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EVALUATION OF DIFFERENT SALINITY LEVELS ON GROWTH PERFORMANCE AND PROXIMATE COMPOSITION OF *WALLAGO ATTU*

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ABSTRACT

The study was conducted to determine the optimum level of salinity tolerance on the growth performance and proximate composition of *Wallago attu* fed with tilapia meat. The experimental fish were collected from River Chenab district Muzaffargarh and acclimatized for 14 days in freshwater before the experiment began. The fish were divided into five treatments: T1, T2, and T3 with salinity levels 4, 8 and 12-ppt respectively with a control group (T0) in freshwater. Each treatment had one replicate and fish were stocked at a density of 5 fish's/aquarium in the Laboratory. Fish were fed 5% of their body weight with tilapia meat and water was exchanged regularly after every alternate day. The present study indicates the highest survival rate at 12-ppt and mortality was observed beyond this point. Non-significant changes in growth parameters viz; Feed intake, Feed conversion ratio, and Weight gain, were found in treatments and the control group. Additionally, proximate composition (moisture, ash content, protein and fat) showed significant changes ($P<0.005$) in groups. Water quality parameters were found within the acceptable range during the study period. The result suggests that *W. attu* is a suitable species for rearing in harsh water earthen lakes and emphasizes the importance of considering salinity levels and leads to innovation in sustainable aquaculture practices.

1. INTRODUCTION

Aquaculture plays an important role in solving global food crisis and practiced especially in the production of 60% protein from Fresh, brackish and saline waters which are considered as suitable for aquaculture development (Jarwar, 2008; Minfal, 2012). Fish is a complete diet and help to improve malnutrition, it contains high proportion of protein, water and lipid soluble vitamins, minerals, polyunsaturated fatty acids and Omega-3 fatty acids. Fish reduce the risk of heart diseases, blood pressure and improve blood clotting regulation (Nettleton, 1995). The intensive and non-intensive farming systems have created an immersive pressure to produce healthy and low-cost fish feed ingredients (Flefil et al., 2021).

Freshwater ecosystem facing salinization, leading to severe impacts on aquatic communities and food webs. However, in aquaculture and fisheries, salinity tolerance has been practiced and are limited but catfish are major targeted species (Sahoo and Ferosekhan, 2018; Thorslund et al., 2021; Astorg et al., 2022). *W. attu* is a new potential catfish in aquaculture belonging to family Siluridae due to its fast-growing nature, high protein content in its flesh, high nutritional and good market demand (Lilabati and Vishwanath, 1996; Azam et al., 2004). It is known as freshwater shark or Asian silurid catfish, found in South-east Asian rivers reservoirs and survive in a wide range of ecological environment (Halls and Johns, 2013; Quyen et al., 2017; Jahan et al., 2019).

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The current study is conducted to present an opportunity for innovation and sustainable aquaculture practices. By using information, farmers can adjust their cultivation method of *W. attu* and improve the survival and growth rates, ultimately leading to more sustainable and profitable aquaculture industry. With connected research and innovation aquaculture can play a critical role in addressing environmental challenges and meet the growing demand for high quality food. Few published literatures are available on salinity tolerance of *W. attu* commercially important fish. The aims of this study to determine the optimum tolerance level of salinity of threaten species *W. attu* and to determine the effects of salinity on proximate composition and growth parameters while making suggestions for its conservational strategies to culture even in salt effected areas.

2. MATERIALS AND METHODS

The freshwater catfish (*W. attu)* were collected from River Chenab and transported to Saline Water Aquaculture Research Centre (SWARC) Muzaffargarh. Fish were acclimatized in freshwater for 7 days in glass aquaria before the experiment began. The experiment was designed into five treatments (T1, T2 and T3) with 4, 8 and 12 and 14 salinity levels respectively with a control group (T0) was on freshwater. Each treatment had one replicate and fish were stocked as 5 fish/aquarium. Fish were fed 5% of their body weight with tilapia meat and water was exchanged regularly after every alternate day. The levels of salinities selected in this experiment was based on various salinities of Punjab in District Muzaffargarh because huge resources of Brackish and saline water forming is present. The continuous aeration was provided to maintain dissolved oxygen, salinity was maintained and tested on daily basis during the experiment lasted 60 days. Detritus, uneaten feed was removed every morning by siphoning out from the tank (Soundarapandian et al., 2009). All the physicochemical parameters were maintained by using Apera 8500 EC meter, Apera 8500 pH meter and P-512 dissolved oxygen meter on daily basis.

