Study the Effect of Water Quality for Fish Health after Stopped Water Recirculation in Individual Tank of Intensive System (PRO/2654)

TSK 4738

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1. Introduction

To economize on the use of water in aquaculture in the present series of investigations, the indoor recirculation of water was coupled with the intensive monoculture of fish.

This approach has already been followed for several decades in different countries in the world with variable degrees of success

In intensive farming, the fish are raised in artificial tanks at very high densities and are subject to supplemental feeding and fertilization.

Farmers must have a thorough understanding of the targeted species so that water quality, temperature levels, oxygen levels, stocking densities, and feed are set at the optimal levels to promote growth, reduce stress, control disease, and reduce mortality.

Essential here is aeration of the water, as fish need a sufficient oxygen level and fresh water for growth.

This is achieved by bubbling, cascade flow or with a water purification system.

Problems are, encountered with the release and accumulation of metabolic wastes in pond water which may lead to potentially toxic conditions as well as to significant fluctuations in some water quality parameters such as pH, alkalinity, turbidity, ammonia and, in the prevailing dissolved oxygen levels of the recirculation water.

In order to remedy this situation, steps were implemented to minimize and, in some cases, also to reduce the initial levels of some of the potentially toxic metabolic wastes discharged into the recirculation water.

Various types of mechanical and biological filters were developed to aerate the water and to facilitate the breakdown processes of nitrogenous wastes.

It is better to maintain enough aeration in the intensive system to make environment healthy and favorable for the fish growth.

1.1 Optimal water parameters for cold- and warm-water fish in intensive aquaculture

When it is functioning intensive aquaculture, optimal water quality parameters should be maintained to provide favorable environment for the fish.

Very high intensity recycle aquaculture systems (RAS), where there is control over all the production parameters, are being used for high value species.

Table 1: Optimal water parameters for cold- and warm-water fish in intensive aquaculture

Acidity	pH 6-9
Alkalinity	>20 mg/L (as $CaCO_3$)
Aluminum	<0.075 mg/L
Ammonia (non-ionized)	<0.02 mg/L
Cadmium	<0.0005 mg/L in soft water; <0.005 mg/L in hard water
Calcium	>5 mg/L
Carbon dioxide	<5–10 mg/L
Chloride	>4.0 mg/L
Chlorine	<0.003 mg/L
Copper	<0.0006 mg/L in soft water; <0.03 mg/L in hard water
Hydrogen sulfide	<0.003 mg/L
Iron	<0.1 mg/L
Lead	<0.02 mg/L
Mercury	<0.0002 mg/L
Nitrate	<1.0 mg/L
Nitrite	<0.1 mg/L
Oxygen	6 mg/L for cold water fish 4 mg/L for warm water fish
Total dissolved solids	<200 mg/L
Total suspended solids	<80 NTU over ambient levels
Zinc	<0.005 mg/L

2 Objective

To find out the effect of water quality for fish health after stopped water recirculation in individual tank of intensive system

3 Methodology

One fish tank from the guppy growing section which is functioning under the intensive system was selected for the experiment.

Table 2: Details of selected tank

Selected Tank	41 G
Guppy Fish Variety	Red Cobra (Male)
Nu. of stocked fish	748
Age of fish	2 and ½ months
Tank Size	5*10 feet
Water level	25 cm

Figure 1: Selected 41 G Tank

Initial water quality parameters mentioned below, were checked in the selected tank at 9.30 am.

- Temperature
- pH
- Nitrite
- Ammonia
- DOH

After that, water recirculating function was stopped temporary in 41 G tank.

Initially measured parameters were checked again thrice per day during 11.30 am, 1.30 pm, and 3.30 pm time periods.

Finally, data were analyzed.

4 Observations

Table 3: Tested water quality Parameters in 41 G Tank

Water Quality Parameter	Test results			
	at 9.30 am	at 11.30 am	at 1.30 pm	at 3.30 pm
Temperature (^{0}C)	27	28	28	28
pH	8.7	8.6	8.6	8.5
Nitrite (mg/l)	0	0.2	0.3	0.5
Ammonia (mg/l)	0	0.25	0.5	1

DOH was zero during the experimental period.

