to increase the weight of tilapia that was kept for 90 days. This pattern applies to all irradiation durations, be it 0 hours, 4 hours and 6 hours. However, because it has the same pattern and after being subjected to a one-way anova statistical test, the result is that the irradiation duration treatment does not have a significant effect on fish weight gain.

These results show that the light irradiation treatment does not have a significant effect on the weight gain of the fish reared. The color of the blue light used in the study The results of this study are in line with one of the studies that irradiated various kinds of lights on tilapia. The results of the study showed that the relative growth rate of tilapia during the maintenance period of the value of each treatment was obtained with the highest treatment E blue light (6.20), D green light (4.69), B red light (4.58), C yellow light (3.52), and A white light (2.85) which means that tilapia at the time of feeding responded faster to the blue light. followed by green and red colors, whereas, yellow and white colors tend to be slow so that the utilization of feed does not go well (Henry et al., 2025). This causes the relative growth rate of tilapia that is given blue light exposure to be higher than other colors.

Another study that states that the color blue has an influence on the growth of tilapia (Noureldin et al., 2021). In this study, the results were obtained that blue light had a great effect on the daily growth rate and survival of tilapia. This shows that the color of blue light is well received by fish. The shorter wavelengths of blue light colors than other light colors and high survival rates indicate that fish are very tolerant and comfortable with blue light

colors. Other studies have also shown that light irradiation in fish farming is able to increase fish growth. Slaughter with 15 watt ultraviolet irradiation treatment made tilapia experience an absolute length growth rate of 6.4cm, a specific length of 0.051%/day, an absolute weight of 9.7g, and a specific weight of 0.060%/day during 45 days of maintenance (Qu et al., 2022) .

As for the length of irradiation that does not affect the weight gain, it is likely because the irradiation time is likely to be still not long. What supports this is the research conducted to determine the survival rate of tilapia related to the length of light irradiation. The study found that the light dark pattern with a light light duration of 12 hours of light: 12 hours of dark darkness and 6 hours of light: 18 hours of darkness had a great effect on the high growth of weight and growth rate of tilapia larvae (Volpato & Barreto, 2001).

The absolute weight growth in tilapia is influenced by various factors, including Feed Quality and Nutrition The protein, fat, and energy content in feed greatly affects growth efficiency. A balanced feed will increase feed conversion and promote weight growth. Water Temperature Temperature affects the metabolism of fish. The ideal temperature for tilapia growth ranges from 26–30°C. Below or above this range, the metabolism of fish can be disrupted, inhibiting growth. Too high Stocking Density will cause stress, feed competition, and decreased water quality, which negatively impacts weight growth. Irradiation or Photoperiod The time of irradiation (the length of daylight in a day) also affects growth. Sufficient bright time allows fish to be active and eat longer. Water Quality Factors such as DO (dissolved oxygen), pH, and ammonia greatly determine the health and metabolism of fish. Poor water quality will cause fish to be lazy to eat and growth is disrupted.

CONCLUSION

Based on the results of the study on the effect of different blue light illumination time on the growth and behavior of tilapia (Oreochromis niloticus), it can be concluded that, Different irradiation time treatment (0 hours, 4 hours, and 6 hours) has a significant influence on the absolute weight growth of tilapia. Treatment with an irradiation time of 6 hours per day showed the best weight growth compared to other treatments. Irradiation with blue light affects tilapia's eating behavior and swimming activities. Moderate lighting helps to increase appetite and lower stress, which has a positive impact on growth performance Lighting affects the circadian rhythm of fish, where adequate lighting stimulates metabolic activity and feed conversion efficiency. Water quality remained within optimal limits during the study, so it was not a growth limiting factor.

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