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EFFECT OF STOCKING DENSITY AND DIETARY PROTEIN LEVEL ON GROWTH PERFORMANCE, FEED UTILIZATION, BLOOD PARAMETERS AND BODY COMPOSITION OF MONO-SEX NILE TILAPIA, *Oreochromis niloticus* (L.)

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ABSTRACT

The present study was carried out to determine the optimal level of dietary protein and rearing density on growth performances, feed utilization, blood parameters and body composition of mono-sex male Nile tilapia during the period from June to September, 2013. In a 2x3 factorial design, fish were stocked into two main groups (100 and 200 fish/m^3). Each group was divided into 3 sub-groups; the first, the second and the third were fed on a diet with 25, 30 and 35% crude protein, respectively. The obtained results could be summarized as follows: Fish group stocked at high density significantly (P<0.01) decreased by 31.85 and 34.38% in live body weight and daily weight gain, respectively, more than low density. Daily feed intake in fish stocked at high density decreased with 21.54 %, more than those stocked at low density. On the other hand feed conversation was impaired with 18.75% in fish group stocked at high density when compared with those stocked at low level. Interaction of fish stocking density and dietary protein level, insignificantly affected live body weight, daily gain weight, feed intake and feed conversion. Alanine amino transferase (ALT) concentration only significantly (P<0.01) affected with stocking density, while serum total protein and albumin significantly (P<0.01 or 0.05, respectively) affected with dietary protein level. But, the other blood parameters studied insignificantly affected with stocking density, dietary protein level and their interaction. Dry matter of body composition significantly (P<0.01) affected with stocking density only, while crude protein, ether extract and ash insignificantly affected with stocking density, dietary protein level and their interaction. The best final profit margin recorded in fish group stocked at normal density and fed on diet with low protein level (25%). Based on the obtained results in the present study it could be concluded that, using stocking density by 100 fish/m^3 and 25% crude protein resulted in the best performance and final profit margin.

Key words: Nile tilapia, stocking density, dietary protein level, growth rate, feed conversion, blood components, profit analysis.

INTRODUCTION

Aquaculture plays a role in food security through the significant production of some low-value freshwater species, which are mainly destined for domestic production, also through integrated farming. In 2012, aquaculture contributed about 49% of the fishery output for human consumption-impressive growth compared with its 5% in 1962 and 37% in 2002, with an average annual growth rate of 6.2% in the period 1992–2012 (FAO, 2014).

Aquaculture is considered as the only possible solution to increase fish production in Egypt. The activity is presently the largest single source of fish in the country. It is the fastest growing sector in the field of fisheries and is considered as the only available option for

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covering or reducing the gap between production and consumption of fish in Egypt (Saleh, 2007).

Rearing density is an important aspect for fish culture, and it is necessary to find a balance between the maximum profit and the minimum incidence of physiological and behavioral disorders (Ashley, 2007; Ayyat *et al.*, 2011). Also, Ahmed and Hamad (2013) found that increasing stocking density from 100 to 200 fish /m^3 resulted in a significant reduction in growth performance. El-Saidy and Hussein (2015) reported that growth performance and feed utilization parameters were significantly the best at the lowest stocking density (50 fish/m^3). The lowest stocking density (50 fish/m^3) had significantly the best feed utilization parameters. There were no significant differences between it and the stocking density of 75 fish/m^3. Montero *et al.* (1999) detected that intensively raised fish (high stocking density) may be exposed to stressful situations which often result in a depressed immune status and growth performance. Good management practices reduce stress and therefore help to maintain healthy animals.

Protein is considered as the main constituent of the fish body thus sufficient dietary supply is needed for optimum growth. Since protein is the most expensive component of the diet, therefore, the amount of protein in the diet should be just enough for fish growth where the excess protein in fish diets may be wasteful and cause diets to be unnecessary expensive (Ahmad *et al.*, 2004). Proteins provide the essential and non-essential amino acids, which are necessary for muscle formation and enzymatic function, and in part provide energy for maintenance (Bahnasawy, 2009). Loum *et al.* (2013) found significant effects of dietary protein on growth performance of reared fish. Weight gain and specific growth rate increased significantly with increasing dietary protein levels between 32.38% and 37.63%. However, 45.5% of crude protein showed less important increase in growth parameters. They added that, the best results were obtained with a dietary protein level of 32% and 37% in respect of growth rate may be due to the increase in protein utilization and digestibility with the increase in dietary protein level up to 37% while, the decrease in growth rate at 45% dietary protein level may be due to the decrease in protein utilization and digestibility above 37% dietary protein level.

