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EFFECTS OF DIETARY PROTEIN LEVELS AND NATURAL FOOD ON THE GROWTH PERFORMANCES AND BODY COMPOSITION OF NILE TILAPIA *(Oreochromis niloticus)* REARED IN EARTHEN PONDS.

Zeinhom, M. M.; Amal S. Hassan and Tartil E. M. Badwy
Central Laboratory for Aquaculture Research (CLAR), Abbassa - Abou Hammad, Sharkia, Agricultural Research Center, Egypt.

ABSTRACT

Net fish production and growth performance of Nile tilapia *(Oreochromis niloticus)* with an average weight 30 ± 0.65g were studied in earthen ponds offered graded dietary protein levels (25%, 35% and 45%) or natural food (control) for 170 days. Four treatments were applied in this study, each treatment was carried out in two ponds (100 × 40m) as replicates, each of one meter water column. The first three treatment were given a daily feeding rate 3% of fresh fish body weight and the fourth treatment did not receive any commercial feed but have only natural food produced from fertilizer ponds and served as control.

The result showed that final body weight of tilapia averaged 230.21, 320.51, 330.30 and 115.65 g / fish fed T1, T2, T3 and the control one, respectively. Net production of tilapia averaged 1250.04, 1786.52, 1805.41, and 618.26 kg / pond in these fish culture treatments, respectively. Crude protein and fat of the whole body fish increased significantly ($P< 0.05$) with increasing dietary protein levels, while moisture and ash of the whole body fish decreased with increasing dietary protein levels. AST, ALT and muscles and plasma cholesterol increased with increasing dietary protein levels. The results indicated that T3(45% protein) gave the highest growth and total production, whereasT2 (35%protein) gave the highest net return (11642.78L.E / ponds). This system T2 (35% protein) may be recommended for semi-intensive fish farming.

Keywords: Dietary protein level - Natural food - Nile tilapia - Earthen ponds.

INTRODUCTION

Aquaculture would contribute partially in the increased demand for animal protein consumed by humans. In the recent years, great attentions have been paid to initiate fish farms. Because the human consumption of high protein foods is gradually rising, its demand is not likely to be covered by livestock production and by development of natural fisheries. Higher fish yields could be obtained by applying supplemental feeds. However, for intensive fish production, compound feeds, which have the proper ratio of energy, proteins and provided with vitamins and minerals should be used. Rakocy and McGinty (2005) noticed that significant production of tilapia can be obtained without supplemental feeds, if the natural food of a pond is increased through fertilization or manuring. Although yields are not as high as those obtained with feed, fertilizers and animal manures can be used to reduce the quantity and expense of supplemental feeds. Lam and Shephard (1988) found that common carp growth in tanks supplied with both natural

feeds and a high protein supplement was very variable, and detected that fish growth was influenced by the presence of natural feed.

Since, feed costs represent an important part of the production costs, it is necessary to identify alternative protein sources and levels to reduce or stabilize the cost of production. For feeding fish, the optimum amount of protein from different sources in formulated feeds is very important for optimum growth. Additionally, excess protein in fish diets may be wasteful and cause the diets to be unnecessary expensive. There are a linear relationship between the percentage of protein in the diet and the increase in fish weight up to optimal level of 43 – 50% as reported by Shuenn *et al.* (2002), Kim *et al*. (2004 a & b), Hammer *et al*. (2006), Wang *et al*. (2006) and Abdel-Tawwab *et al*. (2008). On the other hand, Abdehamid *et al*. (1995, 1997 &2001) and El-Dahhar (2007) reviewed that optimum dietary crude protein level for maximum weigh gain of tilapia ranges from 20 to 56%. However, variations in protein requirements could be due to different reasons such as: fish stoking density, feeding rate, feed quality, fish size (Abdehamid *et al*. 1998), water temperature, and physiological state of fish (Lovell, 1989).

The present work aimed to study the effect of three dietary protein levels on growth and physiological characteristics of tilapia in earthen ponds, as compared with natural feeding (control).

