Effect of Using Low Temperature in the Beginning of Transportation with Closed System of Red Tilapia (*Oreochromis niloticus*)

Walim Lili[2], Hendra Iman Saro Lase[1], Iwang Gumilar[2], Kiki Haetami[2]

[1] Student at Faculty of Fisheries and Marine Science, Padjadjaran University, Bandung, Indonesia
[2] Lecturer at Faculty of Fisheries and Marine Science, Padjadjaran University, Bandung, Indonesia

ABSTRACT

This research aims to analyze the optimum used of low temperatures at the beginning of transport on the survival rates of Red Tilapia (Oreochromis niloticus) with a density of 20 fishes /liters of water in transportation with closed systems for a certain duration where the Red Tilapia is transported during the day. This research used an experimental method Factorial Randomized Group Design method, which consists of two factors that is, a three-level temperature factor 17, 21, 25°C and a three-level time factor 5, 7, 9 hours and repeated three times. The parameters observed were the survival rate, water quality, duration of the process anesthesia, duration of the process recovery after transportation and pisciculture after transportation. The results showed the optimum temperature and length of time for transportation of Red Tilapia (Oreochromis niloticus) was a temperature of 21 ° C and 5 hours of transportation time 98.33% survival was obtained.

Keyword : *Closed system transportation, low temperature, duration of transportation, Oreochromis niloticus.*

---

1. INTRODUCTION

Red tilapia (Oreochomis niloticus) is a type of fish introduced from abroad. These fish seeds were brought to Indonesia officially by the Freshwater Fisheries Research Institute in 1969 (Djarijah, 1995). Tilapia is one of the leading commodities and each year will always increase in both the local market and the export of the Ministry of Marine Affairs and Fisheries (KKP, 2012). Red tilapia fish commodities have advantages, namely: fast growth, highly response to artificial feed, can live in high density conditions, lower FCR values and resistant to disease and inadequate aquatic environment.

Transportation is one of the activities in the fisheries business as the process of distributing the commodity to consumers. Obstacles encountered in transportation activities are stress and death of fish so it needs better handling so that the fish can stay alive and healthy when it comes to farmers, so in this study the method chosen is to use a decrease in temperature is safer because it does not contain chemical residues in it.

Temperature is one of the physical parameters that affect the survival rate of fish. According to Philips (1972) states that metabolism is a chemical reaction and its work process is influenced by temperature. If the temperature increases, the metabolic rate and respiration rate in fish will increase, causing increased ammonia and other metabolic waste and vice versa if the temperature decreases, it will inhibit the respiration rate and metabolic rate of Fish and cause basal metabolism. Therefore this article aims to analyze the use of low temperatures and optimum duration in red tilapia (Oreochromis niloticus) seed by maintaining survival.

2. Material And Methods

The materials used in this research are the red tilapia / (O. niloticus) measuring ± 5 cm as many as 20 O. niloticus/ 2 L of water. bulk ice cubes or blocks as a material for reducing temperature in water and oxygen cylinders for oxygen delivery. The research was carried out with an experimental model with a factorial randomized block design method (RAKF), which consisted of two factors, there are three-level temperature factors and a three-time time factor and repeated three times.

This research transported red tilapia with a density of 20 / 2 liters of water each each treatment used a low temperature at the begun of a closed wet transportation system (temperature control (25°C, 21°C, and 17°C), where the red tilapia seeds are transported for 5, 7 and 9 hours. The parameters observed were fish survival, water quality and the process of sedation, when the anesthesia was taken, and the length of time for the breeding process.

2.2 Survival Rate

Survival Rate (SR) is the ratio of the number of live fish at the end of maintenance to the total number of fish stocked at the beginning of maintenance (Effendi 2004):

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

Description:
SR = Survival of fish during the experiment.
N_t = Number of fish at the end of the experiment.
N_0 = Number of fish at the beginning of the experiment

2.3 Water Quality Parameters

The observed water quality parameters are the key parameters of water quality namely pH, DO, NH_3 and Temperature.

