# Growth performance of Nile tilapia, *Oreochromis niloticus*, fingerlings fed on diets supplemented with different levels of L-Tyrosine

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## ABSTRACT

This study was designed to evaluate the effect of dietary tyrosine supplementation at different levels (0.0, 0.05, 0.10, 0.15 and 0.20 %) on growth performance, feed utilization, body composition and some blood parameters of Nile tilapia, (*Oreochromis niloticus*). Experimental diets were isonitrogenous and isocaloric (29.43 CP % and 4.68 kcal/GE/g in average). A total number of 150 Nile tilapia fingerlings with average initial weight of (10±0.02 g/fish) were randomly distributed into five treatment groups and stocked into 15 glass aquaria (70 liter each). Five experimental groups in triplicate, and were fed daily at a rate of 3% of fish live body weight through 14 weeks as an experimental period.

Results indicated that, higher significant (P<0.05) differences were detected in the final body weight, weight gain, Average daily gain, specific growth rate and feed utilization criteria's between fish groups fed on diets supplemented with tyrosine and the control diet . No significant differences ($P$>0.05) were observed in dry matter, ash and energy content in whole body fish. However, crude protein and ether extract content in fish fed diets containing tyrosine had higher values. Results showed that plasma glucose, total protein and total lipids, were not significantly ($P$>0.05) affected by tyrosine supplementation. Aspartate aminotransferase and alanine aminotransferase showed significantly higher ($P$<0.05) activity in fish fed the control diet; however, they decreased by increasing L-tyrosine in the experimental diets .It could be concluded that, diet containing 0.10% tyrosine was economically superior to the other tested diets. It reduced about 12.65% of feeding cost per unit of fish compared with control diet.

*Keywords*: *Nile tilapia, amino acids, L-Tyrosine and growth parameters.*

## Introduction

Protein is the most expensive dietary macronutrient of fish diets and directly affects on fish weight gain (Abdelghany, 2000 and Ng *et al.,* 2001), because protein intake generally estimates growth. The requirements for these macronutrients in fish are uniformly high irrespective of their dietary habits and ranges from 35:50% in general. In fish, levels of free amino acids (FAA) in tissues are also known to be affected by dietary protein quality (Dabrowska, 1984), and relationship between tissue (EAA) levels and dietary requirements has been suggested by Schuhmacher *et al.* (1997). Thus, tissue FAA levels in fish may be useful to know sufficiency of amino acids in practical feeds containing various protein sources. Dietary AA deficiencies cause a reduction in growth, decrease protein retention in fish (Tibaldi *et al.,* 1994 and Luzzana *et al.,* 1998) and increase AA oxidation (Fauconneau *et al.,* 1992) . Amino acids (AA) seem to be the major energy source during fish larval stages (Rønnestad *et al.*, 1999) and a high and balanced amino acid content in the diet is required in order to maximize growth (Conceição *et al.*, 2003 and Rønnestad *et al.,* 2003).

Tyrosine is aromatic amino acid which is produced from phenylalanine. It is therefore often considered as a semi-indispensable amino acid . Tyrosine is the precursor of thyroid and adrenocortical hormones and of norepinephrine and epinephrine. Dopamine regulates central and peripheric nerve activity and therefore can be related to the control of stress in fish. Tyrosine is also metabolized to catechol derivates which are melanin precursors which play an important role in fish pigmentation. (Saavedra *et al.,* 2008). It is important to the structure of almost all proteins in the body. It is also the precursor of a few neurotransmitters, including L-dopa, dopamine, norepinephrine, and epinephrine (Chiaroni *et al.*, 1990).

Therefore, the present study was undertaken to study the effect of different levels of dietary tyrosine on growth performance, feed utilization, body composition and some blood parameters of Nile tilapia fingerlings.

## MATERIALS AND METHODS

This work was carried out at the Wet Fish Laboratory, Department of Animal Production, Faculty of Agriculture, Kafrelsheikh University, during summer 2008 year.

### *1- Experimental fish*

The experimental Nile tilapia (*Oreochromis niloticus)* fingerlings were collected from Moassasa farms, Tolompate 7. Prior to the start of the experiment. Fish the fingerlings were placed in a fiberglass tank and randomly distributed into glass aquaria to be adapted to the experimental condition until starting the experiment. Fish were fed on the control diet for two weeks, during this period healthy fish at the same weight replaced the died ones.