MATERIALS AND METHODS

Eight stagnant earthen ponds, 4000m^2 each and one meter water column, uses agriculture drainage water, located at the Al-Riyad, Kafr Elsheikh governorate, Egypt, were used from 31 May to 16 November (170 days) to study the effect of graded dietary protein levels (25%, 35% and 45%) or the natural food (control) on fish growth. Flushing the ponds with fresh water from the supply cannel was allowed periodically (monthly) to compensate only the water loss throughout seepage and evaporation. Four treatments were applied in this study, each treatment was carried out in two ponds (replicates). Each pond was fertilized biweekly with 30kg triple superphosphate and 3.75kg ammonium sulphate plus 30kg duck droppings. Each pond was stocked with 6000 Nile tilapia *(Oreochromis niloticus*), obtained from a private Mono_sex tilapia hatchery located in Kafr El-Sheikh governorate. Average initial weight of fish was 30 ± 0.65g. The first three treatments received commercial complete pelleted fish feed containing 25%, 35% and 45% CP and fed at a daily rate of 3 % of fresh fish body weight (T1, T2 and T3, respectively). The fourth treatment (T4) did not receive any commercial feed, but have only natural feeding conduced from fertilizing the ponds and served as a control. The three diets were commercially manufactured in a private factory. The diets were pelleted using meat grinder of kitchen aid with a 1.5 mm diameter. The formulation and chemical analysis of pelleted fish feed used in the experiment are presented in Table 1. Water quality was monitored at sunrise for temperature, dissolved oxygen (DO), pH, total alkalinity, total hardness, orthophosphate, and chlorophyll (a) concentrations. Samples of pond water (6 samples) were taken at the 7th day intervals following fertilization, because the

high population of plankton increase during this time, and samples were collected and mixed together (one liter / pond) from constant sites (outlet, inlet and mid pond) at two depths of water column (at surface and at 25 cm depth). Samples of water were analyzed in the Central Laboratory for Aquaculture Research (CLAR) according to Boyd (1992). Fish body and diets were analyzed at the end of the experiment (on five fish / pond) according to AOAC (1995). Activities of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were determined in samples of fish livers from each treatment according to Reitman and Frankel (1957). Plasma and muscles cholesterol were determined by kits (Biocon D- 57299 Burbach / Germany); therefore, blood samples were withdrawn from caudal ventral sinus according to Watson (1960).

Table (1): The formulation and chemical composition of the experimental diets:

Ingredient	Dietary treatment (Protein %)			
	T1 (25%)	T2 (35%)	T3 (45%)	T4 (%)
Fish meal	4	12	21	-----
Meat meal	6	14	28	-----
Yellow corn	40	22	7	-----
Soybean meal	21	24	17	-----
Cotton seed meal	10	10	10	-----
Rice bran	5	5	5	-----
Wheat bran	5	5	5	-----
Molasses	3	3	3	-----
Vegetable oil	1.5	1	0.5	-----
Fish oil	1.5	1	0.5	-----
Dicalcium phosphate	1	1	1	-----
Min & Vit Mix*	2	2	2	----
Total	100	100	100	-----
Chemical composition (DM basis)				
Moisture	7.67	7.13	6.99	
Crude protein	25.05	35.15	45.14	-----
Ether extract	6.74	6.53	6.89	-----
Crude fiber	3.60	3.34	3.16	-----
Ash	11.32	14.56	16.98	-----
Nitrogen free extract**	53.29	40.42	27.83	-----
Gross energy Kcal/100g***	423.93	426.02	434.01	-----

***Each 100 gram of vitamin and mineral contained:**
Mineral : Zn, 2.50 mg; Mn, 16.00 mg; Fe, 31.50 mg; Cu, 5.50; I, 0.55 mg; Ca, 1.15 gm and P, 450 mg.
Vitamins : A, 7500000 Iu; B1, 100 mg; B3, 500 mg; B6, 150 mg; B12, 2.5 mg; E, 100 mg; K, 100 mg; Pantothnic acid, 275 mg; Folic acid, 100 mg and vit. D3, 7500 Iu.
****NFE (nitrogen free extract) = 100 – (protein + lipid + ash + crude fiber).**
*****GE (gross energy): Calculated according to NRC (1993) as 5.64, 9.44 and 4.11 kcal / g for protein, lipid and carbohydrate, respectively.**

Relative growth rate (RGR %) was calculated as.
RGR% = ((Final weight – initial weight) / initial weight) × 100
Specific growth rate (SGR % /d) was calculated as.
SGR%/d = ((Ln Wf – Ln Wi) / T) × 100
Where:

Ln is the natural logarithm.
T = experimental period in days.
Wf = final weight. and Wi = initial weight.
At the end of the experiment, ponds were drained and harvested. Fish yield was weighed and total production of fish was estimated. Statistical analysis was carried out according to SAS (1985).

RESULTS AND DISCUSSION

1- Effects of dietary protein levels on water quality.