Dissolved oxygen (DO)
Measurement of dissolved oxygen is carried out using a DO meter, by way of being put into water so that it shows a constant number

Ammonia (NH3)
The results of the levels from the spectrophotometer are then calculated using the formula:

$$\frac{1000}{25}\, x\, \frac{(Example\ absorption)}{Standard\ absorption}\, x\, 0.005$$

Water temperature
Water temperature measurements are carried out using a mercury thermometer dipped in water to show a constant number

Acidity (pH)
The degree of acidity of the water is carried out using a pH meter, by inserting electrodes into the water to show a constant number.

2.4 Data analysis

The effect of the use of low temperatures at the beginning of the transportation of closed systems of red tilapia (O. niloticus) was analyzed using the F formula if there were significant differences between treatments tested using the Duncan multiple test with a level of 5% (Gasperz 1991). Survival parameters after post-transport maintenance and water quality data (temperature, dissolved oxygen, ammonia, and pH) were analyzed descriptively.

3. RESULTS AND DISCUSSION

3.1 Duration of Stun Time and Behavior of Red Tilapia

The following is the process of the influence of various temperatures on the condition of red tilapia seeds Tuesday, the process of decreasing the temperature until the red tilapia seed are in the immotile or unconscious phase as shown in table:

Table 1. The Effect of Various Temperatures on the Condition of Red Tilapia Seeds During the Temperature Reduction

Average time (Minutes)	Temperature (°C)	Red Tilapia Activity
0	25	The position of the fish is upright, the fish are actively swimming (normal) and responsive and the operculum movement is normal.
5	21	In an upright position, the fish begins to calm down (less active), still responsive, the operculum speed slows down.
3	17	Weak upright position, sluggish fish, less active, less responsive and slow operculum.

Prior to immotilization, red tilapia seed were fasted for 24 hours. The purpose of fasting fish is to remove impurities that are still present in the digestive organs of the fish. The condition of red tilapia seeds during the temperature reduction process can be seen from the table above. Red tilapia seeds show different behavior when the temperature drops. The difference in behavior is divided into several temperature levels, namely the control temperature of 25°C and the control temperature of 21, 17°C.

When the control temperature is 25°C, the fish activities and conditions are very active. The body position is upright, the fish are very agile and sensitive to external stimuli. The limbs seem to move very quickly, and the tail fin looks erect. At a temperature of 21°C, the activity and condition of the fish seemed to decrease. The condition of the fish showed decreased movement and low mobility, the body was still upright, and the responsiveness to external stimuli began to decrease. The movement of the fish's operculum has begun to slow down, and the position of the caudal fin is still upright.

At a temperature of 17°C, the activity and condition of the fish began to weaken. The position of the fish's body begins to tilt, the fish's movement begins to calm and the response is weak to external stimuli. At this temperature range, fish are easy to catch and will not fight when caught.

Due to the decrease in oxygen levels, the temperature difference in fish activity decreases causing balance disorders. When the temperature is decreasing, the oxygen consumption rate of aquatic animals will decrease (Berka 1986). The condition of the fish that fainted was caused by the reduced oxygen in the body as seen from the slower movement of the fish's operculum. When the fish are calm, it can be attempted to increase the survival of fish in the wet transportation system, namely by reducing the metabolic rate and transportation in the wet transportation system.

The results of observations of the condition and activity of red tilapia seeds showed that the immotile temperature of the fish was between 21°C and 17°C. The results showed different criteria for fish, namely fish in a calm state at a temperature of 21°C and 17°C of them in a slightly conscious state. Below or above this temperature, the risk of fish death will be higher. The lower the ambient temperature, the fish activity will be affected, the decrease in temperature will cause the movement of red tilapia seed which was originally normal, along with the decrease in temperature the movement of tilapia slowly becomes calmer.

3.2 Duration of Restoration

The following is a diagram of the average length of time needed for refurbishment:

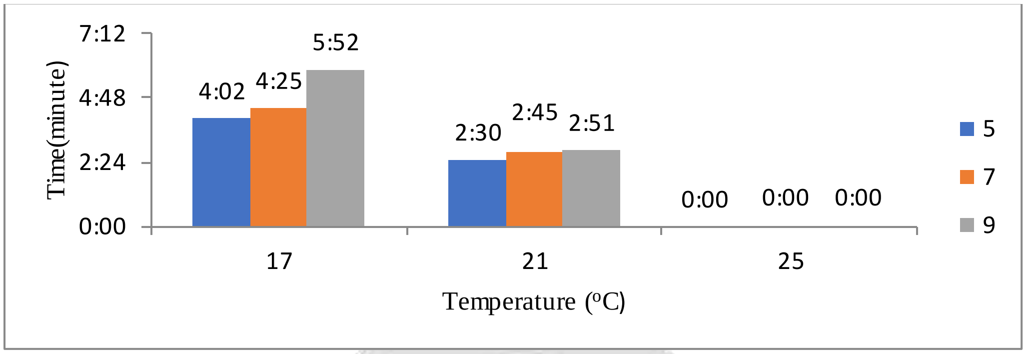

Chart 1. Diagram of the average length of time to restoration.

Performing the restoration process aims to restore the condition of the fish and to determine the survival of the fish after the transportation process. The temperature of the conditioning media is adjusted to the fish habitat (Achmadi 2005). The restoration process for fish that have been transported is carried out using an aquarium container that has been given continuous aeration. The use of aeration aims to help add air to the water so that the dissolved oxygen level in the water becomes sufficient (Boyd 1990). According to Sufianto (2008), the awareness process is carried out by inserting fish that have been in a state of unconsciousness into water with a normal temperature (± 27 °C).

From the results of the data in the graph above it is known that the average length of time to recover from red tilapia seed is between 02:30 – 05:52 minutes. The longest time for the restoration process is 05:52, namely the treatment time is 9 hours with a temperature of 17°C the longer the transportation time is carried out, the longer the recovery process and the fastest time of recovery is 02:30 at the treatment time of 5 hours and a temperature of 21°C. From the graph above, it can be seen that the longer the transportation process is carried out, the longer the proces s of restoring red tilapia seeds will be. The length of the recovery process is due to the weak condition of the fish and the loss of energy during transportation, so that red tilapia seed need longer time as transportation takes longer.

During the fish refining process, the general condition of red tilapia showed the same activity. First, the condition of the red tilapia seed begins with slow fish movements and then gradually becomes normal such as the movement of the fins and operculum which gradually become normal even though they are still in a weak condition. According to Achmadi (2005) stated that during the process of rejuvenation, fish that did not show any signs of limb movement after 10 minutes were considered not to have passed life.

3.3 Survival Rate of Red Tilapia in the Post-Transportation

Here is an diagram of the survival analysis of red tilapia seed transportation can be seen:

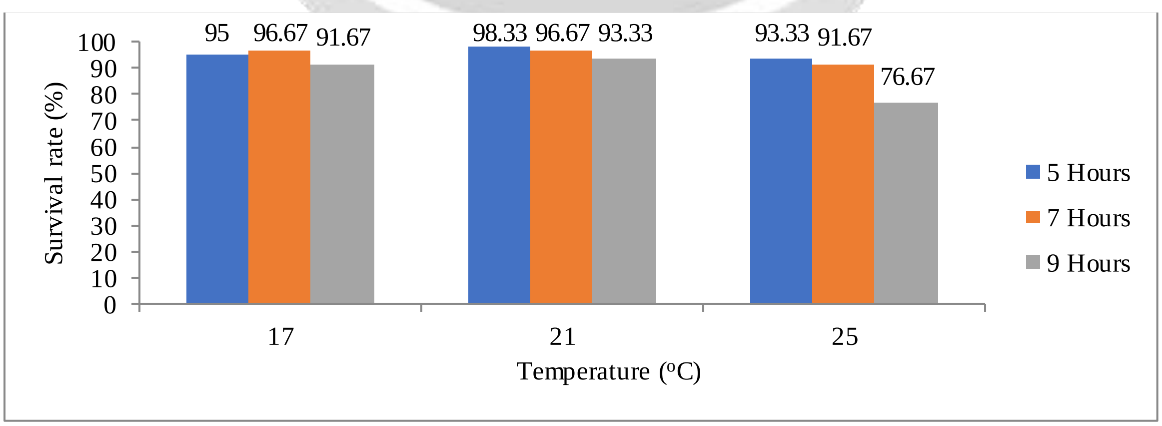

Chart 2. Diagram of The Survival Rate

Survival is an important factor in the transportation process because survival is the main indicator in this research. The following is a graph of the survival of the transportation of red tilapia seed for 5, 7, 9 hours which was transported using low temperatures (25, 21, 17°C) using a closed system as shown in table :

