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INFLUENCE OF DIVERSE LEVELS OF HARDNESS ON GROWTH OF LABEO ROHITA, CIRRHINUS MRIGALA AND CATLA CATLA

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ABSTRACT

The calcium hardness of aquatic bodies is a serious problem for fish production in India, which varies considerably from place to place. During the present study, an experiment was conducted to study the growth performance of the fish fingerlings of Rohu (*Labeo rohita*) Catla (Catla catla) and Mrigal (*Cirrhinus mrigala*) for a period of 60 days at three CaCO3 liming levels (50, 180 and 350mg/L) in glass aquaria's, each having capacity of 15 L of water. Total body weight significantly differed by $CaCO_3$ treatments, however, significant difference in terms of total gain in body weight of all the fingerlings in different hardness levels were observed. The growth rate of fingerlings gradually increased up to 180mg/L and then onward decreases. Growth in terms of body lengths also showed similar significant difference in all the fingerlings.

India.

INTRODUCTION

Liming is a simp procedure used in aquaculture to neutralize acidity and increase alkalinity, thus increasing fishpond productivity. The calcium and magnesium contained in the lime may be absorbed by the aquatic biota, adsorbed by the soil or dissolved in the water. Liming is a necessary and important procedure in any fishpond, and consists of lime addition to the water and sediment, in a range of concentrations according to pond dimensions. In acid water, lime increases the pH and consequently, aquatic life survival, reproduction and growth rates. Effect of liming management on the water quality... is increased due to a higher microbial activity, to a decrease of organic matter in the sediment, and nutrient recycle. The benefits of liming are attributed to a higher availability of carbon dioxide for phytoplankton growth.[1] verified that in ponds where calcium oxide was applied there was a reduction in fish mortality caused by parasites.[2] In general, the problems with liming are related to inappropriate

management, with lack or excess lime being added to the ponds, which may cause problems to the water quality further on. Liming is recommended when hardness and alkalinity are below 20 mg/L. However, alkalinity is the best indicator, since in many fishponds these two parameters display an inverse relationship.

The hardness of the water is a serious problem in the fish production, in India, which varies considerably from place to place. In general, surface water is soften than ground water. The hardness of water reflects the nature of geological formations with which it has been contacted. Hardness is caused by divalent cat-ions; such ions are capable of reacting with soap to form precipitate, and with certain anions, present in the water, to form scales. Calcium and magnesium, which are the major causing agents of hardness, play not only osmotic ally active role in the life of fish but also act as key nutrients for photosynthetic life. Calcium is necessary for blood coagulation and compliment activation.[3] Calcium is most directly involved in the development and growth of skeleton, and it plays important role in many other biochemical reactions. Acidity of acidified lakes becomes decreased by the addition of calcium. Increased levels of calcium also seem to decrease stress effects of low pH levels.[4] Calcium acts as antidoting agent and reduces the toxicity of the heavy metals. It also shows antagonistic effects of histamine release, granulocyte chemotoxic, phagocytosis and calcium ATPase activity of erythrocyte membranes.[5] Its excess can cause renal stone and its deficiency can cause osteoporosis, rickets and hyperparathyroidism. Excess amount of calcium in water is also not healthy sign. Its presence beyond certain limits not only creates problems for human life and industry but also to fish as well. Its limiting effects in terms of growth and survival greatly vary with species, age, physiological state of fish and environmental conditions.

Keeping in mind, the higher hardness values of the ground water of the area, the efforts are being made to evaluate its potential with special reference to pond fisheries. So the present experiment was designed to study the effect of different levels of $CaCO_3$ liming on the growth performance of Indian major carps.[6]

MATERIALS AND METHODS

The experiment was run in the wet laboratory of St. Aloysius College (Autonomous) Department of Zoology Jabalpur (India). Fifteen fingerlings of each fish varieties *viz*; Rohu (*Labeo rohita*), Catla (*Catla catla*) and *Cirrhinus mrigala* (mrigal) were stocked in each of the three Glass aquaria having15 L of water) each. The fishes were acclimatized in available

lime stone mines water having 50 mg/L average hardness value, for a period of approximately one month. Commercial grade CaCO3 was used to increase hardness of the experimental water. No CaCO3 was added in the first Aquaria (control, hardness; 150 mg/L). Total hardness levels of 180and 350 mg/L was produced in the second, and third Aquaria by adding appropriate amount of CaCO3 in each, respectively. Electrical conductivity value of water of each was Aquaria readjusted by adding appropriate amount of NaCl. Prior to stocking, body weight, total length and fork length of fish of both varieties were measured and recorded. All fishes were fed with 21% protein, manually grinded, artificial feed, twice a day at the rate of 10% of body weight daily. The Aquaria were supplied with pumped air to keep the dissolved oxygen level close to saturation. The fish growth in terms of body weight, and total length were recorded after every 96 h for the period of 60 days. Water quality parameters such as temperature, dissolved oxygen, salinity and pH were also recorded after every 96 h for the whole experimental period. The effect of various hardness concentrations on the growth of two experimental fish species was statistically established with help of analysis of variance and mean. The analysis of various water parameters was carried out as per internationally accepted methods.[7,8,9] Physico-chemical parameters of water were also compared with the help of mean.

