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COMPARATIVE STUDY ON LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR BETWEEN HORMONE TREATED AND NON-TREATED TILAPIA (*Oreochromis niloticus*)

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Abstract

The present study comparing the Length-Weight relationships and condition factor of Hormone Non-Treated (HNT) and Hormone Treated (HT) tilapia (*Oreochromis niloticus*) for 99 days from the May 5 to August 12, 2014 in different cages of pond at Sylhet Agricultural University. There were two treatments with six replications each where HNT stocked in treatment I and HT stocked in treatment II with same stocking density. Length and weight were taken randomly collected 16 individuals from each of the cases at 15 days interval throughout the study period. The length-weight relationships of HT and HNT were found Log W=-2.140194+1.196176 Log L and Log W=-2.111263+1.179839 Log L, respectively where the exponential value (b) for HT and HNT were 1.20 and 1.18. The growth trends were found to be allometric type from the present investigations both in HT and HNT. The coefficient of determination (r^2) value found 0.9411 and 0.9294 respectively in HT and HNT tilapia. The values of condition factor (K) found to vary from 2.101-2.267, and 1.870-2.263; for HNT and HT respectively, and the mean values of the condition factor recorded for HNT and HT were 2.165 and 2.116, respectively. The present study concluded that performance of HT and HNT tilapia is almost same within three months of research.

Keywords: Hormone treated and non-treated tilapia

Introduction

Tilapia (*Oreochromis niloticus*) is a bony fish which belongs to the family Cichlidae and they are commonly referred as tilapias. Tilapia can be broadly classified into three subgenera which are mainly the *Tilapia*, *Sarotherodon* and *Oreochromis* species, the latter two being mostly mouth brooders (Pauly and Gayanilo, 1976). The family Cichlidae is highly diversified with a wide area of distribution spreading across Africa and most parts of India and Ceylon (Balarin, 1979). Nile tilapia *Oreochromis niloticus* is an African native fish found versatile in the rivers and lakes. It is a relatively large cichlid fish, which is native to Africa from Egypt to Central Africa, and as Far West Gambia. Among the wide varieties of cultured tilapia the most widely farmed stock is the Nile tilapia (*Oreochromis niloticus*). The introduction of tilapia in Bangladesh was first initiated in 1954 with *O. mossambicus* from Thailand (Ahmed, 1956). However, in 1987 a fresh batch of tilapia was imported by Bangladesh Fisheries Research Institute (BFRI) from Thailand.

Cage culture of fish is defined as the raising of fish from fry to harvestable size in containers (cages) enclosed on all sides and bottom by wooden stalls, hard wire cloth, net or other materials that allow free circulation of water in/and out of the cages (Schmittou, 1969). Raising fish in cages is a successful system used in many parts of the world. Its advantages are well recognized and it is widely spread all over the globe as well as in Bangladesh.

Tilapia could easily be identified by dark bands or stripes found on their bodies which are most prominent in mature form. They inhabit freshwaters and water bodies of low salinity to wide range of salinity. Knowledge of length-weight relationship, condition factor and relative condition factor is very much important for sustainable fisheries management. Length-weight data are essential for estimating growth rate, age structure, recruitment, mortality, and other aspects of fish population dynamics (Hossen, 2012). Length-weight relationships give information on the condition and growth patterns of fish (Bagenal and Tesch, 1978). Fish can attain either isometric growth, negative

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allometric growth or positive allometric growth. Fish are said to exhibit isometric growth when length increases in equal proportions with body weight for constant specific gravity. The regression co-efficient for isometric growth is '3' and values greater or lesser than '3' indicate allometric growth.

The condition factor which show the degree of well-being of the fish in their habitat is expressed by 'coefficient of condition' also known as length–weight factor. This factor is a measure of various ecological and biological factors such as degree of fitness, gonad development and the suitability of the environment with regard to the feeding condition (Mac Gregoer, 1959). When condition factor value is higher it means that the fish has attained a better condition. The condition factor of fish can be affected by a number of factors such as stress, sex, season, availability of feeds, and other water quality parameters (Khallaf *et al.* 2003). Condition factor also gives information when comparing two populations living in certain feeding, density, climate, and other conditions when determining the period of gonad maturation, and when following up the degree of feeding activity of a species to verify whether it is making good use of its feeding source (Bagenal and Tesch, 1978; Oni *et al.* 1983; Anene, 2005; Kumolu-Johnson and Ndimele, 2011; Abowei, 2010). The condition factor was determined from observed total weights and calculated weights.