Table 2. Survival Rate of Red Tilapia Seed Transport with Low Temperature

Time (w)	Temperature (s) (°C)	Average (%)	Notation
5 Hours	25	93,33	bc
	21	98,33	d
	17	95	bcd
7 Hours	25	91,67	b
	21	96,67	cd
	17	96,67	cd
9 Hours	25	76,67	a
	21	93,33	bc
	17	91,67	b

Note: Values followed by the same letter are not significantly different. Treatment S_0 : Water temperature 25°C ± 1°C, S_1 : 21°C ± 1°C, S_2 : 17°C ± 1°C, Treatment W_1 : for 5 hours, W_2 : 7 hours, W_3 : 9 hours,

Based on the data in table 2 shows that the effect of the use of low temperatures at the beginning of the transportation of red tilapia seed transported at a density of 20 fish / liter with different treatments caused the survival rate of red tilapia seed varied. The results of the analysis of the F test at the 5% level ($\alpha = 0.5$) between the low temperature treatment and the transportation time showed significantly different results. Then, further tes ts were carried out with Duncan's test where the results of Duncan's test on these interactions showed significantly different results in some of these interactions.

The average survival rate of red tilapia seed ranging from 76.67% - 98.33%. Based on table 2 in the 5-hour treatment, it is known that the best treatment is in the treatment with a temperature of 21°C with a survival rate of 98.33%. This is because the 5-hour treatment with a temperature of 21°C had the highest DO level so that the oxygen coverage in the container could save the survival of red tilapia. According to Junianto (2003) in closed system fish transportation, factors that need to be considered include oxygen solubility in water, density and transportation time.

Based on the data in table 2 in the 7-hour treatment, the results obtained with cd notation, namely the treatment with a temperature of 21, 17°C with a survival rate of 96.67%. This is because the temperature is lower than the treatment that has a notation b in the 7-hour treatment. Higher temperatures cause metabolism in the body to run faster and reduce dissolved oxygen, thereby increasing carbon dioxide levels. Effendi (2003), explained that an increase in temperature also causes an increase in the rate of metabolism and respiration of aquatic organisms and further results in an increase in oxygen consumption.

In the treatment with a time of 9 hours, the best treatment was found with the notation b, namely with a temperature treatment of 21, 17°C which found the results of the survival rate of 93.33 in a row; 91.67%. The 9-hour treatment with a temperature of 25°C with the smallest survival rate was 76.67% due to the higher treatment temperature causing lower dissolved oxygen levels and higher metabolic rates. Temperature is inversely proportional to the saturated concentration of dissolved oxygen and directly proportional to the oxygen rate of aquatic animals and the rate of chemistry in the water (Afrianto 1998).

From the data in table 2, it can be seen that the best treatment is the treatment that has a notation value of A, namely the 7-hour treatment with a temperature of 25°C because the lower the required temperature, the more expensive the required cost. According to (Novesa, 2012) the lower the temperature of a medium from the ambient temperature of course requires a large enough heat withdrawal both to reach and to maintain that temperature and which means it also requires large costs. This long transportation time causes the temperature to rise due to environmental influences, this rising temperature causes a decrease in dissolved oxygen and an increase in carbon dioxide ($CO2_)$, causing increased activity and high levels of stress so that fish suffocate during transportation. According to Junianto (2003), hyperactive fish will consume a lot of O_2 so and release a lot of CO_2 increase O_2, the transport medium will decrease quickly and CO2 gas will too quickly. Fish transported at relatively high temperatures will require more oxygen. For every 10°C increase in water temperature, oxygen consumption by fish will increase 3-5 times, fish acclimatized at 20°C have a dead point at 31-34°C (Junianto 2003).

