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Comparison of Growth, Feed Conversion and Body Composition of Juvenile Hybrid Red Tilapia (*Oreochromis niloticus* × *O. mossambicus*) and Nile Tilapia (*O. niloticus*) Reared in Concrete Tanks

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ABSTRACT

The objective of this study was to compare growth, feed consumption and body composition of hybrid red tilapia (*Oreochromis niloticus* × *O. mossambicus*) and Nile tilapia (*O. niloticus*) reared in concrete tanks for 60 days. The juvenile of Nile tilapia, T1 (mean weight 2.08±0.2 g) and hybrid red tilapia, T2 (mean weight 2.07±0.16 g) were stocked in concrete tanks (15 × 6 × 3 ft). They were fed with four isoenergetic (20.3 kJ g^{-1}) diets containing 35% protein at a daily ration of 5% body weight with two replications. The highest weight gain was found in T2 (44.2±0.1g), while the lowest one was recorded in T1 (34.3±0.2 g). Specific growth rate (SGR) and feed conversion ratio (FCR) were not significantly different among treatments ($P<0.01$). Survival remained 100% in T2, while 94% was observed in T1. Condition factor was found to be significantly different among the groups ($P<0.01$). The hepatosomatic index (HSI) was greater in T2 that of T1. Production of T2 was 11.05 kg/m^3/60 days and for T1 was found to be 8.58 kg/m^3/60 days ($P<0.05$). Water quality parameters (temperature 28.3±0.14°C, dissolved oxygen 6.4±0.07 mg/l, pH 6.8±0.07, ammonia 0.002±0.00 mg/l, hardness 107.1±1.4 mg/l and nitrite 0.145±0.00 mg/l) were recorded throughout the study period. The values of biochemical constituents including fatty acids of the fish in T1 and T2 did not show prominent changes ($P<0.05$), though little variations were noted in the values of individual fatty acids. Based on the biological and chemical data, it is suggested that hybrid red tilapia, T2 (*O. niloticus* × *O. mossambicus*) has potential for aquaculture in Pakistan.

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Authors' Contributions
AMD executed the experimental work. HK assisted in feed preparation. SAS assisted in fish juvenile stocking. SF determined the fatty acids. AG analyzed the feed. MHR analyzed the fish meat. IBK helped in writing the manuscript. GA supervised the work.

Key words
Hybrid red tilapia, *Oreochromis niloticus* × *O. mossambicus*, Nile tilapia, *O. niloticus*, growth, production.

INTRODUCTION

Aquaculture is one of the fastest-growing food-producing sectors in aquatic field and is set to play a key role in meeting the rising demand for fishery products due to increase in human population and decline natural fisheries resources, World aquaculture production continues to grow and now provides almost half of all fish for human consumption (FAO, 2014; Sing *et al*., 2014; Zhang *et al*., 2014). World aquaculture is heavily dominated by the Asia-Pacific region, which accounts for 89% of production in terms of quantity and 77% in terms of value. This dominance is mainly due to China's enormous production, which accounts for 67% of global production in terms of quantity and 49% of global value (Iqbal *et al.*, 2014a,b). Pond, tank, cage and raceway aquaculture is growing fast in developed and developing countries (Azim *et al.*, 2003; Daudpota *et al.*, 2014,). Aquaculture is rather recently introduced activity and is still in its developing stage; there are large numbers of opportunities to strengthen this sector in Pakistan (Muhammad *et al*., 2013; Perveen *et al*., 2013). Country has vast fresh, brackish and marine water resources where only carp aquaculture is practiced in ponds extensively with very little inputs. Our country is rich in fish fauna but only few carp's species (7 warm water and 2 cold water) are being cultivated on commercial scale (Pillay, 1990; Chughtai and Awan 2011; Chughtai and Mahmood, 2012; Isani *et al*., 2013; Naz and Javed, 2013;

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Qi *et al*., 2014; Kousar and Javed, 2014; Mahboob *et al*., 2014; Daudpota *et al.,* 2014).

