THE USE OF LOW TEMPERATURES IN THE INITIAL TRANSPORTATION SYSTEM OF GUPPY (*Poecilia reticulata*)

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ABSTRACT

Poecilia reticulata is a small freshwater ornamental fish. This fish is popular because it is easy to maintain and has a variety of beautiful color patterns. The guppy market demand has now penetrated the national market. Good handling is necessary to support the survival of fish when transporting. The aim of this research is to determine the optimal temperature at the beginning of the transportation of guppies (Poecilia reticulata) which can provide the highest survival for a certain duration. This research was carried out from August 2020 to September 2020. This research was carried out in the laboratory of building 4, Faculty of Fisheries and Marine Sciences, Padjadjaran University. This research carried out the transportation of guppies with a wet system using low temperatures as fish immotilization. The object (Guppies / Poecilia reticulata) were measured ± 4 cm as many as 240. The guppy (Poecilia reticulata) used in this study were selected to obtain uniform fish size, healthy condition and free from defects and injuries. The research was conducted using an experimental model with a factorial Randomized Block Design, which consisted of two factors, namely temperature with 4 levels and transportation time with 3 levels and repeated three times. The results showed that the optimum temperature and length of time for transportation of guppy (Poecilia reticulata) was 16^{o}C with 6 hours duration, the survival was 98% and was carried out at night, where the temperature reduction was using the temperature comparison of water and ice which 1 liter water: 500 grams of ice. It can be concluded that the effect of low temperature and the length of transportation or transportation has a significant effect on the survival of guppies (Poecilia reticulata) in a closed wet system. The optimum temperature and length of time for transportation of guppy (Poecilia reticulata) was 16^{o}C and with 6 hours duration, the survival is 98% and carried out at night.

Key words: *Guppies, quality of transportation water, survival, temperature*

1. INTRODUCTION

Indonesia is a tropical country that has great potential for fish resources. One of them is ornamental fish, both freshwater and marine ornamental fish. Around 240 species of *marine ornamental fish* and 226 species of *freshwater ornamental fish* live in the territorial waters of Indonesia. The target for ornamental fish production in 2012 is 850 million fishes, from the provisional record it has reached 978 fish, or 115.16% of the target [1]. Since 2011 Indonesia's position as an exporter of ornamental fish has been in 5th place, after the Czech Republic, Thailand, Japan and Singapore.

Ornamental fish production areas are spread over 30 provinces, with ornamental fish cultivation centers located in East Java and West Java [2]. In 2014, West Java contributed to the production of ornamental fish as much as 426,926 thousand heads or 37.42 percent of Indonesia's total production. West Java is one of the locations as a producer of ornamental fish which is quite high, one of which is in the Bogor Regency area, namely Parung District. Bogor Regency is one of the areas in West Java designated by the Ministry of Maritime Affairs and Fisheries of the Republic of Indonesia (KKPRI) as a location for Minapolitan development since 2010. The Minapolitan program is an effort to make the fisheries sector a leading sector in regional development that the areas have fishery potential [3].

One of the varieties of ornamental fish produced by Parung District in Bogor Regency is guppy (*Poecilia reticulata*). Guppy (*Poecilia reticulata*) is one of the ornamental fish that is in great demand by the public. Guppy is asmall freshwater ornamental fish. This fish is popular because it is easy to maintain and has a variety of beautiful color patterns. Guppies are ornamental fish that are widely distributed to various countries,

especially the tropics. The guppy itself was first studied by Wilhelm CH Peters in 1959 in the Venezuelan area and was given the name *Poecilia reticulata* but the most popular name is guppy [4].

The guppy market demand has now penetrated the national market. Some areas that are interested in guppy are widespread in Indonesia and one of the areas that have a lot of interest in guppy is the city of Bandung. In principle, the transportation of live fish aims to maintain the life of the fish during transportation to the destination. Transportation over short distances does not require special treatment. However, transportation over long distances and for a long time requires special treatments to maintain fish survival. Live fish transportation technology that is in accordance with the demands of commodities and conditions is very necessary. Basically, there are two methods of transporting live fish, namely by using water as a medium or a wet system, and a medium without water or a dry system.