The objective of the present study was to determine the optimal level of dietary protein, rearing density, and their interaction to achieve good growth of farmed Nile tilapia fish. Moreover, study the effect of stocking density and protein levels on feed utilization and some blood parameters.

MATERIALS AND METHODS

The present study conducted out at the department of Animal Production, Faculty of Agriculture, Zagazig University, Zagazig, Egypt. The practical work and chemical analysis were carried out at Abbassa Fish farm (Sharkia) of the General Authority for Fish Resources and Development (GAFRD), Egypt. The experimental period lasted from June to September, 2013.

Experimental Design

Healthy fingerlings of Nile tilapia (*Oreochromis niloticus* L.) were obtained from Abbassa fish hatchery, General Authority for Fish Resources and Development (GAFRD). The experimental fish (weighing approximately 2 g) were randomly distributed into 18 hapa (1.5 X 2 X 2 m), representing to 6 treatments (3 replicates per treatment).

In a 2 x 3 factorial design, fish were divided into two main groups. The first group was stoked at 100 fish/m^3 and the second was stoked at 200 fish/m^3. Each group was divided into 3 sub-groups; the first was fed on a diet with 25% crude protein, the second was fed on a diet with 30% crude protein and the third was fed on a diet with 35% crude protein. Three practical diets were formulated to contain increasing percentages of protein (25, 30 and 35% crude protein). The composition and proximate analysis of the experimental diets are given in Table 1.

Experimental Management

Water quality parameters were monitored every month in each hapa during the experimental period. Water temperature was 28°C which measured by oxygen temperature meter. The total ammonium, nitrite, nitrate and

Table 1. Ingredients and chemical composition of the experimental diets

Ingredients (%)	Low protein	Medium protein	High protein
Corn	25	14	12
Rice bran	29.7	29.9	22.5
Soybean meal	35	40.5	40.8
Fish meal	6	11.1	20.4
Vitamin mix.[1]	1.3	1.3	1.3
Minerals mix.[2]	1.5	1.5	1.5
Carboxymethyl cellulose	1.5	1.5	1.5
Chemical composition (%)			
Dray matter	89.96	89.87	89.93
Crude protein	25.95	31.15	36.06
Eather extract	4.95	5.14	5.32
Crude fiber	2.72	2.83	2.66
Ash	5.72	6.11	6.35
Gross energy (Kcal/Kg)[3]	3667.86	3613.54	3686.9

1. Each one Kg of vitamin mixture contained: Vit. A 72000IU, Vit. B_1 6 mg, Vit. B_3 12000 IU, Vit. B6 9 mg, B12 0.06 mg, Vit E 60 mg, Vit. 12 mg, Pantothonic acid 60 mg, Nicotinic acid 120 mg, Folic acid 6 mg, Biotin 0.3 mg and Choline chlorids 3mg.
2. Each one Kg of mineral mixture contained: Zinc sulphat hepahydrate 3.0, Mg, sulphat 0.335, Coppous chloride 0.10, Calcium phosphate monobasic 135.8, Calcium Lactate 327.0, Ferric citrate 29.7, Potassium phosphate dibasic anhydrous 239.8, Sodium phosphate monobasic 87.2, Sodium chloride 43.6, Aluminium chloride anhydrous 0.15, Potassium iodide 0.15, Cobalt chloride 1.0, Sodium selenite 0.011 and L-cellulose 132.25 (as g/Kg mineral mix) Gatlin and Wilson (1984).
3. Calculated from NRC (1993).

pH levels were determined by using Hach Kit model HI 83205 (Multipurameter Bench Photometer, Hanna Instruments, Romania). Also, dissolved oxygen determined by HI 9146 (Oxygen and temperature Meter (Hanna Instruments, Romania).

