Effect Of The Dietary Protein And Lipid Levels On Growth Performance And Some Blood Constituents Of Tilapia Fish (*Oreochromis Niloticus* And *O. Aureus*)

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ABSTRACT

This work was carried out to study the effect of two levels of protein (25&35%) and two levels of lipid (8 &16%) on the growth performance and some blood constituent of tilapia fish (*Oreochromis niloticus* and *Oreochromis aureus*). A 70-day feeding trial was conducted in hapa with tilapia fish, (*O. niloticus* and *O. aureus*), with an average initial weight of 50.31±1.92g and 41.14±1.15g, respectively, to examine the effect of two protein levels and two fat levels on growth performance and some blood constituents. Twelve hapa (2.0 ×1.0 × 1.0 m, each) were stocked with 10 fish and fed diets containing either 25% or 35% crude protein at crude fat of 8% or 16% (2 ×2 factorial experiment). The results revealed that there was a significant increase in the final body weight and weight gain of *O. niloticus* and *O. aureus* with increasing dietary protein and lipid levels. However, feeding diet containing 35% protein + lipid 16% resulted in significantly higher final body weight and weight gain for *O. nilotica* and *O. aurea*. Feed conversion ratio of O. *niloticus* was improved significantly by increase dietary protein level, while feed conversion ratio of *O. aureus* was non significant difference by both dietary protein and fat levels. The best feed conversion ratio was obtained in both fish species by diet containing 35% crude protein + 16% fat. Gonadosomatic index was significantly higher by increased protein and fat levels. The higher gonadosomatic index was observed when diet containing 35% protein + 16 fat to female and male of both fish species (*O. nilotica* and *O. aurea*). Hemoglobin (Hb), Mean corpuscular hemoglobin (MCH) and Mean corpuscular hemoglobin concentration (MCHC) were significant increased in *O. nilotica* and Erythrocyte count (RBC_s) and Packed cell volume (PCV) were significantly decreased as increased dietary protein levels. Whereas there was non significant difference in Mean corpuscular volume (MCV) by increasing protein levels ($P < 0.05$). Feeding fish with higher fat level had significant increase in MCH and significant decrease in RBC_s and PCV, whereas there was non significant difference in Hb, MCV and MCHC. Similar trend of above blood constituents was also observed by the same dietary protein and lipid levels in *O. aurea*. The best Hb, MCV, MCH and MCHC were recorded in groups of *O. nilotica* fed with 35% dietary protein at the 16% lipid level, while the best RBC_s and PCV were recorded in groups of *O. nilotica* fed with 25% dietary protein at the 8% lipid level.

We can conclude that, fish diet inclusion up to a 35% protein and 16% fat is recommended for *O. niloticus* and *O. aureus*, reared in hapas.

INTERODUCTION

For success of intensive Fish culture and hatchery, complete nutritional feed components are needed, especially dietary protein, which is the most expensive component in artificial diets *(1)*. A dietary excess or deficiency of optimal energy can reduce the growth rate of farmed fish because energy is needed for metabolic activities *(2)*. Fish production at or below the carrying capacity of pond is considered a function of the feed available to the fish *(3)*. Tilapia species are second only to carps as the most widely farmed freshwater fish in the world *(4)*. In Egypt, the dominant tilapia species are *O. niloticus, O. aureus, S. galilaeus* and *Tilapia zillii (5)*. Nile tilapia have become important species in fish culture systems because of their rapid growth, high tolerance of low water quality, efficient feed conversion, ease of spawning and resistance to disease *(6)*. Improvement in both weight gain and feed conversion ratio (FCR) of tilapia (*Oreochromis niloticus*) was achieved when dietary protein was increased up to 35% *(7,8)*. Similar

observations were reported for *Oreochromis mossambicus (9)* and *Oreochromis aureus (10).* With respect to dietary energy levels, FCR and protein efficiency ratio (PER) of juvenile hybrid tilapia, (*Oreochromis niloticus X O. aureus*) were improved at dietary lipid levels higher than 5 % lipid diet *(11).* Similarly, the growth and feed utilization of Malawian tilapia were significantly improved by increasing the dietary energy level from 5 to 15% lipid diet *(12).* On other hand, different dietary protein-energy levels and initial sizes of fish are more important factors that affected proximate composition and carcass traits of Nile tilapia *(13-15).* In addition, although nutritional information has increased over the last decade, the understanding of dietary influences on fish health is still incomplete *(16).* An improvement in broodstock nutrition and feeding has shown to greatly improve not only egg and sperm quality but also seed production. Gonadal development and fecundity were affected by certain essential dietary nutrients, especially in continuous spawners with short vitellogenic periods *(17).* Protein and Lipid level of broodstock diet have been identified as major dietary factors that determine successful reproduction and survival of offspring *(18).* The quality and quantity of some blood constituents had successfully used as indicators to health, reproductive, nutritional and physiological statues of the animal *(19).* Previous studies on diet quality were confirmed by reducing gonadal development and plasma 17_-estradiol level in female Nile tilapia fed diets containing only plant protein *(20).* In contrast, a little information is available concerning the effects of dietary protein levels and fat on large size tilapia male and female conducted in net pen where the fish were prepared to hatching. Therefore, the purpose of the present study was to determine the effect of dietary protein and fat levels on growth performance and some blood constituents of tilapia (*O.niloticus* and *O. aureus*) male and female in reared hapas.