However, not much work has been done on the condition factor and length-weight relationship or well-being of fishes in privately managed fish ponds (closed water bodies) especially cage culture system at the fry stage to marketable size of development. The present study has been undertaken to determine the length-weight relationships of hormone treated and hormone non-treated tilapia as well as to know the condition factor of hormone treated and hormone non-treated tilapia.

Materials and Methods

Location and duration of the study

The study was conducted in cage culture from 05 May to 12 August 2014 at Sylhet Agricultural University Campus pond to observe length-weight relationship and condition factor between hormone treated and hormone non-treated tilapia (*Oreochromis niloticus*).

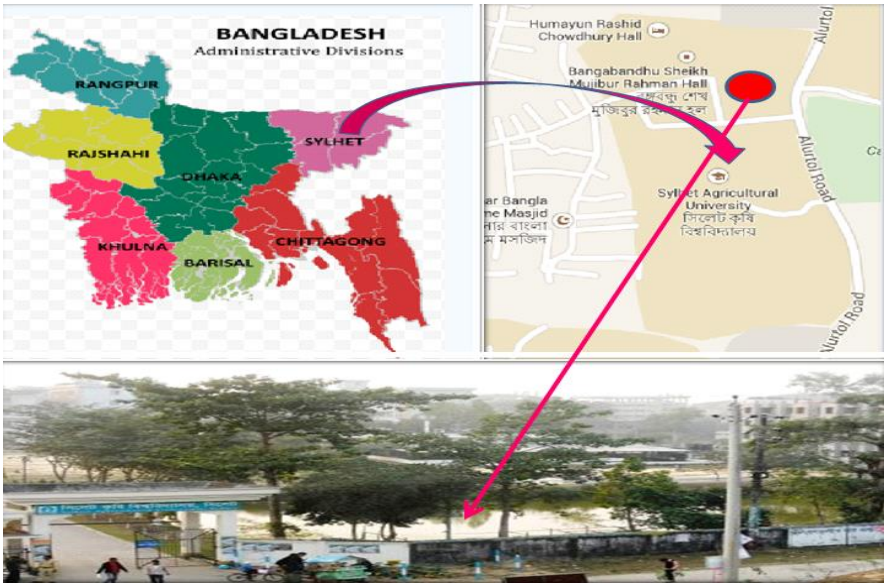

Fig. 1. Geographical showing of the study pond at Sylhet Agricultural University, Bangladesh.

Stocking and feeding of fry in each cage

The experiment consist of 2 treatment i.e. hormone treated (T_2) and hormone non-treated (T_1) and each treatment were 6 replication total 12 replications i.e. T_1R_1, T_1R_2, T_1R_3, T_1R_4, T_1R_5, T_1R_6 (hormone non- treated) and T_2R_1,

T_2R_2, T_2R_3, T_2R_4, T_2R_5, T_2R_6 (hormone treated) respectively. The stocking densities were maintained in each cage 105 fry. Total fry were in 6 cages (105*6) =630 (HT) and another 6 cages 630 (HNT). Feeding was started with commercial feed (floating feed) at 30% of body weight of fish at first month and gradually reduced up to 4% of body weight at the last month of study.

Sampling procedure and Measurement of weight and length

Weight and length of each individual fish was measured by using a sensitive weighing balance (Digital scale model no: AFD (Ek-300i, Max-300g, D-0.001g, E-0.1g) and a measuring scale, respectively at 15 days interval. The length was measured as distance from the snout to the tip of the caudal fin. For sampling purpose length and weight of randomly collected 16 individuals were measured and recorded from each of the cages i.e. total 96 of HNT and 96 of HT at every 15 days interval throughout the study period.