Tilapia is the most important warm water fish used for aquaculture production (Charo-Karisa *et al.,* 2006). The adaptability of tolerance of tilapias to a wide range of environments and strengthening of cultivation systems have resulted in a rapid growth of tilapia farming and introduction of these fish into many subtropical and temperate regions of the world. Tilapias also known as commercially important food fishes all over the world such as Egypt, China; South-east Asia, Africa, USA and Latin America/Caribbean, Russia, Israel and Australia (Daudpota *et al*., 2014; Chowdhury, 2011). Global tilapia production increased up to 3.4% in 2013 and it is expected to approach around 4.6 million tons in 2015 (FAO, 2010). Taiwan exported nearly 8000 tons of whole frozen tilapia, of which about 50% entered the USA market during the first three months of 2013. Other leading destinations are the Middle Eastern countries of Saudi Arabia, Kuwait, UAE and Bahrain. Australia and Canada are also taking increasing shares of Taiwanese tilapia exports (Weisberg *et al*., 2010; FAO, 2013). Africa and South East Asia are the most important consumers of tilapia with 950,000 tons each. China follows with about 500,000 tons of its tilapia production which remain in the country. North America consumes about 480,000 tons of tilapia per year. Central America accounts for 190,000 tons, with about one third coming from imports. Russia consumes about 66,000 tons, while EU is still quite unimportant with some 56,000 tons only. Israel, Caribbean and Australia consume very small quantities of tilapia (FAO, 2013).

There is no comparative data available on the growth and production of hybrid red tilapia *(O. niloticus* × *O.mossambicus*) and Nile tilapia (*Oreochromis niloticus*) in Pakistan. Therefore, this study was carried out to compare the growth performance and feed utilization of red tilapia and Nile tilapia in concrete tanks.

MATERIALS AND METHODS

The study was conducted in four tanks (15×6×3 ft each) at Fish Hatchery Chilya Thatta, Sindh, Pakistan. Treatment replicates were randomly distributed to the tanks and stocked with hybrid red tilapia (*O. niloticus* × *O. mossambicus*) fry which were collected from the Hatchery and acclimatized them for one week. Subsequently, fry of Nile tilapia, T1 (mean initial weight, 2.08±0.02 g; and mean length 2.43± 0.2 cm) and red tilapia, T2 (mean initial weight, 2.07±0.16 g; and mean length 2.47±0.1 cm), respectively were reared for 60 days with 2 replications. To prepare formulated feed from locally available ingredients such as fish meal, mustard oil-cake (MOC), groundnut, rice bran, wheat bran, wheat flour and vitamin premix were ground thoroughly and sieved to pass through 0.5 mm mesh size. An experimental diet was formulated contain 35% protein. All ingredients were mixed together then put into the pellet machine for the preparation of pellet feed of diameter 1mm. The composition of pellet feed is shown in (Table I). The experimental fry were fed thrice a day at 8:00 am, 12:00 pm and 4:00 pm with 5% of the total biomass. Fish from each replicate were randomly sampled and weighed fortnightly and released to the tank. Their weights were taken with an electronic scale to the nearest 0.01 g after gently blotting with a towel. During sampling, 15% of the stocked fish in each tank were scooped out with a scoop net and weighed individually and based on the weight gains feed was adjusted accordingly. After sixty days of culture period, all fish in the tanks were weighed individually and the total number of fish in each tank counted. Growth response and survival rate were calculated by applying the following formulae:

1) Weight gain = (mean final weight – mean initial weight)
2) Average daily weight gain = fresh weight gain in fish (g)/culture period (days)
3) Feed conversion ratio (FCR) = wet weight gain/dry feed intake × 100
4) Specific growth rate/day (SGR) = Log final weight – Log initial weight × 100 /days
5) Survival rate (SR) = (final number of fish/initial number of fish) × 100
6) Condition factor (CF) = final weight/ final lenght^3 × 100