MATERIALS AND METHODS

This experiment was conducted in the Central Laboratory for Aquaculture Research (CLAR), Abbassa, Sharkia Governorate, Egypt.

Experimental treatments

Four treatments (protein levels × fat levels) 2×2 factorial experimental design were evaluated. The two factors evaluated were: protein level (25 and 35%) and fat level 8 and 16%.

Fish and feeding regime

Oreochromis niloticus and *Oreochromis aureus* fish with an average initial weight 50.31±1.92g and 41.14±1.15g, respectively, were obtained from research fish farm (CLAR). Fish were randomly allocated in the hapa (10 fish/ hapa). Each treatment was represented in three hapas (1 x 2 x 1 m).

Fish were fed six days/week, twice a day at 10.00 and 14.00h for 70 days at a rate of 3% from fish body weight. The amount of food was calculated and readjusted every 15 days according to change in the body weight. Composition and proximate analysis of the experimental diet were shown in Table 1. At the end of the experiment, fish of each hapa were counted and weighted, growth parameter and feed utilization were calculated. Also, analysis of diet and fish for moisture, crude protein, fat and ash were determined by standard methods according to Association of Official Analytical Chemists *(21).*

Table 1. The formulation and chemical composition of the tested diets.

Ingredients	Protein/Lipid (%)			
	25/8	**25/16**	**35/8**	**35/16**
Herring fish meal	105.00	105.00	105.00	105.00
Soybean meal	300.00	300.0	480.0	480.00
Wheat bran	85.00	85.00	85.00	85.00
Ground yellow corn	371.40	330.40	183.40	110.40
α-cellulose	40.00	-----	-----	-----
Fish and corn oil (1:1)	62.00	143.00	65.00	138.00
Vit. And Min. premix[1]	15.00	15.00	15.00	15.00
Ascorbic acid	1.60	1.60	1.60	1.60
Binder (CMC)[2]	20.00	20.00	20.00	20.00
Total	1000	1000	1000	1000
Chemical composition (on DM basis)				
Dry matter (DM)	92.03	91.15	91.88	92.17
Crude protein (CP)	25.11	24.83	34.77	34.65
Ether extract	8.31	15.78	9.31	16.20
Crude fiber (CF)	5.69	5.36	5.77	5.26
Ash	8.73	8.76	8.16	9.17
N.F.E[3]	52.16	45.27	41.99	34.72
Gross energy kcal/100g diet[4]	434.78	475.47	445.42	491.65
P:E ratio[5]	57.75	52.22	77.81	70.49

[1]Vit. And Min. premix each 2.5Kg contain Vit A 12 MIU, D_2 1MIU, E 10gm, K 2g, B_1 1 gm, B_2 4g, B_6 1.5g, B_{12} 10gm, Pantothenic acid 10g, Nicotinic acid 20g, Folic acid 1000mg, Biotin 50mg , Coline chloride 500mg. Zn, 55 mg., Mn, 55 mg., Fe, 30 mg., Cu, 10 mg., I, 1 g., Ca, 28.75 g., P, 11.25g and Selenium, 0.1g.

[2]CMC = Carboxymethyl cellulose.

[3]N.F.E = Nitrogen free extract = 100 — (moisture + protein + lipid + fiber +ash)

[4]Gross energy in kcal/100g ,based on 5.7 kcal/g protein, 9.5 kcal/g lipid, 4.0 kcal/g carbohydrate **(40).**

[5]P/E ratio = Protein to energy ratio in mg protein/kcal of gross energy

Experimental system

The experimental facility consisted of twelve hapas each placed in a concreted pond of 40 m^3. The pond was filled by fresh water from the water supply canal. Water was added only to compensate losses due to evaporation. During the 70 day feeding trial, the range water quality parameters were: temperature, 28.1 - 30.3; dissolved oxygen, 4.2 -5.68 ; and pH (7.48 - 9.5), as monitored once daily using a YSI model 556 MPS (Yellow Springs, Ohio, USA) and PH value was measured by using PH meter (Digital Mini-PH Meter, model 55, Fisher Scientific, USA). Total ammonia 0.32 - 0.58 mg /L, was determined employing calorimetric methods with spectronic (Milton Roy spectronic model 211); nitrite, 0.05 - 0.03 mg/ L, was measured following dialyzing method with Mitton Roy Spectronic (model 21 D) and total alkalinity, 182 - 220 mg /L, was measured by titration methods, total ammonia; nitrite and total alkalinity as monitored every 2-week using the previously described *(22).*

Data calculation

Body weight: Fishes were individually weighted at the experimental start, then every 2-week up to 10 weeks experimental periods.

Body weight gain = Final body weight (g/fish) - Initial body weight (g/fish) was determined *(12).*

Feed intake = Total feed consumption during the experimental periods *(12).*

Feed conversion ratio (F.C.R) = Feed intake (g) / Body weight gain (g) *(12).*

Gonadosomatic index (GSI)

Fish gonad was taken from 9 fishes per each treatment. Gonadsomatic index was measured and calculated as gonad percentage to the whole fish weight by the following equation *(23).*

GSI = (Gonad weight (g) / Fish weight (g)) × 100

Blood parameters

Blood samples for biochemical examination were obtained from the fish at the end of the experimental period. The samples were withdrawn from the arterial caudal fin. The needle was run quite deep through the middle line just behind the anal fin in a dorso-crunial direction using anti-coagulant, heparin (0.75 units / ml).

