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The Use of Low Temperature on Different Duration of Giant Gourami Fingerlings (*OSPHRONEMUSGORAMY LACEPÈDE*,1801) Daytime Transport

Walim Lili [1], MeissyaAdilaLuthfia[2*], Iskandar[2], Titin Herawati[2]

[1] *Student of Faculty of Fisheries and Marine Science, UniversitasPadjadjaran, Indonesia*
[2] *Lecture of Faculty of Fisheries and Marine Science, UniversitasPadjadjaran, Indonesia*
**Email address : meissyaadila@gmail.com*

KeyWords
low temperature, transportation, daytime transport, different duration, giant gourami fingerlings, survival rate, induction time, recovery time,

ABSTRACT

This study aims to determine the optimum low temperature and duration of giant gourami fingerlings daytime transport, and to analyze the induction time, recovery time and survival rate of giant gourami fingerlings. This study uses an experimental method with factorial randomized group design (FRGD) which consists of two factors, four levels of temperature (12 °C, 16 °C, 20 °C, and control temperature (24°C)) and three level of duration (3, 5 and 7 hours) during daytime transport. The parameters observed are the time of induction and recovery of giant gourami fingerlings, post-transport and 7 days post-maintenance survival rate and the quality of water in the form of dissolved oxygen (DO), pH, ammonia, and post-transportation temperature. The results show the use of low temperature and short duration of transportation significantly affects the survival of giant gourami fingerlings in closed system transportation. The optimum temperature and duration is 16 °C and 5 hours with 100% survival rate of giant gourami fingerlings.

INTRODUCTION

Gourami fish (*Osphronemusgoramy Lacepède,*1801) is one of the important aquaculture commodity. The market demand of gourami fish is quite high in Indonesia (KKP, 2013). This can be seen from the statistics of gourami fish consumption rate per capita which always increases every year. In 2011 the consumption per capita was 32.25 kg/ capita, in 2012 it increased to 33.89 kg/capita (KKP, 2014), in 2013 it increased to 35.1 kg/capita, in 2014 it increased to 38.14 kg/capita, in 2015 it increased to 41.1 kg/capita, in 2016 it increased to 43.88 kg/capita, and in 2017 it reached 47.12 kg/capita (KKP, 2018).

The demand for gourami fish is relatively high in meeting the needs of the community. Fresh and alive gourami fish are more popular in the market and usually, the price is also higher in this condition. To meet the market demand for fresh & living gourami fish, transportation is important in maintaining the quality of gourami fish distribution to various regions in Indonesia.

Live fish transportation basically forces and places fish in an environment that is different from their original environment, notably these changes occur suddenly. In order to be transported, live fish are required to be in good health and not defective to reduce the chance of dying during transportation (Handisoeparjo, 1982).

The transportation system consists of wet system transportation and dry system transportation (Junianto, 2003). Wet system transportation can be done in two ways, in closed and open ways. Inwet system transport, fish are transported in closed or open containers containing seawater or freshwater depending on the type and origin of the fish. In transportation with closed containers, fish are given oxygen supply in a limited amount that has been calculated as needed during transport. Closed transportation systems are usually used for shipping fish in relatively large quantities, over long distances and relatively long periods. On transporting in open containers, fish are given with a continuous supply of oxygen and aeration during the transport. Open transportation systems are usually used for shipping fish in few quantities, short distance, and relatively short time. Wet transportation is usually used to transport live fishery products during fish farming and fishing ports to collectors or from one collector to another collector.

Transportation of live fish without water media (dry system) is a transportation system of live fish with non-water transport media (Achmadi, 2005). In this system, fish are made in a calm condition or low respiratory and metabolic activity. In the transportation of live fish with a dry system, live fish needs to be handled before transportation . The calm condition of the fish will reduce stress, speed of metabolism and oxygen consumption.

A very important factor in the transportation of fish fingerlings is the availability of adequate dissolved oxygen (DO), but this factor does not guarantee that fish will be in good condition after transportation. The ability of fish to consume oxygen is also influenced by tolerance to stress, water temperature, pH, CO2 concentration, and other metabolic wastes such as ammonia (Junianto, 2003). Transportation of fish fingerling is usually done with a slightly higher stocking density.

