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Observation of Excess Air Discharge in the Budikdamber Pond Aeration System on the Real Effect of Tilapia Fish Health (*Oreochromis spp.*)

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Abstract

A study revealed that there is a negative side from excessive aeration to the point of saturation. This study is about the process and level of exposure related to gas bubble disease caused by hyperopia, with the main symptoms being gas bubbles under the skin of the fins, lateral line, gills and eyes. Other studies are underway to prove the real effects of excess aeration, particularly on the health of tilapia in closed ponds at normal ambient temperatures. The focus of fish species to be observed in this study is tilapia, with an observation time of ± 1 month. The maximum DO measurement results at a normal ambient temperature of 25.6 °C was 8.2 mg/L. The optimum DO level in the first pond which was aerated with 25 L/m air flow was ± 7.9 mg/L, the optimum DO level in the aerated pond with 40 L/m air flow was ± 8.1 mg/L , and the optimum DO level in an aerated pond with an air flow rate of 54 L/m is ± 8.1 mg/L. No matter how big the air flow from the aerator is added to the water, the DO level will not exceed the value of 8.2 mg/L as long as the air temperature is not lower than 25 °C. Tilapia fish in ponds that contain the highest DO levels at normal environmental temperature conditions in this pond water (24.4 – 25.9 °C), grow and develop very well, not even having a bad impact on health..

Keywords: Tilapia health; excessive DO levels; maximum aeration discharge; normal water environment temperature

Introduction

An important factor that needs to be considered in supporting the success of aquaculture business is the condition of good pond water quality so as not to cause stress and trigger disease to cause death (Minggawati and Saptono, 2012). Physical and chemical parameters that affect water quality include temperature, dissolved oxygen (DO), ammonia, acidity (pH), alkalinity, nitrate, other dissolved organic matter and feed 2017), the parameter of water quality that fluctuates rapidly, which then has an impact on fish life is DO. In this study, we compared different siphonation and aeration treatments in ponds A, B, C, and D. The results showed that the highest growth rate was pond "B" which was regularly aerated and siphoned. These results are also reinforced by similar research conducted by (Kusumah et al., 2021 and Kusumah et al., 2022). This happens because DO levels are needed by fish organisms for metabolic processes, so the value changes quickly. The results of other previous studies

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also concluded that the provision of aeration can prevent fish from diseases and parasites caused by pathogenic bacteria such as Edwardsiella ictaluri in catfish (Mqolomba and Plumb 1992).

However, there is a negative side of giving excessive aeration until it reaches the saturation point. A study conducted by Espmark et al., (2010).revealed that there is a risk that fish may be exposed to water that is super saturated with oxygen. The results of the study on the process and level of exposure related to gas bubble disease caused by hyperoxia (very high oxygen concentration), through a combination of morphological observation methods and fish behavior. The first symptom is gas bubbles under the skin that appear on most of the fins, along the lateral line, gills and in the eyes. Gas bubbles were detected by visual observation and confirmed by histological observations. Fish exposed to 110% oxygen saturation during the first week also showed more frequent turns than control group fish. Fish in both the high and low oxygen saturation groups appeared to be more panicked than the control group fish, indicating physiological stress and possibly pain.

Based on these problems, it is necessary to conduct a research that aims to prove the real effect of excess aeration on fish health in closed ponds on the Budikdamber scale at normal ambient temperatures. In this research plan, the focus is on the type of consumption fish, namely Tilapia. The observational variables compared the provision of aeration discharge (air into the water) in three different ponds, but with the same number of fish stock and volume of pond water. The results focused on these observations were the maximum measurement of DO levels at normal ambient temperatures ranging from 25 °C to 26 °C, with the provision of different aerated air discharges in each pond.

The results of this research can be utilized by groups of fish cultivators, one of the benefits is determining the specifications of the aerator machine that is suitable for the planned number of fish stock and the size of the pond used. Another benefit is that cultivators do not need to provide continuous aeration for twenty-four hours without stopping, so they can save the electrical energy used and extend the service life of the aerator.

