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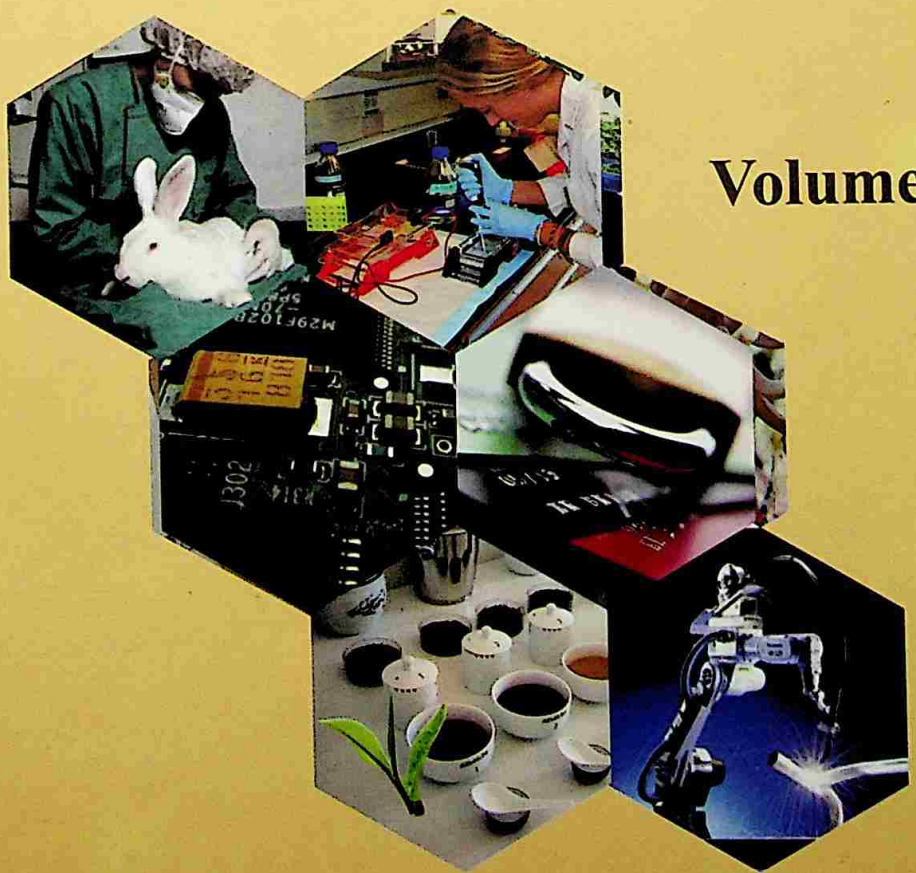
MEETING GLOBAL CHALLENGES THROUGH KNOWLEDGE AND WISDOM

THE CENTRE OF EXCELLENCE FOR VALUE ADDITION



Volume I

Effects of pH on Egg Hatchability, Survival Rate and Growth Rate of Yolk Sac Larvae of Goldfish (*Carassius auratus*)

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Introduction

Ornamental fish trade is a global industry of significant economic importance. For a developing country like Sri Lanka if managed sustainably, fresh water ornamental fish trade can generate employment opportunities as well as foreign exchange (BOBP, 2000). Goldfish (*Carassius auratus*) is a well known freshwater ornamental fish, which is among the most popular freshwater fishes throughout the world.

Water quality parameters have profound effect on fish's biological and physiological factors. For successful fish culture proper management of water quality parameters are required as they are crucial for larval survival and growth (Zaniboni-Filho, *et al.*, 2008: Smartt and Bundell, 1996: Lloyd and Jordan, 1964 cited in Gao, *et al.*, 2011). pH, potential hydrogen ion concentration is such an important water quality parameter in aquaculture.

Fresh water ornamental fish culturists in Sri Lanka uses water from different water sources such as tap water, underground water and surface water sources like rivers, streams, reservoirs, tanks. Due to different climatologic and geographic factors, pH value of above fresh water sources may differ from each other (Silva and Manuweera, 2004). Most of the fresh water sources in Sri Lanka are having pH range of 5.4 -9.0 (Silva, 2004: Kotagama, *et al.*, 1989).

The main objective of this study is to find out the effects of water pH on egg hatchability, survival rate and growth rate of yolk sac larvae of goldfish and to identify the most suitable water pH range for goldfish culture.

Methodology

The experiment was carried out at the ornamental fish unit in Inland Aquatic Resources and Aquaculture Division at the National Aquatic Resources Research and Development Agency (NARA), Mattakkuliya. The tap water of the hatchery with the pH 7.5 was used to prepare the pH series. Five pH solutions were prepared having values of 5.5 ± 0.1, 6.5 ± 0.1, 7.5 ± 0.1, 8.5 ± 0.1, 9.5 ± 0.1, pH 7.5 served as the control pH level. pH was measured using the pH meter, pH 211 Microprocessor with the precision of ± 0.01 pH (HANNA instruments). Alkalinity and water hardness was measured using titrimetric methods. Tuning of the pH was done with sulfuric acid and Sodium hydroxide throughout the experiment.

Completely Randomized Block design was used as the experimental design. Fifteen 500 mL beakers were used for the experiment. Each beaker was filled with 400 mL of

respective solution. Three replicates were used for each pH level. Goldfish brood stock was bred using 2:1 male to female ratio and 40 goldfish eggs were placed in each beaker. Mild aeration was supplied through air stones continuously to ensure a sufficient Dissolved Oxygen level. Beakers were covered with glass lids to minimize the water evaporation.