Metabolism is a change or all chemical and energy transformation that occurs in the body. The method of lowering the metabolic system can be done by using low temperature to make the fish unconscious. Temperature is a factor that affects metabolism (Putra, 2015).

Transportation of live fish with the use of low temperatures (cooling) aims to transport fish in a basal metabolic state. Temperature is one of the physical parameters that affect the life of aquatic organisms, especially fish. Hence, low temperature treatment is given so that fish do not experience stress during transportation and reduce its metabolic activity. Fish have poikilothermic properties whose body temperature is affected by their habitat so that metabolism is very dependent on the surrounding environment (Panjaitan, 2004). Increased temperature will cause an increase in metabolic rate, respiration, and oxygen consumption level in fish. Rising environmental temperatures cause the concentration of dissolved oxygen in the water to decrease and increase oxygen consumption by fish. Besides, an increase in temperature will increase the process of respiration. Energy for respiration is the energy that is included in the metabolic value so it can be concluded that an increase in temperature will cause an increase in metabolism (Putra, 2015). Increased fish metabolic activity will increase levels of free CO_2 in water and reduce oxygen solubility to lethal levels due to relatively high temperatures. The use of low temperatures will decrease the metabolic process of fish. The use of low temperature for live fish transportation is quite effective to reduce fish activity during transportation and increase fish survival (Setiabudi et all 1995).

MATERIAL AND METHODS

Time and place

The research was conducted from October to December 2019. The research was conducted at the Ciparanje Wet Laboratory, Faculty of Fisheries and Marine Sciences, UniversitasPadjadjaran.

Materials and Method

The materials used are 720 giant gourami fingerlings 4-6 cm in length, bulk ice, PF 100 fish fingerlings feed, pure oxygen, water samples, sidnette solution, and nesler solution. This research uses an experimental method with factorial randomized group design (FRGD), which consists of two factors, namely the four-level temperature and the three-level of duration that are repeated three times.

This research carried out transportation of gourami fingerlings with a density of 20 fish/2 liters of water with each treated using different temperatures at the beginning of the closed wet transportation system (temperature control (24°C), 20°C, 16°C and 12°C), and giant gourami fingerlings were transported for 3, 5 and 7 hours at noon. After transportation maintenance for 7 days is carried out to find out the post-transportation survival rate.

Observation Parameters

Induction Time

Induction time is the time needed for fish to faint after being conditioned in each temperature. Observations were made by recording the length of time needed for each test fish from showing the symptoms of fainting to total fainting.

Recovery Time

Observation and calculation of recovery time using a stopwatch starts from the test fish transferred into an aquarium that has been given high aeration until the fish show normal condition. Normal condition of fish is marked by active fish swimming, moving, and very reactive to external stimuli.

Survival Rate

The survival of giant gourami fingerlings was calculated after being transported and after 7 days of maintenance. The survival rate of fish is calculated from the comparison of the number of fish that live at the end of the period with those that live at the beginning of the period, using the following formula:

$$SR\ (\%) = \frac{Nt}{No}\ X\ 100\%$$

Description :
SR : Survival or Survival rate of fish during the experiment
Nt : Number of fish at the end of the experiment
No : Number of fish at the beginning of the experiment

Water Quality Parameters

Water quality parameters observed were temperature, DO, NH_3, and pH.*In situ* water quality measurement includes DO, pH, and temperature while *exsitu* includes DO and ammonia. The measurement was done in the Faculty of Fisheries and Marine Science, Aquatic Resources Management LaboratoryUniversitasPadjadjaran. Measurement of each water quality parameter using a DO meter to measure DO, pH meter to measure pH, a thermometer to measure temperature, and a spectrophotometric method for measuring ammonia.

Ammonia measurement uses the spectrophotometric method to use the following formula:

$$\text{Ammonia Value} = \frac{1000}{25} \text{ x } \frac{\text{Sample Absorbances}}{\text{Standard Absorbances}} \text{ x 5 microgram}$$

Description :
Example absorbance : Calculated Absorbance from the sample
Sample absorbance : Calculated Absorbance from the standard

RESULT AND DISCUSSION

Effect of various temperatures on the activity of giant gourami fingerling

The following is the effect of various temperatures on the condition of giant gourami fingerling which can be seen in table 1.

