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EFFECT OF FEEDING LEVELS ON GROWTH PERFORMANCE OF NILE TILAPIA (*Oreochromis niloticus L.*) FINGERLINGS REARED IN CAGES AT WADI EL RAYIAN LAKES, FAYOUM GOVERNORATE.

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ABSTRACT

The experimental was carried out in the second lake of Wadi El- Rayian Lake at Fayoum Governorate. Twelve floating cages were used as experimental units, each cage measures 7x 7x x2 m with submerged depth 1m (net volume=49 m^3). Fingerlings of Nile tilapia with an initial average weight of 22g ±0.7g were randomly distributed into cages at 30 fish/m^3 with total biomass of 1470 fish in each cage. Four treatments were conducted to study the effect of feeding levels on performance of tilapia. In the T1, fish were fed on the available natural food, whereas in T2 and T3, the fish fed daily at 3 and 5% from their body weight, respectively. However in the fourth treatment (T4), fish were fed to apparent satiation. The commercial pelleted diet (25% C.P.) was offered two times/ day. The Performance of tilapia showed significant differences among treatments ($p< 0.05$). The best performance records for gain, GR, SGR, and PER were obtained with the fish fed to apparent satiation (T4), followed in a decreasing order by fish fed daily at 3% from their body weight. On the other hand, fish depended only on the natural food and which received 5% of B.W., showed inferior performance parameters compared with the other treatments. The carcass composition of tilapia was not affected by feeding levels, except that of fish fed 5% B.W. which gave less increase in their body fat content. In the same trend, the blood characteristics of tilapia (hematocrite, hemoglobin and plasma protein content) were not affected by feeding levels. The total fish production and net returns showed an increase in yields for the cages fed to apparent satiation. It could be concluded that fish fed to apparent satiation (feed amount equivalent 2.7% of body weight/day) enhance the growth performance, blood characteristics and yields of tilapia *Oreochromis niloticus* .

Keywords: Fish- Cage culture- Growth performance- Feeding levels- carcass composition- Blood characteristics- *Oreochromis niloticus*.

INTRODUCTION

Wadi El-Rayian lakes are the immense reservoir for agricultural waste water in the western desert of Egypt. This was connected with the agricultural drainage water outlet in lake Qarun. This reservoir consists of two man – made lakes. They occupy the area between latitudes 29o 05\ & 29o 18\ N and longitudes 29o 21\ &29o 32\ E. The lower lake covers an area of about 51.81 km^2 with a volume of 0.619 km. The maximum depth is more than 25m in the central part and decreases shore words (Abd Ellah, 1999).

Aquaculture has been vigorously developed in recent years to serve two major purposes: food security and income generation. To satisfy these demands for aquatic animal products, aquaculture has been undergoing diversification of cultured species and intensification of production system.

Consequently, aquaculture development requires a larger share of natural resources and has a greater environmental impact. As aquaculture production intensifies, the feed inputs increase and waste materials, including organic matter, nutrients and suspended solids in ponds increase, which have direct impacts on oxygen depletion, eutrophication and turbidity in waste waters. Part of those wastes settles out to the pond bottom, and the parts remaining in pond water are discharged as effluent during harvest, Lin and Yi (2003).

In tropical fresh water, semi- intensive rearing of fishes is the most common method of cage culture, species that feed low in the food chain, such as *Oreochromis niloticus, O. mossambicus, O. aureus* and bighead silver (*Hypophthalmichthys nolitrix*) and common carp which are fed on a variety of materials including rice bran, wheat middings, brewery and domestic wastes (Beveridge and Phillips, 1988; Costa- Pierce and Soemarwoto, 1990 and Beveridge et. al., 1994).

Maximum diet performance involves two important advantages: reduction of feeding costs and decreased wastes. The study of feeding behvaviour in several fish species has revealed that the adjustment of feeding times to match natural rhythm improves nutritional efficiency, feeding frequency, food conversion efficiency and can even vary the utiliziton of certain nutrients (Bolliet *et al.*, 2001).