Growth Parameters

Fish having average weight of 29 g were stocked at 5 fish per aquaria in each treatment groups. The growth parameters *viz.,* feed intake weight gain, growth rate percentage, and FCR was measured (Batool et al. 2018). Fish was regularly fed twice a day up to sixty days at the end of experiment. All of the growth parameters were calculated as per following formulas:

Weight gain = Final weight- Initial weight
FCR= feed given (g)/ Weight gain (g)
Growth Rate (%); WG (g)/ Wi (g) X 100
Feed Intake; FCR X Weight gain (g)

Proximate composition

The proximate composition was analyzed by following AOAC (1990). The 5g of fish meat was dried in an oven at 105 ºC. After complete dryness, loss of moisture was calculated as percent moisture content. The dried samples were finely crushed by mortar and pestle and then content of lipid was determined by using chloroform-methanol method. Crude protein contents were determined using standard micro-Kjeldahl method. The dried sample of 2g was burnt in a muffle furnace at 550 ºC until its complete combustion and then white residue was evaluated as ash content.

Statistical analysis

The data obtained was analyzed statistically by performing Analysis of Variance (ANOVA) technique and means were compared by Duncan's Multiple Range Test.

3. RESULTS AND DISCUSSION

The experiment was specially designed for sixty days to assess the growth performance (final weight, feed intake, growth rate, weight gain and feed conversion ratio) and proximate composition (Crude Protein, Crude fat, Moisture, Ash) of *Wallago attu* at different level of salinities (4-ppt, 8-ppt, 12-ppt and 14-ppt along with their replicates and control group 0-ppt).

The growth parameters under all the treatments are presented in Table I. The initial weight of fish at the time of stocking was T0 (29.26±0.36g), T1 (29.68±.152g), T2 (29.60±.20g) and T3 (29.88±0.120g). The final weight after the end of trial was T0 (58.06±0.50g), T1(58.10±0.361) T2(58.06±.369) and T3 (59.32±0.10). The weight gain was T0 (28.80±0.68), T1(28.42±0.36) T2(28.46±.3826) and T3 (29.44±0.10). The growth rate was T0 (98.57±3.33), T1(95.77±1.40), T2 (96.18±1.64) and T3 (98.53±0.68). The feed intake was T0 (37.71±0.52), T1 (39.60±0.86) T2 (43.05±0.39) and T3 (47.49±0.64). The feed conversion ratio was T0

(1.31±0.02), T1 (1.3±.03), T2 (1.5±0.02) and T3 (1.6±0.02) respectively. The statistical analysis of growth performance shows no significant changes (P≤0.05) between treatments and control group in term of final weight, weight gain, growth rate, feed intake, feed conversion ratio as shown in Table 1 and Figure 1.

Proximate composition is an important factor that determines fish flesh quality which may be changed due to different salinity exposure. The proximate composition (mean ± SEM) of *Wallago attu* was determined at different salinity levels the proximate composition of Crude protein was T0 (67.60±0.17), T1(68.28±0.24), T2(70.44±0.74) and T3 (71.54±0.15); Crude fat was T0 (4.62±0.07), T1(5.32±0.11), T2(6.30±0.15) and T3 (7.26±0.10); Moisture was T0 (73.30±0.40), T1(71.84±0.28), T2(70.74±0.25) and T3 (69.54±0.28); Ash was T0 (1.12±0.02), T1(1.07±0.09), T2(1.03±0.03) and T3 (1.02±0.02). The highest amount of moisture was 73.30±0.40 at 0-ppt while lowest was 69.54±0.28 at 12-ppt. Maximum crude protein was 71.54±0.15 at 12-ppt while minimum was 67.60±0.17 at 0-ppt. The highest crude fat was 7.26±0.10 at 12-ppt and lowest was 4.62±0.07 at 0-ppt. Maximum ash content was 1.12±0.02 observed at 0-ppt and minimum was 1.02±0.02 at 12-ppt. Each parameter of Proximate composition (crude protein, crude fat, moisture and ash) were statistically significant (P<0.005) between treatments and control group. However, Moisture and ash content in the fish significantly decreases as salinity increases and Protein and fat content in the fish significantly increase as salinity increases as shown in (Table 2 and Figure 2).