Data collected on water quality are presented in Table 2. Surface water temperature increased gradually up to the end of August, then decreased. The range of recorded temperature (22.1 - 29.9 ºC) was suitable for tilapia growth (Boyd, 1992). The present results agree with those obtained by Abdel-Mageed (1997) who found that temperature in Egypt in Nile tilapia ponds were 19 to 27 ºC (from June to November). Mostafa *et al*. (2008) noticed that the average values of water temperature were in range between 26.3 and 26.8 ºC in fish ponds. The highest dissolved oxygen (DO) (4.60 mg / l) was obtained in ponds of treatment (T4) with natural feeding; yet, there were no significances differences among treatments. Boyd (1992) postulated that excess feeding can result in an increase in organic material with increases in oxidation through metabolic processes by bacteria producing a decrease in DO. Also, Abdelhamid and Ibrahim (2003) did find any significant effect of diet type on fish ponds water criteria, since its temperature, pH and DO ranged 26.75 – 26.92ºC, 7.855 – 7.915 and 7.045 – 7.485 mg / l, respectively. Soltan *et a*l. (2007) found that DO ranged from 3.4 to 5.58 mg / l by using some feeding regimes for Nile tilapia reared in earthen ponds. Mostafa *et al*. (2008) stated that DO values were ranged between 5.21 and 6.8 mg / l for grey mullet reared in new desert areas.

The pH values in experimental ponds were not significantly different ($P < 0.05$) among treatments. The values were always over 8. These values fall within the range stated by Ali (2007) who found that pH values in Nile tilapia ponds were 8.3 to 8.9. Mostafa *et al* .(2008) reported that pH values for grey mullet reared in new desert areas were always over 8 and not significantly different by different protein levels.

The highest alkalinity (500. 60 mg/l) was obtained in ponds of treatment (T3), while the lowest alkalinity (310.52 mg / l) was obtained in ponds of treatment (T4) with natural feeding (control). It is considerable that the control was poor in chlorophyll (a) and phytoplankton, this confirms that high density of phytoplankton can lead to high alkalinity as studied by Hayes and Anthony (1964). El-Dahhar *et al*. (2007) found that total alkalinity values were in ranged from 474 to 486 mg / l for Nile tilapia fertilizer and feeding ponds. In this study total hardness values were (220.12-390.15 mg/l) are commonly encountered in natural waters (Boyd, 1992). El-Dahhar *et al*. (2007) found that total hardness values were in ranged from 350 to 416 mg / l for Nile tilapia fertilizer and feeding ponds. Orthophosphate concentrations (0.45 - 0.85 mg / l) were similar to those reported by Ali (2007) in Tilapia ponds (22 -

64 mg/l) and were relatively higher in comparison with the values obtained by Boyd (1992) in fertilized ponds (0.02-0.03 mg/l).Values of chlorophyll (a) (110.10 - 220.20 mg / l) were similar to those reported by Ali (2007) in Tilapia ponds (169 – 270 mg/l) and Boyd (1992) in fertilized ponds (109 – 134 mg / l). Abdelhamid *et al*. (2007) reported no significant (P≥0.05) differences among treatments in water quality criteria of the earthen ponds concerning temperature (22.3 – 29.3 ºC), pH values (8.37 – 9.34), DO (4.41 – 7.05 ppm), total phytoplankton (1.06 – 1.89 $\times 10^3$ / l) when mono sex Nile tilapia fed artificially or naturally.

Table (2): Average of physical and chemical properties of water in experimental ponds (Mean ± S.E.).

Protein levels	Parameters						
	Temperature (ºC)	Dissolved Oxygen (mg / l)	Total Alkalinity (mg / l)	Total Hardness (mg / l)	PH value	Orthophos-phate (mg / l)	Chlorophyll (mg / l)
T1 (25%)	27.25[a] ± 0.35	4.52[a] ± 0.10	410.40[c] ± 12.12	290.51[c] ± 20.11	8.50[a] ± 0.01	0.55[c] ± 0.05	180.71[c] ± 8.11
T2 (35%)	27.50[a] ± 0.25	4.45[a] ± 0.11	450.20[b] ± 15.10	300.62[b] ± 18.70	8.55[a] ± 0.15	0.70[b] ± 0.10	200.50[b] ± 8.11
T3 (45%)	27.70[a] ± 0.60	4.30[a] ± 0.25	500.60[a] ± 22.10	390.15[a] ± 20.15	8.65[a] ± 0.12	0.85[a] ± 0.04	220.20[a] ±11.20
T4 (control)	27.20[a] ± 0.75	4.60[a] ± 0.28	310.52[d] ± 10.11	220.12[d] ± 15.10	8.20[a] ± 0.11	0.45[d] ± 0.11	110.10[d] ± 5.10

a…d: Means with the same letter in the same column were not significantly different (P ≥ 0.05).