Length-Weight Relationship

To determine the length-weight relationship a total of 192 fishes were taken randomly from 12 cages (96 HT+96 HNT) of each sampling. Then total length (cm) and weight (g) of individual fish of each species were measured. Among the recorded data, the lowest and highest total length were determined and the range was divided into 10 class intervals. Then the frequencies were found out on the basis of class intervals. The regression line of length-weight relationship for each species was drawn by plotting body weight data against total length data. Again, all the mid values (cm) of the class intervals and the corresponding average weight (g) were converted to base log10 to obtain straight line relationship between length and weight. Calculations for hormone treated and hormone non-treated tilapia was done separately and also combined using the conventional formula described by Le-Cren (1951) as follows:

$W = a L^b$ ---------- (1)

The above equation and data were transformed into logarithms before the calculations were made. Therefore equation (1) becomes: $\text{Log } W = \log a + b \log L$

Where, W = Weight of fish (g), L = Total length of fish (cm), b = Slope of regression line of weight on length (Exponent). a = Intercept

This equation is the same form as the linear equation $Y = bX+c$. LogW is equal to the dependent variable (Y) and LogL is the independent variable (X), b is the regression coefficient or slope and Log a is the intercept. The data was pooled as a linear regression by plotting LogW against LogL.

The equation was log transformed to estimate the parameters 'a' and 'b'. When b is equal to three (3), isometric pattern of growth occurs but when b is not equal to 3, allometric pattern of growth occurs, which may be positive if >3 or negative if <3.

The slope, b, of the above straight-line was estimated by:

$$b = \frac{\sum \log W - (N . \log a)}{\sum \log L}$$

N = Number of class intervals

$$\text{Log } a = \frac{\sum \log W . \sum (\log L)^2 - \sum \log L . \sum (\log L \times \log W)}{N . \sum (\log L)^2 - (\sum \log L)^2}$$

Correlation co-efficient (r) was computed by the following formulae

$$r^2 = \frac{\left(\Sigma \log L.\log W - \frac{\Sigma \log L.\Sigma \log W}{N}\right)^2}{\left\{\Sigma (\log L)^2 - \frac{(\Sigma \log L)^2}{N}\right\}.\left\{\Sigma (\log W)^2 - \frac{(\Sigma \log W)^2}{N}\right\}}$$

$$/r/ = \sqrt{r^2}$$

A power curve of best fit to the data set was drawn through values representing the body weight for range of arbitrarily chosen values for different lengths. A smooth line was drawn through the points was the power curve, which describes the relationship between length and weight.

Condition Factor (K)

The condition factors were calculated separately for each class interval by the following Fultons formula:

$$K = \frac{W \times 10^5}{L^3}, \text{ Where,}$$

K = Condition factor, W= Observed body weight of fish (g) and L = Observed length of fish (mm).

Data analysis

All the data collected during the study period were recorded in a note book and regularly inputted in a computer. At the end of the experiment all data were analyzed by Microsoft Excel and SPSS statistical software (20.0 versions).

Results and Discussion

The scattered diagram of both HT and HNT obtained from the total body length-body weight relationship showed correlation. This evident trend left to upper right showed the regression of body weight Y and body length to be positive as the correlation coefficient (r^2). Logarithmic form of equations so far estimated for the HNT of fishes is log W= -2.111263+1.179839 log L and HT is log W= -2.140194+ 1.196176 log L. (Tables 1 and 2). The exponential value of "b" estimated for HNT is 1.179839 and HT is 1.196176, respectively which indicated negative allometric growth of these fishes. The correlation coefficient (r) values of HNT and HT recorded were 0.964039 and 0.970113 respectively. The values of coefficient of determination (r^2) were very close to 1 which showed strong and highly significant relationships between length and weight of these fishes. The result of the present study showed that the growth of the species in the pond cage culture system both HT and HNT was allometric. This means that the fishes do not grow symmetrically or the fish becomes thinner with increase in length.