The fish were fed on the experimental diets at the rate of 5% of body weight and the experimental diets were offered two times daily at 8:00 am and 3:00 pm. The fish were weighed at 15 days intervals during the experimental period and quantities of feeds were readjusted according to the changes in live body weight.

Fish Weigh and Growth

All fish were individually weighed to the nearest 0.1 g at the beginning of the experiment and biweekly intervals throughout the experimental period three months. Food consumption was calculated as g/fish/day by dividing the amount of food consumed each day by the number of fish in the aquarium. Feed conversion ratio (FCR) was calculated according to Berger and Halver (1987) according to the following equation: FCR = cumulative feed delivered to aquarium/fish biomass gain.

Chemical Analysis of Fish Body and diets

The proximate composition including crude protein, crude fat, crude ash and moisture of body composition and fish diets were determined using the standard procedures of AOAC (2005).

Physiological Parameters

Blood samples were collected from the caudal veins (Steucke and Schoetter, 1967) using 2.5cc disposable plastic syringe, previously rinsed with heparin. Blood samples were centrifuged at 3000 rpm for 20 minutes.

Plasma samples were immediately separated and frozen in copped polyethylene test tubes and stored at -20°C till the determinations of total protein, albumen, globulin, creatinine; urea-N, Aspartate amino transferase (AST) and alanine amino transferase (ALT) were estimated by colorimetric methods using commercial kits. Total protein (g/dl) was determined calorimetrically by biuret method (Sundeman, 1964) using commercial kits Diamond the Diagnostic, USA. Determination of albumin (g/dl) was carried out using the direct colorimetric method with bromocresol green according to commercial kits (Bromocresol green method, Fluites® ALB-BCG German). AST and ALT were determined according to (Reitman and Fankel, 1957) using commercial kits sentinelch, milan, Italy. Creatinine was measured by colorimetric method as described by Henery (1974).

Economic Evaluation

Economic evaluation was calculated according to Ayyat (1991) as the following equation: profit = Income from body gain weight - feed cost. Other overhead costs were assumed constant. Price of one kg of diet 25, 30 and 35% crud protein was 3.50, 4.00 and 4.50 LE, respectively, (Egyptian pound = 0.132 US$) and price of selling of one kg live body weight of fish was 10.0 LE.

Statistical Analysis

The data were statistically analyzed with SAS (2002) according to the following model:

$$Y_{ijk} = \mu + D_i + P_j + DP_{ij} + E_{ijk}$$

Where, Y_{ijk} is an observation, μ is the overall mean, D is the fixed effect of density (i=1…2), P is the fixed effect of dietary protein level (j=1…3), DP_{ij} is the interaction effect of fish stocking density and dietary protein levels and E_{ijk} is random error. Significant differences between treatments were tested with Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Growth Performance and Feed Efficiency

Live body weight and daily gain weight of fish was significantly (P<0.01) affected by stocking density (Table 2). Live body weight and daily gain weight of fish decreased by 31.85 and 34.38%; respectively; in fish group reared at high stocking density level, when compared with fish group reared at the low density. Daily feed intake and conversion rate was affected significantly (P<0.01) with stocking density (Table 2). Daily feed intake in fish stocked at high density decreased with 21.54 %, than those stocked at low density. On the other hand, feed conversion was impaired with 18.75% in fish group stocked at high density when compared with those stocked at low level. In general results of growth performance revealed that the increasing of stocking density decreased the growth rate and impaired the feed conversion of Nile tilapia, these results are similar to those found by El-Saidy and Hussein (2015), Ronald *et al.* (2014), Kpundeh *et al.* (2013), Ahmed and Hamad (2013) and Ayyat *et al.* (2011). Ayyat *et al.* (2011) found that the final live body weight and daily body gain of Nile tilapia fish decreased with increasing stocking density.