The water quality parameters such as temperature, pH, dissolved oxygen (DO), ammonia, hardness and nitrite were monitored daily throughout the experimental period. Water temperature of the tanks was measured with the help of thermometer. DO of the tanks water was measured by using an oxygen meter (Jenway 9500). The hydrogen ion concentration (pH) of water was noted by using a pH meter (Ezdo-6011 CE). API NH4+/NH3 ammonium test kit is used to determine the values of ammonia and nitrite. Hardness was determined by Hanna (HI3812) Hardness Kit. All analyses were done in the laboratory of the hatchery. Chemical analysis of feed and fish meat was done by using the standard methods of AOAC (2000).

After 60 days of the trial completion, three fishes were caught from each experimental tank, killed and then dissected to calculate the weight of liver so as to determine the hepatosomatic index (HSI). After that, these fishes were frozen and stored for chemical analysis.

Table I.- Formulation and chemical analysis of the experimental diet.

Ingredients (%)	g 100 g^{-1} diet (dry)
Fish meal	34.5
Wheat brawn	16.0
Rice brawn	11.0
Mustered oil cake	13.0
Wheat flour	20.0
Vitamin-mineral premix[1]	2.5
Fish oil (cod liver oil)	3.0
Proximate composition	
Moisture	7.0±0.3
Crude protein[3]	34.7±0.2
Crude lipid	5.7±0.5
Crude fiber	5.8±0.5
Ash	7.0±0.6
NFE[4]	46.4±0.2
Energy (kJg^{-1})	20.1±0.5
P/E (mg crude protein kJ^{-1})	17.2±0.3

[1]Vitamin and mineral mixture contained the following ingredients (g 100 g^{-1} diet): Ascorbic acid (vit C), 15.2; thiamin HCl (vit B_6), 1.1; inositol, 39.5; calcium, 1.25; zinc, 1.0; retinol (vit A), 1.5; phosphorus, 3.5; choline chloride, 3.5; magnesium, 2.0; copper, 1.0; pyridoxine (vit B_6), 1.3; phospholipids, 3.5; α-tocopherol acetate (vit E), 5.5; folic acid, 0.4; cholecalciferol (vit D_3), 7.5; cyanocobalamine (vit B_{12}), 0.006; riboflavin (vit B_2), 1.5; menadione sodium bisulphite (vit K_3), 0.03; manganese, 2.0; iodine, 2.0; sodium, 1.0; iron, 1.0; nicotinic acid, 4.3; biotin, 0.35.
[2]Dry matter basis (%): mean ± SE, number of determination = 3.
[3]Measured as nitrogen × 6.25.
[4]Nitrogen-free extract = 100 – (% protein + % fat + % ash + % fiber).

Muscles from the back of fishes stored at -20ºC were obtained and then dried at room temperature. With the help of fan these samples of back muscle and liver were dried and ground into powder form for chemical composition (AOAC, 2000). Gas-liquid chromatography technique was applied in FAME separation and quantification. With the help of oven (Labostar-LG122 Tabia Espec, Osaka, Japan) the moisture was estimated at 105ºC for 24h. Crude lipid was estimated by Soxhlet extraction method (Folch *et al.*, 1957). The Kjeldahl method (N×6.25) was applied for the determination of protein content by means of automatic Kjeldahl system (Buchi 430/323). Ash was obtained from muffle furnace at 550ºC. Energy in each treatment was determined with the help of bomb-calorimeter. The data were reported on wet weight basis (mg/100 g of edible portion).

One way analysis of variance (ANOVA) was used to determine the comparative growth and survival rate of Nile tilapia (*O. niloticus*) and hybrid red tilapia (*O. niloticus* × *O. mossambicus*). This was followed by Duncan's New Multiple Range Test at 0.05% level of significance to determine any difference among the treatment means (Zar, 1996).