4.1 Observations of tested water quality parameters

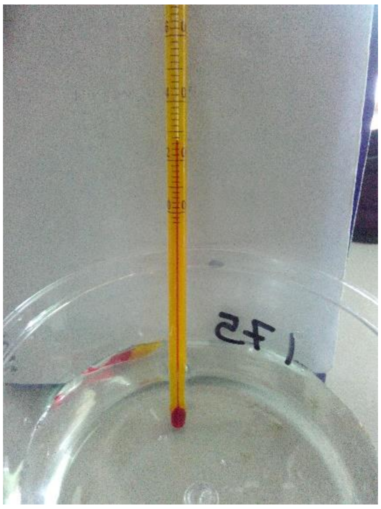

Figure 2: temperature in water at 9.30 am

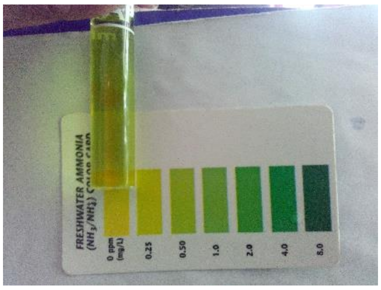

Figure 3: Ammonia level in water at 9.30am

Figure 4: Nitrite level at9.30 am

Figure 5: pH in water at 9.30 am

Figure 6: Temperature in water at 11.30 a

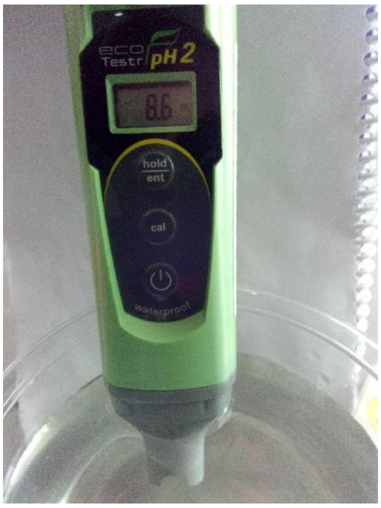

Figure 7: pH in water at 11.30 am

Figure 8: Ammonia level in water at 11.30 am

Figure 9: Nitrite level in water at 11.30am

Figure 10: Temperature at 1.30pm

Figure 11: Ammonia level in water at 1.30 pm

Figure 12: Nitrite level in water at 1.30 pm

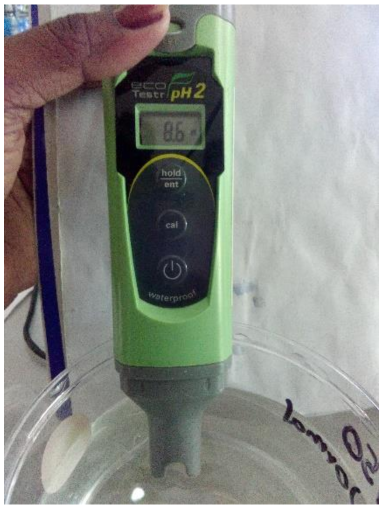

Figure 13: pH in water at 1.30 pm

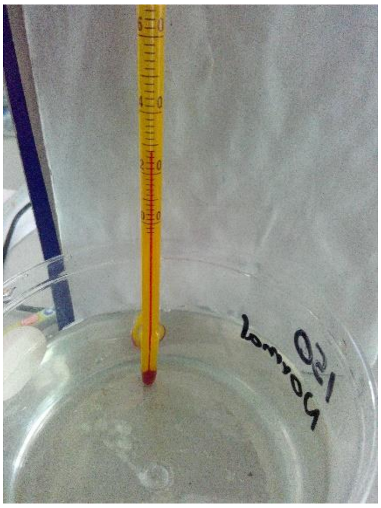

Figure 14:Temperature in water at 3.30pm

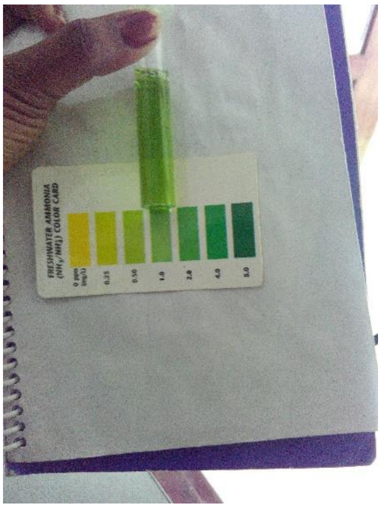

Figure 15:Ammonia level in water at 3.30pm

Figure 16:Nitrite level at 3.30pm

Figure 17: pH in water at 3.30 pm

At 3.30 pm, there were bubbles floating on the surface water column which are the signs of higher level of dissolved nitrogen in water.

At this moment, fish were excited and highly stress.