The transportation technique commonly used by the community is a wet system using a plastic drum. Efforts to increase the carrying capacity have been made by reducing the amount of water used or increasing the number of fish transported. However, these efforts have not been followed up with efforts to increase the survival of fish so that there are still many problems faced and a live fish transportation technique is needed that can ensure that fish reach consumers in a state that is still alive [6].

The problem that is very often faced in fish transportation is the low survival rate of fish during and after the transportation process. The mortality rate of fish in the transportation process can increase due to metabolic processes and competition in oxygen consumption, while the availability of oxygen in the media is decreasing. This phenomenon is thought to be able to make fish during the transportation process more competitive in getting oxygen so that it stimulates fish to be more stressed. Lower oxygen conditions are thought to trigger stress in fish, causing fish death [7].

Some of the factors that cause fish death during transportation are high levels of carbon dioxide ($CO2_)$due to the respiration process, accumulation of ammonia formed from fish metabolism, and hyperactive fish consume more O_2 so and release a lot of CO_2. that O_2 dissolved in the water transport mediaCO_2 gas and dissolved

2. MATERIALS AND METHODS

2.1 Place and Time

This research was conducted from August 2020 to September 2020. This research was conducted in the laboratory of building 4, Faculty of Fisheries and Marine Sciences, Padjadjaran University. This research carried out the transportation of gupppy fish with a wet system using low temperatures as fish immotilization.

2.2 Tools and Materials

The tools used during this research are as follows; Aquariums, digital water pump scales, gutters, fiber tubs, *water checkers*, pH meters, filters, ammonia *test kits*, nitrate *test kits*, nitrite *test kits*, jars, label paper, stationery, and documentation tools.

The materials used in the research are; Test fish (Guppies / *Poecilia reticulata*) and ice cubes.

2.3 Research Methods

The research is conducted using an experimental model with a factorial Randomized Block Design , which consisted of two factors, namely temperature with 4 levels and transportation time with 3 levels and repeated three times.

Temperature factor

1. Treatment P0 is the control temperature (water temperature $24^oC \pm 1^oC$)
2. Treatment P1 is giving a temperature of $16^oC \pm 1^oC$
3. Treatment P2 is giving a temperature of $14^oC \pm 1^oC$
4. Treatment P3 is giving a temperature of $12^oC \pm 1^oC$

Time Factor

1. W1 treatment for 4 hours
2. W2 treatment for 6 hours
3. W3 treatment for 8 hours

The general model of factorial randomized block design (RAKF) used is as follows:

$$Hijk = + Ki + Pj + Pk + (Pj \times Pk) + eijk$$

Description:

Hijk = The result of the j-th

treatment and the k-th treatment in the i-th group
mean = the general
Ki = The influence of the i-th group
Pj = The influence of the j-th
Pk = The influence of the th treatment factor k
Pj x Pk = Interaction of treatment-j and treatment-k
Eijk = Error due to treatment-j and treatment-k in the i-th group
i = 1, 2, …., k (k = group)
j = 1, 2, …., 1st p (p = 1st treatment)
k = 1, 2, ….. 2nd p (p = 2nd treatment)

2.4 Research Procedures

The procedures carried out in research activities are as follows; procedures for measuring water quality parameters, transportation of guppy (*Poecilia reticulata*), post-transportation, and maintenance after transportation.

2.5 Research Parameters

Observations were made by recording the length of time and the physical clinical condition of each test fish from fainting symptoms to the fainting stage so that the length of induction time in each treatment could be known. Induction time was calculated from the test fish put into each treatment until they showed symptoms of immotilization.

Observation and calculation of recovery time using a stopwatch started from the test fish being transferred to an aquarium that had been given high aeration until the fish showed normal symptoms again due to anesthesia. The normal condition of fish after being aware is characterized by active fish swimming, and moving, and very reactive to external stimuli.

The viability of the fry was observed when unpacking the transportation package and after being reared for 7 days. To determine the survival rate of fish can be 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 [8]. To determine the survival of fish, the following formula was used:

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

Description:
SR = Survival 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

Observation of water quality is carried out by measuring water quality before and after transportation. The measurement of each water quality parameter uses a DO meter to measure DO, a pH meter to measure pH, a thermometer to measure temperature, and a spectrophotometric method to measure ammonia.

