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Research Article

Growth performance and body composition analysis of two distant populations of gift tilapia

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Abstract
The purpose of the present study was to compare the growth performance of two GIFT strains of Nile tilapia (*Oreochromis niloticus*), GIFT-Th, imported from Thailand; GIFT-Tw, obtained from a local hatchery). In earthen ponds both the fishes were fed with 30% crude protein diet at an equal rate. Results showed that there was no significant difference in final total length (TL) and standard length (SL) of both strains ($P>0.05$). However, average monthly weight gain, final total wet weight (WW) and weight gain against increase in TL were higher in GIFT-Th as compared to GIFT-Tw ($P<0.05$). There was no significant difference in FCR, SGR and K values measured for both fishes ($P>0.05$). The body composition analysis showed no significant difference in moisture (%), crude protein (%), crude fat (%) and ash (%) contents in both strains ($P>0.05$). These findings suggested that GIFT-Th may has better genetic factors for weight gain as compared to GIFT-Tw, and should be preferred for farming, however an economic analysis determining benefit to cost ratio is pre-requisite before final recommendations.

Keywords: Aquaculture; Condition factor; Feed conservation ratio; Nile tilapia; Specific growth rate

Introduction

Nile tilapia (*Oreochromis niloticus*) is among the most popular farmed fish species over the world, only after the carps in supplying good quality protein food **[1]**. Tilapia is a hardy fish because it can adapt to wide range of conditions **[2]** that makes it the prime culture species for variety of conditions. Tilapia is being cultured over the world in different settings according to cultural and socio-economic conditions **[3]** semi-intensive and intensive pond culture are the most adapted systems of tilapia culture.

As tilapia culture is becoming more intensified to get greater yields from less area available, the input to output ratio may rise due to high cost of fish feed. Hence, selection of an optimal aquaculture species becomes extremely important to make farming more sustainable for small scale farmers.

Aquaculture production can be increased through selective breeding **[4]** so, in recent past genetically improved strains of farm tilapia (GIFT) have been produced by selective breeding over many generations, which show better growth performance and help to maintain optimal benefit to cost

ratio [5, 6] but growth performance of any fish population can vary and pedigree of the fish is highly determinant of its live weight gain [7].Lack of information on complete understanding of fish being cultured would negatively impact aquaculture development. Therefore, the purpose of the study was to assess the growth performance and body composition of two commonly used strains of Nile tilapia (*Oreochromis niloticus*) labeled as GIFT-Th and GIFT-Tw in semi-intensive mono-sex culture in earthen ponds.

Materials and methods

This study was conducted at Satyana Road Fish Hatchery, Faisalabad, Pakistan.

Experimental design

Earthen ponds of same size of 97 × 31 × 2 m (L × W × D) and similar in shape, depth and basin configuration were used in this study in two replicates, before stocking the ponds were drained and dried to remove the aquatic weeds and were limed at an equal rate.

Acclimatization

Then the ponds were left for three days before they were manured with cow dung at the rate of 750 kg/ha. The hormonally sex reversed all male fingerlings of both strains were obtained from Abid Rafique& Company, Rawalpindi, 46000, Pakistan (GIFT-Th) and Tawakkal Tilapia Hatchery, Muzaffar Garh, Punjab, Pakistan (GIFT-Tw) and acclimatized in cemented tanks for 10 days before stoking in experimental ponds. During acclimatization fingerlings were fed with oryza feed (Table 1). Each pond was stocked by 2000 fingerlings. Before stocking, initial values of mean morphometric characteristics such as wet weight (WW), standard length (SL) and total length (TL) were recorded (n=50) for each strain. Sampling was done on monthly basis using drag net (n=50) and morphometric characteristics in terms of increased wet weight (g), increased standard and total lengths (cm) were recorded to evaluate the growth performance of experimental fish during six months (180 days) of experiment period from July to December2015. Specific growth rate (SGR) was calculated by the formula used by [8].

Table1. Proximate composition of the feed (provided by the manufacturer).