Live body weight, daily gain weight of Nile tilapia fish affected significantly (P<0.01) with dietary protein level (Table 2). Live body weight of fish increased with increasing protein level in fish diets at the different experimental periods. The increasing in live body weight for fish fed high protein diet were 13.08 and 25.66%, respectively, at the 30 and 35 % of protein, more than those fed low protein diet (25%). The same trend for daily gain weigh was 13.04 and 30.43%, respectively. Daily feed intake increased significantly (P<0.01) with increasing dietary protein level, while feed conversion insignificantly affected (Table 2). Increasing protein level in fish fed diet increased growth rate in Nile tilapia, these results were similar to those found with Loum *et al.*, (2013), Hooley (2012) and Ayyat *et al.* (2011). Similar results also reported by Adewolu and Adoti (2010) who reported that fish fed continuously on high protein diets (35%) resulted in significantly higher growth rate and feed utilization in *C. gariepinus*.

Interaction of fish stocking density and dietary protein level insignificantly affected live body weight, daily gain weight, feed intake and feed conversion (Table 2). Fish group which fed on diets containing 35% protein level and stocked

Table 2. Growth performance and feed conversion of Nile tilapia ($\bar{X}$±SE) as affected by fish stocking density, dietary protein levels and their interactions

Items	Initial weight (g)	Final weight (g)	Daily gain (g/day)	Daily feed intake (g/day)	Feed conversion (g food/g gain)	Survival rate (%)
Stocking density						
Normal (ND)	2.17±0.01	37.68±1.27	0.32±0.01	0.51±0.016	1.60±0.02	95.22±1.08
High (HD)	2.17±0.01	25.68±1.04	0.21±0.01	0.39±0.016	1.90±0.03	91.39±1.27
Significance	NS	**	**	**	**	*
Dietary protein level						
25% (LP)	2.18±0.01	28.06±2.63^{c}	0.23±0.02^{c}	0.40±0.025^{c}	1.78±0.08	94.08±1.46
30% (MP)	2.16±0.01	31.73±2.80^{b}	0.26±0.02^{b}	0.45±0.028^{b}	1.72±0.06	93.08±1.37
35% (HP)	2.17±0.01	35.26±2.85^{a}	0.30±0.03^{a}	0.51±0.023^{a}	1.74±0.08	92.75±2.16
Significance	NS	**	**	**	NS	NS
Interaction between stocking density and dietary protein level						
NDLP	2.18±0.02	33.71±1.52	0.28±0.01	0.46±0.016	1.62±0.03	96.67±1.33
NDMP	2.17±0.01	37.90±0.64	0.32±0.01	0.51±0.009	1.59±0.03	94.33±2.19
NDHP	2.15±0.01	41.42±1.27	0.35±0.01	0.55±0.014	1.58±0.02	94.67±2.40
HDLP	2.18±0.01	22.40±0.52	0.18±0.00	0.35±0.013	1.95±0.02	91.50±1.50
HDMP	2.16±0.01	25.55±0.77	0.21±0.01	0.38±0.005	1.84±0.04	91.83±1.76
HDHP	2.18±0.02	29.10±0.98	0.24±0.01	0.46±0.005	1.91±0.06	90.83±3.71
Significance	NS	NS	NS	NS	NS	NS

Means in the same column within each classification bearing different letters are significantly different at ($P < 0.05$).

* = significant ($P \leq 0.05$), **= Highly significant ($P \leq 0.01$) and, NS = Not significant.

on the low level recorded higher body gain than the other experimental groups. Abdel-Tawwab (2012) found that the growth parameters were positively affected by protein level and inversely affected by stocking density, but there was no effect of their interaction.

Blood Hematological Parameters

ALT concentration affected significantly (P<0.01) with stocking density, while total protein, albumin, globulin, AST, urea and creatinine insignificantly affected (Table 3). The concentration of ALT decreased in blood of fish reared at high stocking density when compared with the low density. The obtained results were similar to those found with Ayyat *et al.* (2011), who found that blood ALT and thyroxin (T_3) significantly decreased in fish groups reared at high stocking density, when compared with those reared at low stocking density, while the concentration of urea-N, creatinine and AST significantly increased. Tejpal *et al.* (2009) found that ALT activity in muscle exhibited a significant difference between the stocking densities. However, the high density group exhibited higher value than the low density group in both muscle and liver ALT activity comparatively higher activity was found in muscle than the liver.

