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EFFECT OF WATER SALINITY ON THE REPRODUCTIVE AND GROWTH PERFROMANCES AS WELL AS PROLACTIN AND GROWTH HORMONE LEVELS OF NILE TILAPIA, OREOCHROMIS NILOTICUS

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ABSTRACT

The present work was undertaken to study the effect of different salinities on the reproductive and growth performances as well as prolactin (PRL) and growth hormone (GH) levels of Nile tilapia, Oreochromis niloticus. The results showed that:At equivalent salinity, early exposure (spawning) produced progeny of comparatively higher salinity tolerance than those spawned in freshwater and hatched at elevated salinity;Hatching success and fry production were greater in Oreochromis niloticus brood fish spawned at 5 ppt than in freshwater, 10 and 15 ppt;The growth performance of Oreochromis niloticus fingerlings was decreased with increasing water salinity;PRL and GH levels in blood were higher in freshwater fishes than those reared in brackish water, thereby the condition factor (K) of the reared fish fingerlings was decreased with increasing salinities.

INTRODUCTION

Oreochromis nitoticus is one of the most important fresh water fin fish in aquaculture. Because of its importance as a source of animal protein, an increasing interest has been given to its culture and production. Salinity has been shown to be one of the most important environmental factors affecting the growth of fishes. Prolactin (PRL) and growth hormone (GH) are members of the some hormone family and one thought to be derived from a common ancestral molecule. PRL is well established as an important hormone in the fresh water adaptation of several fishes, including the Nile tilapia, *Oreochromis niloticus* (Yada etal., 1994). G H has been reported to play a role

in hydrosaline regulation influencing osmoregulatory organs or activating the release of other osmoregulatory hormones, such as cortico steroids and thyroid hormones (Bern, 1983).

Some authors reported on the effect of salinity on PRL and GH and on the osmoregulatory action of G H (Bern, 1983; Bolton et al., 1987; Mancera et al., 1993 and 1995; Borrski et al., 1994; Yada etal., 1994 and Sakamoto et al., 1997). The present study was undertaken to investigate the influence of salinity on the reproductive and growth performances as well as prolactin and growth hormone levels of Nile tilapia *Oreochromis niloticus* .

MATERIALS AND METHODS

Nile tilapia *Oreochromis niloticus* brood fish with a mean body weight of 51.3 gm were acclimated to 15 ppt water salinity over a period of six days at a rate of 3 ppt per day. Then, the breeders were subsequently distributed into various experimental salinities: 0, 5, 10 and 15 ppt. Spawning were conducted in indoor basins (100 L each). Temperature was maintained at 25—29C^0 under natural photoperiod and additional artificial light. In each basin three females and two males were maintained. Fish were fed twice daily at a rate of 1.5% of body weight with a 29% protein pelleted diet (Table 1). Feces were siphoned out daily and approximately one—half of the tank volume was replaced with new water each week. The broodstock were checked daily for spawing activities. At 7—10 day intervals, fry production in each basin was collected and counted related to various salinities.Then, they were transferred directly to 100-L glass aquaria under various experimental salinities: 0, 5, 10 and 15 ppt to determine their salinity tolerance using Median Survival Time (ST50) indices (Watanabe et al.,1985)."ST50 is defined as the time at which Survival falls to 50%.

Oreochromis niloticus fingerlings were acclimated under appropriate experimental conditions for 80 days at four different concentrations (0 ‰, 5 ‰, 10 ‰ and 15 ‰) of salinities.

The fish of mixed sex with an initial average body weight of 21. 8 gm /fish were raised in four glass aquaria (100 liter /each) containing aerated water at a rate of 10 fish/aquarium for 80 days under controlled laboratory conditions. Each aquarium was supplied with continuous compressed air via air-stones from air pumps. Salinity in the aquaria rose from O ‰ (control) to 5 ‰, 10 ‰ and 15 ‰. The physico-chemical characteristics of water in aquaria were adjusted and the temperature maintained at 22-25 ^{0}C.