Active and healthy fish feeding behavior remains normal up to 12-ppt during the 60-days trial with further increase in salinity signs of stress, poor feeding behavior, sluggish and mortality were also observed.
(a b, c and d) Average in the same row having different superscripts significantly different at level (P≤0.05)

Throughout the experiments no negative variations in water Quality parameters viz; temperature, dissolved oxygen, pH, and TDS. During the whole experimental period, water temperature varied form 20.42 -28.67 ºC in T0; 21.51-28.59 ºC in T1; 19.56 -28.45 ºC in T2 and 20.56 -28.55 ºC in T3, Dissolved oxygen (DO) varied from 6.5 -7.4 mg/L in T0; 6.6-7.3 mg/L in T1; 6.2 -7.1 mg/L in T2 and 6.5 -7.2 mg/L in T3, pH varied from 7.1-7.6 in T0; 7.2-7.8 in T1; 7.4-7.8 in T2 and 7.1-7.6 in T3, total dissolved solids (TDS) varied from 900-1000mg/L in T0; 1334-1450 mg/L in T1; 1835-1843 mg/L in T2 and 2135-2243 mg/L in T3. These water quality parameters were found to be optimum for culture of *W. attu* in brackish water.

The study was conducted to investigate the growth and proximate composition of *Wallago attu* cultured at different salinities (0, 4, 8, 12-ppt) in Laboratory aquarium. It is accepted that salinity is an important key factor in monitoring growth that shows better performance in brackish water. The growth performance in terms of weight gain (g), Food conversion ratio (FCR), Feed intake (FI), Growth rate (%) were seen no significant changes in treatments and in control group. Food conversion ratio (FCR) and Feed intake were found to be increase with increase of salinity up to 12-ppt, with further increase of salinity cause mortality (Table 1). Boeuf and Payan, (2001) and Sparks *et al*. (2003) described accelerated growth performance of tilapia reared in seawater. Similarly, McElwee et al. (2002) also reported faster growth of tilapia (*Oreochromis shiranus chilwae, O. shiranus chilwae* and *O. karongae*) in 10-ppt declaring potential candidate for brackish water aquaculture. Kang'ombe and Joseph, (2008) reported improved growth of *Tilapia rendalli* reared in 5-15-ppt than freshwater. Phuc, (2015) reported better weight gain of *P. hypophthalmus* at 0 to10-ppt while lowest at 14 to18-ppt.

Fish's biochemical constituents are affected by reared medium in which salinity are maintained. The results of proximate composition shown significant differences in treatments and control group. Highest moisture content in the control group (73.30±0.40), which gradually reduced with the increase in the salinity (69.54±0.28) in T3 group. Highest Ash content in the control group (1.12±0.02), which gradually reduced with the increase in the salinity (1.02±0.02) in T3 group. Similarly, protein from 67.60±0.17 to 71.54±0.15 and fat from 4.62±0.07 to 7.26±0.10, showing higher values at 0 to 12 ppt. Dempson et al., (2004) described remarkable decrease in the percentage of ash and increase protein and lipid. Similarly, Barman, (2012) studied Milkfish, reported significant reduction of moisture (%) while protein and fat increased from 0-15-ppt.

The present findings regarding the physicochemical parameters measured in this study such as temperature, dissolved oxygen (DO), pH and total dissolved solids

(TDS) agreed with the findings of Rehman et al. (2006), Dixit et al. (2015) and Okomoda et al. (2016) who also recorded all physicochemical attributes water containing different species of fish. The water quality parameter viz; DO, pH, TDS and Temperature are also considered important factors for fish culture (Buentello et al. 2000; Uzoka et al., 2012, 2015). The water quality parameters were kept suitable for catfish culture in brackish water. The overall results indicate baseline information of improved body composition, survival and cultivation of *W. attu* at various salinities.

4. CONCLUSION

The current study demonstrates *Wallago attu* economically important fish in aquaculture that tolerate salinity up to 12-ppt in Laboratory conditions and shows greatest growth performance with improved body composition. The present study provides base line literature for growth and proximate composition of *W. attu* in brackish water.

5. CONFLICT OF INTERESTS

All authors have declared that the there is no conflict of interest regarding this publication.

6. ACKNOWLEDGEMENTS

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Table 1. Showing growth performance (Mean ± SEM) of *Wallago attu* at different salinity levels (0-ppt, 4-ppt, 8-ppt and 12-ppt) during the 60-days experiment.

