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GROWTH EVALUATION OF TILAPIA (*OREOCHROMIS NILOTICUS*) REARED IN FULLY CONTROL SYSTEM

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M.Y.L planned this idea, P.K.L evolved the growth rate, S.R analyzed the results, T.S wrote the manuscript, H.I analyzed the data, N.T.N revised the manuscript and A.R.K finalized the result for submission.

Key words:
Concrete pond, Growth, High density, Tilapia.

ABSTRACT

Tilapia (*Oreochromis niloticus*) was reared in a fully control system to evaluate the growth performance. A trial of the experiment was conducted for the period of one year (May to April) in cemented pond having an area of 40,000 ft^2 and filled up to one foot with water. Hence, 100,000 fingerlings of tilapia (*O. niloticus*) with the mean initial weight of the 10 ± 2.1 gram were stocked within a volume of 40,000ft^3 of water. The fish were fed with plant origin formulated pellet consisting 19% protein, prepared from rice by-product. All the essential water quality parameters including dissolved oxygen, temperature, pH, TDS, conductivity, salinity and NH_3 were measured and maintained in the required range. Fish were harvested with a mean final weight of 520 ± 80.2 gm; with an average final weight gain of 510 ±78.1. During the study, the survival rate was recorded 99% with specific growth rate (SGR) 0.47% per day. In result, a production of 51,480 Kgs was obtained from 40,000ft^3 of water. Hence, tilapia can be cultured in a control system to produce maximum production by utilizing a minimum area.

1. INTRODUCTION

Aquaculture is efficient mean of animal protein through extensive and intensive systems [1]. As increasing fish demand for human consumption and decreasing production of fish in natural water, fish farming and fish production from culture fisheries is essential [2]. There are many commercial fishes in our country, out of them tilapia is very easily cultivable fish for its taste, fast growth, resistance to poor water quality, tolerance to a wide range of environmental conditions, ability to convert efficiently organic, domestic and agricultural waste into high-quality protein, easy to intensive culture and suitable market value [3]. Out of 70 species of tilapia 9 are used in farming and of these, Nile tilapia (*O. niloticus*) is the main targeted species. Tilapias are native to Africa and the Middle East. The farming of tilapias in its crudest form is believed to have originated more than 4000 years ago from Egypt. The first record of the scientifically oriented culture of tilapia was conducted in Kenya in 1924 and soon spread throughout the Africa [4]. Three species of tilapia belonging to genus *Oreochromis* were introduced in Pakistan in the year 1951, 1954 and 1985 from Indonesia, Thailand and Egypt for stocking in brackish water, lakes and ponds [3]. In the heavily stocked and artificially fed fish ponds, many problems like organic pollution, deficiency of oxygen, increased level of free carbon dioxide and the total increase in the ammonia-Nitrogen ratio is frequently occurring. Aeration is a better way to get rid of them [5], [6], [7], [8] the reported that aeration system is one of best methods to oxidize ammonia to nitrate to adjust pH and to volatize the ammonia. Dissolved oxygen is one of the most important parameters and primary limiting factor controlling the growth and survival of fish [9], [10], [11], [12]. Proved that emergency aeration is the best technique for preventing fish kills during the dissolved oxygen crises. In the Pakistan, pond aeration is not so common and most developed; keeping in view the economic importance of pond aeration in high density and supplementary feeding; present study

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was carried out to determine growth and survival of fish under control system in the aerated pond. Feed is the essential input for the culture of any aquatic species. In formulating the diet for fish and shellfish, low-cost feed ingredients are generally used to compose appropriate cost effective feed [13]. The present study is the first attempt to stock tilapia at high-density and low volume in fully intensive culture to study the survival, growth, and acceptability of artificial diet under captive conditions in Pakistan.

2. MATERIAL AND METHODS

Field studies
A 12 months experiment was conducted in a concrete pond with a volume of 40,000F^3 (200×200×1 Ft) at Habib Aquaculture and Research Center, Hub. Water was supplied from Hub River

Seed production and stocking
Fingerlings of Nile tilapia (*O. niloticus*) were produced at fish hatchery Habib Aquaculture and Research center. Pond having stocking density of 100,000 fish/acre (about 5 fishes per $2F^3$) of Tilapia (*O. niloticus*) (Table 1).

Monitoring of Physico-chemical parameters
Water quality parameters like Dissolved Oxygen (DO) and temperature during the experiment were recorded on daily basis at 9:00 AM, 3:00 PM and 9:00 PM. The temperature was recorded on the spot by a mercury thermometer. DO was measured daily by digital oxygen meter (WTW Oxi 315i/SET # 2B10-0017 Germany) and also confirmed by titration method (Winkler's method). Other parameters like pH, TDS and salinity were recorded by the conductivity meter (WTW Cond 315i/SET # 2C10-0011 Germany), while the ammonia (NH_3) was analyzed by ammonium kit on monthly basis.

