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Evaluation of the Growth Performance, Body Composition and Survival Rate of Juvenile Snakehead (*Channa marulius)* Fed on Different Feeds

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Authors' Contribution
GA concieved and designed the study and wrote the mansucript. Hameeda K did experimental work and AM and Haleema K helped him. SAS analysed the data. IBX edited the mansucript.

Key words
Snakehead, Channa marulius, Growth, Feed conversion, Body composition.

ABSTRACT

This research was done to determine the influence of various feeds on growth increment, body constituents and survival rate of snakehead (*Channa marulius*) cultured in plastic tanks (42.5 liters water carrying capacity each). Fish juveniles (length: 10.63 ±0.980 cm, weight: 9.030±1.40g) were stocked after acclimatization. A total of 3 treatments were tested following 2 replications i.e. first treatment (T_1, Squid feed), second treatment (T_2, Tubifex feed) and third treatment (T_3, pellet feed). Juveniles were fed with 5% of total biomass twice in a day. At the end, higher growth increments were found such as length and weight in average, T_1=15.01±0.33cm and 15.80±0.01g, T_3=14.13±0.76cm and 13.35±0.67g whereas in T_2=11.80 ± 0.96cm and 10.47±1.19g lower growth were found. Specific growth rate (SGR) were obtained 1.160, 0.960 and 1.110 in T_1, T_2 and T_3 individually differing statistically from all treatment groups. Similar situation was found in values of the condition factor which remained as 0.610, 0.720 and 0.620 for T1, T2 and T3, respectively. Feed conversion (FCR) were found to be non-significant among all treatments (P>0.05). Survival rate were 90% in T_1 which was highest than T_2 (50%) and T_3 (80%). Water quality remained as temperature (25.2 ± 0.20 °C), dissolved oxygen (5.2 ± 0.11mg/L), pH (6.9 ± 0.15), ammonia (0.48 ± 0.02 1mg/L) and hardness (118 ± 2.4 mg/L). Our results indicated that better growth increment can be achieved on squid or pellet feed and so it is suggested that in similar culture conditions of Snakehead will be more profitable on pellet feed followed by squid feed.

INTRODUCTION

Aquaculture plays an important role not only in meeting demand for meat, it is also exclusively recognized as the fastest food producing industry. It contributes more than 19 million tons yearly through aquaculture (Baruah *et al*., 2004; Iqbal *et al*., 2014). Aquaculture industry offers a huge amount of protein in the shape of fish-meal, which is used as a food for aquatic animals, providing income source for coastal population of less developed countries. This industry also plays an important role in enhancing the earning source for the fishermen (Iqbal *et al*., 2014; Soto-Zarazua *et al*., 2010; Suloma and Ogata, 2006).

The snakehead (*Channa marulius*) is extremely meat-eating predatory inland water teleost which is commonly spread in Asian as well as African countries. Channa species can flourish in lentic and lotic water bodies and also in weed crowded narrow and less oxygenated water due to the presence of accessory breathing organs; they are the best and admirable table size fish in the South East Asian countries (Zakaria *et al*., 2007; Cruz *et al*., 1980). This specie is popular in Pakistan due to its delicious taste and recovering qualities for ill and weak people physically and mentally (Hafeez-ur-Rehman *et al*., 2017; Khanna, 1978). This specie have acceptable white meat having non intra-muscular skeletons and is believed that this contains curative and strength-giving elements, and is therefore particularly provided to old people and those in recoveries (Ling, 1977; Yakoob and Ali, 1992). However, this specie is carnivore in feeding nature but easily can eat and digest

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foods prepared from various plant by-products with high protein contents. It could be fruitfully culture in mono as well as in polyculture system with indigenous fish species (Hafeez-ur-Rehman *et al*., 2017). Whereas in monoculture, this species can be reared on huge quantities because off air breathing ability surviving at low oxygen levels (Singh *et al*., 1986). Snakehead farming is appreciated when its seed is available particularly during monsoon (Hanifa *et al*., 2000; Marimuthu *et al*., 2001a, b; Mollah *et al*., 2009). Mostly, the snakehead culture on commercial basis depends on wild fry, which are formerly proficient to agree for taking compound feed manufactured from fish meal and plant by products like rice bran or wheat flour (Diana *et al*., 1985; Kulachi *et al*., 2014). In Pakistan, Snakehead is considered as market value target species into the aquaculture system, being indigenous and having potential to survive under variety of stressful freshwater conditions. Nothing has been done on Snakehead culture to encourage its aquaculture practices. Therefore, this study was carried out to investigate appropriate diet for best growth of *Channa marulius* fingerlings reared in captive environment.

Table I.- Ingredients of fish test diet (dry matter basis).