The aim of the present trial was to study the effect of feeding levels on growth performance, body composition and blood characteristics of Nile tilapia (*Oreochromis niloticus L.*) reared in cages.

MATERIALS AND METHODS

Location and experimental design

The experiment consists of twelve floating cages (each of 98 m^3) extending from the surface to a depth of 2m. The trial was done at the second lake of Wadi El – Rayian Fayoum governorate Egypt. The rectangular cages measure (7 X 7 X 2 m) and were made from black polyethylene netting of 3mm mesh size. The submerged depth (1m^3) of each cage made from wood. The cages were fixed by wood and the plastic bottles, attached along the four sides of each cage, to serve as floats. Fingerlings of Nile tilapia were obtained from a private commercial fish farm with an initial weight of 22±0.7g were distributed into the experimental cages, with the same stocking density at a rate of 30fish/m3, and total biomass of 1470 fingerlings in each cage. Fingerlings were kept in the experimental cages for an adaptation period of 2weeks before being allotted to the experiment. The experiment lasted 8 months after start from April till the end of November (2004).

Feed and feeding

One commercial pelleted feed 3mm, diameter was used in this experiment, they obtained from Zoocontrol company (6 October city Giza-Egypt). The feed ingredients are listed on the feed sack labeles were (fish meal, soybean meal, sunflower seed meal, gluten meal, wheat bran, rice bran dicalcium phosphate and DL methionine). The whole diet contained 25% C.P.on dry matter basis. Four levels of feeding were tested as follows: without supplementary feeds (T1) ; 3% of biomass (T2), 5% of biomass (T3)

and supplementary feeds to apparent satiation (T4). Each feeding level was randomly assigned to three replicate cages and the diets was fed to fish by hand. The diets were offered to the fish at two times a day(at 10.00 and 16.00 h). The total biomass of fish in each cage was used to readujust the daily feed quantity downwards from 5 and 3% of body weight. However, the fish fed to apparent satiations, their feed consumption was recorded continuously by weighing the amount of diets downwards minus its rests. After 15 minutes of feed offered the rests were removing, drying and weighing.

Samples

The fish in each cage were weighed every month. Samples were collected by dip net. The purpose was to determine fish growth in length and weight. All fish in each cage were weighed to find out the actual total biomass at one month intervals. Mean fish weight at each period was calculated by dividing the total biomass on the number of fish in each cage. The number was also recorded to estimate the mortality. Temperature, dissolved oxygen, pH and salinity were measured every week in each cage according to (APHA 1992). At the end of the experiment. 20 fish from each cage were randomly collected to determine hepatosomatic index (HSI) and vescerasomatic index (VSI). The chemical composition parameters of carcass were analyzed according to (AOAC, 1995).

The blood was drained from the caudal vein with a heparinized syring and concentrations of hematocrit and hemoglobin were determined according to (Harding and Hogland,1983). Further more, the plasma protein, glucose, triglyceride and phospholipids were determined according to Shimeno *et al.* (1981).

Statistical and economic evaluation

Net income was determined by the difference between the price of fish sales (at current time) after harvest and the costs of fingerlings and feeds.

Analysis of variance (ANOVA) were employed to test the effect of feeding level on various growth parameters, blood characteristics and net yields (Snedecore and Cochran, 1987). Duncan multiple range test was used to compare the significant difference between the means of treatments (Duncun, 1955).

RESULTS AND DISCUSSION

The physicochemical characteristics of cages water are shown in table (1). Averages of temperature, pH, total dissolved salts, salinity and dissolved oxygen were 22 °c, 7.5, 4.3 g/l, 4‰ and 6.4 mg/l, respectively. The values are within the optimum levels required for rearing tilapia according to Abdelhamid (2003).