Groups	Initial weight	Final weight	Weight gain	Feed intake	Growth Rate	FCR
0-ppt	29.26±0.36	58.06±0.50	28.80±0.68	37.71±0.52	98.57±3.33	1.31±0.02
4-ppt	29.68±.152	58.10±0.361	28.42±0.36	39.60±0.86	95.77±1.40	1.3±.03
8-ppt	29.60±.20	58.06±.369	28.46±.3826	43.05±0.39	96.18±1.64	1.5±0.02
12-pp	29.88±0.120	59.32±0.10	29.44±0.10	47.49±0.64	98.53±0.68	1.6±0.02

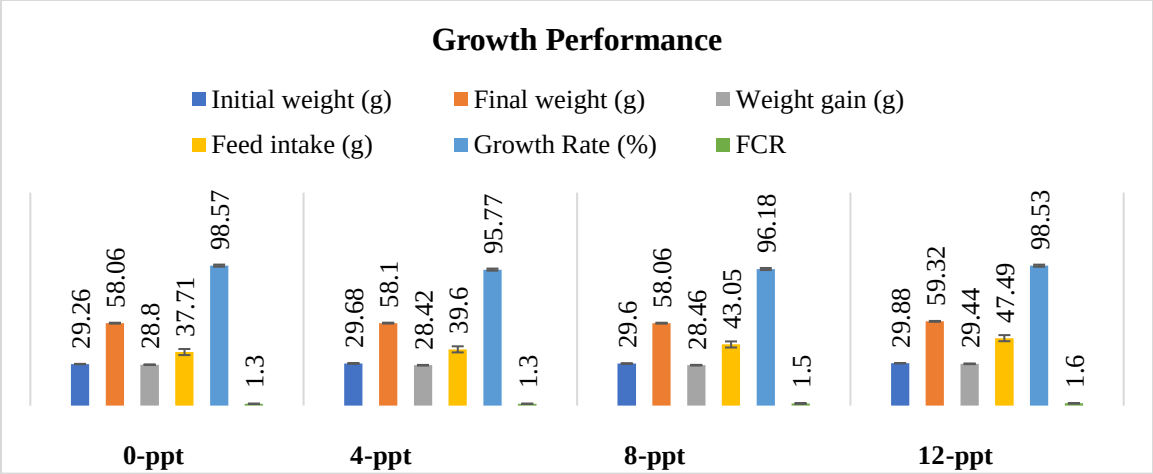

Figure 1. Clustered column bar graph showing growth performance of *Wallago attu* at different salinity levels (0-ppt, 4-ppt, 8-ppt and 12-ppt) during the 60-days experiment.

Table 2. Effect of different salinity levels on proximate composition of freshwater *Wallago attu* at different salinity levels (0-ppt, 4-ppt, 8-ppt and 12-ppt) during the 60-days experiment.

Parameters	**Treatments**			
	0-ppt	**4-ppt**	**8-ppt**	**12-ppt**
Crude Protein	67.60±0.17^{a}	68.28±0.24^{a}	70.44±0.74^{b}	71.54±0.15^{b}
Crude fat	4.62±0.07^{a}	5.32±0.11^{b}	6.30±0.15^{c}	7.26±0.10^{d}
Moisture	73.30±0.40^{d}	71.84±0.28^{c}	70.74±0.25^{b}	69.54±0.28^{a}
Ash	1.12±0.02^{c}	1.07±0.09^{b}	1.03±0.03^{a}	1.02±0.02^{a}

(a b, c and d) Average in the same row having different superscripts significantly different at level (P≤0.05)

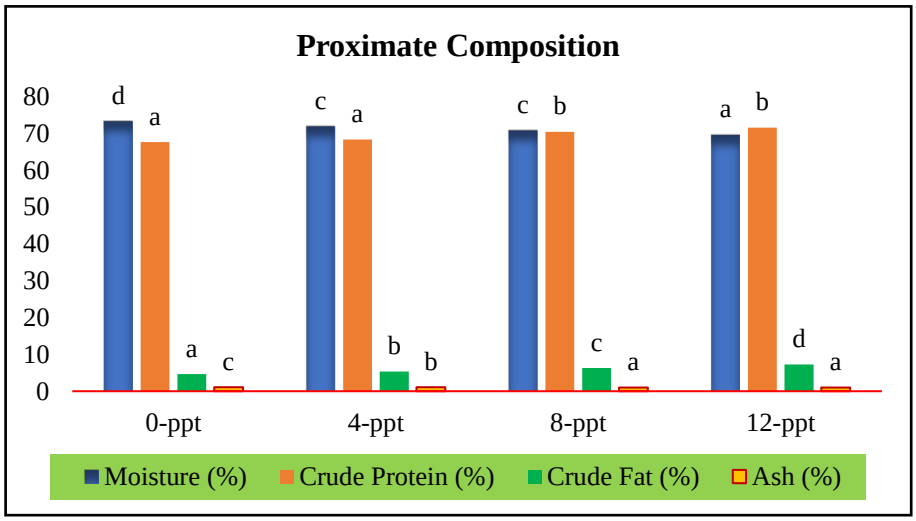

Figure 2. Proximate Composition Analysis of *Wallago attu* under Different Salinity Levels