2- Effects of dietary protein levels on growth of fish.

Effect of dietary protein levels on fish growth is presented in Table 3. The results showed that the highest (P < 0.05) final body weight and weight gain values of tilapia (330.30 and 299.10 g/fish) were obtained in the treatment (T3) receiving complete feed of 45% protein, while the lowest (P < 0.05) final body weight (115.65 g / fish) and weight gain (84.75 g / fish) were obtained in ponds with natural feeding (T4). The presents results indicated that tilapia growth increased with increasing percentage of protein in the diet. The present results are in agreement with those recorded by Chioma (1997), Abdelhamid *et al*. (2001) and Farage *et al.* (2008) they found that tilapia fish (*S. galilaeus, O. niloticus* and *O. aureus*) growth increased with increasing percentage of protein in the diet. Also, Sayed and Abou-Seif (2007) found that Nile tilapia *(Oreochromis niloticus)* fry growth increased with increasing percentage of protein in the diet. Ayyat and Abbas (2003) stated that average daily weight gain increased by 48.04% in Nile tilapia fed the high protein diet than those fed the normal protein diet.

This study showed that the lowest relative and specific growth rates were obtained in ponds with natural feeding (T4). While the highest relative and specific growth rates were obtained in the treatment receiving complete feed of 45% protein (T3), with significant differences (P < 0.05) among treatments (Table 3). These results indicated that relative growth rate and specific growth rate of tilapia increased with increasing percentage of protein in the diet. The present results are in agreement with those of Ayyat and Abbas (2003) who

found that RGR% and SGR %/d of tilapia increased with increasing percentage of protein in the diet. On the other hand, there were significant differences ($P < 0.05$) in survival of tilapia fed the four diets (T1, T2, T3 and T4). The higher value of survival was obtained with T2 (35% CP). Similar results were obtained by Chioma (1997) Sayed and Abou-Seif (2007) and Mostafa *et al* (2008) they stated that protein level fed had remarkable effects on tilapia (*O. galilaeus, O. niloticus*) and grey mullet.

Table (3): Growth performance of Nile tilapia (*Oreochromis niloticus*) fed the experimental diets containing different protein levels (Means ± S.E).

Protein levels	Items					
	Initial weight (g / fish)	Final weight (g / fish)	Weight gain (g / fish)	RGR (%)	SGR (%/d)	Survival (%)
T1 (25%)	30.50^{a} ± 0.43	230.21^{b} ± 4.20	199.71^{c} ± 3.11	654.78^{c} ± 10.20	1.19^{b} ± 0.10	90.50^{c} ± 0.5
T2 (35%)	31.15^{a} ± 0.55	320.51^{a} ± 7.10	289.36^{b} ± 5.15	928.92^{b} ± 12.12	1.37^{a} ± 0.22	92.90^{a} ± 1.0
T3 (45%)	31.20^{a} ± 0.64	330.30^{a} ± 6.20	299.10^{a} ± 6.19	958.65^{a} ± 15.10	1.39^{a} ± 0.25	91.10^{b} ± 1.0
T4 (control)	30.90^{a} ± 0.51	115.65^{c} ± 5.50	84.75^{d} ± 2.12	274.27^{d} ± 7.50	0.78^{c} ± 0.11	89.10^{d} ± 0.5

a…d: Means with the same letter in the same column were not significantly different ($P \geq 0.05$).

3- Effects of dietary protein levels on chemical composition of fish bodies.

Means of chemical components of fish whole body for tilapia are presented in Table 4. The highest values of protein and fat contents were obtained in the treatment receiving complete feed 45% protein (T3), while the lowest values are that of the control group (T4), that with natural feeding. Ash content showed opposite trend to that of protein. These differences among treatments were statistically significant ($P < 0.05$). The tissue water content in fish usually increases with decreased percentage of protein in the diet. This rise in tissue water runs parallel to the fall in tissue protein and lipid levels. However, the main part of the reduction must be due to a real mobilization of the tissue energy reserves (Love, 1970). These results agree with those obtained by Xueliang *et al*. (1991) who observed that Nile tilapia receiving no feed showed reduction in the percentage of lipid and protein in their carcass with a concomitant increase in moisture and ash. Abdelhamid *et al.* (2007) found that earthen pond of mono sex Nile tilapia without artificial feeding had lowest protein content and highest fat content in whole fish body comparing with those fed artificially. Also, Sayed and Abou-Seif (2007) found that the carcass protein of tilapia *(O. niloticus)* fry fed lower protein diets was significantly lower than that of the fish fed higher protein diet. They added that carcass lipid content decreased with increasing dietary protein levels, whereas moisture was inversely related to lipid content.