As presented in Table (2), the initial average weight of tilapia ranged between 21 to 23 g, without significant difference between treatments. However, the final weight of fish recorded significant differences ($p < 0.05$) among treatments. The highest final weight was obtained with fish fed to apparent satiation (T4) followed by fish fed 3% (T2) and 5% (T3),

respectively. On the other hand, the treatment (T1), fed on natural feed, showed the least final body weight. Similar results were reported by Abdelghany and Ahmad (2002). They recorded that the Nile tilapia which fed to apparent satiation (equivalent 2.67% of fish body weight/day) recoded the highest final body weight. In the same trend, the growth rate (GR) and specific growth rate (SGR) showed significant differences ($p< 0.05$) among the tested groups. Results reveled that the fish fed to apparent satiation have the highest values followed by T2, T3 and T1, respectively. These values are in agreement with the results reported by Eid and El-Gamel (1997) on tilapia reared in cages.

Table (1). Physicochemical characteristics of water in the experimental cages.

Parameters	Feeding level			
	T1	T2	T3	T4
Temperature °c	22. ±1.5	22.7 ± 1.5	22.0 ± 1.5	22.0 ± 1.5
PH	7.5l ± 0.04	7.52 ± 5.05	7.23 ± 0.04	7.52 ± 0.05
TDS mg/L	4.2 ± 0.5	4.2 ± 0.4	4.4 ± 0.5	4.1 ± 0.4
Salinity ‰	4.0 ± 0.3	4.1 ± 0.3	4.0 ± 0.3	4.0 ± 0.3
Dissolved 02 mg /L	6.4 ± 0.2	6.3 ± 0.2	6.4 ± 0.3	6.5 ± 0.3

Table (2). Growth performance of tilapia (*Oreochromis niloticus*) fed different feeding levels.

Parameters	Feeding level				
	T1	T2	T3	T4	S.E.±
Initial average weight (g)	23.0	22.0	21.0	22	0.7
Final average weight (g)	165.0^{c}	300.0^{b}	280^{c}	345^{a}	1.6
Weight gain (g)	142.0^{c}	278.0^{b}	259.0^{c}	323.0^{a}	1.4
Growth rate(g / day)	0.59^{d}	1.15^{b}	1.07^{c}	1.34^{a}	0.04
SGR[1]%	0.82^{d}	1.08b	1.07^{bc}	1.14^{a}	0.05
Feed consumption (g/fish)	-	500	830	450	-
FCR[2]	-	1.79^{b}	3.2^{c}	1.39^{a}	0.03
FE[3] %	-	0.52^{b}	0.31^{c}	0.72^{a}	0.04
PER[4]	-	2.22^{b}	1.24^{c}	2.28^{a}	0.1
Survival %	92	94	93	96	-

Means in the same row having the same superscript are not significantly different ($p \geq 0.05$). S.E. standard error of the mean.

1-Specific growth rate = 100X(Ln final weight - Ln initial weight)/ 240 days.

2-Feed conversion ratio = (feed given per fish)/ (weight gain per fish).

3-Feed efficiency= (weight gain per fish)/ (feed given per fish).

4- Protein efficiency ratio = (weight gain per fish)/ (protein intake).

Values of feed conversion ratio (FCR) were 1.79, 3.2 and 1.39 g feed for each g gain in weight for fish fed at a rate of 3 , 5 % of their body weight and for apparent satiation, respectively, (Table, 2). The optimum level under the condition of the present study was feeding to apparent satiation, which achieved better FCR.

Results of Table (2) revealed that the applied treatments showed also significant difference ($P < 0.05$) effects on the feed efficiency (FE) and protein efficiency ratio (PER). Fish feed to apparent satiation (T4) gave the best utilization of diet followed by fish fed T2 and T3, respectively.

The FC, FE and PER in the present trial decrease with the increase of feeding level from 2.7% (apparent satiation), 3 and 5%, respectively. These results were in agreement with the results of Goda (1996) who reported that PER values of Nile Tilapia decreased from 2.97 to 1.85 when the feeding rate increased from 3 to 5% of fish biomass.

Survival rate was decreased to 92% for fish fed on natural feed (T1). However, high survival rate was observed for fish fed for apparent satiation (T4).