Temperature (°C)	Characteristic
24	Actively moving, responsive to normal stimuli and normal operculum. Fish are always moving and trying to get access to the surface.
20	Began to lose balance, still responsive to stimuli but weak, swim up to the surface, calm down and then begin to fall backward, operculum weakened, fish began to calm down, and seek access to the surface.

16	Fish movement is weak, the body cannot straighten up, move irregularly, lose balance, move operculum weakly, and fall to the bottom. efforts to gain access to the surface began to diminish.
12	The fish is not actively swimming, the fish moves its body and then collapses again. fish does not respond to external stimuli. Operculum movement is very slow.

Table 1. Effect of Temperature Reductions on the Phases and Conditions of giant gourami fingerling

Based on Table 1, the optimal temperature for transportation of giant gourami fingerling ranges from 24-16 ° C. The last phase is the fainting phase which is the fish lying on the bottom with weak movements (Syamdidi, 2006). An interesting habit that can be seen from the gouramiis it alwaysswims to the surface because gourami is sensitive to cold temperatures and closed media conditions. A giant gourami fingerling in its habitat has a habit to swim to the surface periodically to take oxygen because besides breathing dissolved oxygen in the water, gourami also breathes by taking free oxygen in the air. The condition of closed plastic transport containers tends to make gourami moves rapidly, passing more water over the gills to get more oxygen, and increase fecal production.

Fainting with low temperature at the beginning of transportation affects the metabolic rate of the fish being transported. This treatment can suppress fish respiration and activity. The use of low-temperature will make the metabolic process of fish in a basal state. Basal or standard metabolism is defined as the level of minimal energy used to maintain the structure and function of the body's tissues (to keep it alive). Basal metabolism includes energy requirements for blood circulation, replacing damaged cells, respiration, and intestinal peristaltic movements. This basal metabolism will make the fish passive, then affect the process of respiration and metabolites released.

Induction Time

The technique of fainting or immotilization is based on the principle of hibernation, which is an attempt to suppress the metabolism of an organism to a minimum to maintain its life longer (Ikasari*et al*.,2008). In the process of fainting the giant gourami fingerling, it is important to observe changes in the behavior of giant gourami fingerling during the panic to fainting phase, according to (Pratisari, 2010), panic phase that occurs in each anesthetic treatment is influenced by the temperature used. Figure 1 shows the effect of temperature reduction on the induction time for giant gourami fingerling.

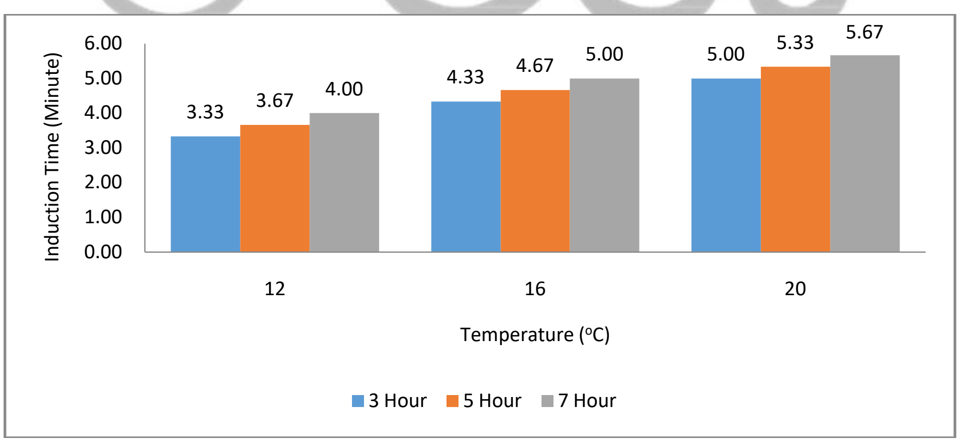

Figure 1. Diagram of the Effect of Low Temperature on Induction Time of Giant Gourami Fingerling

Based on Figure 1, the average value of indication time ranged from 3.33 to 5.67 minutes. The induction time with a temperature of 12 °C is 3.67 minutes. The induction time with a temperature of 16 °C is 4.67 minutes and the induction time with a temperature of 20 °C is 5.33 minutes. This shows that the lower the temperature the faster the fish will faint (shorter duration of induction time).