### *2- Experimental Diets:*

The basal and tested diets were formulated from the commercial feed ingredients. The dry ingredients were grounded through a feed grinder to very small size (0.15 mm). Experimental diets were formulated (Table, 1) to be isocaloric and isonitrogenous (about 29.43% crude protein and about 4.68 kcal GE/g diet.

Table (1): Feed ingredients (%) of the experimental diets.

| Feed ingredients | Diets No[1]. (on dm basis, %) | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Herring fish meal | 10 | 10 | 10 | 10 | 10 |
| Soybean meal | 38 | 38 | 38 | 38 | 38 |
| Yellow corn | 30 | 29.95 | 29.90 | 29.85 | 29.80 |
| Wheat bran | 16 | 16 | 16 | 16 | 16 |
| Sunflower oil | 3 | 3 | 3 | 3 | 3 |
| Vitamins and minerals premix[2] | 3 | 3 | 3 | 3 | 3 |
| Tyrosine | 0 | 0.05 | 0.10 | 0.15 | 0.20 |
| Total | 100 | 100 | 100 | 100 | 100 |

[1]Diet 1(control), diets 2, 3, 4, 5 and 6 containing different levels (0.0, 0.05, 0.10, 0.15 and 0.20 %) of tyrosine, respectively.
[2]Vitamins and minerals premix (product of HEPOMIX) each 2.5 kg contain: 12.000.000 IU Vit.A; 2.000.000 IU Vit. D3 ; 10 g Vit. E ; 2g Vit. K3 ; 1g Vit. B1 5g Vit. B2;1.5 g Vit. B 6 ; 10g Vit.B12; 30 g Nicotinic acid ; 10 g Pantothenic acid ; 1g Folic acid; 50g Biotien; 250g Choline chlorid 50% ; 30g Iron; 10g copper; 50g Zinc; 60g Manganese; 1g Iodine; 0.1g Selenium and Cobalt 0.1g ( Local market )

The ingredients were weighted and mixed by a dough mixer for 20 minutes to homogeneity of the ingredients. The estimated amount of oil components (sunflower oil) was gradually added (few drops gradually) and the mixing operation was continued for 20 minutes. The diets were pelleted through fodder machine and the pellets were dried under room temperature. The diets were collected, and stored in plastic bags in refrigerator at 4C° during the experimental period to avoid the deterioration of nutrients.

***3- Experimental design of rearing fish***

A total of 150 Nile tilapia, *Oreochromis niloticus* fingerlings with an average initial body weight about (10g±0.02)were randomly divided into five treatment groups and stocked into 15 glass aquaria (70 liter each). Three aquaria were assigned for each treatment.

Fresh tap water was stored in fiberglass tanks for 24h under aeration for dechlorination. One third of all aquaria were replaced daily. Five air stones were used for aerating the aquaria water. Water temperature ranged between 26.5-27.5 °C. Photoperiod was 14 hr per day using florescent light. Fish feces and feed residues were removed daily by siphoning.

Fish from each replicate were weighted at the start of each experiment and hencefore counted and weighted every two weeks through out the experimental period (14 weeks). All experimental fish were apparently healthy and free from external parasites.

Fish were fed on the experimental diets at a rate of 3% live body weight/day at 2 equal meals at 8 am and 3 pm through 14 weeks. Fish were weighed biweekly intervals during the experimental period and the feed intake was readjusted according to the change of live body weight.

***4- Biochemical analysis:***

The chemical analysis of the experimental diets and fish samples at the beginning and at the end of the experiment (4 fish) from each group were obtained at the end of the experiment for dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF) and ash chemical analysis (%) according to AOAC (1990) . The gross energy contents of experimental diets were calculated by using the values of 5.65, 9.45 and 4.12 kcal/g of protein, lipids and carbohydrates, respectively (NRC, 1993).

***5- Measurements of water parameters***

Water sample from each aquarium was taken weekly to determine dissolved oxygen by using oxygen meter model 9070; pH was determined immediately by using a digital (pH-meter).

Analysis of $NO_2$, $NO_3$, $PO_4$ and alkalinity were carried out using commercial kits (Hach International Co., Cairo, Egypt).