In the present trial, growth performance parameters showed decreases with the fish depends only on natural food (T1). This finding may be as a result of insufficientally available natural food in the water column. On the other hand, the less performance in the group fed T3 compared with T2 and T4 may be due to that fish received much feeds (overfeeding) and this increased rate of feed passage through the digestive tract, thus depressed feed digestibility and metabolism. These results are in agreement with the results recorded by (Brett and Groves, 1979, Smith, 1989, Muzur *et al.* 1993, Abdelhamid *et al.*, 2001 and El-Sayed, 2002). Morever, at higher feeding levels, significant amount of feed are leached during feeding, leading to poor feed utilization as reported by (Macintosh and De Silva, 1984 and El Sayed, 2002).

As presented in Table (3), the variation in carcass composition parameters of fish was insignificant among the treatments. However, a slight increase in fat content was observed with the fish fed to apparent satiation T4 compared with the other treatments. The results were in accordance with the results of Al- Ogaily *et al.*, (1996) with *Oreochromis niloticus*.

Results of Table (3) indicated that the differences among hepatosomatic index (HSI) and viscerasomatic index (VSI) were insignificant among tested the groups. However, the fish received T4 tended to record high HSI and VSI. Similar observation was reported for salmonids (Buhler and Halver, 1961); channel catfish (Garling and Wilson, 1977 and Jantrarotai *et al.*, 1994) and tilapia (El-Kholy *et al.*, 2001). The increase may be attributed to increased glycogenic processes and deposition of excess lipid, respectively.

Table (3). Carcass composition, hepatosomatic index (HSI) and Vicerasomatic index (VSI) of fish fed different feeding levels.

Composition (% Dry matter basis)	Feeding level				
	Initial	T1	T2	T3	T4
Dry matter	31.5	30.4[a]	29.8[a]	30.4[a]	31.2[a]
Protein	60.2	59.4[a]	58.6[a]	58.3[a]	58.1[a]
Lipid	23.6	24.2[a]	24.8[a]	24.5[a]	25.8[a]
Ash	16.2	16.4[a]	16.6[a]	17.2[a]	16.1[a]
HSI[1]	1.6	2.6[a]	2.4[a]	2.4[a]	2.8[a]
VSI[2]	4.8	7.8[a]	8.5[a]	8.4[a]	9.2[a]

Means in the same row having the same superscript are not significantly different ($p \geq 0.05$).

1-Hepatoaomatic index = (liver weight / body weight) X 100.

2-Viscerasomatic index = (viscera weight / body weight) x 100.

Data in Table (4) show the effect of different feeding levels on blood parameters. Insignificant differences were found in blood parameters (hematocrite, hemoglobin, plasma protein, glucose triglycerides and phospholipids) due to the applied treatments. Similar observation was reported for *Sparus aurata* by Hassanen *et al.*, (1992) and *O. niloticus* by Shimeno *et al.*, (1993).

Table (4). Hematocrite, Hemoglobin and some plasma components concentration at the end of the experiment.

Parameters	Feeding level			
	T1	T2	T3	T4
Hematocrite (%)	$40^{a} \pm 0.52$	$40.4^{a} \pm 0.4$	$40.1^{a} \pm 0.52$	$40.1^{a} \pm 0.42$
Hemoglobin(g/ 100ml)	$7.42^{a} \pm 0.3$	$7.5^{a} \pm 0.2$	$7.7^{a} \pm 0.25$	$7.8^{a} \pm 0.3$
Protein (g/ 100ml)	$4.02^{a} \pm 0.3$	$4.01^{a} \pm 0.25$	$4.03^{a} \pm 0.20$	$4.02^{a} \pm 0.32$
Glucose (mg/ 100ml)	$55.2^{a} \pm 0.5$	$54.3^{a} \pm 0.6$	$55.5^{a} \pm 0.4$	$54.6^{a} \pm 0.5$
Triglyceride(mg/100ml)	$238^{a} \pm 104$	$239^{a} \pm 1.5$	$240^{a} \pm 1.6$	$239^{a} \pm 1.7$
Phospholipid(mg/ 100ml)	$574^{a} \pm 2.4$	$578^{a} \pm 2.6$	$575^{a} \pm 2.5$	$577^{a} \pm 2.5$

Means in the same row having the same superscript are not significantly different ($p \geq 0.05$).