Hematological examination

1-Erythrocyte count (RBCs) *(24),* Hemoglobin concentration *(25)* and Haematocrit value (packed cell volume) *(25)* were determined.

2-Hematological index. (Mean corpuscular volume (M.C.V.); Mean corpuscular hemoglobin (M.C.H.) and Mean corpuscular hemoglobin concentration (MCHC), were determined according to the following formulae respectively *(26).*

$$\textbf{(M.C.V.)}\ (\mu m^3) = \frac{\text{P.C.V. \%} \times 10}{\text{R.B.Cs (million / cmm}^3)}$$

$$\textbf{(M.C.H.)}\ (Pg) = \frac{\text{Hb (gm / 100 bloods)} \times 10}{\text{R.B.Cs (Million / cmm}^3)}$$

$$\textbf{(MCHC)}\ (\%) = \frac{\text{Hb (gm / 100 bloods)} \times 100}{\text{P.C.V. \%}}$$

Statistical analysis

Statistical analysis was performed using the Analysis of variance (ANOVA) two way classification and Duncan's multiple Range Test to determine differences between treatments, means at significance level of 0.05. The standard errors of treatment means were also estimated. All statistics were carried out using Statistical Analysis System (SAS) program *(27).*

RESULTS AND DISCUSSION

1.Growth performance

Results presented in Table, 2 showed that, final body weight and weight gain of *O. niloticus* and *O. aureus* were increased significantly by increasing dietary protein and fat levels. In this connection, improved growth performance with increasing dietary protein levels has been observed in most fish *(7,8,28).* Weight gain was higher in juvenile hybrid tilapia (*O. niloticus X O. aureus*) fed the 10 and 15% lipid diets, followed by the 5% lipid diet, then by the 20% lipid diet and was lowest in fish fed the lipid-free control diet *(11).* On other hand, Increasing the dietary lipid level produced no significant effects on growth rate of Young, male tilapia (*O. niloticus*) *(29).* In the present study, fish that were fed on diet containing 35% protein + 16% fat had significantly higher final body weight (66.12 and 54.4g) and weight gain (16.06 and 12.96g) followed by those fed fish on diet containing 25% protein + 16% fat, then diet containing 35% protein + 8% fat for *O. nilotica* and *O. aurea* respectively. Whereas feeding with diet containing 25% protein + 8% fat product significant lower final body weight (57.54 and 49.50g) and weight gain (7.50 and 6.93g) for *O. nilotica* and *O. aurea* respectively. The final weight and the weight gain of Nile tilapia, reached their highest values ((220 and180.2 g)) when they were fed the diet containing 30% protein and 9.8% lipid diet *(15). Tilapia nilotica* fingerlings grew optimally with diets containing 30–40% proteins, 12–15% lipids *(30).* At all three protein levels (15, 20 and 30%) the best growth of a hybrid of *O. mossambicus x O. niloticus* was obtained with diets of 18% lipid *(31).*

Table 2. Effect of protein and fat levels on growth performance(Mean ± S.E) of *O. niloticus* and *O. areaus.*

Treatment		*Oreochromis niloticus*					*Oreochromis areaus.*				
		Initial wet	Final wet	Wet gain	FI	FCR	Initial wet	Final wet	Wet gain	FI	FCR
Main effect factor											
Protein level	25	50.07±3.0^{a}	66.12±2.91^{b}	16.06±2.43^{b}	44.61±5.66^{a}	2.78±0.24^{a}	41.43±0.74^{a}	54.4±1.74^{b}	12.96±1.94^{b}	31.93± 2.98^{a}	2.46±0.29^{a}
	35	50.55±2.47^{a}	74.30±2.18^{a}	23.75±1.85^{a}	47.98±3.70^{a}	2.02±0.23^{b}	40.85±2.20^{a}	57.73±1.68^{a}	16.88± 1.55^{a}	38.50±3.66^{a}	2.28±0.22^{a}
Lipid level	8	50.22±0.96^{a}	64.87± 2.12^{b}	14.65±2.01^{b}	36.90±3.96^{b}	2.52±0.27^{a}	41.49±1.36^{a}	52.67± 0.98^{b}	11.18± 1.31^{b}	29.75± 3.05^{b}	2.66±0.20^{a}
	16	50.40±3.77^{a}	75.55±2.73^{a}	25.16± 1.98^{a}	55.69±4.58^{a}	2.21±0.23^{a}	40.8±1.88^{a}	59.46± 1.99^{a}	18.66±1.84^{a}	40.68±3.31^{a}	2.18±0.32^{a}
Two-factor interaction											
Protein 25 and fat 8 %		50.04±1.98^{a}	57.54±1.43^{c}	7.50±1.02^{b}	25.32±4.64^{c}	3.38±0.37^{a}	42.57±1.42^{a}	49.50±0.72^{c}	6.93±1.15^{b}	21.49± 3.30^{b}	3.10±0.32^{a}
Protein 25 and fat 16%		50.09±5.84^{a}	74.70±4.15^{ab}	24.61±2.75^{a}	63.90± 5.57^{a}	2.6±0.29^{ab}	40.30±0.10^{a}	59.30±2.63^{a}	19.00±2.55^{a}	42.38± 1.56^{a}	2.23±0.39^{b}
Protein 35 and fat 8 %		50.40±0.05^{a}	72.20±2.22^{b}	21.80±2.18^{a}	48.48±3.88^{b}	2.22±033^{ab}	40.40±2.36^{a}	55.83±1.16^{b}	15.43±1.38^{a}	38.02± 3.65^{a}	2.46±0.18^{b}
Protein 35 and fat 16 %		50.70±5.08^{a}	76.40±11.91^{a}	25.70±9.44^{a}	47.48± 6.53^{b}	1.85±0.31^{b}	41.30±3.86^{a}	59.63±3.13^{a}	18.33±2.79^{a}	38.97±6.57^{a}	2.13±0.32^{b}
significant											
Protein level		NS	*	**	NS	*	NS	*	*	NS	NS
Lipid level		NS	**	***	**	NS	NS	**	**	*	NS
Two-factor interaction		NS	**	**	***	*	NS	*	**	*	*