Table II.- Comparison of growth parameters of red tilapia and Nile tilapia reared in concrete tanks.

Parameters	Nile tilapia	Red tilapia
Average initial weight (g)	2.08±0.21[a]	2.07±0.16[a]
Average final weight (g)	36.40±0.90[b]	46.27±2.5[b]
Average initial length (cm)	2.43±0.2[a]	2.47±0.1[b]
Average final length (cm)	14.91± 0.5[a]	15.15±0.4[b]
Weight gain (g)	34.32±0.2[a]	44.2±0.1[b]
Average daily weight gain (ADWG)	0.61±0.02[a]	0.74±0.01[b]
Percent weight gain	1650±0.70[a]	2135.5±0.14[b]
Specific growth rate (SGR)	2.1±0.02[a]	2.2±0.02[b]
Feed conversion ratio (FCR)	0.84 ± 0.2[a]	0.84±0.2[a]
Hepatosomatic index (HSI)	0.71±0.02[a]	1.42±0.02[b]
Survival rate (%)	94.0±0.1[a]	100.0±0.2[b]
Condition factor (CF)	1.1±0.08[a]	1.32±12[b]
Production (kg/m^3/60 days)	8.58±0.01[a]	11.05±0.02[b]

Similar superscripts indicate no statistical difference among treatments.

RESULTS

Growth parameters

Growth parameters of hybrid red tilapia, T2 (*O. niloticus* × *O. mossambicus*) and Nile tilapia, T1 (*O. niloticus*) in terms of weight gain (WG), average daily weight gain (ADWG), percent weight gain (PWG), specific growth rate (SGR), food conversion ratio (FCR), survival rate (SR) and condition factor (CF) are presented in Table II. Growth of red tilapia and Nile tilapia in tanks indicated significant differences among treatments. T2 showed significantly ($P<0.05$) highest growth rate, survival and PWG than those of T1. The average daily weight gain was 0.61 g in T1, 0.74 g in T2, which is significantly different among groups (Fig. 1). FCR was same in all treatment groups ($P>0.05$). SGR was 2.1% and 2.2% in T1 and T2, respectively ($P>0.05$). Condition factor values were found to be different among treatments ($P<0.01$). The hepatosomatic index (HSI) was greater in T2 than that of T1 (Table II).

Water quality

Water quality parameters were maintained as temperature 27.2°C to 28.5°C, DO 5.9 mg/l to 6.4 mg/l, pH 6.9 to 7.6, ammonia 0.001 mg/l to 0.002 mg/l, hardness 106 ppm to 110 ppm and nitrite from 0.151 mg/l to 0.162 mg/l throughout the study period (Table III).

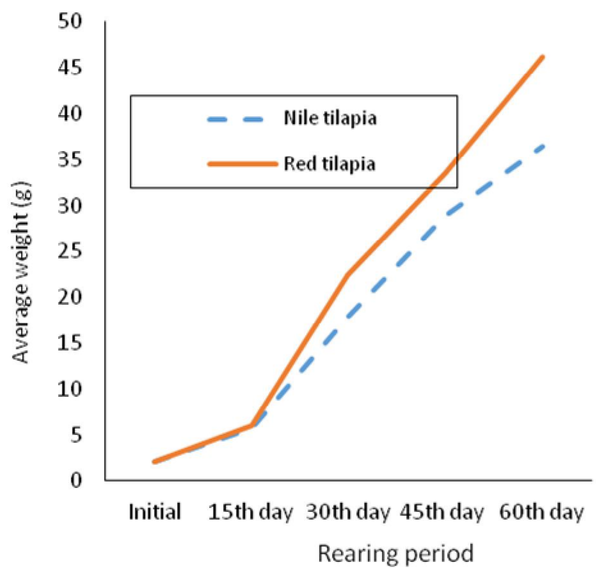

Fig. 1. Growth increment of Nile tilapia and hybrid red tilapia reared in concrete tanks for 60 days.