Hatchability was measured in proportion to the number of yolk sac larvae present compared to the total number of eggs placed in the beaker. Survival rate was measured in proportion to the number of larvae present at the end of the experiment to the number of yolk sac larvae present at the beginning of the experiment. Growth rate was measured in relation to the yolk sac absorption rate. Yolk sac absorption rate was measured as the percentage change in a yolk sac volume over time.

$$\text{Yolk sac absorption rate} = \frac{(\text{Initial yolk sac volume} - \text{Yolk sac volume at } 3^{rd} \text{ date})}{\text{Initial yolk sac volume}} \times 100$$

Data obtained regarding hatchability, survival rate and yolk sac absorption were analyzed using the n Krukal-Wallis test, the non parametric version of one way ANOVA, at the 0.05% significance level with MINITAB 14. As sample size is small and the data is not normally distributed, Kruskal-Wallis test was used to analyze the data.

Results and Discussion

Alkalinity during the period of study was 24.6 mg / l and water hardness was 24 mg / l. No significant difference ($p < 0.05$) observed in the hatchability, survival rate and growth rate with varying pH from 5.5 – 9.5. Mean values for egg hatchability varied between 87.50 % – 97.50 %, mean values for survival rate varied between 85.82 % – 98.29 % and mean values for yolk sac absorption varied from 78.59 % to 96.42 % at the tested pH range.

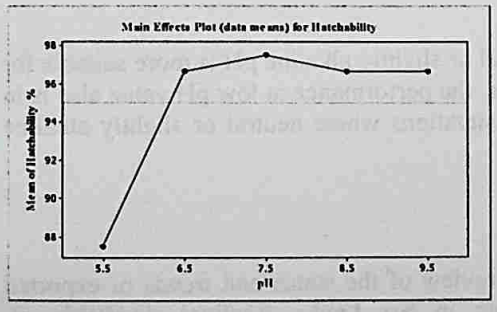

Figure 1: Main effect plot for hatchability

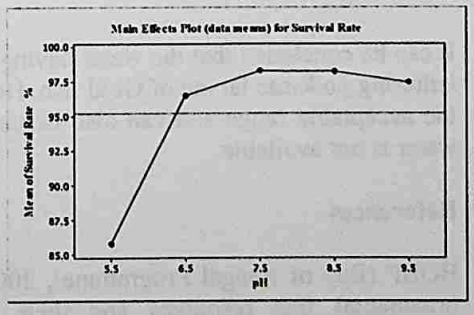

Figure 2: Main effects plot for survival rate

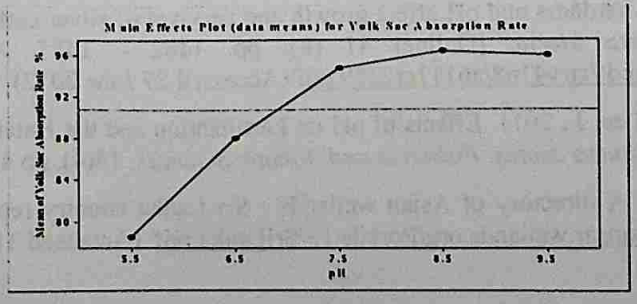

Figure 3: Main effect plot for yolk sac absorption rate

The lowest mean values (numerically) for hatchability, survival rate and growth rate were observed in pH 5.5 compared to the other pH levels (Figure 1, 2, 3). At other pH levels there is no variance between treatments, which proves that near neutral and slight alkalinity levels are more suitable for egg hatchability, survival and growth rate of the yolk sac larvae of goldfish.

A similar finding on reduction of egg hatchability of fathead minnow at pH 5.9 was observed by Mount, 1973. Highest egg hatchability of goldfish was observed in the control pH of 7.5, similarly Gao, *et al.*, 2011 reported that the highest egg hatching rate of Far Eastern catfish was observed in pH 7.

Lowest survival of this study was observed in the pH 5.5 and highest was observed in pH 7.5. Similarly survival rate of *Procilodus lineatus* larvae at pH 4.8 – 5.9 is recorded about 70% - 80 % while it is about 90 % at pH 8.7 – 9.2 (Zaniboni-Filho, *et al.*, 2008).

Yolk sac absorption rate (which is proportionate to the growth rate) of goldfish yolk sac larvae was lowest at the pH of 5.5 and increased with the increasing pH. Lopes *et al.*, 2001 as cited in Copatti, *et al.*,2011 report that exposure to low pH 5.5 -6.0 reduced length and weight of silver catfish larvae compared to those maintained at pH 8.0 -8.5.

Though pH 5.5 is showing lowest values for the test parameters compared to the other pH values, it is also showing comparably acceptable level of hatchability, survival and growth rate. Therefore pH 5.5 also could be used for goldfish fish culture .Thus it is possible to state that 5.5 - 9.5 pH range is suitable for goldfish eggs and yolk sac larvae, while to obtain best performances it is suitable to have neutral to slightly alkaline pH range. Copatti, *et al.*, 2011 also had stated the same phenomenon while Wurts and Durborrow, 1992 stated that 6.5 -9.0 pH range is desired for fish production.

Conclusion

It can be concluded that the water having neutral or slightly alkaline pH is more suitable for culturing yolk-sac larvae of Gold fish. However, the performance at low pH value also is in the acceptable range and can also be used in situations where neutral or slightly alkaline water is not available.

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