Figure 18: Floating bubbles on surface water column

4.2 Temperature changes in water after stopped water circulation in the tank

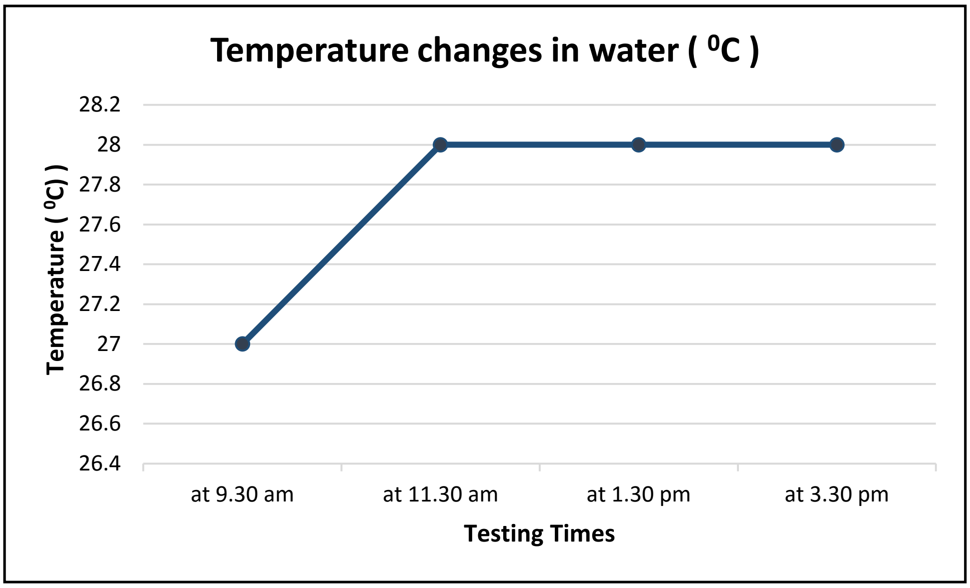

Figure 19: temperature changes in water after stopped water circulation

4.3 pH changes in water after stopped water circulation in the tank

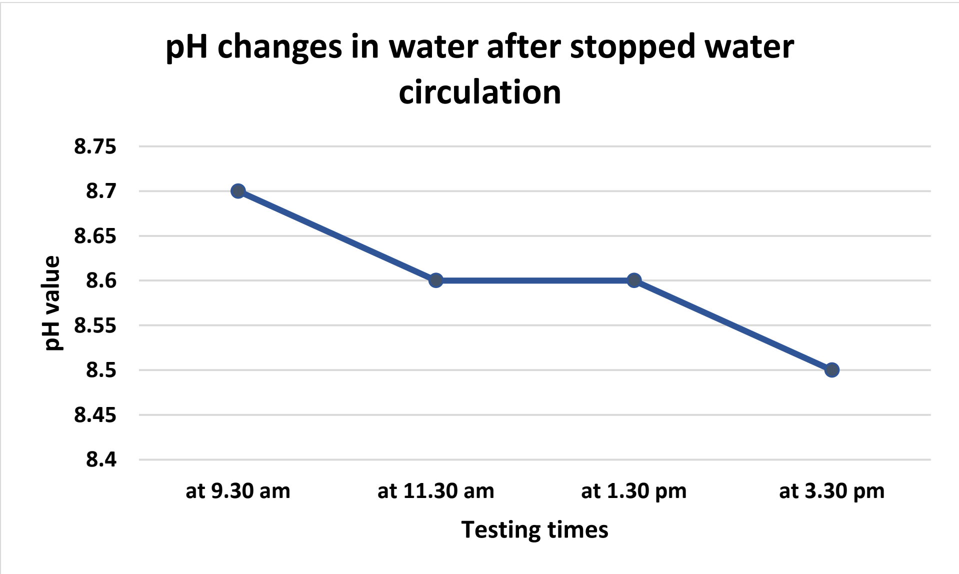

Figure 20: pH changes in water after stopped water circulation

4.4 Ammonia level changes in water after stopped water circulation in the tank

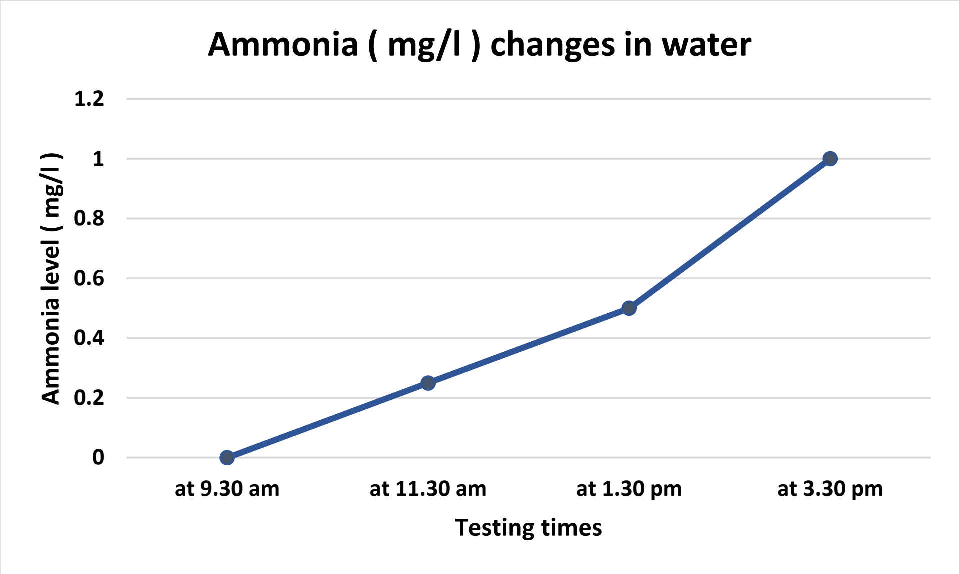

Figure 21: Ammonia level changes in water after stopped water circulation

4.5 Nitrite level changes in water after stopped water circulation in the tank

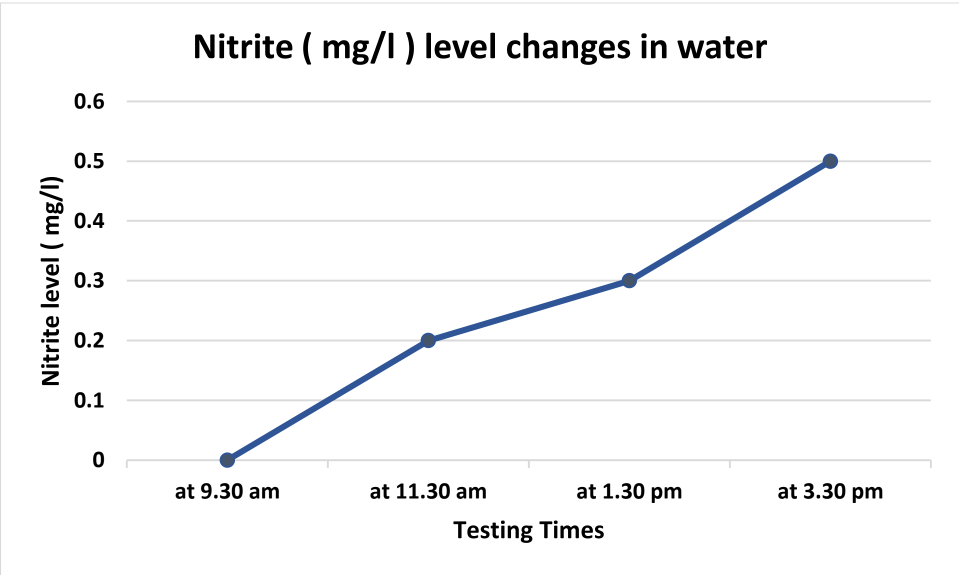

Figure 22: Nitrite level changes in water after stopped water circulation

5 Discussion

After stopped water recirculation in the tank, water temperature was increased within first two hours. Water recirculation helps to aerate well and prevent temperature rises up. Within the time duration after 11.30 am, there were no changes in water temperature hence it was not a sunny day.

CO_2 cause to lower the pH value. When the amount of dissolved CO_2 in water is lower, pH value rises up. In here, water circulation helps to increase the Oxygen level in water. But, when that function was stopped, accumulating oxygen amount goes lower. Existing oxygen amount is consuming by fish and add CO_2 in to the water. Acidic environment was created due to whole functions.

According to the Table 1, at least, Nitrite level should be lower than 0.1 ppm and Ammonia level should be lower than 0.02 ppm. But it is compare with the tested results, both Nitrite and Ammonia levels were risen up continuously after stopped the water recirculation.