Means with the same letter in the same column are not significantly different (P < 0.01)

FI: Feed intake FCR: Feed conversion ratio

2.Feed efficiency

Feed intake did not differ significantly by dietary protein levels, whereas increasing the fat level to 16% was significantly increased, feed intake in both fish species of *O. niloticus* and *O. aureus* (Table, 2). When fish were fed on diet containing 25% crud protein + 8% fat significantly reduced feed intake in both fish species. Feed conversion ratio of *O. niloticus* was significantly improved (2.02)) by increasing dietary protein level. However the best significantly Feed conversion ratio (1.85 and 2.13) was obtained in both *O. nilotica* and *O. aurea* respectively by diet containing 35% crude protein + 16% fat, whereas there was no significant difference from those fed 25% crude protein + 16% fat and 35% crude protein + 8 % fat. Daily feed consumption was correlated negatively to the digestible energy content of the diets, who add that the food conversion ratio ranged from 1.10 ($P_{30}L_{24}$) to 2.32 ($P_{15}L_{12}$) ***(31)***. The highest feed intake was observed in fish fed the diet containing 25%protein and 9.6% lipid diet. Feed conversion ratio had its better value (1.43) in fish fed the 30% protein and 7% lipid diet ***(15)***. No significant differences in feed intake across dietary lipid level for Malawian tilapia were observed ***(12)***. However, high amount of feed was consumed at lower dietary energy levels. Feed conversion ratios (FCR) were better ($P < 0.05$) for *O. niloticus X O. aureus* fed the lipid diets than those fed the control diet ***(11)***. Increasing dietary protein to 30% and dietary lipid to 10% diet improved the FCR values of Nile tilapia ***(32)***. On other hand, Increasing the dietary lipid level produced no significant effects on food conversion ratio and protein gain in Young, male tilapia (*O. niloticus*) ***(29)***.

Gonadosomatic index

Gonadosomatic index was increased when protein level increased from 25 to 35% in female and male of both fish species (*O. nilotica* and *O. aurea*) (Table, 3). Fish *O. niloticus* fed higher protein levels (32 and 40%) reached puberty at an earlier age, with oocytes growing and maturing faster, than those fed lower levels (≤25%),the same authors suggested that, dietary protein may have influenced oocyte growth and puberty by its effect on growth ***(33)***. In respect with the dietary fat, higher fat level 16% increased gonadosomatic index in male *O. nilotica*, female and male *O. aurea*, while gonadosomatic index did no significantly differ between two fat levels 8 and 16% in female *O. nilotica*. It has been demonstrated that, the elevation of dietary lipid levels from 12% to 18% in broodstock diets for rabbitfish resulted in an increase in fecundity and hatching ***(34)***. In the present study, the higher gonadosomatic index was observed by diet containing 35% protein + 16 fat in female (1.35 and 1.60) and male (0.88 and 0.98) of both *O. nilotica* and *O. aurea* species respectively. Low protein–high calorie diet caused a reduction in rainbow trout reproductive performance ***(18)***. Moreover, It has been reported that, reduction of dietary protein levels from 51% to 34% together with an increase in dietary carbohydrate levels from 10% to 32% reportedly reduced egg viability in seabass ***(35)***. On other hand, an increased lipids (+41%), protein (+26%), increased reproduction, and gonadal lipids in female mosquito fish at 25 °C ***(36)***.

Blood constituents

Data illustrated in Table, 4 showed that, *O. nilotica* had significant increase in Hb, MCH and MCHC and significant decrease in RBC_s and PCV when a dietary protein level was increased, whereas there was no significant difference in MCV ($P < 0.05$). With respect to dietary lipid levels, feeding fish with higher fat level caused significant increase in MCH and significant decrease in RBC_s and PCV, whereas there was no significant difference in Hb, MCV and MCHC by both tow fat levels ($P < 0.05$). Similar trend of the above blood constituents was observed by the same dietary protein and lipid levels in *O. aurea*. Nile tilapia fish fed basal diet had significantly ($P < 0.05$) lower erythrocytes and hematocrit values (Htc) than fish fed fat and Vitamin C supplemented diets and Hb was lower, although not significantly different. Also there was no a significant effect for mean

values of MCV and MCHC between bloods from fish fed basal diet and those from fed fat and Vitamin C supplemented diets *(37)*.