Components	Percentage
Crude protein	30.0% (minimum)
Crude fat	6.2% (maximum
Crude fiber	6.0% (maximum)
Moisture	10.0% (maximum)
Ash	7.2% (maximum)
Feeding rate	
Fish weight	**Feed % body weight**
1-5	15.0
6-15	12.0
16-30	9.0
31-50	6.0
51-80	5.0
81-100	4.0
>100	3.0
>350	2.5

$$SGR = \frac{\ln(final\ weight) - \ln(initial\ weight) \times 100}{Number\ of\ experimental\ days}$$

Feed conversion ratio (FCR) was calculated by the formula used by [9].

$$FCR = \frac{\text{Feed given(Dry weight)}}{\text{Body weight (wet weight)}}$$

The value of condition factor (K) was calculated by formula given by [10]

$$K = \frac{W \times 1000}{L^3}$$

Where:
W = Wet fish body weight
L = Wet fish total length (TL)

Physicochemical parameters of the pond water like total hardness, temperature, pH, DO, salinity etc, were determined on fortnightly basis. Oryza feed was obtained from Oryza Organics® Pvt. Ltd., with the proximate composition and feeding rate given in table 1.

At the end of experimental trial (180 days) representative samples of body meat of every replicate were homogenized separately using a mortar and pestle and analyzed chemically by AOAC (1990) procedure, oven drying at 105°C for dry matter (DM), micro kjeldahl analysisfor crude protein, chloroform methanol extraction method for crude lipid through 10454 soxtec system HTz, electric furnace for ash.

Statistical analysis

Data was statistically analyzed by using software packages SPSS® version 17. Analysis of variance (ANOVA) and Duncan multiple range tests were used to compare the means and fit line regression model was used to determine the relationship between TL increase and WW gain in the fish.

Results

It was observed that GIFT-Th strain showed better growth as compared to GIFT-Tw in terms of gain in wet weight (WW) ($P<0.05$), however there was no significant difference in terms of gain in total length (TL) and standard length (SL) of both the fishes ($P>0.05$) (Table 2).

The rate of growth in terms of WW gain was higher in GIFT-Th from very initial stages of the trial (Figure: 1). The Fit Line Regression model depicted that there was greater increase in WW for every unit increase in TL in GIFT-Th as compared to GIFT-Tw. Following regression equations were calculated for both the fishes:

GIFT-Th:
$WW=-204.4+22.97\times TL$ ($R^2=83.6\%$; CI = 95%)

GIFT-Tw:
$WW=-149.6+18.80\times TL$ ($R^2=81.2\%$; CI = 95%)

Table2. Comparison of initial and final values of total length, standard length and wet weight for both species (Mean±S.D) n= 3

		Initial value	Final value
TL (cm)	GIFT-Th	2.0±0.01a	27.1±2.5a
	GIFT-Tw	2.0±0.02a	26.4±1.7a
SL (cm)	GIFT-Th	1.7±0.03b	24.0±3.3b
	GIFT-Tw	1.7±0.01b	22.4±1.9b
WW (g)	GIFT-Th	0.55±0.05c	504.3±3.9c
	GIFT-Tw	0.49±0.06c	406.2±2.7d
Means within a column with same letter are statistically non-significant (P>0.05)			

Figure 1 showed that identical trend of weight gain was present in both species, where maximum weight gain was achieved during September and October, and minimum gain was observed from November to December.

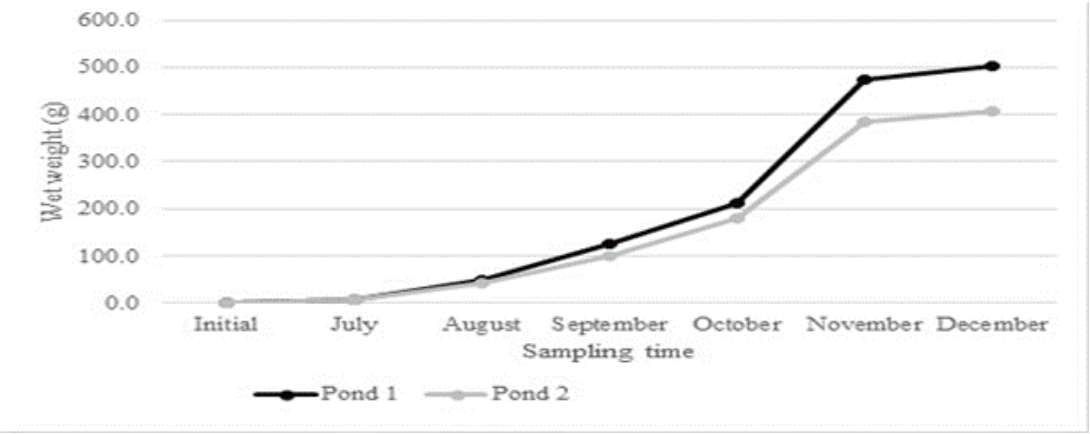

Figure 1. Trend of increase in WW (g) in both fish species throughout the trial period

Whereas the different physico-chemical parameters remained similar in both ponds (Table 3).

