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Kinerja pertumbuhan ikan sidat (*Anguilla bicolor*) yang dipelihara dalam wadah dengan warna yang berbeda

Growth performance of eel fish (*Anguilla bicolor*) which are maintained in containers of different colors

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Abstrak

Pertumbuhan merupakan pendorong utama dalam meningkatkan profitabilitas akuakultur. Selain manajemen pemeliharaan, warna wadah juga menjadi faktor penunjang pertumbuhan ikan sidat. Penelitian ini bertujuan untuk mengetahui pengaruh warna wadah pemeliharaan yang berbeda terhadap kinerja pertumbuhan ikan sidat. Ikan uji yang digunakan berupa ikan sidat stadia elver dengan rata-rata bobot (129±1,31 g). Adapun metode yang digunakan adalah eksperimen dengan dua perlakuan yakni warna wadah abu dan hijau. Ikan uji ditempatkan di dalam wadah berukuran 19x4 m^2 dan ketinggian air 1m dengan padat tebar masing-masing 1100 ekor, lama pemeliharaan 30 hari. Variabel yang diamati yaitu performa pertumbuhan meliputi SR *(Survival Rate)*, ADG *(Average Daily Growth)*, FCR *(Food Convertion Ratio)*, SGR *(Spesific Growth Rate)*. Hasil yang didapat menunjukkan bahwa terdapat perbedaan signifikan rata-rata pertumbuhan ikan yang dipelihara dalam wadah abu dan hijau. Perlakuan wadah abu terbukti mendapatkan hasil lebih tinggi dengan nilai rata-rata berat akhir (192,4±4,5 g), FCR (1,01±0,02), ADG (2,01g/day±0,06), SGR (1,25%BW/day±0,02). Berdasarkan hasil penelitian dapat disimpulkan terdapat perbedaaan yang nyata pertumbuhan ikan sidat yang dipelihara dalam wadah abu dan hijau. Warna wadah abu terbukti lebih baik dalam menunjang kinerja pertumbuhan.

Kata kunci: Abu; Elver; Hijau; Nokturnal

Abstract

Performance of Eel (*Anguilla bicolor*) maintened in containers of different colors. Growth is the main driver in increasing the profitability of aquaculture. In addition to maintenance management the color of the container is also a factor supporting the growth of eels. This study aims to determine the effect of the color of different rearing containers on the growth and appetite response of eel. The test fish used were elver stage eels with an average weight (129 ±131g). The method used is an experiment with two treatments they are grey and green. The test fish were placed in a container measuring 19x4 m^2 and a water level of 1m with a stocking density of 1100 individuals each, 30 days of rearing. The variables observed were growth performance including SR (Survival Rate), ADG (Average Daily Growth), FCR (Food Conversion Ratio), SGR (Specific Growth Rate). The results obtained indicated that there was a significant difference in the average growth of fish reared in grey and green containers. Grey container treatment was proven to get higher yields with average final weight values (192.4 ± 4.5 g), FCR (1.01 ± 0.02), ADG (2.01g/day ± 0.06), SGR (1 .25%BW/day±0.02). Based on the results of the study it can be concluded that there is a significant difference in the growth of eels reared in ash and green containers. The color of the ash container proved to be better in supporting growth performance.

Keywords: Elver; Green; Grey; Nocturnal

1. Introduction

Eel Fish *(Anguilla bicolor)* is a type of fish that has high economic value and has export potential from the fisheries sector (Sembiring, 2015). This fish is very popular because it tastes delicious and has high nutritional content. Eel fish meat contains a lot of unsaturated fats which are rich in EPA *(Eicosapentaenoic Acid)* and DHA *(Docosehaxaenoic Acid)* as well as vitamins A, B1, B2 and E. It has a high omega 3 content so it is believed to be able to improve human mental function,

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memory and concentration (Setianto, 2011). Eels have high resistance to disease and high tolerance to various extreme water conditions. Apart from maintenance management, the appropriate color of the maintenance container is also a factor supporting fish growth and appetite (Puja *et al*., 2020).