The best Hb (0.17), MCV(165.9), MCH (1.77) and MCHC (1.19) values were recorded in groups of *O. nilotica* fed with 35% dietary protein at 16% lipid level, while the best RBC_s (1.34) and PCV (21.78) values were recorded in groups of *O. nilotica* fed with 25% dietary protein at 8% lipid level. Liver malic enzyme, glucose-6-phosphate dehydrogenase and phosphogluconate dehydrogenase activities were higher in *O. niloticus X O. aureus* fed the lipid-free control diet and generally decreased as the lipid content in the diet increased *(11)*. Lipid concentrations between 7 and 14%, in a diet contains 60 IU vitamin E/kg, are likely to limit oxidative stress and result in normal physiological responses of red drum fish *(16)*. Korean rockfish fed 30% CP diet showed significantly lower hemoglobin (Hb) concentration than those of fish fed 40 in 5.0 and 11.5 diet lipid levels. Whereas in 8.5 and 20.0 diet lipid level , there was no significant difference in Hb among the dietary protein level. Percent cell volume (PCV) increased significantly with increasing dietary protein from 30 to 40% in 8.5, 11.5, and 20.0 diet lipid level. plasma triglyceride TG, enzyme activities GOT and GPT in blood were not affected by different dietary protein and energy levels *(38)*. Hemoglobin (Hb) and Haematocrit value were increased significantly with increasing dietary protein from 25 to 45% and dietary lipid from 3.5 to 8.5 for juvenile olive flounder *(39)*.

We can conclude that, fish diet inclusion up to 35% protein and 16% fat is recommended for adult *O. niloticus* (50.31±1.92g) and *O. aureus* (41.14±1.15g), reared in hapas.

Table 3. Effect of protein and fat levels on gonadosomatic index (Mean ± S.E) of *O. niloticus* and *O. areaus*.

Treatment		*Oreochromis niloticus*		*Oreochromis areaus*	
		Female	**Male**	**Female**	**Male**
Main effect factor					
Protein level	25	0.54 ± 0.09^{b}	0.46 ± 0.05^{b}	0.48 ± 0.07^{b}	0.43 ± 0.12^{b}
	35	1.25 ± 0.11^{a}	0.59 ± 0.14^{a}	1.24 ± 0.55^{a}	0.90 ± 0.69^{a}
Lipid level	8	0.81 ± 0.19^{a}	0.36 ± 0.07^{b}	0.57 ± 0.10^{b}	0.40 ± 0.13^{b}
	16	0.98 ± 0.10^{a}	0.70 ± 0.07^{a}	1.15 ± 0.58^{a}	0.93 ± 0.67^{a}
Two-factor interaction					
Protein 25 and fat 8 %		0.28 ± 0.01^{c}	0.25 ± 0.01^{c}	0.26 ± 0.01^{c}	0.25 ± 0.02^{c}
Protein 25 and fat 16%		0.81 ± 0.05^{b}	0.40 ± 0.07^{bc}	0.69 ± 0.01^{b}	0.27 ± 0.01^{c}
Protein 35 and fat 8 %		1.14 ± 0.18^{ab}	0.47 ± 0.06^{b}	0.88 ± 0.02^{b}	0.65 ± 0.03^{b}
Protein 35 and fat 16 %		1.35 ± 0.13^{a}	0.88 ± 0.02^{a}	1.60 ± 0.22^{a}	0.98 ± 0.06^{a}
significant					
Protein level		***	*	***	***
Lipid level		NS	***	***	***
Two-factor interaction		**	***	*	**

Means with the same letter in the same column are not significantly different ($P < 0.01$)

Table 4. Effect of protein and fat levels on hematological parameters (Mean ± S.E) of *O. niloticus* and *O. areaus.*