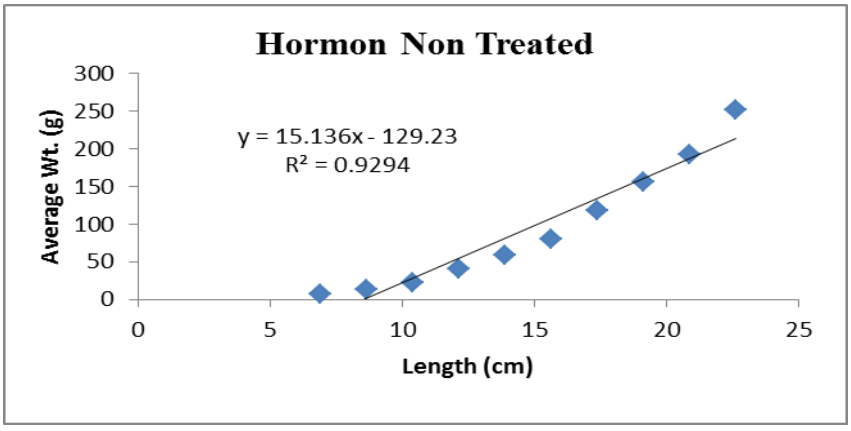

Fig. 2. Relationship between body weight and body length of HNT tilapia.

Table 1. Length-weight relationship calculated values of Correlation co-efficient (r) and condition factor (K) of total hormone non- treated (HNT) Tilapia.

SL NO	Class interval	Mid value (L) cm	Frequency (f)	Average Wt. (W)	log L	log W	Log L x log w	$(\log L)^2$	r	K
1	6-7.75	6.88	60.00	7.01	0.84	0.85	0.71	0.70	0.96	2.16
2	7.75-9.5	8.63	74.00	13.49	0.94	1.13	1.06	0.88		2.10
3	9.5-11.25	10.38	64.00	23.09	1.02	1.36	1.39	1.03		2.07
4	11.25-13	12.13	70.00	40.40	1.08	1.61	1.74	1.17		2.27
5	13-14.75	13.88	83.00	58.77	1.14	1.77	2.02	1.30		2.20
6	14.75-16.5	15.63	75.00	80.15	1.19	1.90	2.27	1.43		2.10
7	16.5-18.25	17.38	82.00	117.40	1.24	2.07	2.57	1.54		2.24
8	18.25-20	19.13	120.00	155.58	1.28	2.19	2.81	1.64		2.22
9	20-21.75	20.88	36.00	193.06	1.32	2.29	3.02	1.74		2.12
10	21.75-23.5	22.63	8.00	251.31	1.35	2.40	3.25	1.83		2.17
			∑f= 672		∑logL = 11.40	∑logW= 17.57	∑(logLxlogW) 20.83	$\sum(\log L)^2$= 13.27		K= 2.16

Table 2. Length-weight relationship calculated values of Correlation co-efficient (r) and condition factor (K) of total hormone treated (HT) Tilapia.

SL NO	Class interval	Mid value (L) cm	Frequency (f)	Average Wt. (W)	Log L	Log W	Log L x log w	$(\log L)^2$	r	K
1	6.3-8.07	7.19	76.00	7.62	0.86	0.88	0.76	0.73	0.97	2.06
2	8.07-9.84	8.96	53.00	13.43	0.95	1.13	1.07	0.91		1.87
3	9.84-11.61	10.73	73.00	23.74	1.03	1.38	1.42	1.06		1.92
4	11.61-13.38	12.50	64.00	44.14	1.10	1.64	1.80	1.20		2.26
5	13.38-15.15	14.27	81.00	65.90	1.15	1.82	2.10	1.33		2.27
6	15.15-16.92	16.04	87.00	86.76	1.21	1.94	2.34	1.45		2.10
7	16.92-18.69	17.81	86.00	125.90	1.25	2.10	2.63	1.56		2.23
8	18.69-20.46	19.58	90.00	167.46	1.29	2.22	2.87	1.67		2.23
9	20.46-22.23	21.35	43.00	206.46	1.33	2.31	3.08	1.77		2.12
10	22.23-24	23.12	19.00	257.94	1.36	2.41	3.29	1.86		2.09
			∑f= 672		∑logL=11.53	∑logW= 17.84	∑(logLxlogW) 21.35	$\sum(\log L)^2$=13.54		K=2.11