Naturally fish have the ability to adapt in various environmental conditions including extreme and low temperatures environments. Physiological properties of fish alsoinfluence the time of fainting (induction time). Gouramiis sensitive to cold temperatures,short duration of induction time may increase the risk of death of giant gourami fingerlings.

Recovery Time

The time of fish to recover consciously is calculated from when fish are transported into clean water until it regains consciousness and begins to swim normally. Fainted fish can be revived by transporting it into normal temperature water (Sufianto, 2008). Figure 2 shows the effect of Low Temperature on the recovery time for giant gourami fingerling

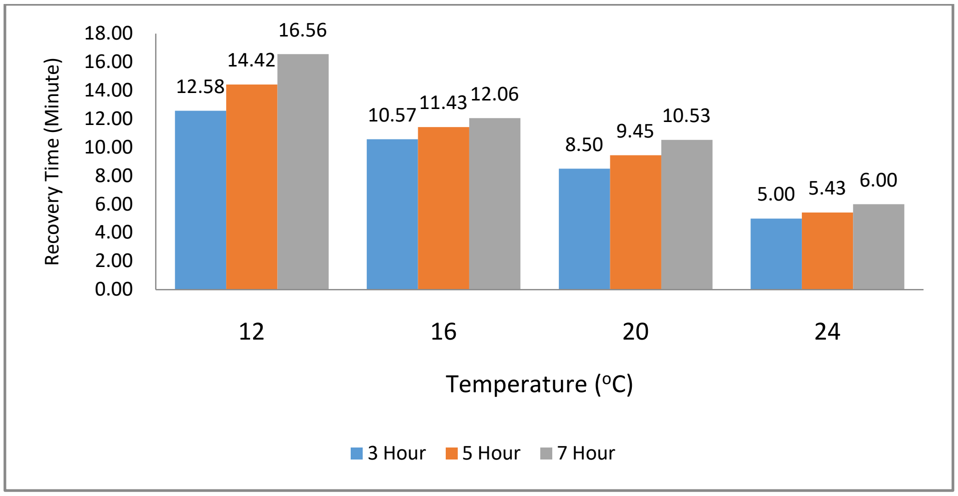

Figure 2. Diagram of the Effect of Low Temperature on the Recovery Time of giant gourami fingerling

Figure 2 shows that the average recovery time of giant gourami fingerling ranges from 5.00 - 16.56 minutes. The longest recovery time is in the treatment of 7 hours transport time using a temperature of 12 ^{o}C, the average recovery time is 16.56 minutes. The fastest recovery time is in the treatment of 3 hours transport time using a temperature of 24^{o}C with the average recovery time is 5.00 minutes. The long duration of recoveryis due to the weak condition of the fish and energy loss during transportation, so the giant gourami fingerling needs a long recovery time according to the length of time of transportation. The lower the temperature used during transportation, the longer the recovery time needed. It is due to physiological adaptation to the environmental condition. The lower water temperature will reduce the ability of fish to take oxygen in the water.

Generally, the fish recovery time usually takes 5 to 30 minutes (Utomo, 2001). The longer the time of fish faints will cause the longer time for fish to recover. Because, lack of oxygen for a long time will cause the muscles to become weak and loose (Junianto, 2003). Recovered fish will swim swiftly and responsive to external stimuli (M. Nurdiyan *et al.*, 2017). Movement of the limbs (gills, dorsal fins, ventral fins, and caudal fins) of fish will also move back actively. This is indicated by the difficulty of catching fish that have recovered.

The recovery time of fish is calculated when the test fish are put back in normal temperature water, and the time calculation ends until the fish has regained consciousness and begins to return to normal swimming. This can be seen by the characteristics of the fish, it begins to reactivate and is able to receive responses from external stimuli and the body is not weak (Sufianto, 2008).

Post Transportation Survival Rate

Figure 3. shows the result of observation in post-transportation survival rate of giant gourami fingerlings.