Treatment		*Oreochromis niloticus* RBCs	Hb	PCV	MCV	MCH	MCHC
Main effect factor							
Protein level	25	1.40±0.05^{a}	0.11±0.01^{b}	19.39±1.22^{a}	141.09±10.29^{a}	0.80±0.05^{b}	0.60±0.06^{b}
	35	1.17±0.09^{b}	0.15±0.01^{a}	16.50±0.98^{b}	148.02±14.05^{a}	1.37±0.16^{a}	0.98±0.13^{a}
Lipid level	8	1.37±0.03^{a}	0.13±0.01^{a}	19.89±0.93^{a}	146.22±7.13^{a}	0.95± 0.03^{b}	0.67±0.04^{a}
	16	1.21±0.11^{b}	0.13±0.01^{a}	16.00±1.11^{b}	142.89±15.96^{a}	1.23±0.20^{a}	0.91±0.15^{a}
Two-factor interaction							
Protein 25 and fat 8 %		1.34± 0.05^{a}	0.12± 0.01^{bc}	21.78± 1.18^{a}	162.28 ±6.61^{a}	0.92± 0.04^{b}	0.57± 0.03^{b}
Protein 25 and fat 16%		1.45± 0.12^{a}	0.10± 0.01^{c}	17.00± 1.8^{b}	119.9± 18.50^{b}	0.69± 0.06^{b}	0.64± 0.16^{b}
Protein 35 and fat 8 %		1.39± 0.03^{a}	0.14± 0.01^{ab}	18.00± 0.87^{ab}	130.16± 5.37^{b}	0.98± 0.04^{b}	0.76± 0.02^{b}
Protein 35 and fat 16 %		0.96± 0.12^{b}	0.17± 0.01^{a}	15.00± 1.80^{b}	165.9± 30.42^{a}	1.77± 0.17^{a}	1.19± 0.17^{a}
Significant							
Protein level		**	**	*	NS	***	**
Lipid level		*	NS	*	NS	*	NO
Two-factor interaction		**	*	*	*	***	*
		Oreochromis areaus.					
Main effect factor							
Protein level	25	1.29±0.09^{a}	0.12±0.01^{b}	17.75±2.33^{a}	136.57±15.76^{a}	0.93±0.05^{a}	0.73±0.07^{b}
	35	1.49±0.10^{a}	0.15±0.01^{a}	12.75±1.26^{b}	94.83±14.60 ^{b}	1.03±0.04^{a}	1.36±0.22^{a}
Lipid level	8	1.39±0.11^{a}	0.13±0.01^{a}	20.00±1.81^{a}	151.39±15.17^{a}	0.97±0.06^{a}	0.69±0.05^{b}
	16	1.39±0.10^{a}	0.14±0.01^{a}	10.50±0.37^{b}	80.01±6.73^{b}	0.99±0.04^{a}	1.41±0.20^{a}
Two-factor interaction							
Protein 25 and fat 8 %		1.46± 0.15^{ab}	0.14± 0.01^{b}	24.50± 1.28^{a}	174.93± 19.56^{a}	0.96± 0.10^{a}	0.55± 0.03^{b}
Protein 25 and fat 16%		1.12± 0.04^{b}	0.10± 0.01^{c}	11.00± 0.41b^{c}	98.20± 0.07^{bc}	0.90± 0.07^{a}	0.92± 0.07^{b}
Protein 35 and fat 8 %		1.32± 0.20^{ab}	0.12± 0.02^{bc}	15.50± 2.25^{b}	127.84± 25.03^{b}	0.97± 0.11^{a}	0.82± 0.07^{b}
Protein 35 and fat 16 %		1.66± 0.08^{a}	0.18± 0.02^{a}	10.00± 0.82^{c}	61.81± 8.02^{c}	1.08± 0.05^{a}	1.91± 0.33^{a}
significant							
Protein level		NS	**	***	**	NS	***
Lipid level		NS	NS	***	***	NS	***
Two-factor interaction		*	***	**	*	NS	*

Means with the same letter in the same column are not significantly different (P < 0.01)

REFERENCES

1. ***Miller, C. L., D. A, Davis and R. P, Phelps. (2005):*** The effects of dietary protein and lipid on growth and body composition of juvenile and sub-adult red snapper, *Lutjanus campechanus* (Poey, 1860). Aquaculture Research. Vol 36, pp: 52-60.

2. ***El-Sayed, A. M. and S. Teshima. (1992):*** Protein and energy requirements of Nile tilapia (*Oreochromis niloticus*) fry. Aquaculture103,55-63. Fish Physiology and Biochemistry. Vol 21, pp: 249–255.

3. ***Delince, G. (1992):*** The Ecology of the Fish Pond Ecosystem with Special Reference to Africa. The Netherlands. Kluwer Academic Publisher, London. pp 223.

4. ***Popma. T and M. Masser.(1999):*** Tilapia Life History and Biology. Southern Regional Aquaculture Center. Publication No. 283

5. ***Ishak, M. M., A. Sayes and K. Tallaat. (1985):*** Tilapia fisheries in Lake Borollus (Egypt). Kuwait. Bulletin of Marine Society. Vol 6, pp: 225-242.

6. ***Siddiqui, A. Q., M. S. Howladar and A. A. Adam (1991):*** Effect of water exchange on *Oreochromis niloticus* growth and water quality in outdoor concrete tanks. Aquaculture. Vol 95, pp: 67-74.

7. ***Ayyat, M. S and F. S. Abbas. (2003):*** Effect of dietary protein level, stoking density and feeding rate on performance of Nil tilapia (Oreochromis niloticus). Egyptian J. Nutrition and feeds. Vol 6 (Special Issue) pp: 407-408.

8. ***Sayed, S. H and R. A. Abou-Seif. (2007):*** Preliminary investigation on the dietary protein levels and its effects on growth performance, survival rates, feed utilization and chemical composition of Nil tilapia (*Oreochromis niloticus*) fry. The 11th Conference of the Egyptian society for the development of fisheries resources & human health. Book of abstract, pp:94.

9. ***El-Dahhar, A. A. and R.T, Lovell. (1995):*** Effect of protein to energy ratio in purified diets on growth performance, feed utilization and body composition of Mozambique tilapia (*Oreochromis mossambicus*). Aquaculture.Vol 26, pp: 451-557.

10. ***Kheir M.T. (1998):*** Growth response and feed utilization in *Oreochromis aureus* fed on three dietary protein levels. Egyptian Journal of Zoology. Vol 31, pp: 349-359.