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The fish were fed a 25% protein diet, twice daily for 6 days a week at a rate of 3 % of their body weight and readjusted bi-weekly after the biomass of fish in each aquarium was determined. Siphoning a portion of water from each aquarium was done every day for removing of accumulating waste materials and an equal volume of water with the same salinity replaced it. All fish in each aquariumm was bi-weekly weighed individually for growth measurements. The survival rate of *O. niloticus* reared in aquaria at different salinities (0 ‰ ,5 ‰ ,10 ‰ and 15 ‰) was 100 %.

Blood was collected directly from the caudal artery of fish in glass tubes, centrifuged and serum is collected in Eppendorf tubes for PRL and GH levels measurements. The estimation of PRL and GH levels was conducted at a special medical laboratory.

RESULTS

1- reproductive performance of *Oreochromis niloticus* broodfish and their fry reared at various salinities

The results of the reproductive performance of *Oreochromis niloticus* broodfish in indoor basins at various salinities are summarized in Table (2). The total number of spawning was greater in the brackish water of 5 through 15 ppt than in freshwater. Hence, when determining mean hatching success of eggs spawned in various salinities (Table 2), mean hatching success were approximately similar for eggs spawned by *Oreochromis niloticus* broodfish in freshwater (32.4%), 10 ppt (32.7%) and 15 ppt (34.9%), but higher for eggs spawned at 5 ppt (51.6%).

From table (3), it is obvious that mean gain in body weight and length of the freshwater spawned broods were generally higher than those of broods spawned in brackish water.

ST 50 values for seven--day old fry reared at various salinities are also presented in Table (3). ST 50 increased gradually from 51.0 min. for fry reared in freshwater to greater than 5760 min. for fry reared at 15 ppt.

2-Growth performance of *Oreochromis niloticus* fingerlings:

The results of the growth performance of *Oreochromis niloticus* fingerlinges reared at various salinities are summarized in Tables (4) to (7). *The highest growth rate (final weight, gain, gain %) of* O. niloticus *were obtained in the control aquarium with zero* salinity (Table 4). The lowest growth rate was observed at high salinity (Table 7). The increment in weight showed a decreased percentage in weight of 299.1, 184.4, 120.2 and 35.3 for 0 ‰, 5 ‰, 10 ‰ and 15 ‰ salinities, respectively (Tables 4, 5, 6 and 7). In comparison with the control, the daily gain in weight decreased also with increasing salinity as follow: 0.82 gm/fish, 0.5 gm/fish, 0.33 gm/fish and 0.1 gm/fish for control, 5 ‰ , 10 ‰ and 15 ‰ salinity, respectively. The condition factor (K) of the reared fish decreased from 1.77 in the control aquarium (Table 4) to 1.51 in aquarium with 15 ‰ salinity (Table 7).

3-The influence of salinity on the levels of PRL and GH of *Oreochromis niloticus* fingerlings blood:

Serum PRL levels was found to decrease with increasing salinity (Table 8 and fig.1). The maximum levels of serum PRL (< 5 ng/ml) was recorded at low salinity (control), while the minimum levels (< 0.5 ng/ml) was recorded at high salinity (15 ‰).

GH levels showed a constant level at control and 5 ‰ salinity with an average of < 0.8 ng/ml (Table 8 and fig. 2). Then it began to decrease with increasing salinities reaching its minimum values (< 0.3 ng/ml) at 15 ‰ salinity.

DISCUSSION

1. Reproductive performance of *Oreochromis niloticus* broodfish and their fry reared at various salinities ;

An apparently anomalous result was that total number of spawning was lowest among broodfish females in freshwater, and greatest in the brackish salinities (5, 10 and 15ppt). According to Payne (1983), in tilapias, early maturity at small size was thought to be a common response to unstable or stress of environmental conditions. Therefore, greater spawning activity in brackish water may have been related to the salinity exposure history of those individuals. According to this author alternatively, infrequent spawning in freshwater might have resulted from greater resorption of ripe spawns for unclear reasons. The inhibitory effect of high salinity on reproduction was evident by considerably lowered hatching success at 10 and 15ppt. These results may reflect a greatest total fry production, 1757 per group (3 females); 585.7 / female; 11.4 /g body weight, at 5ppt (Table2).