Ingredients (%)	g 100 g^{-1} diet (dry)
Fish meal	34.4
Wheat brawn	16.1
Rice brawn	11.2
Mustered oil cake	12.8
Wheat flour	20.1
Vitamin-mineral premix[1]	2.4
Fish oil	3.0

[1]Abbas and Siddiqui (2013); Dry matter basis (%): mean ± SE, number of determination = 3.

MATERIALS AND METHODS

The present study was started from 10th October 2014 to 26th November 2014 in plastic tanks (42.5 liters of water holding capacity) in the laboratory of Freshwater Biology and Fisheries, University of Sindh. There were three treatments having two replicates. Three different feeds *i.e.* Squid meat obtained from the Karachi Fish Harbour, Tubifex feed obtained from the Ornamental Market Karachi and pellet feed was formulated using ingredients purchased from the Local Market of Jamshoro (Table I). Two replicates of each treatment were stocked with 60 fingerlings (10.63 ±0.98 cm, 9.03±1.4g). The fingerlings of Snakehead were collected from the wild, acclimatized for one week before stocking into the experimental tanks. After that juveniles were equally distributed in experimental tanks; all tanks were cleaned with $KMnO_4$. Tanks were covered with net to stop escaping out and artificial oxygen was provided through aeration into the tanks. Fish were fed 5 percent of total biomass two times in a day (09.00 and 14.00) for 48 days. Pelleted feed was formulated and organized from indigenous available ingredients such as fish meal (FM), mustard oil-cake (MOC), groundnut (GN), rice bran (RB), wheat bran (WB), wheat flour (WF) and vitamin premix were crushed and sieved with net having 0.5 mm mesh size. After weighing ingredients according to formula, all ingredients were homogenized and passed from pelleted machine to make with 1 mm diameter pellet. The chemical composition of test diets is shown in Table II. Feed was offered daily and after 2 h uneaten feed was siphoned. The daily ration was reset appropriately after each sampling. Subsequently, all experimental tanks were cleaned properly at the time of sampling. Length size of experimental fish were calculated with the help of a foot scale in cm. The weight increment was calculated through moveable electric weight machine model (AK-3000H AFD) nearest 1 g. Water quality of the experimental tanks was monitored daily according to Boyd and Tucker (1992).

Table II.- Nutritive value of experimental diet used for Snakehead, *Channa marulius* juveniles for 48 days rearing period.

Parameters	Squid	Tubifex	Pellet
Crude protein	76.1±0.8	52.0±0.4	39.7±0.3
Crude lipid	2.7±0.2	---	5.7±0.2
Crude fiber	---	2.0±0.1	5.8
Crude fat	1.2±0.1	12.0±0.2	---
Moisture	---	5.0±0.1	7.0
Ash	1.3±0.2	12.0±0.1	7.1±0.3
Minerals	1.9±0.1	---	---

Data calculations/analysis

ANOVA was applied for determination of relative increment in growth and surviving percentage of Snakehead, *Channa marulius* juveniles. These are followed by statistical analysis through Duncan test at 95 % confidence level.

RESULTS

The parameters of growth increment were shown as weight gain (WG), average daily weight gain (ADWG), specific growth rate (SGR), food conversion ratio (FCR),

survival rate (SR) and condition factor (CF) in Table III. Fish growth varied among all treatments. Higher growth in relation to increase in length and weight was found in T_1 and T3 (Fig. 1A, C), while growth of fish was lower in T2 (Fig. 1B). SGR was recorded as 1.160, 0.960 and 1.110 in T_1, T_2 and T_3 individually which were different among all treatment (P<0.01). Condition factor remained similar among treatments. Similar condition was found in the values of FCR. The rate of survival was found different in all treatments (P<0.01). Maximum percentage of survival was obtained in T_1 (90%) fed upon squid feed than T_2 (50%) and T_3 (80%) which are significantly different from each other (P<0.05).