Similar works from Inland water bodies in Nigeria. Ibrahim *et al*. (2009) observed allometric growth pattern in Kontagora Reservoir while Ude *et al.* (2011) made similar findings in an evaluation of length-weight relationship of fish species of Ebonyi River. The b values is similar with the findings of Imam *et al.* (2010) with a recorded range of between 1.4 and 2.5 in Wasai Reservoir in Kano. *Barbus occidentalis* and *Barilius loati* belongs to the fish family Cyprinidae and had a b-value range of between 1.9 and 2.3 and this value agreed with the findings of Ibrahim *et al.* (2012) from Kontagora Reservoir in Niger state with a maximum b-value of 2.8 for Cyprinids. However the b-values recorded for all the species in the present study is below the documented values of 2.5 to 3.5 for tropical fish species (Gayannilo and Pauly, 1997). Dan-Kishiya, 2013 studied length-weight relationship and condition factor of *Tilapia zilli*, *Tilapia mariae*, *Oreochromis niloticus*, *Barbus occidentalis* and *Barilius loati* from Lower Usuma Reservoir in Abuja from July 2009 to June 2010 obtained growth pattern of the fishes was negatively allometric with b values range of between 1.4 and 2.3 obtained at $P<0.001$. There was strong correlation between the length and weight of all the species except *Tilapia mariae* which was weakly correlated.

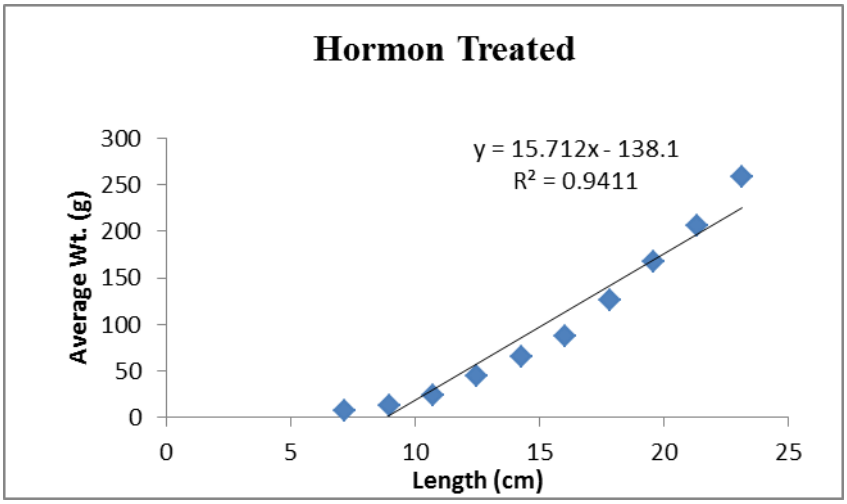

Fig. 3. Relationship between body weight and body length of HT tilapia.

The values of condition factor (K) found to vary from 2.101 to 2.267 and 1.870 to 2.263; for HNT and HT, respectively and the mean values of the same recorded for HNT and HT were 2.165 and 2.116, respectively. Here condition factor values of both HT and HNT are almost same so, HNT growth condition can be considered are almost same like HT. A related work in Nigeria, a range of condition factor between 0.49-1.48 was recorded by Nwadiaro and Okorie (1985) in Oguta Lake. Kumolu-Johnson and Ndimele (2011) obtained a K-value of between 0.91 and 8.46 from Ologe Lagoon in Lagos. Whereas Ibrahim *et al.* (2012) recorded a mean K-value of 1.98 ± 0.35 in Kontagora Reservoir in Niger State. Ahmed *et al.* (2011) in Sudan recorded a K-value range of 0.506 and 3.415. The mean K-values of species sampled had their value greater than 1 which was an indication that the fish species were doing well in the Reservoir even though is less than the 2.9 to 4.8 reported by Bagenal and Tesch (1978) for mature fresh water fish fresh body weight which was attributed to variation in weight of individual fish sampled.

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