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DEVELOPMENT OF A FISH TRANSPORTATION EFFICIENCY SYSTEM FOR THE COMMUNITY

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ABSTRACT--*Indonesia is the largest archipelago country that has territorial waters with a great fisheries potential. The utilization of this great fishery potential will be more optimal if the fish products obtained are able to be distributed to various regions. The important thing in the process of distributing fish is the fish transportation system. Determining the type of fish transportation system will affect the costs incurred and the life span of fish. Conventionally, fish transportation is carried out in closed systems using oxygen which can only last for 3 hours. Therefore, efforts needed to develop techniques in the fish transportation system that are able to extend the life span of fish so the distribution can be done in the wider area. Research on the effect of adding substance which can maintain the survival of fish can be a solution to overcome the distribution problem. The research was conducted by giving pellets made from a mixture of D-glucose vit. C, palm sugar, soda flour, tapioca, and water. Then the pellets were added to a plastic bag containing 25 fishes with various treatments P1 (without oxygen); P2 (with oxygen); P3 (pellets); P4 (pellets with oxygen). The results showed that there were effects of adding pellets on the viability of fish, DO, water temperature, and pH. The P4 treatment showed the highest number of live fish compared to other treatments.*

Keyword-- *fish transportation system, oxygen, pellet*

I. INTRODUCTION

Indonesia is the largest archipelago country with 17 thousand islands covering 3 million km^2 and surrounded by an ocean of 6 million km^2 (Wahyono, 2009). That conditions because Indonesia has great potential in the fisheries sector, both sea fish and freshwater fish. Potential fish that have been caught from the sea and cultured freshwater fish will be marketed to various regions. Marketing is activity to transport fish commodity from producer to consumer (Abidin *et al*., 2017). The marketing process is related to the fish transportation system during distribution (Berka, 1986) that can maintain the quality of fish to consumers. Determinations of fish transportation system influence costs and fish life span. Berka (1986) explains that fish transportation system is influenced by many factors, including fish quality, dissolved oxygen levels, and temperature. There are two kind

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of fish transportation systems, closed system and open system (Berka, 1986). Fish distribution with closed system using polyethylene (PE) plastic bag, which put some fishes into plastic bag then filled with oxygen. Closed system is common system in marketing fishery product for fish transportation because it is more efficient and spend lower cost. However, the closed system has not been able to extend the life span of fish during distribution.

In this research, we develop a kind of pellets to overcome problems in fish distribution. The pellets contained carbohydrate groups, oxide compounds, and salts that able to maintain the dissolved oxygen, which are needed by fish during the distribution period. The use of pellets in water during distribution can extend the life of fish, so it can maintain the quality of fish from producer to consumers. The study aims to determine the effect of pellets on fish viability in closed system transportation.

II. MATERIALS AND METHODS

2.1 Materials

The pellet was substance which made from mixture D-glucose, vitamin C, palm sugar, soda flour, tapioca, and water. It used to increase dissolved oxygen levels in water. Red Nile Tilapia fishes (*Oreochromis niloticus*) as object of research were purchased from market. The measuring device for measure water quality: Dissolve Oxygen (DO) meter, pH meter, and thermometer.

2.2 Methods

The research was conducted at Pandu Foundation laboratory in Pasar Minggu, East Jakarta. Research has been done to determine the effect of pellets on fish survival during distribution process by closed system. In closed system, the fishes were put into plastic bag (30 x 47 cm) with 2.5 L water. There were 4 treatments to compare the effect of pellets, P1 (without oxygen), P2 (with oxygen), P3 (pellet without oxygen), and P4 (pellet with oxygen). The 25 red nile tilapia fish have been used in each treatment, with the weight of each fish was 2 grams. Fish viability was measured after 14 hours in closed system. The survive fishes were counted and calculated as percentage of Survival Rate (SR) based on Effendi (1979) based on following formula:

$$SR = \frac{\sum Fish\ at\ the\ end\ of\ treatment}{\sum Fish\ at\ the\ beginning\ of\ treatment} \times 100\% \qquad (1)$$

Water quality in closed system also measured to determine differences of each treatment condition. The quality of water: Dissolved Oxygen (DO), temperature, and pH were measured before and after treatment. Each data will be analysed to find out the effect of pellets on fish survival.