Serum total protein and albumin of Nile tilapia fish affected significantly (P<0.01 or 0.05, respectively) with dietary protein level, on

Table 3. Blood components of Nile tilapia ($\overline{X}$±SE) as affected by fish stocking density, dietary protein levels and their interactions

Items	Total protein (g/100ml)	Albumin (g/100ml)	Globulin (g/100ml)	AST (U/L)	ALT (U/L)	Urea (mg/100 ml)	Creatinine (mg/100 ml)
Stocking density							
Normal (ND)	6.58±0.24	3.88±0.22	2.70±0.08	36.78±1.02	49.00±1.97	5.63±0.24	0.41±0.02
High (HD)	6.29±0.22	3.68±0.15	2.61±0.14	36.56±0.99	40.78±1.66	5.67±0.15	0.36±0.03
Significance	NS	NS	NS	NS	**	NS	NS
Dietary protein level							
25% (LP)	5.80±0.21^{b}	3.29±0.17^{b}	2.50±0.12	38.50±1.34	47.33±3.25	5.83±0.29	0.36±0.03
30% (MP)	6.52±0.24^{a}	3.87±0.17^{a}	2.66±0.16	35.17±0.60	44.50±3.08	5.73±0.22	0.41±0.02
35% (HP)	6.99±0.18^{a}	4.18±0.18^{a}	2.80±0.13	36.33±1.26	42.83±1.97	5.38±0.18	0.40±0.05
Significance	**	*	NS	NS	NS	NS	NS
Interaction between stocking density and dietary protein level							
NDLP	5.91±0.43	3.36±0.34	2.55±0.10	39.00±2.52	50.33±4.98	6.10±0.38	0.42±0.03
NDMP	6.75±0.23	3.96±0.32	2.79±0.10	35.00±1.15	50.00±3.79	5.67±0.44	0.42±0.04
NDHP	7.09±0.33	4.32±0.34	2.77±0.18	36.33±0.88	46.67±1.86	5.13±0.32	0.40±0.07
HDLP	5.68±0.13	3.22±0.15	2.45±0.24	38.00±1.53	44.33±4.37	5.57±0.44	0.30±0.01
HDMP	6.30±0.43	3.77±0.18	2.53±0.31	35.33±0.67	39.00±1.73	5.80±0.21	0.39±0.03
HDHP	6.88±0.21	4.04±0.17	2.84±0.22	36.33±2.67	39.00±1.15	5.63±0.03	0.40±0.07
Significance	NS	NS	NS	NS	NS	NS	NS

Means in the same column within each classification bearing different letters are significantly different at ($P < 0.05$).

* = significant ($P \leq 0.05$), **= Highly significant ($P \leq 0.01$) and, NS = Not significant

the other hand serum globulin, AST, ALT, urea and creatinine insignificantly affected with dietary protein level (Table 3). Serum total protein and albumin increased with increasing protein level in tilapia fish diets. The obtained results may indicate that the protein synthesis increased in fish fed high dietary protein level. The obtained results are in agreement with those reported by Ajani *et al.* (2015) and Abdel-Tawwab (2012). Also, Ajani *et al.* (2015) showed that the plasma protein was significantly influenced by the crude protein elevation in the diets. On the other hand, Cheng *et al.* (2006) reported that no dietary protein effect on total plasma protein observed in fish.

Serum total protein, albumin, globulin, AST, ALT, urea and creatinine insignificantly affected with the interaction between fish stocking density and dietary protein level (Table 3). Within each dietary protein level, increasing dietary protein content on tilapia fish diets slightly decreased serum total protein and albumin concentrations.