The color of the rearing container is thought to influence the rate of food predation and survival. Success in the food predation process is influenced by the color of the container which makes it easier for the fish to detect and eat the food (Muthmainah *et al*, 2020). The choice of color of rearing container depends on the species which can trigger a positive, negative or no impact on the fish. Several attempts have been made to determine the appropriate container background color for growth performance (Nawang *et al*, 2019). Fish growth performance has been manipulated by feeding frequency, stocking density and light intensity (Mukai, 2011). The color and intensity of the light greatly influence the success of the lamp in attracting fish (Guntur *et al*, 2015). However, each type of fish has a different attraction to the color of light (Nguyen *et al*., 2019). Fish kept in light conditions will react differently to fish kept in dark conditions. In accordance with the statement (Prasetyo *et al*., 2020) which states that apart from color intensity, color brightness also affects the visible color. The response and sensitivity of fish eyes to certain intensities and wavelengths are not the same. The sensitivity of the retina to the color of light is influenced by the pigments in the con cells and rod cells. In this case, eel fish have dominant rod cells which are more attracted to waters that tend to be dark (Siregar *et al.,* 2020).

Fish growth can be influenced by internal factors including age, heredity, ability to utilize food and resistance to disease. Then external factors include fish living media (Astuti *et al*, 2018). According to Pratama (2018), the color of the cultivation container will affect the light intensity and wavelength that is reflected, this condition will affect the development and survival of cultivated fish. Eel fish have a high adaptability so they can maintain their body condition in a new environment. This comparison of the colors of rearing containers was carried out to identify the most ideal color to further improve growth performance, utilization of feed for the eel fish's body and increase the survival value of the eel fish.

The effectiveness of the background color of the rearing container also plays a role in reducing the stress level of the fish during the trial period. This finding was also reported by Tamazouzt*, et al*., 2000 on European perch larvae *(Perch fluviatilis)* which are cultured in black and gray tanks. The results showed Eurasian perch performed best in survival and growth when cultivated in ashcolored containers. Okomoda *et al* (2017) also reported that African catfish *(Clarias gariepinus)* has good growth performance and feed consumption in dark containers compared to bright containers such as green. In this case, the eel fish commodity has not been studied much regarding the response to appetite and growth according to the ideal color for rearing, so the aim of the research carried out was to determine the effect of different colors of rearing containers on the growth rate and appetite of eel fish.

2. Materi dan Metode

The research was conducted for two month The research was conducted for 1 month in a hatchery in the Banyuwangi East Java. The method used was an experiment with two treatments, namely dark gray with paint code No Drop 002 and green with jade palace paint code G25-001. In the research, grey is the color that creates a dark situation and green is the color that creates a lighter pool situation than grey. Six maintenance containers are measuring 19×4 m^2 with a water height of 1 m. Containers equipped with aeration, *fish house*, *feeding tray*, *central pole* and outlet pipe. The research material used was elver stage eel fish with a stocking density of 1100 individuals with an average weight (129 ± 13.1 g). Test fish were fed twice a day at 07.00 am and 04.00 pm *at satiation* with FR *(Feeding Rate)* in ash and green containers 3%. The feed given by the KAE 5 brand is a type of floating feed measuring 5mm (50-52% protein, 9% fat, 2% crude fiber, 12% water content).

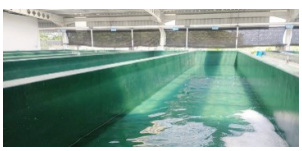

Figure 1. Green container.

Figure 2. Ash color container.

The water source used in raising eels comes from reservoirs. The water used is previously settled and filtered and then distributed into maintenance containers. Siphoning is carried out every day to maintain water quality in normal conditions. Water quality checks are also carried out twice a day with three main parameters, namely temperature, DO *(Disolved Oxygen)* and pH.

The test parameters observed include growth parameters including SR *(Survival Rate),* FCR *(Food Convertion Ratio),* ADG *(Average Daily Growth),* SGR *(Spesific Growth Rate)* and final weight. The growth rate and appetite response of eels were observed for 30 days. This research also uses independent sample t-test analysis which was carried out using SPSS software.