Body composition

The values of biochemical constituents including fatty acids of the fish in T1 and T2 did not show prominent changes (Table IV, $P<0.05$), though little variations were noted in the values of individual fatty acids (Table V). Both fish species fed the diet containing 35% protein and 5.7% lipid showed 26.5-23.7% monoenes (mainly 18:1n-9, but also significant amounts of 16:1n-7, 22:1 and 20:1n-9, 26.4% saturated fatty acids, of which more than half was 16:0, 25.5% n-3 polyunsaturated fatty acid (PUFA) mainly 22:6n-3 (DHA; docosahexaenoic acid) and 20:5n-3 (EPA; eicosapentaenoic acid), and 8.1% n-6 PUFAs largely in the form of 18:2n-6. Graded inclusion of cod liver oil resulted in increased 16:0, 18:1n-9 and 18:2n-6. Total saturated, monoenes and n-6 PUFA also increased. On the other hand, 14:0, most of the monoenes, 20:2n-6, ARA and all the total n-3 PUFAs, EPA and DHA, decreased drastically.

DISCUSSION

In the present study, juvenile hybrid red tilapia (*Oreochromis niloticus* × *O. mossambicus*) showed good growth performance, associated with significantly higher weight gain and better feed conversion. Since, growth and food conversion are influenced by dietary nutrients like protein and higher protein diets are supposed to be expensive for aquaculture operation (Ng *et al.*, 2000; Houlihan *et al.*, 2008; Jobling, 2012). Therefore, dietary protein should be reduced to a minimal level. This minimal level corresponds to 35% with three times a day in the present study. More or less same findings reported by Daudpota *et al.* (2014) who acquired daily WG of 0.83 g at different stocking densities of red tilapia in nylon hapa supplied with pelleted feed containing 35% crude protein. In the present study, survival rate of the red tilapia remained 100% as compared to Nile tilapia i.e, 94%. These results are corroborate the findings of Khan *et al.* (2014). According to them, higher survival rate 83% in genetically male tilapia (GMT) was found when it fed with 40% crude protein. Evidence to support this and the findings of the present study is available in the research of Abid and Ahmed (2009), Ahmed *et al.* (2012) and Tayyab *et al.* (2014) who observed 100% survival of the fish fed 40% protein diet. This indicates that the red tilapia has more survival than Nile tilapia. However, these findings contradict the results of Yildirim *et al.* (2014) who documented 100 % survival at replacing fish meal with peanut meal on 0% and 10% which are similar with the current study while 86%, 93% and 83% on replacing fish meal with peanut meal 20%, 30% and 40%, respectively in Mozambique tilapia diet.

FCR is considered as the best parameter to assess the acceptability of feed and its ultimate performance in fish (Inayat and Salim, 2005). In our study, FCR values were good and not significantly different among treatments. These results were better than the findings of Tayyab *et al.* (2014). In addition, Kalsoom *et al.* (2009) reported higher FCR in another hybrid fish (*Catla catla* × *Labeo rohita*) than our study. Malik *et al.* (2014) got the similar FCR for exotic fish red tilapia cultured in cemented cisterns. The imaginable reason of this variation in good FCR of the current study might have been due to the proper feed supply and availability of some natural feed in water, suitable water temperature and dissolve oxygen. De Silva and Davy (1992) reported that feed digestibility play significant part in lesser FCR by effective feed consumption. Net production of red tilapia was 11.05 (kg/m^3) which is higher than that of Nile tilapia. These results are in agreement with those reported by Daudpota *et al.* (2014). The overall higher growth and survival of red tilapia might be due high resistance as it is hybrid specie or cross breed and more active to intake proper feed within the space.

Water quality parameters in aquaculture practices are those factors which directly affect fish metabolism, food intake and nutritional efficiency (Ertan *et al*., 2015). In the present study, water quality parameters measured in both treatments were found more or less similar and all of them were within the acceptable range for fish

Table III.- Water quality parameters of the experimental tanks throughout the study period.

