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Growth response of rohu, *Labeo rohita* (Ham.) fry to salt (NaCl) incorporated diets

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ABSTRACT

This experiment of 50 days duration aimed at evaluating the growth and survival of rohu, *Labeo rohita* fry to dietary salt (NaCl) was carried out in six outdoor, 25 m³ (5mx5mx1m), unfertilised cement tanks with soil base (5 cm), stocking rohu fry @ 1.5 lakh ha⁻¹. Powdered mixture (1:1) of rice bran and groundnut oil cake was provided in dough form in plastic feeding trays. NaCl was added to two test diets at 1% and 2% levels. Water quality parameters and dry weight of plankton were analysed fortnightly. No significant difference was observed with respect to the water quality parameters analysed. Weight at harvest and the related parameters like specific growth rate, percent weight gain and fish biomass production were significantly higher ($p < 0.05$) in those fed 2% salt. However, no difference ($p > 0.05$) in length and survival of fingerlings was observed between the salt fed fish and control. Addition of 2% sodium chloride is suggested in the diet of rohu during fry to fingerling rearing for better weight gain.

Keywords: Growth, *Labeo rohita*, Salt, Seed rearing, Water quality

Carp are the mainstay of freshwater aquaculture in the Indian sub-continent. Availability of their seed of desired quality and size is of paramount importance. Culture ponds in this region primarily rely on the seed produced from nursery ponds. Over the years, area expansion and intensification of culture systems have increased the seed demand. During this period, the practice of seed rearing has received increased attention of the farmers due to higher profit realisation.

In freshwater fish, there will be a continuous efflux of ions from their body (Cowey and Sargent, 1979) and hence they spend more energy than brackishwater fish to obtain minerals from the surrounding medium through osmoregulation. An increased effort for osmoregulation reduces growth because of the higher energy requirement for maintenance. Provision of adequate amount of salt through feed would spare energy used in osmoregulation and reduce stress, thereby leaving more energy for growth. Although not consistent, several grow-out studies report an increase in growth when fed salt supplemented diets with freshwater fish (Tacon *et al.*, 1984; Nandeeshha *et al.*, 2000; Gangadhar *et al.*, 2004) and salt water fish in low saline waters (Gatlin *et al.*, 1992; Sheenan *et al.*, 2005; Appelbaum and Arockiaraj, 2009). Not much information is available on the effect of dietary NaCl on the growth and survival of fish during seed rearing, particularly in the case of Indian major carps. Earlier work with the

fingerlings of *Labeo rohita*, one of the important species in carp polyculture has clearly shown that the species utilises the incorporated salt from the diet (Gangadhar *et al.*, 2004). Hence, the present study evaluated the growth and survival of rohu during fry to fingerling rearing.

This experiment of 50 days duration was carried out in six outdoor, 25 m³ (5mx5mx1m) cement tanks with soil base (5 cm). Water from a nearby open well was filled in the tanks to maintain a water column of 80±5 cm; the evaporation loss was compensated fortnightly. No fertilizer was added to the tanks. *L. rohita* fry (16.27±0.88 mm and 38.87±8.97 mg) were stocked @ 1.5 lakh ha⁻¹ in the tanks. Powdered mixture of rice bran and groundnut oil cake at 1:1 ratio, which is the most commonly used supplementary feed in carp seed rearing (Jena *et al.*, 1996) was used for feeding the fish. It was provided in dough form in plastic feeding trays. Reagent grade NaCl (E-Merck India Ltd., Mumbai, India) was added to two test diets at 1% and 2% levels respectively during the making of the dough. Fish were fed at 10% of body weight during the first month, followed by 7% during the rest of the experimental duration (Jena *et al.*, 2005). Water quality parameters were analysed fortnightly for pH, temperature, dissolved oxygen (DO), total alkalinity, free carbon dioxide and chloride (APHA, 1998). In addition, dry weight of plankton was also determined every fortnight by filtering 100 l of water through a plankton net of 60 µm and drying the filtrate in

a hot-air oven at 80°C, till a constant weight was obtained (Priyadarshini *et al.*, 2011).

On termination of the experiment, fingerlings were harvested by draining the tanks. All surviving fish were counted, their length and weight measured. Comparison among treatments for growth, survival and water quality parameters was done by one-way analysis of variance (ANOVA), followed by Duncan's multiple range test at $p < 0.05$ (Duncan, 1955; Snedecor and Cochran, 1968).

The proximate composition (%) of 1:1 mixture of rice bran and groundnut oil cake (DM) as estimated through AOAC (1975) methods was: moisture - 6.67 ± 0.08 , crude protein - 24.17 ± 0.27 , fat - 6.80 ± 0.34 , ash - 15.02 ± 0.16 , crude fibre - 14.51 ± 0.23 and NFE - 32.83.

Table 1 shows the mean value of water quality parameters recorded during the study period. No significant difference was observed between the treatments and control with respect to the water quality parameters analysed. All the parameters were within acceptable limits for the seed rearing of carps (Jena *et al.*, 1998; 2011). pH was in the alkaline range throughout the experimental duration, indicating favourable conditions for biological production. The quick consumption of significant amount of food, leading to no significant leaching could have been the reason for no difference in the water chloride levels. Plankton dry weight values recorded were much lower than that is normally encountered in fertilised ponds (Wohlfarth and Schroeder, 1979; Priyadarshi *et al.*, 2011). This plankton biomass could be attributed to the nutrient content of the tank soil base and to fish faecal matter, since no fertiliser was used during the experiment.