Table (4): Proximate analyses (% DM basis) of fish whole body of tilapia fed the experimental diets containing different protein levels (Means ± S.E).

Protein levels	Items			
	Moisture	Crude protein	Total lipid	Ash
Initial	82.25 ± 0.30	65.41 ± 2.10	17.70 ± 0.52	15.22 ± 0.82
T1 (25%)	72.60 ± 0.59[b]	67.59 ± 1.20[c]	19.22 ± 0.60[c]	12.10 ± 0.82[b]
T2 (35%)	72.10 ± 0.71[b]	68.60 ± 2.51[b]	19.45 ± 0.75[b]	10.90 ± 0.82[c]
T3 (45%)	71.50 ± 0.35[c]	69.12 ± 1.90[a]	21.66 ± 0.59[a]	9.15 ± 0.75[d]
T4 (control)	73.25 ± 0.45[a]	66.85 ± 1.16[d]	18.20 ± 0.69[d]	13.10 ± 0.88[a]

a…d: Means with the same letter in the same column were not significantly different (P ≥ 0.05).

4- Effects of dietary protein levels on physiological characteristics.

Effect of dietary protein levels on physiological characteristics of tilapia are presented in Table 5. Assessments of both AST and ALT enzymes activity in liver of tilapia indicated that activity of these enzymes increased gradually with increasing percentage of protein in the diet. The highest AST and ALT (160.22 and 85.81 u / 100 g tissue) activity in tilapia liver was found in the treatment receiving T3, while the lowest values (90.19 and 50.55 u / 100 g tissue) were recorded in the control group (T4). Statistical analysis showed that differences among treatment were significant (P< 0.05). This might indicate that at increasing percentage of protein in the diet, liver function may be elevated to meet the more protein intake. In addition, increased enzyme activity may relate to the fact that enzymes are protein, and increased feeding rate of either protein, or amino acids, may induce enzyme synthesis. These results are in a partial agreement with those reported by Ayyat and Abbas (2003) who observed that values of serum total protein, albumin, globulin, creatinine and AST significantly increased with increased dietary protein level, while ALT activity significantly decreased. Also, EL–Sherbiny *et al*. (1998) found that the activities of these liver enzymes increased with increasing percentage of protein in the diet. On the other hand, plasma enzyme AST and ALT activities were not affected by different dietary protein (Kim *et al*., 2004a).

Muscles and plasma cholesterol content of tilapia (Table 5) indicate that cholesterol increased gradually with increasing percentage of protein in the diet. The highest muscles and plasma cholesterol (30.51 mg / g wet weight and 600.85 mg / dl) in tilapia was found in the treatment receiving complete feed 45% CP (T3), while the lowest values (22.10 mg / g wet and 390.29 mg / dl) were recorded in the control (T4), that with natural feeding. Statistical analysis showed that these differences among treatments were significant (P < 0.05). Two factors probably contributed to these differences; increasing percentage of protein in the diet and the specific type of dietary fat. These results are in agreement with those obtained by Farrell and Munt (1983) who observed that the muscles and plasma cholesterol increased with increasing percentage of protein in the diet. On the other hand, plasma triglyceride TG was not affected by different dietary protein (Kim *et al*., 2004a).

Table (5): Biochemical characteristics of tilapia fed the experimental diets containing different protein levels (Means ± S.E.).

Protein levels	Items			
	Liver AST (U/100g tissue)	Liver ALT (U/100g tissue)	Muscles cholesterol (mg/g wet weight)	Plasma cholesterol (mg/dl)
T_1 (25%)	110.10 ± 6.10^c	65.82 ± 2.90^c	25.90 ± 0.60^c	501.51 ± 30.20^c
T_2 (35%)	128.60 ± 5.20^b	75.10 ± 3.05^b	28.30 ± 0.35^b	555.11 ± 20.10^b
T_3 (45%)	160.22 ± 4.10^a	85.81 ± 3.10^a	30.51 ± 0.75^a	600.85 ± 35.10^a
T_4 (control)	90.19 ± 4.10^d	50.55 ± 2.85^d	22.10 ± 0.19^d	390.29 ± 10.10^d

a…d: Means with the same letter in the same column were not significantly different (P ≥ 0.05).