	Temperature (°C)	D.O (ml/l)	pH	Ammonia (ml/l)	Hardness (ppm)	Nitrite (ml/l)
Nile tilapia	28.4±0.20^{a}	6.5±0.11^{a}	6.8±0.15^{a}	0.46±0.03^{a}	108±2.0^{a}	0.148±0.05^{a}
Red tilapia	28.2±0.20^{a}	6.4±0.11^{a}	6.9±0.15^{a}	0.45±0.03^{a}	106±2.0^{a}	0.151±0.05^{a}
Mean	28.3±0.14^{a}	6.4±0.07^{a}	6.8±0.07^{a}	0.45±0.00^{a}	107±1.4^{a}	0.145±0.03^{a}

Similar superscripts indicate no statistical difference among treatments.

Table IV.- Chemical composition of Nile tilapia and red tilapia reared in concrete tanks.

	Nile tilapia		Red tilapia	
	Initial	Cultured	Initial	Cultured
Moisture (%)	71.28±0.3^{a}	72.08±0.2^{a}	71.17±0.11^{a}	72.07±0.13^{a}
Protein (%)	15.54±0.4^{a}	16.14±0.9^{a}	15.27±0.5^{a}	16.33±0.3^{a}
Lipid (%)	2.44±0.2^{a}	2.43±0.4^{a}	2.45±0.1^{a}	2.47±0.2^{a}
Ash (%)	3.91±0.5^{a}	4.11±0.3^{a}	4.10±0.4^{a}	4.15±0.1^{a}

Similar superscripts indicate no statistical difference among treatment groups.

Table V.- Fatty acid composition of Nile tilapia and red tilapia reared in concrete tanks.

Fatty acids	Nile tilapia		Red tilapia	
	Initial	Cultured	Initial	Cultured
14:0	3.1±0.1^{a}	3.0±0.1^{a}	3.2±0.2^{a}	3.32±0.1^{a}
16:0	21.2±1.1^{a}	21.3±1.0^{a}	20.4±1.2^{a}	20.5±1.0^{a}
18:0	7.1±0.3^{a}	7.2±0.2^{a}	6.5±0.1^{a}	6.6±0.2^{a}
16:1n-7	4.0±0.1^{a}	4.2±0.3^{a}	4.2±0.1^{a}	4.4±0.2^{a}
18:1n-9	11.3±1.1^{a}	11.4±1.3^{a}	14.2±1.2^{b}	14.3±1.1^{b}
18:1n-7	2.1±0.2^{ab}	2.1±0.2^{ab}	2.3±0.2^{a}	2.5±0.1^{a}
20:1n-9	3.1±0.1^{a}	3.0±0.3^{a}	3.4±0.2^{a}	3.5±0.1^{a}
22:0	1.4±0.2^{a}	1.5±0.2^{a}	1.0±0.1^{b}	1.2±0.3^{b}
24:1n-9	1.3±0.1^{a}	1.4±0.2^{a}	0.6±0.2^{ab}	0.6±0.1^{ab}
18:2n-6	3.2±0.3^{b}	3.4±0.1^{b}	4.3±1.1^{ab}	4.5±1.3^{ab}
20:2n-6	0.4±0.01^{a}	0.5±0.01^{a}	0.8±0.02^{b}	0.8±0.01^{b}
20:3n-6	1.2±0.01^{a}	1.3±0.02^{a}	1.2±0.01^{b}	1.2±0.02^{b}
20:4n-6	1.8±0.02^{a}	1.9±0.02^{a}	1.3±0.01^{a}	1.4±0.01^{a}
18:3n-3	00.2±0.002^{a}	00.3±0.002^{a}	00.3±0.002^{a}	00.4±0.002^{a}
18:4n-3	00.5±0.02^{a}	00.5±0.01^{a}	00.7±0.01^{a}	00.7±0.02^{a}
20:4n-3	00.4±0.002^{a}	00.5±0.001^{a}	00.3±0.001^{a}	00.4±0.002^{a}
20:5n-3	02.1±1.0^{a}	02.3±1.1^{a}	01.7±0.7^{ab}	01.8±0.3^{ab}
22:5n-3	01.1±0.01^{a}	01.3±0.02^{a}	00.6±0.01^{b}	00.7±0.01^{b}
22:6n-3	32.0±2.1^{a}	32.0±2.3^{a}	31.3±2.5^{a}	31.5±2.4^{a}
Saturates	31.2±1.6^{a}	31.3±1.3^{a}	30.5±2.0^{a}	30.5±2.0^{a}
Monoenes	23.7±2.2^{a}	23.7±2.2^{a}	26.5±3.0^{b}	26.6±2.0^{b}
n-6 PUFA	6.6±0.1^{a}	6.8±0.2^{a}	8.0±1.1^{b}	8.3±1.0^{b}
n-3 PUFA	37.7±2.5^{a}	37.8±2.4^{a}	34.5±1.2^{a}	34.7±1.3^{a}
PUFA	44.6±3.1^{b}	44.7±3.0^{b}	42.6±2.8^{a}	42.8±2.5^{a}
n-3/n-6	5.4±0.6^{b}	5.5±0.2^{b}	4.2±0.03^{a}	4.3±0.02^{a}