The elimination of most nitrogen waste products in land animals is performed through the kidneys. In contrast, fish rely heavily on their gills for this function, excreting primarily ammonia. Freshwater fish do not drink water, but excrete large amounts of dilute urine.

Suspended fish wastes are a serious concern for water recirculating culture systems. Large amounts of suspended and settleable solids are produced during fish production. During this period, dissolved oxygen amount also lower. Fish waste particles can be a major source of poor water quality since they may contain up to 70 percent of the nitrogen load in the system. Because of that both Ammonia and Nitrite levels were increased. As a result of those functions, water bubbles can be arisen from the water column.

These wastes not only irritate the fish's gills, but can cause several problems to the biological filter. Finally, unfavorable environment for the fish was created.

6 Conclusion

Water recirculating is important in intensive system. When the water recirculation is stopped, helps to create environment with poor water quality. It is badly affect to the fish growth and fish health. Because of that, it is better to maintain continuous water recirculation system in intensive farming.

7 Literature Review

https://www.extension.purdue.edu/extmedia/as/as-503.html

https://en.wikipedia.org/wiki/Fish_farming#Intensive_aquaculture

http://fishcount.org.uk/farmed-fish-welfare/development-of-intensive-fish-farming

http://biology.kenyon.edu/stures/Compsnelson/Aquaculturepage.htm