Fish Body Composition

Dry matter significantly (P<0.01) affected with stocking density, while crude protein, ether extract and ash, insignificantly affected (Table 4). Dry matter, significantly (P<0.01) increased in fish group stocked at the high density than those reared

Table 4. Whole body composition of Nile tilapia ($\bar{X}$±SE) as affected by fish stocking density, dietary protein levels and their interactions

Items	Dry matter (%)	Crud protein (%)	Ether extract (%)	Ash (%)
Stocking density				
Normal (ND)	26.52±0.22[b]	57.12±0.32	11.89±0.38	21.97±0.08
High (HD)	28.67±0.41[a]	57.63±0.40	11.50±0.22	21.86±0.07
Significance	**	NS	NS	NS
Dietary protein level:				
25% (LP)	27.65±0.64	57.45±0.36	11.58±0.39	22.06±0.09
30% (MP)	27.46±0.52	57.46±0.46	11.65±0.32	21.85±0.06
35% (HP)	27.68±0.72	57.22±0.57	11.86±0.47	21.83±0.10
Significance	NS	NS	NS	NS
Interaction between stocking density and dietary protein level				
NDLP	26.53±0.42	56.99±0.15	11.96±0.74	22.17±0.17
NDMP	26.84±0.41	57.55±0.98	11.73±0.69	21.88±0.09
NDHP	26.21±0.38	56.82±0.35	11.97±0.81	21.87±0.09
HDLP	28.76±0.79	57.90±0.66	11.20±0.22	21.95±0.04
HDMP	28.07±0.90	57.37±0.32	11.57±0.22	21.82±0.09
HDHP	29.16±0.52	57.62±1.15	11.74±0.64	21.79±0.21
Significance	NS	NS	NS	NS

Means in the same column within each classification bearing different letters are significantly different at ($P < 0.05$).

**= Highly significant ($P \leq 0.01$) and, NS = Not significant

under the low stocking density, while ether extract and ash slightly decreased. Similar results were obtained by Ayyat *et al.* (2011). Mahmoud (2007) showed that the whole body and flesh composition of Nile tilapia fish were insignificantly affected with increasing stocking density. But, ether extract and ash percentages of the whole fish body were significantly increased by 2.27 and 1.56%, respectively in fish stocked at high density compared with those stocked at lower density.

Analysis of flesh composition of Nile tilapia, insignificantly affected with dietary protein level (Table 4). These results are in agreement with the finding of Al Hafedh (1999) who found insignificant difference in percentage moisture and body protein with increasing dietary protein level. On the other hand, Daudpota *et al.* (2014) found that fish whole body composition showed that moisture, protein and ash content of the fish fed diets of 35% and 40% protein was higher than that of fish fed diets containing protein levels of 25% and 30%, although the lipid contents were lower.

Analysis of flesh composition of Nile tilapia insignificantly affected with interaction between fish stocking density and dietary protein level (Table 4).

Profit Analysis

Return from body gain and final margin decreased with increasing fish stoking density (Table 5). Fish group stocked with high density recorded lower return from body gain and final

Table 5. Profit analysis of Nile tilapia as affected by stocking density, dietary protein level and their interactions

Items	Total body gain (g)	Total feed intake (g)	Feed cost/ fish (LE)	Return from body gain/fish (LE)	Final margin / fish (LE)
Stocking density					
Normal (ND)	35.507	56.622	0.226	0.355	0.129
High (HD)	23.511	44.489	0.178	0.235	0.057
Dietary protein level					
25% (LP)	25.873	45.173	0.158	0.259	0.101
30% (MP)	29.562	49.877	0.200	0.296	0.096
35% (HP)	33.092	56.616	0.255	0.331	0.076
Interaction between stocking density and dietary protein level					
NDLP	31.527	50.997	0.178	0.315	0.137
NDMP	35.730	56.784	0.227	0.357	0.130
NDHP	39.263	62.085	0.279	0.393	0.113
HDLP	20.220	39.349	0.138	0.202	0.064
HDMP	23.393	42.971	0.172	0.234	0.062
HDHP	26.920	51.147	0.230	0.269	0.039

profit margin by 33.80 and 55.81%, respectively, when compared with the normal density. Rearing density is an important aspect for fish culture, and it is necessary to find a balance between the maximum profit and the minimum incidence of physiological and behavioral disorders (Ashley 2007 and Ayyat *et al.* 2011). The full utilization of space for maximum fish production through intensive culture can improve the profitability of the fish farm. On the other hand, several studies have indicated an inverse relationship between the stocking density and growth rate of tilapia (Ridha *et al.*, 2006).