***6- Blood parameters.***

Blood samples were collected at the end of experiment, fish in each aquarium were weighted and 5 fish were taken randomly for blood sampling. The blood samples were received in heparinzed plastic tubes. Blood samples were centrifuged at 4000 rpm for 20 minutes to allow separation of plasma which was subjected to determine plasma total protein (Tietz, 1990). Blood plasma total lipids were determined according to the method of McGowan *et al.* (1983). Glucose concentration was determined according to Trinder (1969). Alanine aminotransferase (ALT) and activity of aspartate aminotransferase (AST) were determined by the methods of Young, (1990).

***7- Performance parameters:***

Weight gain , average daily gain (ADG), specific growth rate (SGR), feed conversion ratio (FCR), protein efficiency ratio (PER), protein productive value (PPV), energy utilization (EU) and survival rate (SR) were calculated as follows:

Weight gain (g/fish) =average final weight (g) – average initial weight (g).

ADG (g/fish/day) = (weight gain (g)/experimental period (d)).

SGR (%/day) = [(In final body weight–In initial body weight) 100]/experimental period (d).

FCR = feed Intake (g)/ weight gain (g).

PER = weight gain (g)/ protein intake (g).

PPV (%) =100 (protein gain / protein intake).

EU % = 100 [energy gain / energy intake]

SR =100[Total No of fish at the end of the experimental/Total No of fish at the start of the experiment].

***8- Preliminary economical efficiency***

Preliminary economical evaluation of the experimental diets has been calculated based on the cost of one kg fish weight gain produced (in LE), using feed conversion rate and the price of feed ingredients in local markets during May, 2008. The prices were 10, 2.5, 1.25, 2.00, 7.00, 8.00 and 400.00 LE/kg, for fish meal, soybean meal, wheat bran, yellow corn, sunflower oil, vitamins and minerals premix and tyrosine respectively.

### *9- Statistical analysis*

The obtained numerical data were statistically analyzed using SPSS (1997) for one-way analysis of variance. When F-test was significant, least significant difference was calculated according to Duncan (1955).

## RESULTS AND DISCUSSION

### *1- Chemical composition of diets.*

Experimental diets table, 2 contained nearly similar levels of dry matter (DM),crude protein (CP),ether extract (EE) ,crude fiber (CF) , Ash, Nitrogen free extract (NFE), gross energy (GE) and protein to energy ratio (CP/GE ratio). The CP and GE content of experimental diets were around 29.43 % and 4.68 kcal/g, respectively. These values were within the range suggested for tilapia by Jauncey and Ross (1982) and NRC, (1993) for CP and Hassanen *et al.*, (1995) for GE.

Table (2): Chemical analysis (%) of the experimental diets.

| Ingredients | Diets No.(on DM basis, %)[1] | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Dry matter | 93.70 | 93.14 | 93.66 | 92.87 | 92.79 |
| Crude protein | 29.27 | 29.36 | 29.42 | 29.52 | 29.58 |
| Ether extract | 11.76 | 11.48 | 11.64 | 11.60 | 12.08 |
| Crude fiber | 5.16 | 5.13 | 5.09 | 4.99 | 4.97 |
| Total ash | 8.70 | 8.66 | 8.74 | 8.62 | 8.58 |
| Nitrogen free extract | 45.11 | 45.37 | 45.11 | 45.27 | 44.79 |
| *Calculated energy value* | | | | | |
| GE (kcal/g)[2] | 4.67 | 4.66 | 4.67 | 4.67 | 4.70 |
| ME (kcal/g)[3] | 3.84 | 3.83 | 3.84 | 3.85 | 3.87 |
| P/E ratio ,mg/kcal[4] | 62.68 | 63.00 | 63.00 | 63.21 | 62.94 |
| P/E, g/Kj [5] | 14.98 | 15.06 | 15.06 | 15.11 | 15.04 |

[1]Diet 1(control), diets 2, 3, 4 and 5 containing different levels (0.0, 0.05, 0.10, 0.15 and 0.20 %) of Tyrosine, respectively.

[2]GE (Gross energy) was calculated according to NRC (1993) by using factors of 5.65, 9.45 and 4.12 K cal per gram of protein, lipid and carbohydrate, respectively .