11. ***Chou, B. S and S.Y. Shiau. (1996):*** Optimal dietary lipid level for growth of juvenile hybrid tilapia (*Oreochromis niloticus* X *Oreochromis aureus*). Aquaculture, Vol 143, Issue 2, pp: 185-195

12. ***Kangombe. J., J. S. Likongwe., H. Eda and J. P. Mtimuni. (2007):*** Effect of varying dietary energy level on feed intake, feed conversion, whole-body composition and growth of Malawian tilapia, (*Oreochromis shiranus – Boulenger*). Aquaculture Research. Vol 38, pp: 373-380.

13. ***Al-Hafedh, Y. S. A. (1999):*** Effects of dietary protein on growth and body composition of Nile tilapia (*Oreochromis niloticus*). Aquaculture Research. Vol 30. pp, 385-393.

14. ***El-Dahhar, A. A. (2000):*** Developing a feeding guide for Nile tilapia (*Oreochromis niloticus*) based on dietary protein levels fed. Conference of Social and Agricultural Development of Sinai 25, pp: 127-138.

15. ***Sweilum M. A., M. M Abdella and S. A Salah El-Din. (2005):*** Effect of dietary protein-energy levels and fish initial sizes on growth rate, development and production of Nile tilapia, (*Oreochromis niloticus* L). Aquaculture Research. Vol 36, pp:1414-1421

16. ***Craig, S. R., B. S. Washburn and D. M. Gatlin (1999):*** Effects of dietary lipids on body composition and liver function in juvenile red drum, *Sciaenops ocellatus*. Journal Fish Physiology and Biochemistry. Vol 21, Number 3 pp:249-255

17. ***Izquierdo, M. S., H. Fernández-Palacios and A. G. J. Tacon (2001):*** Effect of broodstock nutrition on reproductive performance of fish. Aquaculture. Vol 197, Issues 1-4, pp: 25-42.

18.Watanabe, T., Takeuchi, T., Saito, M., Nishimura, K. (1984): Effect of low protein–high calorie or essential fatty acid deficiency diet on reproduction of rainbow trout. Nippon Suisan Gakkaishi. Vol 50 (7), pp: 1207–1215.

19.Fletcher, D. J. (1984): plasma glucose and plasma fatty acids levels of limonda limonda (L) in relation to season, stress, glucose and nutritional state. Fish Biology. Vol 25. No (6), pp: 629-648.

20.Fernandes, F. A ., M. Monteiro., A. Figueiredo., E. Gomes., J. Coimbra and M. A. Reis-Henriques.(2000): Partial or total replacement of fish meal by plant protein affects gonadal development and plasma 17_-estradiol levels in female Nile tilapia. Aquaculture International. Vol 8, pp: 299–313.

21.A. O. A. C. (1990): Association of Official Analytical Chemists. Official Methods of Analysis. 13th Ed. Washington DC,USA.

22.A. P. H. A (2000): Standard methods for examination of water and waste water. Amrican puplic health association. Washington. D. D., USA.

23.Memis, D. and H. Gun (2004): Effects of different diets on the growth performance, gonad development and body composition at first sexual maturity of rainbow trout (*Oncorhynchus mykiss*). Turk. J. Vet Anim. Sci. Vol 28, pp: 315-322.

24.Dacie, J. V and Lewis, S. M. (1975): Methods for routine fish hematology.The progressive Fish Cultiurist. Vol 22, pp: 164-171.

25.Wintrobe, M. M. (1965): Clinical Haematology, 4th ed. Lea and Febiger, Philadephia, pp: 146-153.

26.Hesser, E. F. (1960): Method for routine fish haematology. The progressive fish

Culturist. Vol 22, pp: 164-171.

27.S. A. S. (2000): Statistical Analysis Systems. program Vel. 6. 12, SAS institute incorporation. Cary. NC 27513. USA.

28.National Research Council (NRC) (1993): Nutrition requirements of fish. National Academy Press Washington C.U.S.A.

29.Fred Hanley (1991): Effects of feeding supplementary diets containing varying levels of lipid on growth, food conversion, and body composition of Nile tilapia (*Oreochromis niloticus* (L.)). Aquaculture. Vol 93, Issue 4, pp: 323-334.

30.Teshima S., Kanzawa A., Uchiyama Y. (1985): Effects of dietary protein, lipid and digestible carbohydrate levels on the weight gain, feed conversion efficiency and protein efficiency ratio of *Tilapia nilotica*, Mem. Kagoshima Univ. Res. Center S. Pac. (6), pp: 56–71.

31.De-Silva, S. S, Rasanthi M. Gunasekera and K. F. Shim (1991): Interactions of varying dietary protein and lipid levels in young red tilapia: Evidence of protein sparing. Aquaculture, Vol 95, Issues 3-4, pp: 305-318

32.Samra, I.M. (2002): Some factors affecting protein requirements for tilapia fish. MSc Thesis, Faculty of Agricultural, Moshtohor, Zagazig University (Benha Branch), Zagazig, Egypt.

33.Gunasekera, M. R., K. F. Shim and T. J. Lam (1995): Effect of dietary protein level on puberty, oocyte growth and egg chemical composition in the tilapia, (*Oreochromis niloticus* (L.)). Aquaculture, Vol 134, Issues 1-2, pp:169-183.