Maintenance of fish pond
The pond was served as artificially aerated. Four paddle wheels aerator (PA-112 T 2HP (1400RPM), manufactured by Pioneer A.E Co. Taiwan), were installed at every corner of the pond. Paddle wheels (aerators) were operated from 6:00 pm to 8:00 am regularly to maintain the DO and reduce the suffocation and exhaust other harmful or poisons gases from the pond. Aeration was also done by the help of Blower 20 HP (18.5AMPS) (3500RPM) (vertical pump diffuser) in emergency. The aeration line from the blower was fixed across the pond. Sand filter and bio filter also proved beneficial to increase the oxygen contents in the water and release the other gases; hence we got rid of suffocation. Water was exchanged every month during January and February, fortnightly during March and April; and weekly during remaining all over the study period. Freshwater was supplied from the reservoir (Filled by Hub Dam) and was drained by gravity. The depth of the water was maintained up to 15 cm from January to April and then it was increased up to 45 cm till December.

Feeding and sampling method
The feed was (with 20% crude protein) supplied thrice a day in the feeding trays ($2ft^2$ in size) in the morning (9:00 AM), at noon (12:00 noon) and in the evening (at 3:00 PM) at rate of 6% of the body weight for initial three months and then feeding rate was reduced to 4% for the rest of the period. The feed was supplied in 16 feeding trays; four trays on each side nearby the wall of the pond were installed. A sampling of experimental fish was carried out monthly. Sampled fish were weighed on an electronic balance (model AFD-3000B, Korea) with the help of plastic bucket. Tilapia and common carp were sampled every 100 numbers while 50 number each were used for other fish species randomly.

Waste removal method
The residue of feed and waste, excreted by fish, were removed by siphoning method. The pond was siphoned by four hose pipes of dia 3.5 cm, by gravity and some time by sucking pump, from 9:00 AM to 3:00 PM as per routine. About 38880 liters (8640 gallons) was siphoned for waste purpose daily. Suspension of the water was also removed by filtration. The filtration system was consists of a sand filter (25 × 25ft size, with the help of submersible pump 7.5 HP-1450 RPM) and Biofilter.

3. RESULTS

Growth under high density
The average maximum growth of tilapia was recorded 520gm, while the maximum weight of tilapia was recorded 1000 gm (1kg). While survival rate remained the 99% with SGR 0.47 per day (Table 1).

Water Quality Assessment
The water quality assessment was carried out throughout the study period by draining and supplying fresh water so that the physico-chemical parameters of the experimental pond showed much variation. Dissolved Oxygen (DO) was maintained by aeration, with the help of aerators and paddle wheels throughout the experimental period. Mean maximum DO was observed 7.22 mg/L in the month of June and minimum 4.92 mg/L in the month of March

(Table 2). It was noticed that the mean lowest DO (3.53 ppm) found during the evening in the month of October while highest (11.22 ppm) was observed during the afternoon in the month of June during the study period. During the experimental period, there was also a significant ($p>0.05$) fluctuation in temperature, even temperature remained high at night time because of absorption of heat in concrete. The high temperature was found 36^0C in the June at 3:00 PM and low 18^0C in December at 9:00 AM. The mean values of temperature throughout the study period ranged 33^0C-20^0C (Table 2). Other parameters like pH, Total Dissolved Solids (TDS), Conductivity and Salinity were found as high as 8.7, 1000, 2040, 10 and low as 7.2, 200, 380 and 2 respectively during the study period.

Table 1- Growth, survival and production of Tilapia (*Oreochromis niloticus*) at Low Volume High Density (LVHD) over a period of 12 months at Habib ADM (Ltd) Hub, Balochistan.

Parameters	Tilapia
Stocking density/acre	100,000
Mean Initial weight (g)	10 ± 2.1
Mean Final weight (g)	520 ± 80.2
Mean Weight gain (g)	510 ±78.1
Weight gain%	5100
SGR% (per day)	0.47
Survival rate %	99
Production(Kgs)/acre/year	51480

Table 2- Mean values of various physiochemical parameters as observed throughout the study period at Habib ADM (Ltd) Hub, Balochistan.