[3]ME (Metabolizable energy) was calculated using the value of 4.5, 8.1 and 3.49 Kcal per gram of protein, ether extract and nitrogen free extract, respectively according to Pantha ( 1982).

[4]P/E (protein to energy ratio) = mg crude protein / Kcal GE.

[5] K cal = 4.184 kj (McDonald *et al.*, 1979) .

### *2- Water quality parameters*

Water quality parameters of the experimental aquaria were affected without significant differences by varying feed supplements of tyrosine during the experimental period. Average data of samples are summarized in Table (3). In general, average water temperature of the different treatments was ranged between 26.5 and 27.5 °C. Averages of pH values for the supplements ranged from 7.26 to 7.68. The lower pH values may be attributed to the increase in organic matter contents in these aquariums (Kamal *et al.,* 2004). The concentration of dissolved oxygen (mg/l) for different supplements ranged between 5.24 and 6.08 ppm which are beneficial to fish growth.

Table (3): Some physical and chemical parameters of water during the feeding experimental period.

| Items / Diets No.[1] | Water Temperature (C°) | Water pH | DO mg/l | Alkalinity ppm | $PO_4$ mg/l | $NO_2$ mg/l | $NO_3$ mg/l |
|---|---|---|---|---|---|---|---|
| 1 | 27.0 | 7.65 | 5.64 | 131 | 0.4 | 0.15 | 2.80 |
| 2 | 26.5 | 7.26 | 5.24 | 127 | 0.2 | 0.12 | 3.10 |
| 3 | 27.5 | 7.34 | 5.75 | 130 | 0.3 | 0.13 | 2.70 |
| 4 | 27.0 | 7.68 | 6.08 | 128 | 0.4 | 0.14 | 2.50 |
| 5 | 26.5 | 7.23 | 5.74 | 135 | 0.2 | 0.16 | 2.60 |

[1]Diet 1(control), diets 2, 3, 4 and 5 containing different levels (0.0, 0.05, 0.10, 0.15 and 0.20 %) of Tyrosine, respectively.

Kamal *et al.,* (2004) reported that, levels of dissolved oxygen above 4 ppm are considered a limiting value for a suitable feeding and growth of fish. Average of available phosphorus ranged between 0.2 and 0.4 mg/l which reflex the normal range of phosphorus. This range was found to be suitable for growth of fish as reported by Forts *et al.,* (1986) and Boyd and Musing (1981). The values of the total alkalinity ranged from 128 to 135 ppm. Nitrite ($NO_2$) and nitrate ($NO_3$) concentration ranged from 0.12 to 0.16 mg/l and from 2.5 to 3.10 mg/l, respectively. The above results represented that, all parameters of water quality were within the normal range.

### *3- Growth performance and survival rate*

Data concerning average total gain (ATG), average daily gain (ADG), specific growth rate (SGR%) and survival rate (SR) for all the experimental diets fed to Nile tilapia fingerlings are presented in Table (4).

Data indicated, no significant differences (P>0.05) in the initial fish weight were found among the different experimental groups. Results also showed that, fish fed diets 3 and 4 that containing 0.10 and 0.15 % tyrosine were significantly higher (P<0.05) in final body weight, average total gain, average daily gain, specific growth rate than those fed the diets, 2 and 5 that containing 0.05 and 0.20 % tyrosine . On the other hand, pervious growth performance parameters were lower, especially with unsupplemented diet (1). Survival rate of the experimental fish groups was recorded 100% for all experimental fish groups (Table, 4).

Table (4): Growth performance parameters of Nile tilapia *(O. niloticus)* fed on the experimental diets.

| Items | Diets No.(on DM basis, %)[1] | | | | | SE[2] |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | |
| Initial weight, (g/fish) | 10.12 | 10.12 | 10.05 | 10.04 | 10.09 | 0.02 |
| Final weight, (g/fish) | 40.82[c] | 47.25[b] | 51.35[a] | 49.10[ab] | 48.21[b] | 1.20 |
| Weight gain, (g/fish ) | 30.70[c] | 37.13[b] | 41.30[a] | 39.06[ab] | 38.12[b] | 1.20 |
| Average daily gain, (g/fish/day) | 0.31[c] | 0.38[b] | 0.42[a] | 0.40[ab] | 0.39[b] | 0.01 |
| Specific growth rate (SGR % /day) | 1.43[c] | 1.58[b] | 1.67[a] | 1.62[ab] | 1.60[b] | 0.02 |
| Survival rate, (%) | 100 | 100 | 100 | 100 | 100 | 0.00 |