Measurement of ammonia using the spectrophotometric method using the following formula:

$$Ammonia\ value\ = \frac{1000}{25}\ x\ \frac{Sample}{Absorbance\ Standard\ Absorbance}\ x\ 5\ micrograms$$

Remarks:
Absorbance sample : Absorbance calculated from sample
Absorbance sample : Absorbance calculated from standard

2.6 Data Analysis

Survival rate data is tested by ANOVA (test F) at the 95% confidence level. If there is a significant difference between treatments in the F test, then it is continued with Duncan's multiple distance at a 95% confidence level [9]. Data on duration of fainting, length of recovery from fish consciousness and data on water quality were analyzed descriptively.

3. RESULTS AND DISCUSSION

3.1 The Effect of Various Temperatures on Guppy Activity and Length of Time for Recovery

The following table is the effect of various temperatures on the condition of guppies during the pre-transportation process, namely when the temperature of the transportation medium decreases until the fish are in an immotile condition as can be seen in table 1 below.

Table 1. Effect of Various Temperatures on Guppy Conditions During the Process of Decreasing Temperature

Average time (Second)	Temperature	Description
0	**24**	Fish position is upright, fish are actively swimming (normal) and responsive to external stimuli and normal operculum motion
45	**16**	Fish position is upright , fish start to calm down (less active), quite responsive to external stimuli and slow operculum movement
35	**14**	Weak upright position, sluggish fish, less active, not very responsive and slow operculum movement
17	**12**	Collapsed position, very slow fish even just collapse , not actively swimming and unresponsive, move the operculum very slowly

From the results of table 1 above it shows that during the process of decreasing temperature, guppies show different behavioral patterns quite clearly along with the decreasing temperature. The behavior pattern of guppy during the temperature decrease was divided into several temperature levels including the control temperature (24^oC), 16^oC, 14^oC and 12^oC.

At the control temperature (24^oC), activity and the condition of the fish is very normal, the normal position of the fish is upright, the fish are very active in swimming, the movement of the fish is quite agile and very responsive to external stimuli, the movement of the limbs such as the gills, dorsal fin, pectoral fin and tail fin move very actively, and the movement of the operculum move normally.

At a temperature of 16^oC, the activity and condition of the fish is quite reduced. This is indicated by the fact that some fish are in an upright position but their movements are quite calm, the fish are not very active in swimming but are still quite responsive to external stimuli. In addition, the movement of the fish's operculum begins to slow down a bit. At a temperature of 16^oC guppies will reach the immotile phase in an average of 45 seconds after the temperature reduction process.

At a temperature of 14^oC, the activity and condition of the fish is greatly reduced. Most of the fish movements began to slow down and their movements were very less active, the fish were not very sensitive to external stimuli and even some fish had entered the immotile phase or collapsed. In addition, the movement of the operculum began to slow down. At a temperature of 14^oC guppies will reach the immotile phase on an average of 35 seconds after the temperature reduction process.

At a temperature of 12^oC, the activity and condition of the fish is greatly reduced, almost all fish begin to enter the collapsed or immotile phase. The movement of fish is very slow and does not actively swim and fish are very unresponsive to external stimuli. In this temperature range, fish are very easy to catch because their movements are very inactive and their operculum moves very slowly. At a temperature of 12^oC guppies will reach the immotile phase at an average of 19 seconds after the temperature reduction process.

Immotilization is one of the important processes in one of the fish transportation activities and is very influential on the transportation process. The use of low temperatures will make the metabolism of fish decrease until it reaches basal metabolism. Basal metabolism or minimal metabolism is the minimum amount of energy required to maintain vital functions in an organism. Basal metabolism represents the use of energy for such things as respiration, blood circulation, pulmonary ventilation, membrane transport of ions (especially sodium and potassium), and muscle tone, cell repair and replacement [10].

The following is an analysis of the recovery time, which can be seen in table 2.