Materials and Methods

Diet Preparation

This research proves that excessive aeration is used to obtain maximum DO levels to saturation in closed ponds on the Budikdamber scale. In the first to third budikdamber ponds, respectively, air discharges of 25 mg/L, 40 mg/L, and 54 mg/L were given, with the same variables as feed treatment, water quality (temperature fan pH), and the same volume. The focus of the type of fish that will be observed in this research is Tilapia, with a duration of observation for about one month.

The experimental pond media needed in this research were three units of 80 L bucket pools (budikdamber). The three pool units are stored in an area exposed to the sun, but not exposed to rainwater. The first experimental pond was given aeration with a measured air flow rate of 25 L/m, the second pool was aerated with a measured air flow rate of 40 L/m, while the third pond was given a measurable aeration of 54 L/m. Observational data required from these observations is the visual condition of fish in each pond, as well as fish length data, and is associated with DO level data measured using a DO meter (Lutron 5510) at the same time. The experimental model for obtaining these data is illustrated in Figure 1.

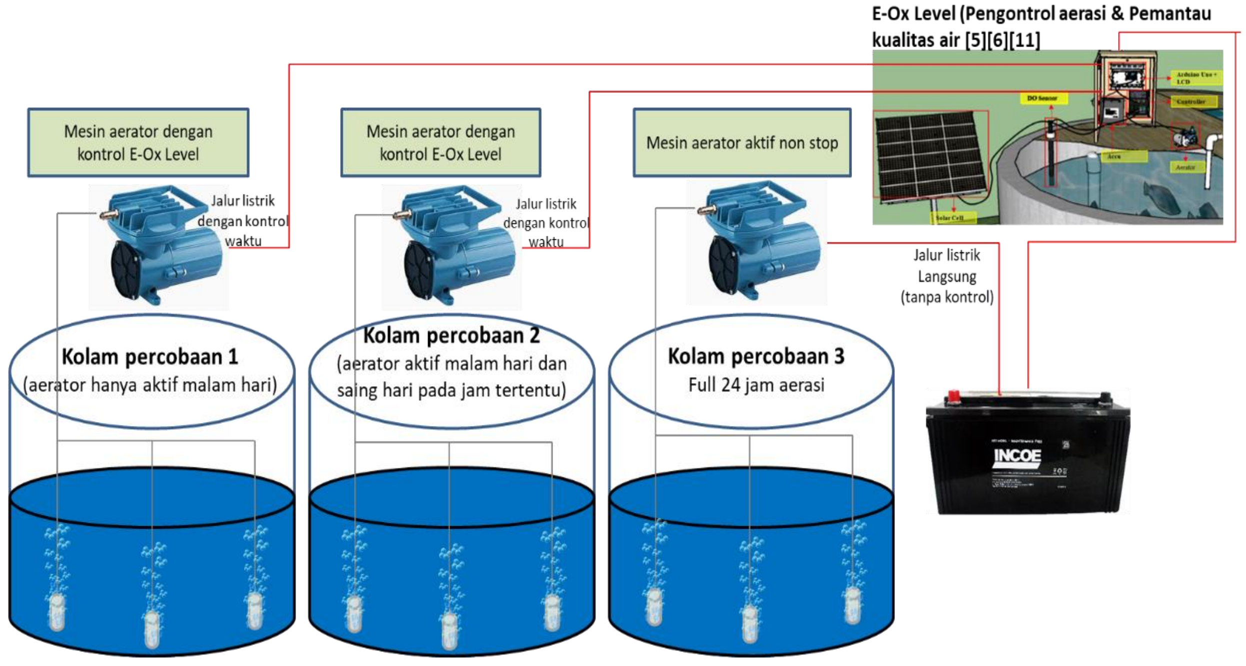


Figure 1 Illustration of data collection observations
(Kusumah et al., 2021; Kusumah et al., 2022; Siskandar et al., 2022)

Budikdamber Pond Media Sterilization

As in general, new ponds that will be used for stocking media, rearing or fish farming must be sterilized first. The sterilization process carried out in this research is to enter sufficient krosok salt into a new bucket pool that is already fully filled with water. The process of immersing the pond with salt water is carried out for seven days to be considered sterile from the source of bacteria and fungi, then the soaking water is discarded, replaced with new water which is added with EM4 probiotic liquid for fisheries. The sterilization process can be seen in Figure 2.