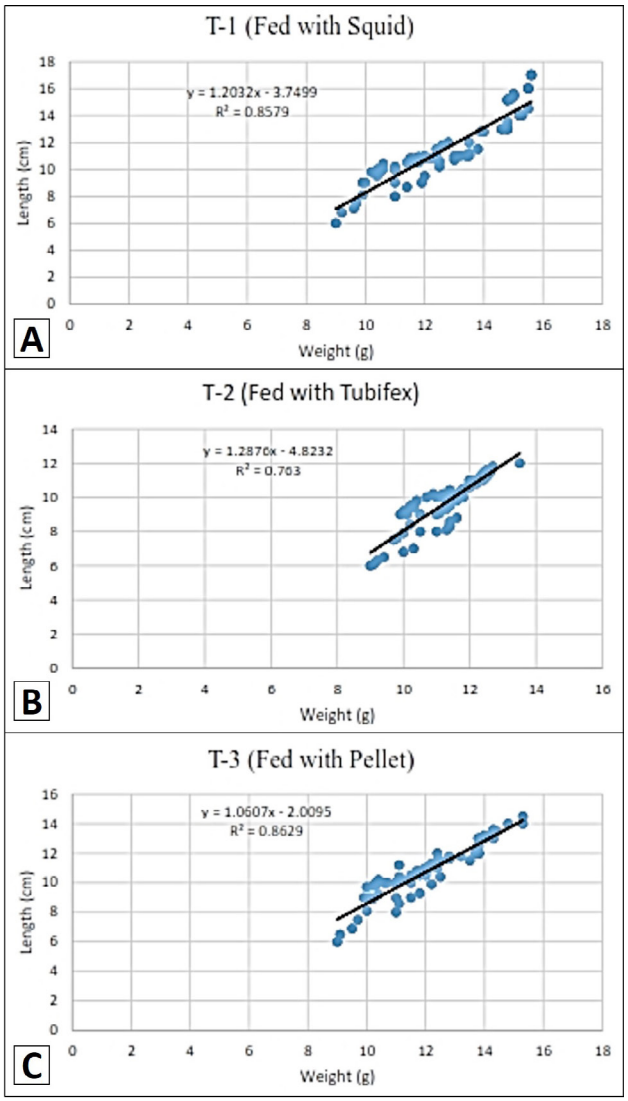

Fig. 1. Regression on the length and weight of snakehead (Channa marulius) juveniles fed with squid (A), Tubifex (B) and pelleted feed (C) for 48 days.

Table III.- Growth parameters of snakehead (*Channa marulius*) fish reared for 48 days.

Parameters	Diets		
	T1 (Squid)	T2 (Tubifex)	T3 (Pellet feed)
Mean final weight (g)	15.8±0.70[a]	10.47±1.18[b]	13.35±0.66[c]
Mean final length (cm)	15.0±0.33[a]	11.81±0.95[b]	14.13±0.75[c]
Weight gain (g)	6.77 ± 0.0[a]	1.44 ± 0.0[c]	4.32 ± 0.0[b]
ADWG	0.35 ± 0.0[a]	0.22 ± 0.0[c]	0.28 ± 0.0[b]
SGR	1.16±0.01[a]	0.96±0.02[b]	1.11 ± 0.01[a]
FCR	0.4 ± 0.0[a]	0.4 ± 0.0[a]	0.4 ± 0.0[a]
Survival rate (%)	90 ± 0.01[a]	50 ± 0.02[c]	80 ± 0.02[b]
CF	0.61±0.13[a]	0.72 ± 0.05[b]	0.62 ± 0.11[a]

Values in mean ± SE, n=2 and each n consists of 10 fish per replicate) in the same row with different superscripts are significantly different (P>0.05). Initial bodyweight and lengthof the fish was 9.03±1.4g and 10.63 ±0.98 cm, respectively. WG = Mean final weight–Mean initial weight. ADWG = Fresh WG in fish (g)/Culture period (days). FCR=Wet WG / Dry FI x 100. SGR = Log final weight–Log initial weight×100/ Culture period in days. SR = Final number of fish/Initial number of fish x100. CF = final weight/final lenght^3 x 100.

Table IV.- Whole body composition (% dry weight basis) of Snakehead, *Channa marulius* juveniles fed at different feeds for 48 days.

Parameters	Squid	Tubifex	Pellet
Protein content	21.5±0.4[a]	20.9±0.5[b]	21.4±0.3[a]
Fat	17.3±0.2[a]	17.1±0.3[a]	17.2±0.2[a]
Moisture content	51.4±0.7[a]	50.6±0.5[b]	51.3±0.6[a]
Ash	7.67±0.3[a]	7.52±0.4[b]	7.66±0.3[a]
Crude Fiber	0.04±0.01[a]	0.02±0.01[c]	0.03±0.01[b]

Whole body composition (% dry weight basis) were analysis, protein contents were not significantly (P>0.05) affected with squid and pellet feed and significantly affected on tubifex feed (Table IV). Moisture content of fish fed on squid and pellet were not significantly affected (P<0.05) and affected fed on tubifex. Fat, ash and crude fiber were not significantly different affected on different feed.

Water quality parameters were determined throughout the experiment were found non-significant among all treatments, P>0.05; temperature of the water, 25.2 ± 0.20 °C, concentration of dissolved oxygen was 5.2 ± 0.11mg/L, pH was 6.90 ± 0.15, ammonia concentration was 0.48 ± 0.021mg/L and water-hardness were found 118±2.4 mg/L (Table V).

Table V.- Water quality parameters of the snakehead (*Channa marulius*) fish reared for 48 days.