34.Duray, M., Kohno, H., F. Pascual. (1994): The effect of lipid enriched broodstock diets on spawning and on egg and larval quality of hatchery-bred rabbitfish *Siganus guttatus*. Philipp. Sci. Vol 31, pp: 42–57.

35.Cerda, J., Carrillo, M., Zanuy, S., Ramos, J., de la Higuera, M.(1994): Influence of nutritional composition of diet on sea bass, *Dicentrarchus labrax* L., reproductive performance and egg and larval quality. Aquaculture. Vol 128, pp: 345–361.

36.Cech, J . J ., R. G. Schwab., W. C. Coles and B. B. Bridges. (1992): Mosquitofish reproduction: Effects of photoperiod and nutrition. Aquaculture. Vol 101, Issues 3-4, pp: 361-369.

37.Falcon, R . D, M. M. Barros, L. E. Pezzato, F. G. Sampaio And H. Hisano (2007): Physiological Responses of Nile

Tilapia (*Oreochromis niloticus*) Fed Vitamin C- and Lipid-Supplemented Diets and Submitted to Low-Temperature Stress. Journal Of The World Aquaculture Society. Vol 38, No. 2, pp: 287-295.

38.Kim, K. W., X. Wang., K. Han and S. C. BAi. (2004): Optimum Dietary Protein Level and Protein-to-Energy Ratio for Growth of Juvenile Korean Rockfish Sebastes *schlegeli.* Journal Of The World Aquaculture Society. Vol 35, No 3, pp: 305-314.

39.Kim, K. W., X. Wang., S. M. Choi., G. J. Park and S. C. Bai (2004): Evaluation of optimum dietary protein-to-energy ratio in juvenile olive flounder *Paralichthys olivaceus* (Temminck et Schlegel) Aquaculture Research. Vol 35, No 3, pp:250-255.

40.Jobling, M (1983): Towards and explanation of specific dynamic action (SDA). Journal of Fish Biology. Vol 23, pp:549-555.

الملخص العربى

تأثير مستويات بروتين ودهن العليقة على أداء النمو وبعض مركبات الدم فى أسماك البلطى النيلى والاوريا

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المعمل المركزى لبحوث الثروة السمكية بالعباسة

أجرى هذا العمل لدراسة تأثير مستويين من البروتين (٢٥ , ٣٥%) وكذا مستويين من الدهون (٨ , ١٦%) على أداء النمو وبعض مركبات الدم فى أسماك البلطى النيلى والأوريا حيث تم إجراء تجربة لمدة ٧٠ يوم فى هابات شبكية على أسماك البلطى النيلى والاوريا بمتوسط وزن ابتدائي ٥٠،٣١ ± ١,٢٩و١٤،١٤ ±١،١٥ على التوالى. تم اختبار تأثير مستويين من كل من البروتين والدهن على النمو وبعض مركبات الدم للبلطى النيلى والاوريا. استخدم ١٢ هابه ذات أبعاد (٢×١×١م) بمعدل ١٠ سمكات لكل هابه وتم استخدام مستويين بروتين ٢٥ و٣٥% ومستويين دهن ٨ و ١٦% (تصميم عاملى ٢×٢).

وأوضحت النتائج زيادة معنوية فى الوزن النهائى وعائد الوزن بزيادة كل من بروتين ودهن العليقة فى كل من البلطى النيلى والاوريا. وأعطت المعاملة ٣٥ % بروتين+١٦%دهن أعلى وزن نهائى وعائد وزن فى البلطى النيلى والاوريا. تحسن معدل التحويل الغذائى معنويا بزيادة بروتين العليقة فى البلطى النيلى ولم توجد اختلافات معنوية فى البلطى الاوريا بزيادة بروتين ودهن العليقة. وكان أفضل معدل تحويل غذائى فى الأسماك المغذة ٣٥%بروتين+١٦%دهن فى كل البلطى النيلى والاوريا. زاد دليل الأعضاء التناسلية بزيادة كل من بروتين ودهن العليقة وأعطت المعاملة ٣٥ % بروتين+١٦%دهن أعلى قيمة لدليل الأعضاء التناسلية فى ذكور وإناث كل من البلطى النيلى والاوريا.

لوحظ ايضا زيادة معنويه فى تركيز كل من الهيموجلوبين (Hb) و (MCH) و(MCHC) وانخفض تركيز كل من (RBC_s) و(PCV) فى البلطى النيلى بزيادة بروتين العليقة, بينما لم تتأثر قيم (MCV) ببروتين العليقة. زيادة دهن العليقة أدى إلى زيادة معنوية فى MCH وانخفاض معنوى فى كل من RBC_sوPCV بينما لايوجد اختلافات معنوية فى (Hb) و(MCV) و(MCHC). وجد نفس الاتجاه لتأثير البروتين والدهن فى البلطى الاوريا. المعاملة ٣٥ % بروتين+١٦%دهن أعطت أفضل قيم (Hb) و (MCV) و(MCH) و(MCHC) بينما المعاملة ٢٥% بروتين + ٨% دهن أعطت أفضل قيم (RBC_s) و (PCV) فى البلطى النيلى.

يمكننا تلخيص أن احتواء العليقة حتى ٣٥% بروتين+١٦% دهن يوصى بيه للبلطى النيلى والاوريا المحضن فى هابات.