Moreover, it was observed that the values of FCR and K remained similar throughout the trial ($P>0.05$), except in case of GIFT-The the value of K was significantly lower in first two nettings ($P<0.05$). Monthly comparison of SGR showed that growth rate was maximum at the beginning of the trial and it continued to decrease in each successive netting ($P<0.05$) (Table 4).

Table 5 shows the proximate body composition (mean±SD) of two strains studied. The mean moisture % content was 80.09±2.11 and 80.21±1.09 in GIFT-Th and GIFT-Tw strains respectively, while crude protein % level was 16.9±2.21 (Th) and 16.42±2.10 (Tw), crude lipid%, 0.45±1.19 (Th) and 0.51±2.10 (Tw) and ash % content was 2.48±2.01 (Th) and 2.63±1.98 (Tw). There was no significant difference observed in moisture (%), crude protein (%), crude fat (%) and ash (%) contents in both strains ($P>0.05$).

Discussion

The difference in growth in terms of weight gain observed in this study suggests the genetic diversity present among the two populations, as was reported by [7] within GIFT populations of Malaysia. Many studies have reported the genetic correlation of growth in different strains of tilapia. The findings of [11] emphasized the influence of genetic variability on weight gain of GIFT strain of tilapia.[12] also described that the harvest weight of GIFT strain of tilapia is the product of interaction between environment and the genotype of the fish. Similar findings were also presented by [13, 14] for Nile tilapia (*Oreochromis niloticus*), they demonstrated that the heritability of both body weight and survival rate of the fish. A genetic analysis for both strains will therefore be followed up in next study to highlight the genetic diversity present between two strains.

There was no significant difference in mean FCR, SGR and K values obtained from both ponds that may be due to the similar environmental conditions present in both ponds throughout the trial period. Initial uplift and gradual decline in SGR observed in studied populations can be attributed to fast metabolic rate of the fish at early age as compared to its body size which kept on declining in later part of the age. These findings are in accordance with the findings of [15] who reported that the age related variations in the growth rate of animals do exist, but this needs to be further investigated in case of GIFT strain of Nile tilapia.

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Table 3. Physico-chemical parameters recorded fortnightly in pond 1 and 2

Fortnights #	pH		Temperature (°C)		DO (ppm)		CO_2 (mg/L)		Hardness(mg/L)		Conductivity (ms)		Salinity (ppt)		Alkalinity (mg/L)	
	p1	p2	P1	p2	P1	p2	P1	p2	P1	p2	P1	p2	P1	p2	P1	p2
1	9.02	8.90	30.4	30.3	4.9	4.5	0	0	210	240	6.55	6.33	3.6	3.1	1350	1200
2	9.02	8.80	33.6	33.5	6.02	6.1	0	0	210	210	6.91	6.89	2.6	2.6	1260	1140
3	8.69	9.01	32.4	30.0	5.9	6.1	0	0	220	210	5.7	5.41	2.7	2.6	1320	1220
4	8.8	8.88	31.6	31.0	6	6.7	0	0	210	220	5.67	5.67	2.7	2.7	1230	1230
5	8.7	8.90	31.2	31.5	5.7	5.7	0	0	220	240	5.4	5.7	2.6	2.8	1340	1240
6	8.6	8.65	32.4	32.2	5.8	8.01	0	0	210	220	5.4	5.4	2.5	2.6	1370	1260
7	9	9.00	30.9	31.5	5.6	5.9	0	0	210	240	5.63	5.53	2.6	2.8	1220	930
8	8.93	8.90	24.7	24.8	5.89	8.1	0	0	220	360	5.9	5.6	2.8	2.8	1338	1260
9	8.8	8.80	24.8	24.9	7.7	6.2	0	0	320	340	4.9	5.4	2.9	2.7	1240	1380
10	8.7	8.60	18.6	18.7	6.8	6.4	0	0	340	360	5.2	5.2	2.8	3.1	1180	1140
11	8.6	8.80	13.6	13.9	8.5	10.5	0	0	220	280	5.3	5.1	2.7	2.8	1220	920
12	8.7	8.70	12.9	12.8	6.5	8.5	0	0	295	295	5.4	5.2	2.8	2.7	1240	960
Means± S.D	**8.80±0.16**	**8.83±0.1**	**26.43±7.52**	**26.26±7.3**	**6.28±0.98**	**6.89±1.6**	**0.00**	**0.00**	**240.42±48.17**	**267.92±57.7**	**5.66±0.57**	**5.62±0.5**	**2.78±0.28**	**2.78±0.2**	**1275.67±63.7**	**1156.67±146.5**