3. Results And Discussion

Based on the research results, it shows that the color treatment of the ash container has the best influence on the growth of eel fish. Eels kept in two different colors, namely gray and green, achieved a survival rate of 94-96% and no incidents of cannibalism were recorded. Eel fish in the ash container showed growth performance, namely final weight (192.4 ± 4.5 g), FCR *(Food Convertion Ratio)* (1,01 ± 0,02), ADG *(Average Daily Growth)* (2,01%/day ± 0,06), SGR *(Specific Growth Rate)* (1.25%/BW/day ± 0.02). The following is a diagram of fish survival in different colored containers:

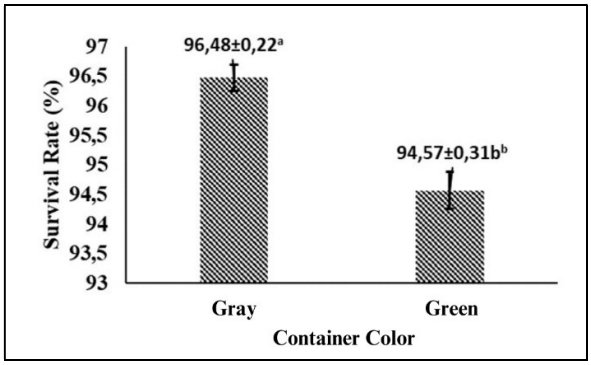

Figure 3. Survival rate (SR) eel fish.

Based on the Figure 3 above, eel fish kept in containers with gray and green colors achieved their respective survival rates (96.48%±0.22^a) and (94,57%±0,31^b). The difference in superscript marks on the diagram shows that there is a significant difference between the gray and green treatments. Analysis of variance shows that there is a significant difference

in the average *Survival rate* in fish kept in different colored containers. The ash container gets an SR value *(Survival Rate)* higher which indicates that eel fish are better and more comfortable to keep in dark containers according to their nocturnal characteristics and like darker places. Eels have dominant rod cells in the retina of the eye (monochromatic) which are more attracted to waters that tend to be dark. This fish has a single visual pigment so it is difficult to distinguish colors (Kelber, 2016). Fish that are not kept according to their habits will easily become stressed and this will affect their growth and survival. According to Dergisi (2015), the color of the container is one of the environmental factors that can influence fish survival.

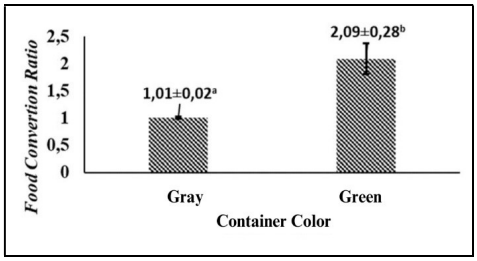

Figure 4. Food Convertion Ratio (FCR) of eels during the research.

Figure 4 shows the FCR value *(Food Convertion Ratio)* the highest was achieved by eels kept in green containers (2.09 ± 0,28^{b}) then followed by an ashcolored container (1.01± 0.02^{a}). analysis of variance showed significance (p <0.05) between treatments on the average FCR value *(Food Convertion Ratio)* which indicates that the eel fish in the ash container are able to utilize the feed well to gain weight. The eel fish in the ash container swim a little but are still active in preying on their food, unlike the eel fish in the green container which swim actively so their diet is not a priority. Pools with a green background color indicate FCR *(Food Convertion Ratio)* which is bad compared to ash containers because nutrients are consumed for swimming and not for growth because fish have medium swimming speeds (Palstra *et al*., 2015).

Eels are a type of nocturnal fish that have a habit of looking for food at night so that eels rely more on their sense of smell than sight (Mawardi, 2021). With its characteristics, eel fish will look for and recognize food from the smell (aroma) so this fish food must have a high amino acid content by the feed given in the study, namely KAE 5 which has a protein content of 50-52% so the smell is strong and attracts attention. eel fish.