The present results showed also a progressive increase in salinity tolerance for seven—day old fry with increasing exposure salinity. ST50 was greatest at 15ppt salinity (Table3). These results were in agreement with those by bashamohideen and Parvatheswararad (1972) for *O. mossambicus*.

The growth performance of the freshwater spawned broods was generally higher than those of broods spawned in brackish water (Table3). These might be attributed to the differences in egg weight which were greatest in freshwater spawned eggs (Peters, 1983).

2- The influence of salinity on the growth performance and the levels of PRL and GH of *Oreochromis niloticus* fingerlings blood:

In comparison with the control fish in fresh water, the fish showed low growth rate with increasing salinity. The present results agree with the Observations of Jermey et al., (1996) who recorded that salinity levels higher than 8 g/l depressed growth in *O. niloticus*. The present results reported high PRL levels in fresh water *O. niloticus* serum (control) over that in brackish water fish. The present results agree with the observations of Young et al., (1989), Sakamoto et al., (1991), Suzuki and Hirano (1991), Yada et al. (1991). Yada and Hirano (1992a), Ayson et al, (1993). And Auperin et al. (1994). They recorded a drop in PRL levels when fish transferred from fresh to brackish water, whereas levels increase after transfer to fresh water. The present results showed constant levels in GH with control and 5 ‰ salinity, despite the decreased growth rate with increasing salinity. This may be due to the secondary role of GH in osmoregulation beside its main role in growth. The present results agree with the observations of Helms et al. (1987, Madsen and Bern (1992), Sakamoto et al. (1993), Borski et al. (1994) and Yada et al. (1994). The previous authors reported the role of GH in the sea water adaptation. Helmes et al (1987) explained that the transfer of tilapia to brackish water leads to increase in plasma cortisol that can increase GH.

In conclusion at equivalent salinity, early exposure (spawning) produced progeny of comparatively higher salinity tolerance than those spawned in freshwater and hatched at elevated salinity. But at fingerlings stage, Oreochromis niloticus growth was decreased with increasing water salinity. Also PRL and GH levels in blood were higher in freshwater fishes than in fishes reared in brackish water

Table (1) : Percent composition (%) of artificial pelleted diet for *Oreochromis niloticus* broodstock*

Ingredients	*%*
Fish meal	15.00
Soybean meal	22.00
Broken corn	10.00
Wheat milling by-product	52.00
Mineral mixture	0.70
Vit. Premix	0.30
Chemical analysis:	
Dry matter	87.12
Crude protein	28.93
Fat	2.90
Crude fiber	2.56
Ash	11.51
Nitrogen free extract	54.10

*After Essa and Salama (1994).

Table (2) : Reproductive performance of Nile tilapia brood fish spawned in indoor basins at various salinities.

Spawning salinity (ppt)	*No.of spawnings*	*Mean hatching success (%)*	*Fry production*		
			Per group*	Per female	*Per g body weight*
0	7	32.4	538	179.5	3.5
5	12	51.6	1757	585.5	11.4
10	15	32.7	1452	484.0	9.4
15	4	34.9	1334	444.7	8.7

*One group consisted of 3 females and 2 males.

Table (3) : Mean gain in body weight and length as well as median survival time (ST50) of seven day old *O. niloticus* fry reared at various salinities.