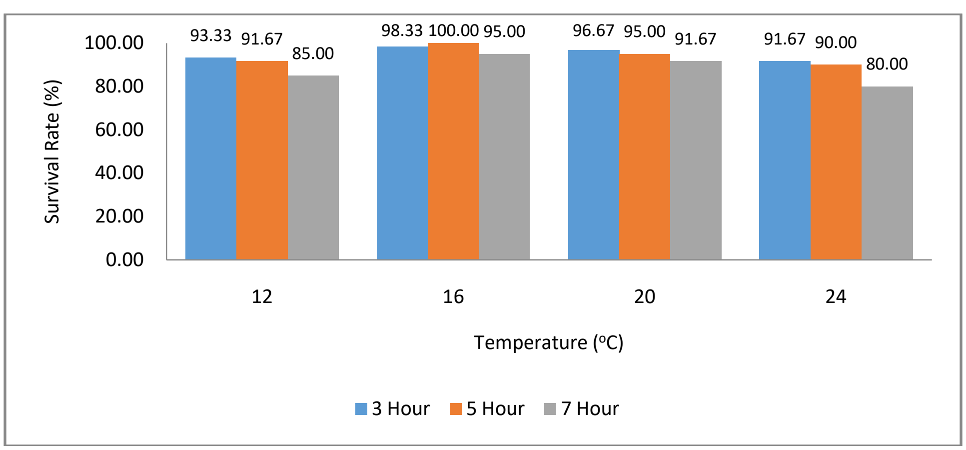

Figure 3. Diagram of the Effect of Low Temperature on the Survival Rate of Post-Transportation Fish Test

Based on Figure 3 the average survival rate of gourami seeds after transportation ranges from 80% - 100%. The three hours duration of transport with different low temperatures used during transport (20°C, 16°C, 12°C, and control temperature) results in statistically significant survival rate difference. The highest average of survival rate is at 16°C and 20°C namely 98.33% and 96.67%. The cause of death during transportation is due to fish experiencing stress during the fainting process, and during moving fish from the fasting container to the transportation container that has a lower temperature.

Five hours duration transport also provides different survival rates in each temperature setting. The survival rate of giant gourami fingerlings ranges from 90-100%, with the highest survival at 16°C and the lowest at 24°C. Transportation time influences the water temperature in the transport media. An increase in temperature also causes an increase in the metabolic rate and respiration of aquatic organisms and subsequently results in an increase in oxygen consumption (Effendi, 2003).

The seven-hour duration treatment gives different survival rates in each low temperature treatment. The highest survival rate of giant gourami fingerlings is at 16-20°C and lowest at 24°C. At 24°C, giant gourami fingerlings experienced a mortality rate of 20% which was the largest mortality in the seven hour duration transport . The oxygen consumption rate of aquatic animals will decrease with the decreasing temperature of water media (drisatya, 2006).

The temperature range that has the opportunity to beused in live giant gourami fingerling transportation is at 23-16 °C. In this temperature range, the rate of respiration of giant gourami fingerling has begun to decline. But at the temperature range of 18.6-21.1°C, fish may recover (Syamdidi *et al*., 2006).

7 Days Post Maintenance Survival Rate

Maintenance of giant gourami fingerling is intended to determine the effect of the low temperature use on giant gourami fingerling transportation. The results of calculation of the survival rate of giant gourami fingerling post maintenance for seven days is presented in Figure 4.

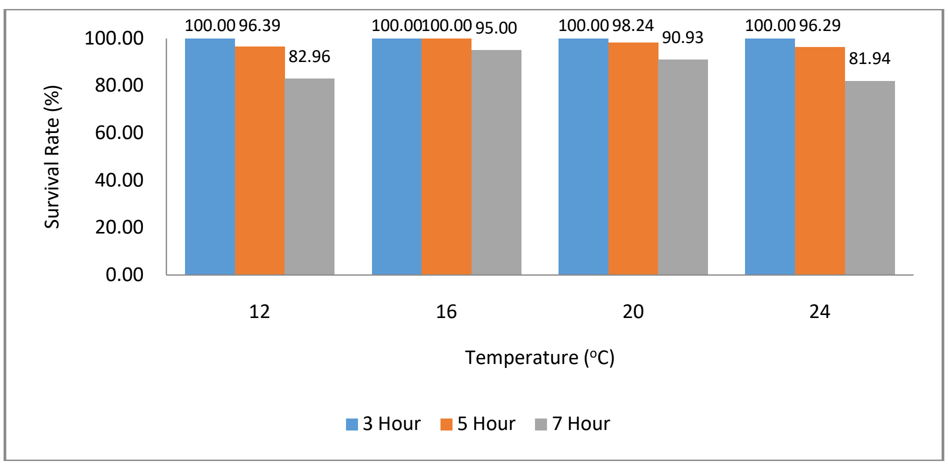

Figure 4. Diagram of the Effect of Low Temperature on the Survival Rate of Seven Days Post Maintenance