3.4 Survival Rate of Red Tilapia Seed Maintenance Post-Transportation

Here is an diagram of the average survival analysis of red tilapia seed transportation can be seen:

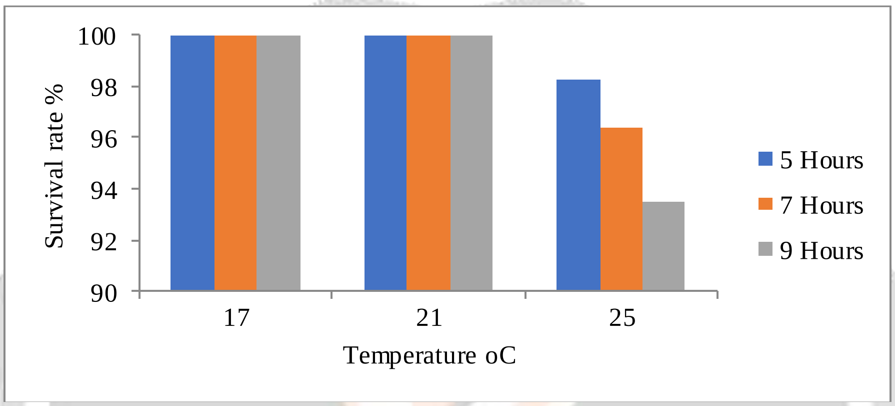

Chart 3. Diagram of Average Survival Rate of Red Tilapia Seed Maintenance Post-Transportation

Red tilapia seed rearing is intended to determine the effect of the use of low temperature on the transportation of red tilapia seed. Observations were made on the survival of red tilapia seed from post-transport effects. This maintenance is carried out for 7 days.

Based on the observations of the survival rate, the treatment at temperatures of 17°C and 21°C got a survival rate of 100%. The effects after transportation that occur do not affect the physiological processes of the fish which can reduce the health condition and body resistance of the fish, so handling with low temperatures does not have an effect on the life of red tilapia seed after transportation. According to Junianto (2003), handling at low temperatures is declared safe because it does not contain chemicals that can harm fish. Thus, this indicates that handling using low temperatures in the transportation of red tilapia seed has no impact on the life of red tilapia seed during rearing after transportation. because, at the time of rearing, no red tilapia seed died after fish transportation was carried out. The survival rate at 25°C has a lower value this is because the temperature is quite high during transportation, causing fish to become stressed. According to Anggraini et al (2014) the effect of transportation that occurs can directly affect the physiological processes of fish, this in turn can reduce health conditions and body resistance, causing stress in the fish kept.

3.5 Water Quality in Transportation of Red Tilapia

The following is the average water quality of red tilapia transportation as shown in the table:

Table 3. Average Red Tilapia Seed Transport Water Quality

Time (Hour)	Temperatur (°C)		DO (mg/L)		pH		Amonia (mg/L)
	t_0	t_1	t_0	t_1	t_1	t_0	
5	17	24	7,4	6,7	6,65	6,52	0,01
	21	24	7,6	6,5	6,58	6,46	0,018

	25	24	7,25	6,3	6,68	6,59	0,01
Average	19	23,75	7,36	6,52	6,65	6,55	0,013
7	17	22	7,11	6,4	6,67	6,64	0,002
	21	22	7,49	6,4	6,69	6,57	0,012
	25	23	7,13	6,2	6,68	6,59	0,045
Average	19	22,25	7,24	6,35	6,65	6,57	0,016
9	17	22	7,21	6,3	6,63	6,47	0,017
	21	21	7,12	6,1	6,68	6,49	0,011
	25	22	7,19	6	6,73	6,42	0,009
Average	19	21,75	7,1	6,2	6,69	6,49	0,01
SNI	25^{o}C-30 ^{o}C		>5		6,5 – 8,5		

In the table of average water quality above, it is known that the initial average DO is 7.1 and the final DO is 6.2 then the DO observations at the end of maintenance range from 6.0 to 6.7 mg/L. These conditions are ideal for fish rearing. According to Lesmana and Darmawan (2006) water for fish maintenance should have an oxygen content of 5 mg/L. According to Bachtiar (2002) that the optimal DO for ornamental fish maintenance is around 5-7 mg/L.

The average temperature before transportation is 19℃ and the average temperature after transportation is 21.75℃. The increase in temperature after transportation occurs because the packaging container cannot maintain the temperature inside and the outside temperature is higher than the inside temperature, thereby accelerating changes in the temperature inside. The packaging media in styrofoam packaging assisted by the use of ice was unable to maintain a stable temperature during storage at room temperature. According to (Herodian et al. 2004) The temperature of the packaging used will continue to increase so that it affects the survival of the transported biota. The increase in temperature occurs due to the higher penetration of outside air into the packaging so that it can increase the temperature. The initial temperature of the filler material and the temperature of the outside environment which is too high will cause the packaging temperature to rise more quickly (Nitibaskara et al. 2006). The increase in temperature is also due to the absence of an insulator between the car and the fish so that the high temperature of the car accelerates the temperature rise in the fish and the use of pickup trucks which causes the fish to be directly exposed to the ambient temperature.