No difference in length and survival of fingerlings was observed between the salt fed fish and control (Table 2). However, the weight at harvest and the related parameters

like specific growth rate, percent weight gain and fish biomass production were significantly higher ($p < 0.05$) in those fed 2% salt. Like other freshwater fish species, rohu is dependent on an adequate mineral supply from outside. The positive effect of ions such as Na^+ and Cl^- on the osmoregulatory system of the young fish due to dietary supplementation could be the reason for better growth of the fry observed in this study (Gatlin *et al.*, 1992). Dietary supplemented salt can act as a ready reserve to meet the osmoregulatory requirement of freshwater fishes. The passive outward flux of ions such as Na^+ and Cl^- to the external medium, *via* the gills, faeces and renal system in freshwater fish is overcome by active uptake of ions from the water and/or from the diet (Evans *et al.*, 2005).

Our earlier grow-out study with rohu fingerlings revealed that they respond positively to dietary NaCl at 0.5 and 1.0% levels in terms of growth (Gangadhar *et al.*, 2004). However, still higher levels did not result in further growth promotion. The results of the present experiment and our earlier study suggest that the optimum level of dietary NaCl for growth promotion varies between life stages of rohu. Dietary NaCl up to 0.6% had positive effect on growth and food conversion in African catfish larvae (Zamal *et al.*, 1991). Earlier research shows wide variation in the effective dose of dietary salt that induces higher growth in different fish species: 2% in juveniles of red drum (Holsapple, 1990; Gatlin *et al.*, 1992), 4% or 5% in trout and carp (Ogino and Kamizono, 1975; Tacon and De Silva, 1983), 12% in rainbow trout (Salman and Eddy, 1988; Smith *et al.*, 1995), 1.5% in mrigal and common carp (Nandeeshia *et al.*, 2000), 5% in European seabass (Eroldogan *et al.*, 2005), 1.2% in silver catfish fingerlings (Garcia *et al.*, 2007), 1.5%, 6% and 12% in gilthead seabream juveniles (Appelbaum *et al.*, 2008; Appelbaum and Arockiaraj, 2008; Appelbaum and Arockiaraj, 2009).

Table 1. Water quality parameters (Mean $\pm$ S. E.) recorded during the experiment

Treatment	pH	Temperature (°C)	DO (mg l ⁻¹)	Total alkalinity (mg l ⁻¹)	Free carbon dioxide (mg l ⁻¹)	Chloride (mg l ⁻¹)	Plankton DM (mg 100 l ⁻¹)
Control	8.24 $\pm$ 0.09	27.54 $\pm$ 0.76	6.91 $\pm$ 0.19	147.91 $\pm$ 4.41	1.96 $\pm$ 0.38	9.29 $\pm$ 0.13	18.97 $\pm$ 1.89
1% Salt feed	8.16 $\pm$ 0.14	27.49 $\pm$ 0.75	6.57 $\pm$ 0.28	151.43 $\pm$ 6.16	2.04 $\pm$ 0.13	9.88 $\pm$ 0.33	12.76 $\pm$ 3.70
2% Salt feed	8.14 $\pm$ 0.12	27.53 $\pm$ 0.75	6.18 $\pm$ 0.31	156.78 $\pm$ 5.43	1.42 $\pm$ 0.33	9.31 $\pm$ 0.40	15.33 $\pm$ 3.11

Table 2. Growth parameters (Average $\pm$ S.E) of rohu at harvest.

Treatment	Length* (cm)	Weight* (g)	Specific growth rate	Percent weight gain	Survival (%)	Biomass (g tank ⁻¹)
Control	9.71 $\pm$ 1.89 ^a	6.08 $\pm$ 1.43 ^a	5.04 $\pm$ 0.24 ^a	15570.13 $\pm$ 3693.08 ^a	68.20 $\pm$ 3.49 ^a	2844.92 $\pm$ 215.70 ^a
1% Salt feed	9.10 $\pm$ 1.23 ^a	6.28 $\pm$ 1.56 ^a	5.08 $\pm$ 0.08 ^a	16043.96 $\pm$ 1454.21 ^a	69.00 $\pm$ 8.02 ^a	3232.90 $\pm$ 084.71 ^a
2% Salt feed	9.85 $\pm$ 1.76 ^a	9.12 $\pm$ 1.48 ^b	5.45 $\pm$ 0.16 ^b	23357.58 $\pm$ 3799.11 ^b	69.06 $\pm$ 3.20 ^a	4708.98 $\pm$ 546.15 ^b

*Initial length and weight of fish were 16.27 $\pm$ 0.88 mm and 38.87 $\pm$ 8.97 mg, respectively.

Values bearing different superscripts are significantly different ($p < 0.05$)

and 8% in Asian sea bass (Arockiaraj and Appelbaum, 2010). Based on the results of the present study, addition of 2% sodium chloride can be suggested in the diet of rohu during fry to fingerling rearing.

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