Mukai *et al.,* (2010) reported that this species prefers low light conditions in the larval stage. Rearing container color preferences may change as fish grow from the juvenile stage. Feeding success for fish that rely on sight *(visual feeders)* In natural conditions, it depends on the contrast between the prey (food) and the background, therefore the appearance of this food can influence the success of feeding and fish growth (Puja *et al*., 2020). This is different from eel fish, where the food typically relies on smell. In nocturnal fish the photoreceptors undergo modifications where the rod cell density is $10^{6} – 10^{7}$ per mm which is more than diurnal reef fish. The visual pigments in rod cells of several types of Pacific coral fish can absorb color waves ranging from 480-502nm (average 493nm), meaning that the maximum wave absorption adaptation of the visual pigments of nocturnal fish is around 493 nm (Razak, 2017). A response to a stimulus due to something *"Pavlovian Conditioning'* namely a reflex to a stimulus due to a habit that is carried out repeatedly (Subandiono *et al*., 2016).

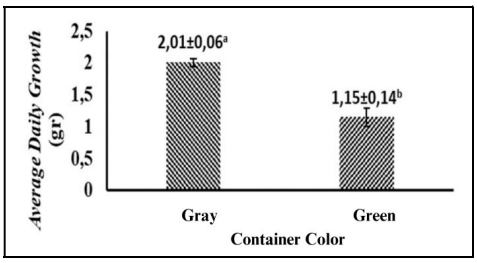

Figure 5. Average Daily Growth (ADG) of eels during the research.

On the ADG diagram *(Average Daily Growth)* the highest average value was achieved by eels reared in ash containers (2.01g/day ± 0.06^{a}) had a significant difference (p<0.05) in the green container (1.15g/day±0.14^{b}). It was found that body weight and weight gain of eels were positively influenced by the favorable environment created by the background color of the rearing container. Research on container color during maintenance was carried out by (Alimuddin *et al*., 2019) on mud crab larvae, the results of this research show that the color of the container influences the rate of feed predation because high feed consumption causes the larvae to get more energy to survive and grow.

Daily feed intake during maintenance in the ash container received a better value, this indicates that the ash container had a more voracious appetite response in eating its food. Fish that adapt to darkness show less activity than those that are light colored (Sabri *et al*., 2012). In this case, it corresponds to the ash container, which shows that eel fish have more appetite in dim light conditions. The increase in fish weight is also influenced by feed, research results (Handajani *et al*, 2018) shows that the weight of individual fish has increased. It has been proven that the nutritional content consumed by fish exceeds its needs for body maintenance and the excess is used for growth.

Similar findings were obtained for weight gain and final weight of eel fish. These results are also by those reported by (Aziz *et al*., 2016) Low feed consumption was found in the green container color treatment, this is thought to be because the color and reflection from the walls and bottom of the green container affect the contrast between the feed and the background, the result is that the feed capture rate is very low. Eels can eat in the dark and do not depend on light conditions, but light is also an important abiotic factor that can influence feeding behavior. Eels have negative phototaxis, which responds away from light. Fish schools and fish attraction to light sources differ between fish species due to differences in phylogenetic and ecological factors (Fuad *et al.,*2020)

Fish kept in ponds with dark background colors, in this case gray, tend to be more comfortable sticking to the substrate in the container compared to bright background colors where the main priority is that the trial fish appear to be swimming actively. The color of the container and light intensity are important factors to consider to maximize feed intake and fish growth rate so that at optimal levels it can increase fish farming production.

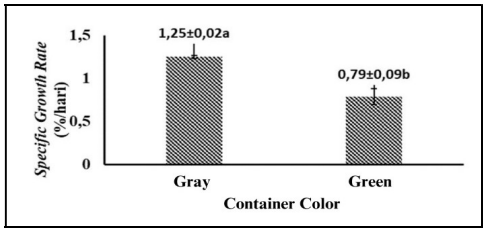

Figure 6. Specific Growth Rate (SGR) of eel during the research.