Month	pH	TDS mg/L	Cond µS/cm	Salinity ppt	NH_3	Temp ^{0}C	DO mg/L
Jan	7.7	200	380	2	0	25	5.36
Feb	7.5	300	570	2	0	28	5.88
Mar	7.7	200	400	3	0	28	4.92
Apr	7.2	900	1900	5	0	29	6.12
May	7.8	650	1200	4	0	31	5.65
Jun	8.1	300	550	3	0	33	7.22
Jul	8.2	1000	2040	10	0	31	6.31
Aug	7.2	900	1900	10	0	29	5.14
Sep	8.7	300	570	3	0	30	5.02
Oct	8.6	280	450	3	0	30	6.01
Nov	7.5	500	1020	4	0	27	6.01
Dec	6.8	400	750	3	0	20	6.04

*(TDS =Total Dissolved Solids, Cond = Conductivity, NH3= Ammonia, Temp = Temperature, DO = Dissolved Oxygen)

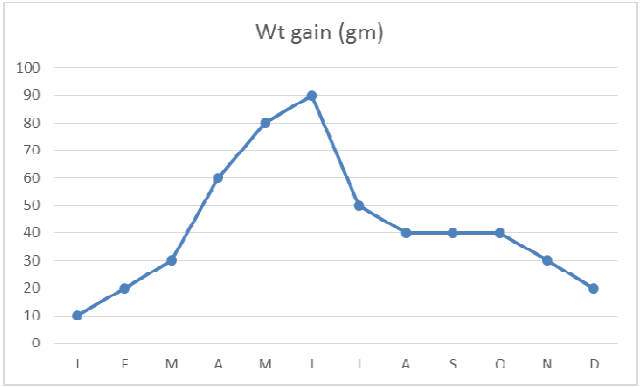

Figure 1- Graph shows growth (weight gain in gram) per month of Tilapia.

4. DISCUSSION

The aim of the aquaculture is to produce as much marketable fish as possible from given volume of water in the shortest period and at the cheapest cost. Large areas from 50 to 2000 acres are difficult to control and monitor, while water, labor, and security is the main problem during the look after. At present average stocking around 400 fish per acre is practiced in Pakistan, Bangladesh and India. In Asia, the intensive culture of tilapia in concrete tanks practiced in the Taiwan, Malaysia, and the Philippines. Taiwan is the pioneer in the region for the intensive culture of tilapia in concrete tanks and produces over 50,000

tons annually [14]. It was observed that growth of tilapia at initial day was fast, while the maximum growth rate was observed up to 5th and 6th month of the experiment after that growth rate had been decreased (Fig.1). In the present study, tilapia was stocked at the rate of 4 fishes per 5 cubic ft of water and yielded around 51.48 tons per year/acre in the concrete pond. The fish production obtained through the results of the present study is similar as reported by [14] in tilapia from the Taiwan. In the present study, Nile Tilapia (*O. niloticus*) was found to be a fast-growing species (520 g) under high density and low volume. Various workers like [15], [16], [17], [18], [19] commented that the Nile Tilapia is considered as prime species for culture in tropical and subtropical regions, due to its fast growth and adapts to a wide range of environmental conditions. The comments of the above authors support the findings of present study. In the present study, survival rate of tilapia was found 99% fed with (19% protein) pelleted feed. [20] Reported 98% survival rate of tilapia fed with formulated feed from Vietnam. This confirms the present findings. In the present study, fluctuation was observed in various water quality parameters. DO was high (7.22ppm) during the month of June and low (4.92 ppm) in March. Reported high DO (5.6) during February and low (4.1) in July from Bangladesh [20, 21]. This is more or less similar to the present findings. The slight variation in DO might be due to different environmental conditions of the two countries. During the present study highest 33^0C and lowest 20^0C water temperature was recorded during June and December respectively. Similar observation on Temperature, DO, Salinity, Conductivity and TDS have been reported by [22] from Thar reservoir, District Tharparker Sindh, Balochistan, Pakistan. In the present study, the range of TDS 200-1000µS/cm was recorded during January and July respectively. Leghari *et al*., [23] reported the range of TDS 600-1214 mg/L from wastewater of Latifabad, Hyderabad. These ranges of TDS reported by [23] more or less similar to the present study and within the suitable range.

5. CONCLUSION

It can be stated that the scientifically designed fish farms, adoption of tilapia production system by the farmers would enhance the profitability of Nile tilapia farming in Pakistan. This would contribute significantly to placing Nile tilapia farming and marketing on a sound footing and establishing it as growing industry. Establishing a local feed industry, to fulfill the requirements of the farmers for good quality feed at a relatively low price, in order to decrease production cost and increase the profitability of the farmers. Furthermore, the various water bodies which are otherwise unsuitable for the culture of our endemic species can be made productive by introducing Nile tilapia. Hence, Nile tilapia (*O. niloticus*) can prove to be an important commercial and economical fishery in Pakistan. The present study also suggests that tilapia can be stocked maximum period of six months, because after that period growth rate is decreasing, which might be not economically feasible for culture. Results from this study indicate that using the appropriate formulated diets as feed for Nile tilapia in intensive culture is profitable in Pakistan.

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7. CONFLICT OF INTEREST

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

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