Based on Figure 4 the survival rate of giant gourami fingerling after maintenance for seven days ranges from 81.94 - 100%. The lowest survival rate is at 24°C with a duration of seven hours transportation has a percentage of 81.94% while the highest value at 24-12 °C with a duration of three hours has a percentage of 100%.

Based on the results of the maintenance of the test fish from the initial recovery to the maintenance for seven days, is that the first three days of maintenance is the critical period for the test fish because the highest fish mortality rate occurs at the beginning of maintenance. At the beginning of maintenance, fish begin to adapt to the new environment. The difference of environment from the transport container to maintenance container causes a high mortality rate of fish. Transferring fish to the aquarium has an impact (stress) on fish. Stress can cause physiological changes with the consequence of maladaptation in the form of a decrease in immune system to adapt with environmental changes which ultimately affects survival of fish (Tort *et al*., 2003).

Water Quality Parameters

The temperature conditions at the beginning of transport are 24°C, 20°C, 16°C, and 12°C. The average post-transportation temperature ranges between 14-27 °C. There is an increase of temperature between before and after transportation because the time used for transportation is daytime. According to (BSNI, 2000) the optimal temperature range for gourami fish is in the range of 25-30 °C. Temperature is one of the important factors in a closed transportation system,it affects the oxygen consumption of giant gourami fingerling thus affecting survival during transportation. Gourami respiration will tend to decrease with a decrease in temperature. This corresponds with the use of low temperature can suppress the respiration and activity of fish (Wibowo *et al*., 2002). An increase in temperature after transportation will increase the respiration activity in fish, and an increase in metabolic rate (Putra, 2015).

Dissolved oxygen (DO) content is an important factor in fish survivability because it is needed for the respiratory process and a major component for fish metabolism. The survival rate of the fish transported is related to the availability of dissolved oxygen in the transport media (Wedemeyer, 1996). The value of dissolved oxygen before transport was 5.1 - 5.5 mg / L. The average value of dissolved oxygen after transport is 6.5 - 7.4 mg / L. This is because it is in natural water, the introduction of oxygen into the water occurs. After all, the water that enters already contains oxygen. DO value after transportation is very high due to the addition of pure oxygen to the transportation process of fish so that during transportation the fish will not lack oxygen. The optimal dissolved oxygen range for gourami is 3-8 mg.L (Irmawan, 2006).

Based on the results of research that has been done, obtained the pH value before and after transportation. The average value of pH before transportation is 7.4 - 7.6 and after transportation is 7.03 - 7.32. According to (BSNI, 2000), the optimal pH range for gourami is in the range of 6.5–8.5. A decrease in pH after transportation compared to before transportation is associated with an increase in fish excretion results. The decrease in pH during transportation in this research is still suitable for the life of giant gourami fingerling. Fish able to adapt to waters that have no drastic pH changes (Nitibaskara et al., 2006).

The ammonia (NH_3) level before transportation in this study has an average value of 0.02 – 0.03 and after transportation of 0.003 – 0.013. The optimal ammonia content for gourami is 0.0-0.12 mg/l [Sulistyodkk., 2016]. Temperature reduction able to lower the production of NH_3 and also associated with decreased gouramy activity which characterized it starts to calm down and then falls down to the bottom (Syamdidi*et al*., 2006).

Conclusion

Based on the research that has been conducted, it can be concluded that:

1. The effective temperature and duration in transporting giant gourami fingerling (*Osphronemusgoramy Lacepède,*1801) for transportation is at the temperature 16 °C with a duration of transportation for 5 hours because the survival rate is 100% post-transportation and 100% post seven days of maintenance.
2. Water quality parameters during transportation are still considered quite good because the results and the level of eligibility for gourami to live does not differ much.according to the literature.

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