In the Figure 6, it can be seen that the specific growth rate of eel fish is different, each of the grey and green colors has a value of (1.25%/BW/day ± 0.02[a]) and (0.79%/BW/day± 0.09[b]). Based on data analysis showed significant differences ($p<0.05$) in the average growth rates in the ash and green containers. This is in line with the statement (Zulfikar *et al*., 2018), the color of the container influences fish eating behavior. The results of the analysis showed that the use of different container colors had a real influence on the absolute weight growth of the fish. This is because the color of the container influences the level of fish food consumption which is related to their instinct in eating their food. The color of the container can determine the intensity of light in the rearing media water because it is related to the absorption, reflection and refraction of light which will influence several fish behaviors such as stimulation to eat, protect themselves and stimulation of approaching light (Kusuma, 2020). Similar studies also show that nocturnal fish have better growth performance and daily feed consumption in dark containers. This may be due to the fish's ability to utilize nutrients and can also be a factor that causes the ideal level of water quality during the rearing period (Handajani *et al*, 2021).

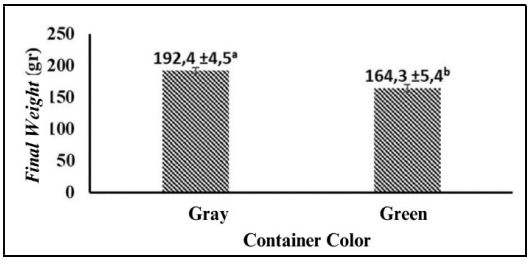

Figure 7. The final weight of eel during the research.

In the Figure 7 the ash color reaches a value of (192.4g ± 4.5[a]) there is a significant mean difference in green (164.3g ± 10.11[b]). It was concluded that there was a difference in the average growth of fish kept in ash and green containers.

Table 1
Water quality parameters.

Parameter	Receptacle		Optimum
	Abu	Green	
Temperature (^{O}C)	28,3-29,7	28,3-29,7	27,0-31,0*
DO (ppm)	6,65-7,2	4,21-6,3	≥4*
pH	7-8	7-8	7,0-8,0*

Description*: KKP, 2011.

Water quality measurements are carried out twice a day, namely at 08.00 am and at 04.00 pm. The results of temperature measurements during the eel fish rearing period in ash and green containers ranged from 28.3-29.7°C. The temperature value is by (Setianto *et al*., 2012) which states that during eel rearing the ideal temperature is 28-30°C. This is also supported by research (Handajani *et al*, 2018) which states the average temperature is 28.5-30 ^{O}C and is still in good condition for eel fish growth.

The lowest temperature range occurs when measurements are made in rainy conditions and the highest range occurs when measurements are taken in sunny conditions. The results of these observations show a normal range, this is by Roy's (2013) statement which states that regular temperature measurements can have a positive impact on eels both in terms of appetite, eel growth and preventing the emergence of disease.

To measure dissolved oxygen (DO), use a DO tool YSI Pro20 meters. This tool can measure 3 parameters at once, namely temperature, DO and salinity. The DO value obtained in the ash container ranges from 6.65 mgL^{-1} -7.2 mgL^{-1}, whereas for the green container the value is 4.21-6.3. It can be concluded that the green pond has a DO value which can affect the survival of eel fish. DO also plays an important role in supporting the life of fish. If DO is low it can make it difficult for fish to respire, for DO the ideal is 5 ppm. Fish can live in water and consume oxygen because fish have gills. DO in the water it will diffuse into the gill cells to the inner tissues of the body (Sugianti *et al*., 2018). When measuring pH during research, the value range was 7-8. The pH value of the water was still within the optimal range until the end of the study.

pH measurements during the maintenance period twice a week, namely at 07.00 am and 05.00 pm. pH measurements were carried out using a pH meter. The pH value in both pools tends to be close to the normal ring limit, namely 7-8. This is in line with (Amri *et al*., 2018), which reports that the ideal pH in a body of water is 7-8. pH has a big influence on the life of aquatic plants and animals, so the pH of a body of water is often used as an indication of whether the water is good or bad as a living environment. A pH condition that can disrupt fish life is a pH that is too low (very acidic) or conversely too high (very alkaline). Each fish will show a different response to changes in pH and the impacts considered will also vary (Zubaidah *et al*., 2020).

4. Conclusion

Based on the research results, it can be concluded that there are significant differences in the growth and appetite of eel fish kept in ash containers and green containers. The gray container color provided better growth and appetite results than the green color, with ADG values of 2.01g/day ± 0.06 g, SGR 1.25%/BW/day ± 0.02 and FCR 1.01 ± 0.01.

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