Table 2. The length of time to recover for various temperatures

temperature	test			Total	Average
	i	ii	iii		
12	30.57	32.21	31.72	94.5	31.5
14	14.29	11.11	10.23	35.63	11.88
16	6.84	6.76	7.22	20.82	6.94

In transportation live fish after being transported and arriving at their destination the fish will undergo a process of rejuvenation to determine the level of survival. The restoration process aims to restore the condition of the fish. The temperature of the conditioning medium is adjusted to the fish habitat [11]. The restoration process is carried out by putting the fish into the maintenance medium that has been given continuous aeration which aims to help add air to the water so that the dissolved oxygen level in the water becomes sufficient. first aerated [12].

From the results of the data in table 2 shows that the average recovery of guppies ranges from 6.94 to 31.5 seconds on average. The longest time during the recovery process was in the transportation treatment at a temperature of 12°C where the average length of time for the recovery was 31.5 seconds. In addition, the fastest time during the recovery process is found in the transportation treatment at a temperature of 16°C where the average length of time to recover is 6.94 seconds.

From the results of the fitment data in table 2, it can be analyzed that the longer the transportation time (4, 6, and 8 hours) and the lower the temperature (24°C, 16°C, 14°C and 12°C) the treatment will affect the length of the process. The longer the transportation time will cause the longer the recovery process, because the fish are in a weak condition and lose more energy during transportation, so these guppy need a longer time to regain consciousness. In addition, the lower the transportation temperature, the longer the recovery process because the fish need time to adjust to the conditions of their habitat when they are rehabilitated. 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). So that the normal temperature of 28°C is sufficient to support success in the tests carried out [13].

3.2 The Effect of Temperature Differences on the Survival of Guppy Transportation

Analysis *Survival Rate* of the transportation of guppy, which can be seen in Chart 1.

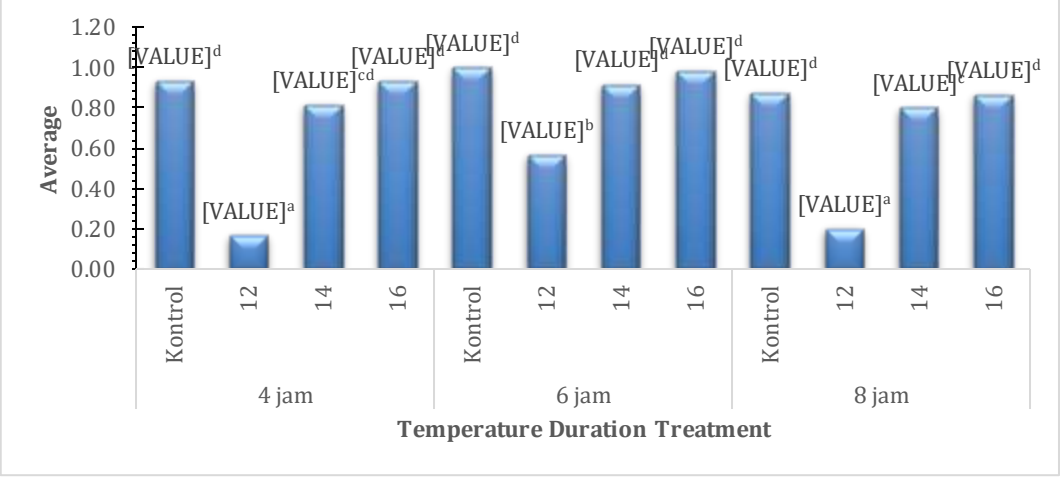

Chart 1. Diagram of the average survival rate of guppy after transportation

The following chart is a survival rate diagram from the results of guppy transportation with a duration of 4 hours, 6 hours and 8 hours with a low temperature of 24°C (control temperature), 16°C, 14°C and 12°C using a closed transportation system carried out at night, namely 00.00 - finished as the duration is applied. The following table shows the results of observations made for the survival *rate* of guppy transportation.