Equipment Installation

The sterilized bucket pond was re-entered with water and a small amount of EM4 probiotic liquid for fisheries and then stored at the experimental location and fitted with an aerator machine. Each bucket pool is inserted with a hose and aeration stone according to the amount of air flow for the planned aeration system. The first pool was aerated with an air flow of 25 L/m, the second pool was aerated with an air flow of 40 L/m, and the third pool was aerated with an air flow of 54 L/m.

Figure 2. Sterilization of the Budikdamber Pond

Data Analysis

Measure the maximum DO of water samples at low, medium and high temperatures

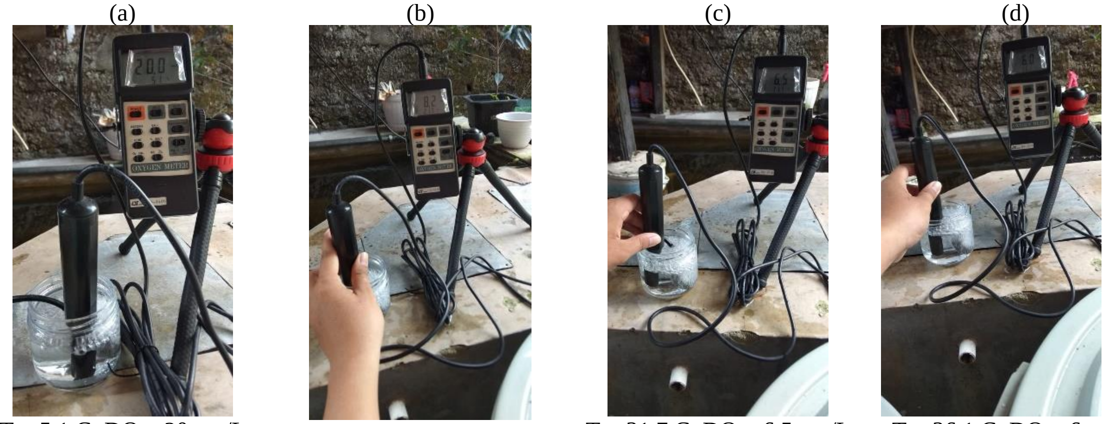
We measure the maximum DO level using a DO meter (Lutron 5510) in every engineering change in water temperature (low temperature, medium temperature, and high temperature), the aim is to serve as a reference source that DO levels will be at a certain maximum value at a certain water temperature, and will no longer increase to be higher as long as the water temperature remains in the same range. The measurement results are shown in Figure 3. At a water temperature of 5.1 C, the maximum DO is 20 mg/L; at water temperature 21 C, maximum DO 8.2 mg/L; at water temperature 31.7 C, maximum DO 6.5 mg/L; and at a water temperature of 36.1 C, the maximum DO is 6 mg/L.

Table 1. The relationship between saturated dissolved oxygen (DO) levels and temperature at air pressure of 760 mm Hg (Cole 1983).

Suhu (°C)	Kadar Oksigen terlarut (mg/l)	Suhu (°C)	Kadar Oksigen terlarut (mg/l)	Suhu (°C)	Kadar Oksigen terlarut (mg/l)
0	14,62	14	10,31	28	7,83
1	14,22	15	10,08	29	7,69
2	13,83	16	9,87	30	7,56
3	13,46	17	9,66	31	7,43
4	13,11	18	9,47	32	7,30
5	12,77	19	9,28	33	7,18
6	12,45	20	9,09	34	7,06
7	12,14	21	8,91	35	6,95
8	11,84	22	8,74	36	6,84
9	11,56	23	8,58	37	6,73
10	11,29	24	8,42	38	6,62
11	11,03	25	8,26	39	6,51
12	10,78	26	8,11	40	6,41
13	10,54	27	7,97		

The results of this measurement are in line with the results of research that has been carried out by previous research, namely.