[1]Diet 1(control), diets 2, 3, 4 and 5 containing different levels (0.0, 0.05, 0.10, 0.15 and 0.20 %) of Tyrosine, respectively.
[2]a, b and c means in the same rows bearing different letters differ significantly at 0.05 levels.
* Standard error of the mean derived from the analysis of variance.

These results are in agreement with those obtained by Khan and Abidi (2007). They found that, the total aromatic amino acids supplementation (0.4 to 1.65 % dry diet from phenylalanine + tyrosine) recorded higher significant differences (P<0.05) with different levels in live weight gain percent and specific growth rate of Indian major carp *Labeo rohita* fry compared with unsupplemented control diet, without any mortality during the feeding trial . Rumsey and Ketola (1975) reported that, collective supplementation of soybean with lysine; methionine, histidine and leucine did an increase growth rate of rainbow trout .The same trend was also reported by Fordiani and Ketola (1980) who found that, methionine supplementation of commercial soybean improved growth rate of rainbow trout

***4- Feed intake and nutrient utilization.***

Results of feed intake and nutrient utilization in terms of feed intake (FI), feed conversion ratio (FCR), protein efficiency ratio (PER), protein productive value (PPV %) and energy utilization (EU) are illustrated in Table (5). Feed intake (FI) was ranged between 54.41 and 56.94 g/fish and was insignificantly ($P$>0.05) differed among all experimental fish groups fed tyrosine levels. There were significant differences ($P$<0.05) in FCR, PER and PPV% among the fish fed graded levels of tyrosine and the fish fed control diet. The supplementation of 0.10 % tyrosine was the best supplemented level for FCR, PER, PPV (%) and EU (%) comparison to the control or other experimental tyrosine levels.

Table (5): Feed intake and nutrient utilization of Nile tilapia fingerlings fed on the experimental diets.

| Items | Diets No.(on DM basis, %)[1] | | | | | SE[2] |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | |
| FI, g/fish | 54.41 | 55.72 | 56.94 | 55.28 | 54.95 | 0.40 |
| FCR | 1.78$^{a}$ | 1.50$^{b}$ | 1.38$^{b}$ | 1.42$^{b}$ | 1.44$^{b}$ | 0.05 |
| PER | 1.93$^{b}$ | 2.27$^{a}$ | 2.47$^{a}$ | 2.40$^{a}$ | 2.35$^{a}$ | 0.07 |
| PPV, % | 24.83$^{b}$ | 33.55$^{a}$ | 35.53$^{a}$ | 30.08$^{a}$ | 30.69$^{a}$ | 1.35 |
| EU, % | 18.12$^{b}$ | 20.44$^{ab}$ | 22.58$^{a}$ | 22.46$^{a}$ | 22.44$^{a}$ | 0.72 |

[1]Diet 1(control), diets 2, 3, 4 and 5 containing different levels (0.0, 0.05, 0.10, 0.15 and 0.20 %) of Tyrosine, respectively.

[2]a and b means in the same rows bearing different letters differ significantly at 0.05 levels.

Standard error of the mean derived from the analysis of variance.

Khan and Abidi (2007) used various levels of phenylalanine and tyrosine (0.4 to 1.65%) for Indian major carp *Labeo rohita* fry and reported that, *Labeo rohita* fed supplemented diets had higher significant effect ($P$<0.05) growth performance, feed conversion ratio, protein efficiency ratio and protein productive value than the control group . Robinson et al., (1980) explained that, the addition of 0.5% tyrosine in a basal diet significantly improved growth performance of fingerlings channel catfish.