Table 3. Survival Rate of Guppy Transport with Low Temperature

Interaction	Mean	Notation
4 hours Control (24°)	93%	d
4 hours 12°	17%	a
4 hours 14°	82%	cd
4 hours 16°	93%	d
6 hours Control (24°)	100%	d
6 hours 12°	57%	b
6 hours 14°	92%	d
6 hours 16°	98%	d
8 hours Control (24°)	88%	d
8 hours 12°	20%	a
8 hours 14°	80%	c
8 hours 16°	87%	d

Based on the data in Table 3 shows that the effect of low temperature at the beginning of transportation on the survival of guppies transported with a density of 20 fish / 2 liters of water with a long transportation time applied causes a high survival rate diverse. The results of the F test analysis at the 5% level ($\alpha = 0.05$) between the low temperature treatment and the long duration of transportation showed significantly different results. Duncan's test was also carried out as a follow-up test and the results obtained on the test results showed results indicating that the interactions were significantly different.

Table 3 shows the average survival rate of guppies ranging from 17% - 100%, this figure shows that the average survival results are very diverse. Fish transported with transport time and stunning temperature control 4 hours (24°), 4 hours 14°C, 4 hours 16°C 4 hours 16°C, 6 hours 14°C, 6 hours 16°C, 8 hours control (24°), and 8 h 16°C were not significantly different and had the highest survival rate above 82%. Meanwhile, fish at transportation duration and stunning temperature of 4 hours 12°C and 8 hours 12°C had the lowest survival rates, which was below 21% (Table 2). In general, the transportation of live fish, either for fry size or consumption size, is carried out at night until the morning in order to achieve good transport success results, this condition allows to maintain high oxygen solubility and fish avoid stress during transportation [14]. At night and in the morning the ambient temperature is relatively lower so that the change in water temperature is relatively lower. This low water medium temperature can last longer in the plastic so that fish metabolism remains at a low point or even in basal metabolism and the availability of dissolved oxygen is adequate. Low water temperature can reduce the activity and metabolism and the level of fish oxygen consumption [15].

The longest duration of 8 hours showed the lowest average survival compared to the duration of 4 hours and 6 hours. At the control temperature (24°C) with a duration of 8 hours, the figure was 88%, this figure shows the lowest number compared to the 4 hour duration of the control temperature (24°C) with a survival rate of 93% and the 6 hour duration of °C with a survival rate of 100%. At a temperature of 16°C with a duration of 8 hours, the figure is 87%, this figure shows the lowest number compared to a 4 hour duration at 16°C with a survival rate of 93% and a duration of 6 hours at a temperature of 16°C with a survival rate of 98%. . At a temperature of 14°C with a duration of 8 hours, the figure is 80%, this figure shows the lowest number compared to a duration of 4 hours at a temperature of 14°C with a survival rate of 82% and a duration of 6 hours at a temperature of 14°C with a survival rate of 92%. At a temperature of 12°C the number is quite different compared to other temperatures and durations, the lowest survival rate is obtained at a duration of 4 hours with a rate of 17%, while at a duration of 6 hours the number is 57% and at a duration of 8 hours the number is 20%, this is because the temperature used is very low and has approached the lower limit of the fish.

The following chart is a graphic diagram of the average survival of guppy after transportation:

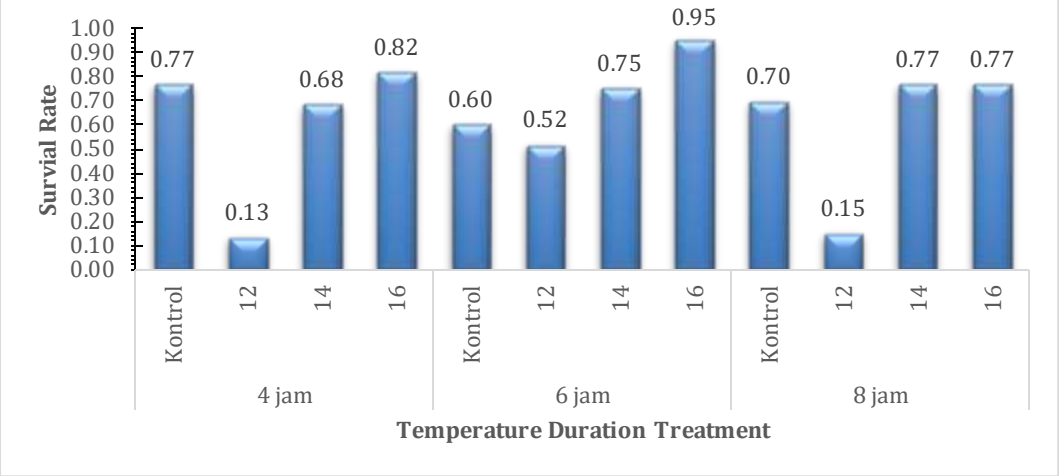

Chart 2. Diagram of the average survival of guppy after rearing

The maintenance of guppies is intended to determine the effect of using low temperatures on the survival of guppies after being transported using low temperatures. This maintenance was carried out for 7 days and the survival of guppy was observed after being reared for 7 days after transportation. The results obtained are not much different from the survival rate after the fish is transported, but the numbers show a decrease in the survival rate.

Chart 2 shows that the interaction of guppies reared after being induced at the time of transportation and rearing in the Ciparanje Hatchery, Faculty of Fisheries and Marine Sciences, Padjadjaran University for 7 days with transportation duration of 4 hours, 6 hours and 8 hours and with temperature control (24^{o}), a temperature of 12^{o}C, a temperature of 14^{o}C and a temperature of 16 ^{o}C have significant differences in their survival. Fish that were transported with a control time and temperature of 4 hours control (24^{o}), 4 hours 14 ^{o}C, 6 hours 14 ^{o}C, 6 hours 16 ^{o}C, 8 hours 14 ^{o}C, and 8 hours 16 ^{o}C were declared no different and has the highest survival rate above 75%. Meanwhile, fish at the transport duration and stunning temperature of 4 hours 12 ^{o}C and 8 hours 12 ^{o}C had the lowest survival rate, which was below 15%. This can happen due to several factors, one of which is the temperature of the ciparanje water, the temperature of the maintenance in Ciparanje is very volatile even though the maintenance is carried out in the Ciparanje Hatchery, Faculty of Fisheries and Marine Sciences, Padjadjaran University. Maintenance for 7 days using a small aquarium without using *heater* because the size of the aquarium is too small to use a *heater* and when the research was carried out there was no *heater* with the required number and size.

Temperature fluctuations in a small aquarium located in the Ciparanje Hatchery, Faculty of Fisheries and Marine Sciences, Padjajaran University are very diverse but the temperature in the morning can range from 15^{o} - 22^{o}C and during the day can range from 25^{o} - 32^{o}C, this is causes significant temperature fluctuations from the morning with fairly cold water and in the afternoon with relatively warm water. Fish have a degree of tolerance to temperature within a certain range which is very important for growth, egg incubation, feed conversion and resistance to disease and fish will experience stress when exposed to temperatures outside the tolerable range [16]. In general, guppies can live normally with a temperature tolerance of 26^{o} – 30^{o} C [5]. Temperature fluctuations that occur in the Ciparanje Hatchery, Faculty of Fisheries and Marine Sciences, University of Padjadjaran, are beyond the guppy's tolerance temperature, which ranges from 26^{o} - 30^{o} C and can affect several things, such as stress on fish due to significant temperature changes every day. High temperatures can cause stress, which is characterized by weak, thin, and abnormal behavior, while low temperatures cause fish to become susceptible to fungal infections and pathogenic bacteria due to a weakened fish immune system [16].

3.3 Water Quality

Water quality is the most important factor in fish transportation, without water fish will not be able to live. Therefore, water quality must be considered so that fish transportation activities can run as expected. Temperature, *dissolved oxygen* (DO), pH and ammonia are some of the water quality parameters that are quite important in fish transportation activities [17]. The quality of water media in fish transportation is divided into

two parts, namely the quality of water media before transportation of fish before transportation and quality of water media after transportation.

The following table below is the average water quality after guppy transportation is carried out.