Table 4. Monthly comparison of FCR, SGR and K values in both fishes

	FCR		SGR		K	
Month	**GIFT-Th**	**GIFT-Tw**	**GIFT-Th**	**GIFT-Tw**	**GIFT-Th**	**GIFT-Tw**
July	0.01±0.0a	0.01±0.0a	8.04±0.4a	8.41±0.7a	1.12±0.5a	1.66±0.7a
August	0.02±0.0a	0.02±0.0a	6.73±0.1b	6.35±0.1b	1.81±0.4a,b	2.66±1.3a
September	0.03±0.0a	0.03±0.0a	3.26±0.0c	2.92±0.1c	2.57±0.8a,b	2.11±0.8a
October	0.04±0.0a	0.03±0.0a	1.74±0.0d	1.90±0.0d	2.03±0.7b	2.02±0.4a
November	0.02±0.0a	0.02±0.0a	2.69±0.0e	2.55±0.0c	2.62±0.5b	2.40±0.5a
December	0.37±0.0b	0.41±0.0b	0.20±0.0f	0.18±0.0e	2.61±0.7b	2.24±0.4a

Means sharing same letters within a column are statistically non-significant (P>0.05)

Table 5. Proximate body composition of GIFT-Th and GIFT-Tw strains

Variable	GIFT-Th	GIFT-Tw
Moisture %	80.09±2.11a	80.21±1.09a
Crude protein %	16.9±2.21a	16.42±2.10a
Crude lipid%	0.45±1.19a	0.51±2.10a
Ash %	2.48±2.01a	2.63±1.98a

Variables with same letters in a row are non-significantly different (P>0.05

In present study monthly weight gain was variable through the trial it was observed that maximum weight gain in both fishes was achieved during the months of September and October when average water temperature was around 31 and 28°C, respectively. It can be inferred by these findings that this is the optimum temperature for GIFT tilapia growth. Then there was a sharp decline in weight gain during the month of December when average water temperature was around 13°C (Table 3). It shows that the growth performance of GIFT tilapia is not suitable at colder water temperatures. Similar conclusion was made by **[16]**, they suggested that tilapia shows best growth performance when water temperature ranges from 22 to 28 to 30°C. Similarly, **[17]**, reported that at lower temperature survival rate of Nile tilapia significantly decreases. So decreased growth rate of fish during the month of December may be due to deteriorated health condition of the fish and the fish might have started dying if it was not harvested at the end of sixth month. Overall these findings suggest that from two genetically improved strain of tilapia, GIFT-Th performed comparatively better in terms of wet weight gain as compared to the strain that is managed and supplied by a local supplier, GIFT-Tw. There may be contamination of genetically unimproved tilapia at maintenance and brooding sites of said local hatchery or the local population needs to undergo further selection to attain genetic purity. Secondly, there may be incomplete sex reversal that caused overall low performance because some fishes may have spent their energies in gametes production. However further studies need to be done to find out the exact cause of lower growth performance of locally available fish seeds. Moreover, a careful economic analysis for both strains determining benefit to cost ratio is mandatory before final recommendation of any strain for farming.

Conclusion

From trial findings it was concluded that GIFT-Th may has better genetic factors for weight gain as compared to GIFT-Tw, and should be preferred for farming.

Authors' contributions

Conceived and designed the experiments: F Asad, Performed the experiments: Zulqurnain, Analyzed the data: S Qamar, Contributed reagents/ materials/ analysis tools: S Qamar, Wrote the paper: F Asad.

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