RESULT AND DISCUSSION

The original average body weight of rohu in the all three treatments was 5.6, 2.8and 7.0 g and last average weight was observed as 10.5, 9.7 and 12.0 g respectively (Table I). Net gain in average weight of rohu was 4.9, 6.9, 5.9 and 5.0 g. The original average total length of rohu in three treatments was 7.2, 6.2, and 7.7 cm respectively, while the final total length was 9.7, 9.6 and 9.0 cm respectively (Table I). Net gain in average total length of rohu was 2.5, 3.8and 1.3 cm; in all three treatments respectively. (Table I). Growth of rohu under different hardness level.

The original average body weight of catla in the all three treatments was 5.0, 2.5and 2.5 g and final average weight was observed as 9.3, 9.3 and 8.7 g respectively (Table I). Net gain in average weight of rohu was 4.3, 6.8, and 6.2 g. The original average total length of catla in three treatments was 7.1, 5.6, and 7.2cm respectively, while the final total length was 8.3, 9.2 and 9.0 cm respectively (Table I). Net gain in average total length of rohu was 1.2, 3.6and 1.9 cm; in all three treatments respectively. (Table I). Growth of catla under different hardness level.

The original average body weight of mrigal in the all three treatments was 6.5,1.6. and 7.0 g and final average weight was observed as 9.7,9.2 and, 11.5 g respectively (Table I). Net gain in average weight of rohu was 3.2., 7.6, and 4.5 g. The original average total length of mrigal in three treatments was 7.5, 5.0, and 7.9 cm respectively, while the final total length was 9.2, 9.0 and 9.1 cm respectively (Table I). Net gain in average total length of rohu was 1.7, 4.0and 1.2 cm; in all three treatments respectively. (Table I). Growth of mrigal under different hardness levels.

Experimental analysis of fish growth

Table I: Mean value of body weight and total length of the fishes during 60 days experiments.

Hardness of caco3 mg/l	Species	Average Body weight (g)			Average Total length(cm)		
		Initial	Final	Gain	Initial	Final	Gain
50	Labeo rohita	5.6	10.5	4.9	7.2	9.7	2.5
	Cala catla	5.0	9.3	4.3	7.1	8.3	1.2
	Cirhinus mrigala	6.5	9.7	3.2	7.5	9.2	1.7
180	Labeo rohita	2.8	9.7	6.9	6.2	9.6	3.8
	Cala catla	2.5	9.3	6.8	5.6	9.2	3.6
	Cirhinus mrigala	1.6	9.2	7.6	5.0	9.0	4.0
350	Labeo rohita	7.0	12.0	5.0	7.7	9.0	1.3
	Cala catla	2.5	8.7	6.2	7.2	9.0	1.9
	Cirhinus mrigala	7.0	11.5	4.5	7.9	9.1	1.2

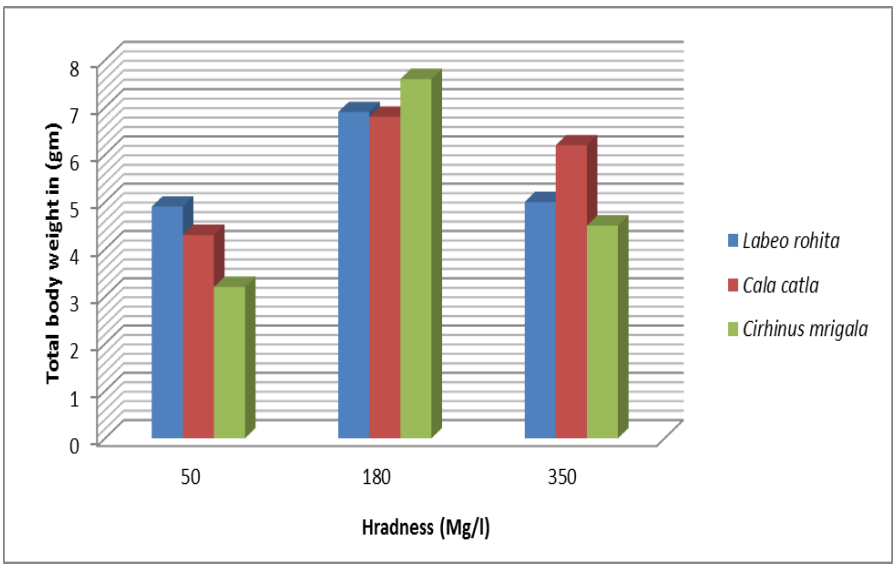

Fig. 1. Comparison of weight in (gm) of Indian major carp at different hardness levels.