Table 4. Pre-transportation water quality of guppy

Duration Factor	Concentration	Range			
		Temperature	DO	pH	Ammonia
4 hours	Control	23.3 - 23.3	6.8 - 7.6	6.74 - 6.78	0
	12	23.7 - 23.8	6.6 - 6.7	6.9 - 6.98	0
	14	23.7 - 23.8	6.6 - 6.7	6.73 - 6.96	0
	16	23.7 - 23.7	6.7 - 6.8	6.88 - 6.99	0
6 hours	Control	23.5 - 23.5	6.7 - 7.1	6.81 - 6.9	0
	12	23.8 - 24.2	6.5 - 7.2	6.33 - 6.57	0
	14	23.7 - 23.7	6.6 - 6.9	6.83 - 6.85	0
	16	23.7 - 23.7	6.6 - 6.7	6.98 - 7.05	0
8 hours	Control	24.1 - 24.1	5.1 - 8.4	6.79 - 6.81	0
	12	24.5 - 24.8	7.4 - 7.6	6.73 - 6.93	0
	14	22.8 - 23.8	6.6 - 6.9	6.53 - 6.64	0
	16	23.2 - 24	6.5 - 6.8	6.63 - 6.69	0

Table 4 shows that the initial temperature before being applied was low (temperature 12^{o}C,14^{o}C and 16 ^{o}C) at the beginning of guppy fish transportation. Then, pre-transportation of guppies was observed, the temperature ranged from the lowest to 22.8^{o}C and the highest to 24.8^{o}C. Temperature is one of the factors that has a significant influence on wet transportation in a closed system, because if the temperature of the water media increases then the temperature of the water medium increases. This will affect the metabolic rate of fish which will have a direct effect on their energy needs. This figure is a number that is quite good for low temperature applications because it is not too far from the control temperature and a number that is quite good for guppy survival where the optimum temperature for guppies to live normally is between 26^{o} – 30^{o}C [4].

From the results of table 4, it shows that the *dissolved oxygen* (DO) was applied before low temperatures were applied (temperature 12^{o}C, 14^{o}C and 16^{o}C) at the beginning of guppy fish transportation. Then, pre-transportation observations of guppy fish showed that dissolved oxygen (DO) levels ranged from the lowest 5.1 mg/L and the highest 8.4 mg/L. this number is a number that is quite good and supportive for guppies. The content of 5.3-6.2 mg.L is the dissolved oxygen content or dissolved oxygen range that supports the survival of guppy fish [18].

Table 4 shows that the initial pH content before application was low (temperature 12^{o}C, 14^{o}C and 16^{o}C) at the beginning of guppy fish transportation. Then the pre-transportation of guppies was observed, and the pH ranged from the lowest to 6.53 and the highest to 7.05. this number is a number that is quite good and supportive for guppies. In order to live properly guppies require acidity between 6.8 to 8.0 [19].

The following is the average water quality after guppy transportation is carried out as shown in the following table.

Table 5. Water quality after transportation of guppy

Duration	Concentration	Range			
		Temperature	DO	pH	Ammonia
4 hours	Control	22.5 - 22.9	7.8 - 9.4	7.18 - 7.37	0.0013 - 0.0027
	12	16.8 - 21.6	11 - 11.9	7.53 - 7.64	0.001 - 0.0013
	14	15.9 - 16.7	12.4 - 14.4	7.37 - 7.49	0.0013 - 0.002
	16	17 - 17.4	10.8 - 12	7.23 - 7.56	0.0008 - 0.0022
6 hours	Control	21.6 - 22.1	8.2 - 9.5	7.14 - 7.21	0.0026 - 0.0036
	12	16.9 - 17.3	12.1 - 12.6	7.25 - 7.56	0.0008 - 0.0019
	14	17.8 - 18.7	9.6 - 10.5	7.55 - 7.81	0.0027 - 0.0052
	16	18.4 - 18.7	9.9 - 10.3	6.87 - 7.05	0.0012 - 0.0019
8 hours	Control	23.8 - 25	12.6 - 13.8	7.13 - 7.41	0.007 - 0.01
	12	15.8 - 20.1	8.1 - 8.5	7.16 - 7.31	0.001 - 0.003
	14	16.2 - 18.4	9 - 11	7.13 - 7.8	0.001 - 0.002
	16	16.7 - 21.8	8.7 - 11	7.45 - 7.54	0.008 - 0.01