5- Effects of dietary protein levels on the economic evaluation.

Effects of dietary protein levels on total production and the economic evaluation are presented in Table 6. The highest total production of tilapia (1805.41 kg) was obtained in the treatment receiving complete feed 45% protein (T3), while the lowest total production (618.26 kg) was obtained in ponds with natural feeding (T4). These results indicated that, total production of tilapia increased with increasing percentage of protein in the diet. The present results are in agreement with those of Chioma (1997) and Mostafa *et al*. (2008) they found that total production of tilapia and grey mullet increased with increasing percentage of protein in the diet. The net return (total return - total cost) was 7249.81, 11642.78, 11543.24 and 4068.84 L.E. / pond for T1, T2, T3, and T4 treatments, respectively (Table 6). The best net return (11642.78 L.E. / pond) was obtained with T2. The same observations were reported by Mostafa *et al*. (2008) who found that the best net return was observed in high protein diet level than low protein diet level

In conclusion, a dietary protein level of 35% is recommended for semi-intensive tilapia fish farming in earthen ponds.

Table (6): The effect of different protein levels on profitability of growing tilapia.

Protein levels	Items			
	Total production (kg/pond)	Total costs* (L.E./pond)	Total return (L.E./pond)	Net return** (L.E./pond)
T_1 (25%)	1250.04	4000.55	11250.36	7249.81
T_2 (35%)	1786.52	4435.90	16078.68	11642.78
T_3 (45%)	1805.41	4705.45	16248.69	11543.24
T_4 (control)	618.26	1495.50	5564.34	4068.84

*** Total cost include: Feed cost, fertilizer cost, fingerlings cost, land rent, labor, machinery, interest on capital and others.**

**** Net return = total return – total cost.**

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تأثير مستويات بروتين العليقة والغذاء الطبيعى على النمو ومكونات الجسم لأسماك البلطي النيلي المرباة في الأحواض الترابية

محمد محمد زينهم ، أمل سيد حسن و ترتيل السيد محمد بدوي

المعمل المركزي لبحوث الثروة السمكية- العباسة- أبو حماد- شرقية- مركز البحوث الزراعية

تم دراسة تأثير ثلاث مستويات بروتين مختلفة في العليقة على أداء النمو لسمكة البلطي النيلي متوسط وزن ٣٠جم في الأحواض الترابية وهى ٢٥٪ ، ٣٥٪ ، ٤٥٪ , وذلك بالمقارنة بالمعاملة الرابعة التي أجريت بدون إضافة غذاء صناعي (كنترول), حيث تم اعتمادها على الغذاء الطبيعي فقط الناتج من تسميد الأحواض. كل معاملة تم إجراؤها في حوضين (مكررتين) مساحة الحوض الواحد ٤٠٠٠ متر مربع بعمق عمود ماء ١م

أوضحت النتائج أن متوسط الوزن النهائي للأسماك في نهاية التجربة (١٧٠ يوما) كان ٢٣٠,٢١ - ٣٢٠,٥١ - ٣٣٠,٣٠ - ١١٥,٦٥ جم في المعاملات الأربعة على الترتيب. بلغ متوسط الإنتاج الصافي للأسماك في نهاية التجربة ١٢٥٠,٠٤ - ١٧٨٦,٥٢ - ١٨٠٥,٤١ - ٦١٨,٢٦ كجم/ حوض في هذه النظم على التوالي. ذاد محتوى جسم الأسماك من البروتين الخام والدهن و انخفض محتوى جسم الأسماك من الرطوبة والرماد بزيادة بروتين العليق. ذادت إنزيمات ALT ,AST وكولسترول عضلات ودم الأسماك بزيادة بروتين العليقة. كما أوضحت النتائج تفوق النمو لسمكة البلطي وأيضاً زيادة الإنتاج الكلي في أحواض المعاملة الثالثة (٤٥٪ بروتين). ولكن العائد الصافي كان أعلى في المعاملة الثانية (٣٥٪ بروتين) وبلغ ١١٦٤٢,٧٨ جنيه بالمقارنة بالمعاملة الثالثة (٤٥٪ بروتين)، وذلك راجع إلى زيادة تكلفة الغذاء في المعاملة الثالثة. والمعاملة الثانية المغذاة بعليقة ٣٥٪ بروتين هي أنسب نظام غذائي توصى التجربة باتباعه في أحواض تربية البلطي النصف مكثفة.