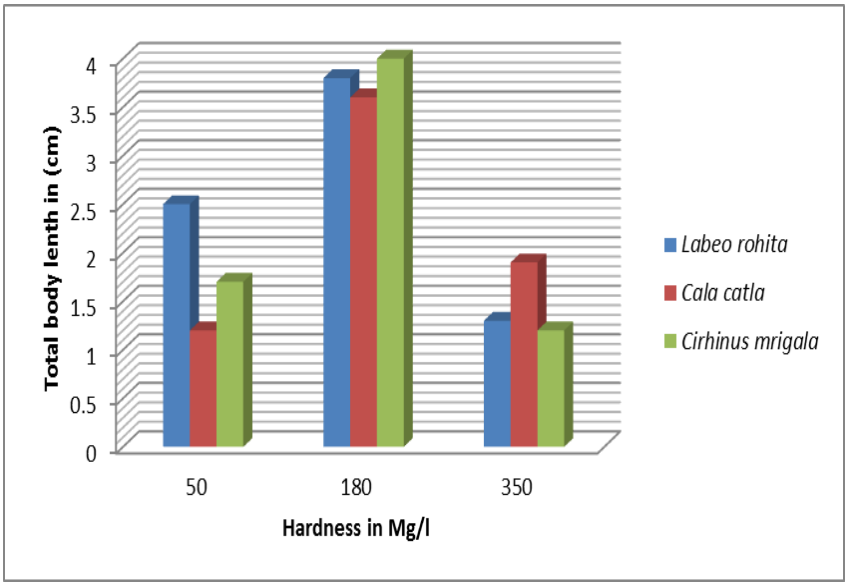

Fig. 2. Comparison of length in (Cm) of Indian major carp at different hardness levels.

Table II: Analysis of variance table for Body weight.

Source of variation	SOS	Degree of freedom	mean square
Between hardness level	8.695	2	4.34
Between species	0.719	2	0.35
Residual	2.275	4	0.56
Total	11.68	8	
F for between hardness	7.64		
F for between species	0.63		

Analysis of variance –inference

F for between hardness level the calculate value 7.64 and tabulated value 6.9 at 0.05p significance level.

F for between species the calculate value 0.63 and tabulated value 6.9 at 0.05p significance level.

Table III: Analysis of variance table for total length.

Source of variation	SOS	Degree of freedom	mean squre
Between hardness level	10.03	2	5.01
Between species	0.62	2	0.31
Residual	0.61	4	0.15
Total	11.26	8	
F for between hardness	32.88		

F for between species 2.03

Analysis of variance –inference

F for between hardness level the calculate value 32.88 tabulated value 6.9 at 0.05p and 18.0 at 0.01significance level.

F for between species the calculate value 2.03 and tabulated value 6.9 at 0.05p significance level.

Table IV. Experimental mean values of important water quality parameters for various water hardness treatments.

Water Hardness levels (mg/l)	50	180	350
Temperature (C^o)	30.4 (28.4-33.1)	30.5 (28.6-33.1)	30.4 (28.7-32.9)
Dissolved Oxygen mg/L	3.5 (2.9-4.8)	3.6 (3.0-4.9)	3.6 (3.0-5.0)
Salinity (%)	0.073 (0.07-0.08)	0.074 (0.07-0.08)	0.074(0.07-0.08)
pH	8.07 (8.0-8.2)	8.07 (7.9-8.2)	9.05 (8.9-9.2)

In the current study, No fish mortality was observed throughout the period. high calcium hardness affected the growth of Indian major carp. Earlier studies have shown that high calcium level could affect the growth of the fish, these studies also reported the effect of calcium on fish growth. Highly significant difference in growth of total body weight was observed under different hardness levels. The species (catla, rohu and mrigal) showed maximum growth at 180 mg/L;). Significant difference in terms of total gain in body weight of species in different hardness was observed. Growth in terms of body lengths was also highly significantly different. There is no changed between species. Demonstrated little beneficial or detrimental effects of increased water hardness and salinity on the survival and growth of striped bass fry within a range of 30 to 175 mg/L of total hardness and 1100 to 1500 mg/L of Chlorides.[10] The percentage survival of fry decreased in water with added salinity but conflicted results were obtained with added total hardness. Water with added total hardness and added salinity resulted in a slight increase in growth as compared to untreated water. having the view that water containing lower values of hardness (20 mg/L), effect the production and may need liming and calcium fertilizers.[11] Had the opinion that fish grow well over a wide range of alkalinities and hardness but values of 120 to 400 ppm are optimum, however the present study hints that even higher values of hardness are more favorable or at least no detrimental effect on the growth of major carps in prevailing slightly saline conditions[12]

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