From the temperature results obtained after being given the desired temperature treatment, the temperature increase from several applied temperatures is very high. diverse. With a temperature treatment of 12^{o}C with a duration of 4 hours, it can be seen that the temperature after being transported becomes 16.8^{o}C to 21.6^{o}C, while with a duration of 6 hours the temperature becomes 16.9^{o}C to 17.3^{o}C and a duration of 8 hours becomes 15.8^{o}C to 20.1^{o}C. With a temperature treatment of 14◦C with a duration of 4 hours, the temperature after being transported becomes 15.9^{o}C to 16.7^{o}C, while with a duration of 6 hours the temperature becomes 17.8^{o}C to 18.7^{o}C and a duration of 8 hours to 16.2^{o}C to 18.4^{o}C. With a temperature treatment of 16^{o}C with a duration of 4 hours, it can be seen that the temperature after being transported becomes 17^{o}C to 17.4^{o}C, while with a duration of 6 hours temperature to 18.4^{o}C to 18.7^{o}C and duration of 8 hours to 16.7^{o}C to 21.8^{o}C. this proves that the temperature will increase during transportation, some duration of temperature increase is quite not too significant starting from from 2^{o}C to 5^{o}C. this is due to the long transportation time which causes the water temperature to increase but This can be overcome by choosing the timing of trans portation activities carried out in the evening until the morning.increase in water temperature 10^{o}C, oxygen consumption will increase 3-5 times [14].

Table 5 shows that *dissolved oxygen* (DO) after application of low temperatures (temperature 12^{o}C, 14^{o}C and 16^{o}C) post-transportation of guppies. After that, post-transportation of guppy fish showed that the dissolved oxygen *(* DO) number ranged from the lowest to 7.8 mg/L and the highest to 14.4 mg/L. this is due to the addition of pure oxygen at the time of transportation so that the dissolved oxygen number increases significantly even with the oxygen consumption carried out by fish. With immotilization activities will also affect the oxygen consumption of fish so that oxygen consumption decreases. The effect of low temperature on aquatic biota is its ability to take in oxygen. The decrease in this ability is caused by a decrease in heart rate so that the osmoregulation of fish is disturbed [20].

Table 5 shows that the initial pH content before application was low (temperature 12^{o}C, 14^{o}C and 16^{o}C) at the beginning of guppy fish transportation. Then the pre-transportation of guppies was observed, and the pH ranged

from the lowest to 6.53 and the highest to 7.05. However, there was an increase in pH after transportation was carried out, which ranged between the lowest 6.87 and the highest 7.64. This change is not so significant th at it is still said to be safe for transportation activities. In order to live properly guppies require acidity between 6.8 to 8.0 [19].

Viewed from table 5 above, it shows that the ammonia level after application of low temperatures (temperature 12^{o}C, 14^{o}C and 16 ^{o}C) in post-transportation of guppies. Then, post-transportation of guppy fish showed that ammonia levels ranged from the lowest to 0.001 mg/L and the highest to 0.0052 mg/L. This figure shows that the ammonia level in the post-transportation water media shows an increase from the beginning of transportation, which is 0 mg/L and can be categorized as a safe number and can still be tolerated by fish. Ammonia is toxic to commercially farmed fish at concentrations [21].

4. CONCLUSIONS

Based on the results of this research, it can be concluded that the effect of low temperature and long transportation time has a significant effect on the survival of guppies (*Poecilia reticulata*) in a closed wet system. The optimum temperature and length of time for transportation of guppy fish (*Poecilia reticulata*) is a temperature of 16^{o}C with a duration of 6 hours, the survival rate is 98% and carried out at night, where the temperature decreases using a ratio of water and ice temperatures of 1 liter of water: 500 grams of ice.

Applications for the transportation of guppies (*Poecilia reticulata*) are recommended to use a temperature of 16 ^{o}C and carried out at night. If further research is carried out for the application of live fish transportation in a wet system with low temperatures and transportation time, it is necessary to transport fish above the hours that have been researched (> 8 hours) and carried out at different transportation times (during the day).

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