The average pH before transportation was 6.69 and the pH after transportation was 6.49. The decrease in pH during transportation is still within reasonable limits because it is still at a stage where red tilapia seed can survive. According to (SNI 2009) red tilapia seeds can survive in the pH range of 6.5-8.5. The average ammonia in the table above is known to be 0.01, the value obtained is still within the tolerance limit recommended by BSNI (2009) red tilapia can tolerate ammonia levels <0.02mg/L.

4. CONCLUSION

Based on the results of research that has been done, it can be concluded that the use of low temperature and long transportation time influence the survival of red tilapia seeds. The best treatment in this research was obtained at a temperature of 21^{o}C with a duration of 5 hours with red tilapia survival of 98,33%. The lower the temperature, the slower the metabolic rate of fish. Water quality parameters are an important factor for fish life when transportation takes place.

5. REFERENCES

[1]. Achmadi D. 2005. The anesthesia of tilapia (Oreochromis niloticus) with electric voltage for the transportation of dry systems [thesis]. Bogor: Faculty of Fisheries and Marine Sciences, Bogor Agricultural University.

Budiyanto. 2002. The Influence of Injections of Patin Pituitary Gland (Pangasius sp.) Glands on Daily Growth Rate of Koi Fish (Cyprinus carpio L.) Maintained in the Recirculation System. Thesis. Faculty of Fisheries and Marine Sciences, Bogor Agricultural University. Bogor. 44 p.

[2]. Afrianto, E. and E. Liviawaty. 1998. *Several Fish Cultivation Methods*. Kanisius: Yogyakarta.

[3]. Anggraini D., Taqwa F.H ., Yulisman. Mortality of Common Carp Seed (Cyprinus carpio) on Various Media Cork Baggase Base Height and Length of Time on the Transportation. Sriwjaya University, Indralaya, Ogan Ilir.

[4]. Bachtiar, Y. 2002. Sumatran Fish Cultivation. Self-Help Spreader. Jakarta.

[5]. Djarijah, USA 1995. *Intensive Seedling and Enlargement of Red Tilapia*. Canisius. Yogyakarta.

[6]. Effendi, H. 2003. *Study of Water Quality for Water Resources and Environment Management*. Kansius. Yogyakarta.

[7]. Gasperz, V. 1991. Experimental Design Method. CV. Armico. Bandung. 442 p.

[8]. Junianto. 2003. Fish Handling Techniques. Self-Help Spreader. Jakarta.

[9]. Lesmana, DS 2001. *Water Quality for Freshwater Ornamental Fish. Self-Help Spreader,*. Jakarta. 88 pp.

[10]. Nitibaskara, R. Wibowo, S. Uju. 2006. Handling and Transport of Live Fish for Consumption. Bogor: Department of Aquatic Products Technology. Faculty of Fisheries and Marine Science. Bogor Agricultural Institute.

[11]. Novesa A. 2012. anaesthesia of fresh water pomfret *(Colossoma macropomum)* with low temperature gradually in dry transportation system. IPB. Bogor.

[12]. Philips, J. 1972. *Calory and Energy Recuitment in Fish Nutrition*, Hak: 173 dalam J.E. Halver (Editor). Academic Press. Inc. New York.

[13]. Standard National Indonesian 6141. 2009. *Seed production of black tilapia (Oreochomis niloticus Bleeker) by seed grade*. National Standardization Agency.

[14]. Standard National Indonesian 7583. 2010. *Packaging of Seeds of black tilapia (Oreochomis niloticus Bleeker) on land transportation facilities.* National Standardization Agency.

[15]. Sufianto B. 2008. *Transport Test of Goldfish (Carassius auratus Linnaeus) Living Dry System With Temperature Treatment And Decreased Oxygen Concentration* [*thesis*]. Bogor: Postgraduate Program, Bogor Agricultural University.