(a) (b) (c) (d)



T = 5,1 C; DO = 20 mg/L T = 21 C; DO = 8,2 mg/L T = 31,7 C; DO = 6,5 mg/L T = 36,1 C; DO = 6 mg/L

Figure 3. Treat the maximum DO measurement on engineering changes in water temperature

Data Observation

The first data observation that was carried out was visual observation of the condition of Tilapia. Observed from color; the presence of air bubbles such as white spots in the eye area, dorsal back, fins, tail, and eyes; and aggressiveness.

The second data observation carried out was the observation of DO levels in each pond. This measurement is carried out every three days, simultaneously with other observational measurements. The measurement method is to first calibrate the Lutron 5510 Do meter, then insert it into each bucket pool.

The third data observation is the measurement of fish length. All fish observed,including the length of the fish, were taken and measured and documented. These three observations were carried out simultaneously every three days for one month.

Results

The data obtained and the results of the analysis

Observations of water quality data have been carried out from the day before the fish objects were inserted into the Budikdamber pond. Some of the observations made previously were observing the condition of pond water quality before being given an aerator and fish (step I), then observing the condition of pond water quality after being given an aerator but no fish (step II), then observing the condition of pond water quality after being given an aerator and fish (step III), and then the observation of maximum DO in the ambient water temperature range (step IV). The results of these observations are shown in Table 2.

Table 2. Observation of water quality data carried out before the fish objects are inserted into the Budikdamber pond

Observation Parameter	(Step I)	(Step II)	(Step III)	(Step IV)
DO (mg/L	6,5	8,1	8,1	8,1
Temp. (°C)	25,9	24,5	25,5	25,5

Each treatment of water quality data observations at each of these steps (Table 2) was repeated three times. Observation of Step I was carried out at 14.30 WIB. After repeated measurements, obtained DO values ranging from 6.3 to 6.6 mg/L at a temperature range of 25.8 - 25.9 °C. The results of the average water temperature measured in the first pool, second pool, and third pool were around ± 25.9 °C, while the DO level was around ± 6.5 mg/L. Observation of Step II was carried out at 18.50 WIB. After repeated measurements, obtained DO values ranging from 8 to 8.2 mg/L at a temperature range of 24.4 to 24.6 °C. The results of the average water temperature measured in the first pool, second pool, and third pool were around ± 24.5 °C, while the DO level was around ± 8.1 mg/L. Step III observations were carried out at 15.30 WIB. After repeated measurements, obtained DO values ranging from 8 to 8.1 mg/L at a temperature range of 25.3 - 25.7 °C. The results of the average water temperature measured in the first pool, second pool, and third pool were in the range of ± 25.5°C, while the DO level was ± 6.5 mg/L. Step IV observations were carried out at 15.30 WIB. After repeated measurements, obtained DO values ranging from 8 to 8.2 mg/L at a temperature range of 25.5 to 25.6 °C. The results of the average water temperature measured in the first pool, second pool, and third pool were in the range of ± 25.5°C, while the DO level was ± 6.5 mg/L.

The first day begins when the Tilapia fish samples have been added to each of the Budikdamber ponds. The observation process carried out was to measure the DO levels in each pond, as well as to visually observe the condition of the skin and scales of Tilapia fish, to the process of measuring the length of the fish of all the tilapia stocked in the budikdamber test pond, as many as 30 fish with details of 10 per budikdamber pond, only experienced one death. The death of 1 fish occurred in the first pond, namely a pond that was given an aerated air discharge of 40 L/m. This incident was not caused by the low air flow given to the pool, but due to other things. The death of this fish was initially indicated due to the presence of white spots such as gas bubbles on the dorsal fin (pinnae dorsalis), but as time went on it became clear that these spots were caused by a fungus. This is easily confirmed by simply looking at the increasing number of white spots on each side of the fish. The more days it becomes more clearly visible the fungus on the fish. On day 26, the only fish that had mold was isolated from the test pond, then three days later, on day 30 the moldy fish died. In this condition, all the other fish remained in the test pond with normal health conditions. Until the end of the day of observation, which is day 53, all fish in each test pond of Budikdamber were monitored in a healthy condition. The growth and development of fish conditions more clearly can be seen in Table 3.