III. RESULTS AND DISCUSSION

The fish viability in closed system treatment is higher shown in treatment P4 (pellets and oxygen) than P1 (without oxygen), P2 (with oxygen), and P3 (pellets without oxygen) (Table 1). Percentage of Survival Rate (SR) showed viability of fish in treatment P4 (92%), higher than SR percentage in other treatment. Based on the data, fish transportation in closed system is depend on oxygen. In treatment P1 (without oxygen) and P3 (pellets without oxygen), mortality rate of fish was higher than P2 (oxygen) and P4 (pellets with oxygen), with SR percentage 24%

and 48% respectively. The pellets will affect fish survivability in closed system transportation when added oxygen in plastic bag. According to Berka (1986) oxygen is important factor during fish transportation, especially in closed system transportation.

Table 1: Fish survivability in closed system transportation

Treatments	Fish survive	SR
P1	6	24%
P2	15	60%
P3	12	4%
P4	23	92%

The fish transportation system influenced by many factors, including fish quality, dissolved oxygen levels, and temperature (Berka, 1986). Water quality of closed system treatment (Fig. 1) was measured to find out water temperature, pH, and concentration of dissolved oxygen (DO). In the beginning of treatment, the water showed 27.5°C, pH 7.2, and DO 7.3 mg/L, but after 14 hours of treatment the water quality has changed (Table 2).

Figure 1: Fish treatment in closed system transportation

Table 2: Water quality in closed systems after 14 hours

		Temperature (°C)	pH	DO (mg/L)
Control		27.5	7.2	7.3
Treatments	**P1**	29.3	7.0	1.2
	P2	28.1	7.2	2.4
	P3	27.5	6.3	2.2
	P4	28.3	6.6	3.8

Based on observation of water quality test, the water temperature after 14 hours was increased. The water temperature significantly increased in treatment P1 (without oxygen). The pellets in treatment P3 (pellets) showed water temperature remain stable and treatment P4 showed water temperature slightly increase, but it was not significant. It proves that pellets can maintain temperature in water. The increasing of water temperature might happen because of carbon dioxide (CO_2) in water from fish respiration in closed system transportation. The increasing of temperature in closed system can influence decomposition of fish feces (Karnila & Edison, 2001) and fish metabolic rate (Saanin, 1984; Barka, 1986). Decomposition of fish feces will cause decrease in water pH (Karnila & Edison, 2001). Moreover, increasing temperature also cause enhancement of fish metabolism which affect concentration of dissolved oxygen parallel with fish's demand oxygen. According to Sannin (1984) in Afriansyah et al. (2016) fish transportation is optimally carried out at low temperatures to suppress physiological activity of fish, so oxygen demand decreases and DO level in water remain stable.

Water contained in 3 plastic bags treatment (P1, P3, and P4) showed decreasing of pH after 14 hours of treatment. Significant pH decrease occurred in treatment P3 (pellets without oxygen) that might be caused by pellets. Another factor which can decrease pH is production of CO_2 by fish's respiration (Berka, 1986). The pH range in water quality observation was within the optimal for fish survivability in accordance with Wedmeyer (1996) in Afriansyah et al. (2016), with pH range between 6-9. According to Berka (1986), the optimum pH rage for fish transportation is 7-8.

Beside of pH and temperature, the water quality test also measured dissolved oxygen in plastic bag of treatment. Dissolved oxygen in water during fish transportation using closed systems is important parameter (Ismi, 2007). The result of DO levels showed water contained in each plastic bag treatment has decreased. In treatment P4 (pellets with oxygen) showed higher dissolved oxygen (3.8 mg/L) than other treatments. The pellets can hold DO level in water. The DO level decreased significantly in treatment P1 (without oxygen), which was caused by fish using DO for respiration. It was showed correlation of DO levels in water and survivability of fish (Table 1). Based on Clucas & Ward (1996), DO will decrease during closed systems transportation due to oxygen demand by fish. The lack of dissolved oxygen in certain period can cause fish death (Ismi, 2017). Harmon (2009) also state that fish can death suddenly in large number can occur due to lack of oxygen in water.

Based on the research, the treatment P4 (pellets with oxygen) was better system for fish transportation than other. The pellets will maintain condition in closed system which was added by oxygen.

IV. CONCLUSION

Fish transportation using closed systems was related to water quality: water temperature, pH, and DO. The pellets affect water quality during treatment. The addition of pellets with oxygen (P4) will affect viability of fish, water temperature, pH, and dissolved oxygen.

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