Similar superscripts indicate no statistical difference among treatments.

farming. These values are similar with the findings of Uddin (2002), Daudpota *et al.* (2014), Malik *et al.* (2014), Chughtai *et al.* (2015), Iqbal *et al.* (2014b). Emmanuel *et al.* (2014) and Shah *et al.* (2014).

Considering the whole body composition, protein content in the both species remained at a comparatively stable level. It comes into view that the diet containing 35% protein could provide dietary protein at or slightly above the maintenance level of the fish as suggested by Hung and Lutes (1987), Al-Asgah (1992) and Cho *et al.* (2003). This is also supported by slight increase of body protein in the fish as compared to their body protein before they were put on the experiment (16.1% versus 15.1%). This further suggests that body lipid is the preferred energy reserve for deposition or mobilization over protein in juvenile tilapia which is inveterate by the lower lipid contents of fish whole body. Similar conclusions were drawn by Love (1980), Hung and Lutes (1987) and Hung *et al.* (1993). Storebakken and Austreng (1987) believed the variation in the fat content in salmonids was mainly a direct result of appropriate dietary protein level. Likewise, Shimeno *et al.* (1997) while studying the metabolic response to ration level in common carp (*Cyprinus carpio*), mentioned that the activities of pentose phosphate cycle dehydrogenases, glucose-6-phosphate dehydrogenase and phosphogluconate dehydrogenase were most susceptible to nourishing level. According to him, these rapid actions together with the body fat content obviously increased as food level increased.

In the current study, no statistically significant differences in moisture and crude lipid contents were found among both fish species, though moisture content showed a clear inverse relationship with crude fat contents (Rigos *et al.*, 2011; Oh *et al*., 2013; El-Husseiny *et al.*, 2013; Mongile *et al*., 2014; Huang *et al*., 2014; Han *et al.*, 2014). In this study, whole body composition including EPA and DHA remained consistent and similar to the recommended values (Tocher, 2003; Mourente and Bell, 2006; Morkore, 2006; Karalazos *et al*., 2011; FAO, 2012). In this study, the combined values of DHA and EPA are higher than the requirement reported for other fishes (Hossain *et al.*, 2011).

In conclusion, the growth, survival and production of hybrid red tilapia is greater than Nile tilapia specie, and have more resistance against Nile tilapia, also have ability to grow fast at high density and due to these qualities this specie will be more profitable in promotion of aquaculture in Pakistan.

Conflict of interest statement

None declared.

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