(a) DO measurement of the pool on the first day

(b) Visual observation of skin & fish scales on the first day

(c) Fish measurement on the first day

Figure 4. Observation process. (a) Measurement of DO pond on the first day, (b) Observation of visual skin & fish scales on the first day, and (c) Measurement of fish on the first day.

Table 3. Results of DO measurements at normal ambient water temperatures, and visual observations, as well as fish length growth data

Day	Fish Condition Monitoring (Visual)	Long (cm)	Information
Days to-1	Normal	± 13	There are no specific indications in fish (all fish are agile)
Days to-2	Normal	± 13	There are no specific indications in fish (all fish are agile)
Days to-4	Normal	± 13	There are no specific indications in fish (all fish are agile)
Days to-6	Normal	± 13,1	One of the fish appears slightly white on the back near the fin, and the other fish have no negative indications (all fish are lively)
Days to-8	Normal	± 13,1	One of the fish appears slightly white on the back near the fin, and the other fish have no negative indications (all fish are lively)
Days to-10	Normal	± 13,1	One of the fish appears slightly white on the back near the fin, and the other fish have no negative indications (all fish are lively)
Days to-12	Normal	± 13,1	The white markings on one of these fish are slightly more visible on the back near the fins, and the other fish have no negative indications (all fish are agile)
Days to-14	Normal	± 13,2	The white markings on these fish are slightly more clearly visible on the back near the fins, and the other fish have no negative indications (all fish are agile)
Days to-16	Normal	± 13,2	The white markings on these fish are slightly more clearly visible on the back near the fins, and the other fish have no negative indications (all fish are agile)
Days to-18	Normal	± 13,2	The white markings on these fish are a little more clearly visible on the back near the fins, and one fish has no negative indications (all fish are agile)
Days to-20	Normal	± 13,3	The white markings on the same fish are more clearly visible on the back near the fins, and the other fish have no negative indications (all fish are agile)
Days to-22	Normal	± 13,3	The white markings on the same fish are more clearly visible on the back near the fins, and the other fish have no negative indications (all fish are agile)
Days to-24	Normal	± 13,4	The white markings on one of the fish that are becoming increasingly visible are an indication of mold, not bubbles of gas. and other fish there are no negative indications (all fish are lively)
Days to-26	Normal	± 13,4	Fish that are indicated to be affected by fungus are thinner and tend to be quiet.
Days to-28	Normal	± 13,5	And the other fish are normal fat, and agile
Days to-30	Normal	± 13,6	Fish affected by the fungus die. And the other fish are normal fat, and agile fish that
Days to-32	Normal	± 13,6	Fish that are still living normally without any symptoms of disease, are agile and aggressive. Also tends to be timid when looking at people
Days to-34	Normal	± 13,7	Fish that are still living normally without any symptoms of disease, are agile and aggressive. Also tends to be timid when looking at people

Day	Fish Condition Monitoring (Visual)	Long (cm)	Information
Days to-43	Normal	± 14,0	There are no specific indications in fish (all fish are agile)
Days to-53	Normal	± 14,3	Fish that are still living normally without any symptoms of disease, are agile and aggressive. Also tends to be timid when looking at people

Conclusion

The maximum DO measurement results at a normal ambient temperature of 25.6 °C pool water is 8.2 mg/L. The optimum DO level in the first pond that is aerated with an air flow of 25 L/m is ± 7.9 mg/L, the optimum DO level in an aerated pond with an air flow of 40 L/m is ± 8.1 mg/L, and the optimum DO level in an aerated pond with an air flow rate of 54 L/m is ± 8.1 mg/L. No matter how big the air flow from the aerator is put into the water, the DO level will not exceed the value of 8.2 mg/L as long as the water temperature is not lower than 25 °C. Tilapia in ponds containing the highest DO levels at normal ambient temperature conditions of this pond water (24.4 – 25.9 °C), grew and developed very well, in fact there was no adverse effect on health.

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