As presented in Table (5), the differences in results of fish yields and net returns were significance ($p < 0.05$) among treatments. The highest net yields and net returns were obtained with fish fed on (T4) and (T2), respectively. However, the lowest net yields were recorded with the fish depended only on natural feed (T1). Results of the same table revealed that fish fed at a rate of 5%B.W. recorded less yields and net returns compared with the other levels. The reduction may have been due to the decrease in yields and increase in feed consumed, then high costs of feeds.

In conclusion: The results of the present trial confirmed that the best growth performance and yields were obtained with tilapia fingerlings reared in cages fed to apparent satiation (equivalent 2.7% of fish body weight/day).

Table (5). Production and net returns of tilapia (*Oreochromis niloticus*) at different levels.

Parameters	Feeding level				
	T1	T2	T3	T4	S.E. ±
Total fish production (kg/cage)	227.7	443.0	390.6	466.8	13.44
Total fish production (kg/m^3)	4.64^{d}	9.04^{b}	7.97^{c}	9.52^{a}	1.83
Feed costs/kg/LE	-	1.8	1.8	1.8	-
Total feed costs/cage/LE	-	1260.0	2091.6	1166.0	-
Total feed costs m^3/LE	-	25.71	42.68	23.79	-
Other feeding costs/cage/LE (Price of fingerlings, labor etc.)	675	675	675	675	-
Other feeding costs m2/LE	13.77	13.77	13.77	13.77	-
Price of one kg sales/LE	10	10	10	10	-
Price of total fish sales	2277	4430	3906	4668	-
Net returns	1602.0^{c}	2495.0^{b}	1139.4^{d}	2827.0^{a}	-

Means in the same row having the same superscript are not significantly different ($p \geq 0.05$). , S.E. standard error of the mean.

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تأثير معدلات التغذية علي أداء النمو لإصبعيات أسماك البلطي النيلي المرباه في أقفاص في بحيرات وادي الريان

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أجريت الدراسة في البحيرة الثانية لوادي الريان في محافظة الفيوم حيث تم استخدام ١٢قفص عائم في الدراسة وكانت أبعاد القفص (٧×٧×٢متر) بحجم غاطس ٤٩ مترمكعب.
واستخدمت أصبعيات البلطي النيلي ذات الوزن الأولي (٢٢ ± ٠,٧جم) والتي وزعت عشوائيا علي كل قفص بمقدار ١٤٧٠ أصبعية للقفص، وبمعدل تخزيني ٣٠سمكة / م٣.
تم دراسة أربع مستويات تغذية: المستوى الأول اعتمد علي الغذاء الطبيعي الموجود بعامود الماء، المستوى الثاني غذيت الأسماك بعليقة تجارية تحتوى علي ٢٥% بروتين خام بنسبة ٣% من وزن الجسم، المستوي الثالث غذيت الأسماك بنفس العليقة بنسبة ٥%، وأخيرا المستوى الرابع غذيت فيه الأسماك حتى الشبع، وتم تقديم العليقة مرتين يوميا للأسماك.
أظهرت نتائج الأداء للنمو في البلطي اختلافا معنويا بين المجاميع المختبرة عند مستوى (٠,٠٥%) حيث أعطت المجموعة المغذاة حتى الشبع أفضل النتائج تلتها بمستوى أقل الأسماك المغذاة علي ٣% من وزن الجسم، ثم المجموعة ٥% وأخيرا المعتمده علي الغذاء الطبيعي ولم يظهر تركيب جسم الأسماك اختلافا معنويا بين معدلات التغذية في حين أظهرت المجموعة المغذاه علي ٥% زيادة طفيفة في نسبة الدهن وفي نفس الاتجاه لم تعكس قياسات الدم اختلافا معنويا بين المجاميع بالنسبة لمعدلات التغذية.
وخلصت الدراسة إلي أن أسماك البلطي المغذاة حتى الشبع والتي قدرت بـ ٢,٧%من وزن الجسم يومياً قد ظهرت تحسنا في أداء النمو، صفات الدم وإنتاج الأسماك المرباه في أقفاص.