Return from body gain increased while final profit margin decreased with increasing dietary protein levels (Table 5). Fish group which fed on a diet contained 30 and 35% protein recorded lower final profit margin by 4.95 and 24.75%, respectively, when compared with fish group fed on 25% protein.

Within the interaction between fish stocking density and dietary protein level, increasing dietary protein level achieved increasing in total body gain, feed cost and return from body gain while total profit margin decreased (Table 5). The best final profit margin recorded in fish group stocked at normal density and fed on diet with low protein level. The fish group which stocked at high density and fed on a diet with high protein (35%) recorded the lower final profit margin by 71.53% when compared with fish group stocked at low density and fed on a diet with low protein level.

It could be concluded that the optimum stocking density and dietary protein level was 100 fish/m^3 and 25% crude protein in term of growth and profit analysis.

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تأثير الكثافة ومستوي بروتين العليقة على أداء النمو، كفاءة الاستفادة من الغذاء، قياسات الدم ومكونات الجسم في البلطي النيلي وحيد الجنس

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أجريت هذه الدراسة بهدف تحديد المستوي الامثل من كل من كثافة التسكين وبروتين العليقة علي أداء النمو، كفاءة الاستفادة من الغذاء، قياسات الدم ومكونات الجسم في البلطي النيلي وحيد الجنس وذلك خلال الفترة من يونيه إلى سبتمبر ٢٠١٣. تم استخدام تصميم عاملي ٢ × ٣ حيث قسمت الأسماك إلي مجموعتين رئيسيتين: المجموعة الأولى سكنت بمستوي ١٠٠ سمكة/م^{٣} والمجموعة الثانية بمستوي ٢٠٠ سمكة/ م^{٣} ثم قسمت كل مجموعة رئيسية الي ٣ مجموعات غذيت الاولي علي عليقة تحتوي علي ٢٥% بروتين خام وغذيت الثانية على عليقة تحتوى على ٣٠% وغذيت الثالثة علي ٣٥% بروتين خام. ويمكن تلخيص أهم النتائج المتحصل عليها كما يلي: سجلت مجموعة الاسماك التي سكنت بكثافة مرتفعة انخفاضا معنويا (٠,٠١) في كل من وزن الجسم ومعدل الزيادة اليومية بنسبة ٣١,٨٥ و ٣٤,٣٨% مقارنة بتلك التي سكنت بكثافة منخفضة، انخفض الغذاء المأكول معنويا (٠,٠١) بنسبة ٢١,٥٤% في مجموعة الأسماك التي سكنت بكثافة عالية مقارنة بالكثافة المنخفضة، تدهور معدل تحويل للغذاء بنسبة ١٨,٧٥% في مجموعة الأسماك التي سكنت بكثافة عالية مقارنة بالكثافة المنخفضة، لم يتأثر كل من وزن الجسم، معدل الزيادة اليومية، الغذاء المأكول و معدل تحويل الغذاء معنويا بالتداخل بين كل من كثافة تسكين الأسماك ومستوي بروتين العليقة، تأثر إنزيم الكبد ALT فقط معنويا (٠,٠١) بكثافة تسكين الأسماك، بينما تأثر معنويا كل من البروتين الكلي لسيرم الدم والالبيومين بمستوي بروتين العليقة، ولكن لم تتأثر باقي قياسات الدم الأخرى المدروسة بكثافة التسكين، بروتين العليقة وكذلك التداخل بينهما، تأثرت معنويا (٠,٠١) نسبة المادة الجافة في التحليل الكيماوي للجسم بكثافة تسكين الأسماك فقط، بينما لم تتأثر نسبة كل من البروتين الخام ومستخلص الأثير والرماد معنويا بكثافة تسكين الأسماك، بروتين العليقة والتداخل بينهما، سجلت مجموعة الأسماك التي سكنت بكثافة منخفضة وغذيت علي عليقة منخفضة البروتين (٢٥%) أفضل ربح نهائي، وبناء علي النتائج المتحصل عليها توصي الدراسة باستخدام كثافة التسكين المنخفضة ومستوي ٢٥ % بروتين خام لإنتاج أفضل أداء ومعدل ربح نهائي.

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