Treatments	Parameters				
	Temperature (°C)	Dissolve Oxygen (mg/L)	pH (mg/L)	Ammonia (mg/L)	Hardness (mg/L)
T-1 (Squid)	25.2 ± 0.20[a]	5.2 ± 0.11[a]	6.9 ± 0.15[a]	0.42 ± 0.03[a]	116 ± 2.0[a]
T-2 (Tubifex)	25.1 ± 0.17[a]	4.9 ± 0.25[a]	7.4 ± 0.20[a]	0.48 ± 0.02[a]	120 ± 2.6[a]
T-3 (Pellet)	25.3 ± 0.14[a]	5.1 ± 0.26[a]	7.6 ± 0.15[a]	0.50 ± 0.03[a]	118 ± 2.4[a]
Mean values	25.2 ± 0.17[a]	5.1 ± 0.2[a]	7.3 ± 0.16[a]	0.46 ± 0.02[a]	118 ± 2.3[a]

Similar superscripts indicate no statically difference among treatments.

DISCUSSION

Chana marulius locally called Chitto Shakur or Chitti Mondhi, is highly carnivore in feeding habit and been identified cannibalistic fish by several researchers (Sonawane *et al*., 2012). It has also been documented that carnivorous fish require high protein diet as compared to herbivore fish (Ashraf *et al*., 2011; Wee, 1982). Findings of the present study presented maximum growth-increment like mean weight, WG, mean WG per day and SGR percentage were presented in T_1-meat of squid and T_3-Pellet feed, whereas lower growth-increment observed in T_2 fed on Tubifex. These outcomes are parallel with outcomes of Srivastava *et al*. (2012) and Mohanty and Samantaray (1996). They obtained higher growth increment of *Channa striata* fry fed with formulated feed. Similar results have found on juveniles of *Channa striata* (Srivastava *et al*., 2012; Giri *et al*., 2003; Wee, 1986), milk fish, *Chanos chanos* (Srivastava *et al*., 2012; Lim *et al*., 1979), *Channa micropeltes*, (Srivastava *et al*., 2012; Wee and Tacon, 1982), Common carp, *Cyprinus carpio* (Ogino and Saito, 1970), *Icthalurus punctatus* (Prather and Lovell, 1973) *Epinephelus tauvina* (Teng *et al*., 1978), and tilapia *S. mossambicus* (Jauncey, 1982). In the current outcomes, highest survival rate *i.e.* 90 % and 80% fed with squid meat and pellet feed was detected respectively whereas lower survival rate *i.e.* 50 % was found with tubifex feed these results are in contrast with the results of Giri *et al*. (2003); they found maximum survival rate of Jarko or Mallee fish larvae fed on natural food and dry food. Significant death rate and poorest growth rate were found in those fishes which were supplied with plankton. It was generally observed that the sluggish growing fish are omnivorous and rapid growers are carnivorous (van Densen, 1985; Jesu *et al*., 2001). It is recognized that higher cannibalistic character present in *Channa* species at all ages of life and due to this main cause, less survival rate was recoded throughout their culturing (Ng and Lim, 1990). According to Diana *et al*. (1985), in cannibalism though shooters have ability to target on 2 to 3 inches size feed conversion ratio (FCR) was non-significantly different for all treatment groups. These findings contradict with the outcomes reported by Daudpota *et al*. (2014) and lesser as compared with the values stated by Das and Ray (1989), Islam (2002), Islam *et al*. (2002) and Matjais *et al*. (1994). Qin and Fast (2003) reported that snakehead fed with compound feed required 1.0. Feed conversion ratio value which is higher than those gained in this study. The values of K were significant in second treatment and lower in first and third treatments. These outcomes are lesser than the findings of Malik *et al*. (2014, 2017), Shah *et al*. (2014), Daudpota *et al*. (2014) and Moreira *et al*. (2008). The parameters regarding water quality were observed in the range of acceptable values for warm water fish farming and similar with pervious results of Shah *et al*. (2014), Daudpota *et al*. (2014), Hannibal (2011), Narejo *et al*. (2010) and Wee (1982).

In the light of present finding that the effects of different feeds on Snakehead, *Channa marulius* body-composition, protein-content in fish flesh remained at a relatively stable level. It comes into view that the lowest frequency could provide dietary protein at or slightly above the maintenance level of the fish as recommended by Hung and Lutes (1987), Mehboob *et al*. (1996), Michelle *et al*. (2004), Qin and Fast (1997) and Cho *et al*. (2003).

CONCLUSION

In the present study, highest growth increment was achieved with squid meat. Thus, it is recommended that for commercial scale this species can be culture on pellet feed would be cost effective and more profitable than culture on the feed of squid meat.

Statement of conflict of interest

Authors have declared no conflict of interest.

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