Spawning salinity(ppt)	*Gain*		*ST50 (min.)*
	Body weight (mg)	*Body length (mm)*	
0	7.8	8.8	51
5	5.2	8.1	600
10	5.6	8.1	3360
15	6.9	8.8	5760

Table (4) : Growth in weight and length of *O. niloticus* cultured in fresh water (control)

Items	*Rate*
Average initial weight (gm/fish)	21.8
Average final weight (gm/fish)	87
Average initial length (cm/fish)	10.34
Average final length (cm/fish)	17
Gain in weight (gm/fish)	65.2
Rearing period /day	80
Daily gain in weight (gm/fish)	0.82
% increment in weight /fish	299.1
Condition factor (k)	1.77

Table (5) : Growth in weight and length of *O. niloticus* cultured in water with 5 ‰ salinity

Items	*Rate*
Average initial weight (gm/fish)	21.8
Average final weight (gm/fish)	62
Average initial length (cm/fish)	10.34
Average final length (cm/fish)	15.3
Gain in weight (gm/fish)	40.2
Rearing period /day	80
Daily gain in weight (gm/fish)	0.50
% increment in weight /fish	184.4
Condition factor (k)	1.73

Table (6) : Growth in weight and length of *O. niloticus* cultured in water with 10 ‰ salinity

Items	*Rate*
Average initial weight (gm/fish)	21.8
Average final weight (gm/fish)	48
Average initial length (cm/fish)	10.34
Average final length (cm/fish)	14.5
Gain in weight (gm/fish)	26.2
Rearing period /day	80
Daily gain in weight (gm/fish)	0.33
% increment in weight /fish	120.2
Condition factor (k)	1.57

Table (7) : Growth in weight and length of *O. niloticus* cultured in water with 15 ‰ salinity

Items	*Rate*
Average initial weight (gm/fish)	21.8
Average final weight (gm/fish)	29.5
Average initial length (cm/fish)	10.34
Average final length (cm/fish)	12.50
Gain in weight (gm/fish)	7.70
Rearing period /day	80.0
Daily gain in weight (gm/fish)	0.10
% increment in weight /fish	35.3
Condition factor (k)	1.51

Table (8) Changes in serum prolactin (PRL) and growth hormone (GH) in *O. niloticus* cultured at different salinities

Aquarium No.	Salinity, gm/l	PRL ng/ml	GH ng/ml
1	Fresh water (control)	< 5	< 0.8
2	5 ‰	< 4	< 0.8
3	10 ‰	< 1	< 0.5
4	15 ‰	< 0.5	< 0.3

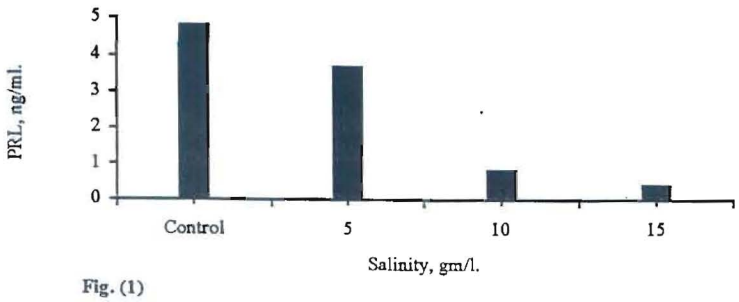

Fig. (1)

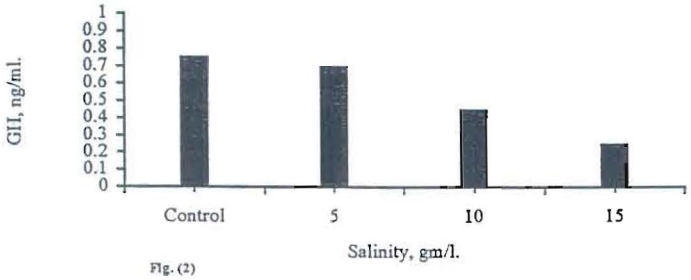

Fig. (2)

Figs (1 and 2) : Changes in serum prolactin (PRL) and growth hormone (GH) in *O. niloticus* cultured at different salinity

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