Additional nitrogen may have stimulated growth since the diets were not isonitrogenous .The utilization of amino acids depends in general upon the level of their intake and balance in the diet. Growth of fish is the result of intake in balanced protein, of all the ten essential amino acids contained in the dietary protein component (Halver *et al.,* 1957 and 1959). The wide variations observed in the total aromatic amino acid requirement among fish species may be because of the differences in the methodologies used such as the natural of the dietary protein sources in the test diets, the reference protein, energy density of the diet, which dietary amino acid pattern is chosen and the culture conditions (Luzzana *et al.,* 1998) and variations may also be attributed to phylogenetically distinct families or species (Akiyama *et al.,* 1997).

***5- Biochemical blood parameters:***

Results in Table (6) showed that, blood plasma glucose, total protein and total lipids, were not significantly affected ($P$>0.05) by the different levels of tyrosine supplementation. It was clear that, increasing of tyrosine levels in tilapia diets caused a slight increase in plasma glucose, total protein and total lipid.

Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) showed significantly higher ($P$<0.05) activity in fish fed the basal diet. However, it was decreased by increasing tyrosine level in the experimental diets. These results suggested that, tyrosine may influence through its component to improve liver function. In addition, tyrosine could increase the immunity of fish. It has a potent protective action through decreasing AST and ALT concentration. It supports liver structure, improves health condition of fish and increase fish resistance to diseases .Also all values of pervious blood parameters were within the normal range reported by Abd Elmonem *et al.*, (2002), Shalaby, (2004) and El-Dakar (2004) in Nile tilapia. .

Table (6): Blood plasma parameters of Nile tilapia fed different levels of tyrosine.

| Items | Diets No.(on DM basis, %)[1] | | | | | SE[2] |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | |
| Plasma glucose, mg/dl | 55.21 | 56.32 | 56.84 | 58.27 | 59.24 | 0.54 |
| Plasma total protein, g/dl | 5.10 | 5.32 | 5.66 | 5.69 | 5.74 | 0.08 |
| Plasma total lipid, g/dl | 4.45 | 4.55 | 4.58 | 4.62 | 4.87 | 0.14 |
| AST, U/dl | 150[a] | 140[b] | 137[b] | 132[bc] | 130[c] | 2.24 |
| ALT, U/dl | 55[a] | 46[b] | 44[b] | 43[b] | 40[b] | 0.68 |

[1]Diet 1(control), diets 2, 3, 4 and 5 containing different levels (0.0, 0.05, 0.10, 0.15 and 0.20 %) of Tyrosine, respectively.

[2]a, b and c means in the same rows bearing different letters differ significantly at 0.05 levels. Standard error of the mean derived from the analysis of variance.

***6- Body composition:***

Body chemical composition of Nile tilapia fish fed varied levels of tyrosine is shown in Table (7). No significant differences ($P$>0.05) were observed for dry matter, ash and energy content. However, crude protein and ether extract content of body fish recorded higher values with various levels of tyrosine, than for an unsupplemented one. Also, fish at the start of the experiment had lower dry matter, crude protein, ether extract, ash and energy contents.

Similar results were obtained by Khan and Abidī (2007) who found that, the body protein and fat were significantly increased ($P$<0.05) with increasing levels of phenylalanine and tyrosine incorporation in all the diets, also, they found that no significant differences were detected in the ash content among all treatments .Since the fish has a metabolic need for both phenylalanine and tyrosine, and only a certain portion of the phenylalanine can be converted to tyrosine and still meet the animal's need for phenylalanine, it is important to determine the requirement in terms of its total aromatic amino acid needs (Khan and Abidi, 2007) .

Table (7): Effect of tyrosine levels (%) on Nile tilapia body composition (%, on DM basis).

| Items | Initial fish | Diets No.(on DM basis, %)[1] | | | | | SE[2] |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | |
| Dry matter, % | 21.82 | 27.01 | 25.86 | 25.87 | 26.04 | 25.67 | 0.24 |
| Crude protein, % | 57.26 | 61.22[b] | 62.75[ab] | 63.21[a] | 62.17[ab] | 62.25[ab] | 0.23 |
| Ether extract, % | 15.68 | 18.09 | 19.62 | 18.43 | 19.56 | 19.75 | 0.32 |
| Ash, % | 14.66 | 16.52 | 16.34 | 16.55 | 16.47 | 16.41 | 0.20 |
| Energy content , Kcal/g DM | 5.24 | 5.21 | 5.45 | 5.39 | 5.44 | 5.45 | 1.54 |

[1]Diet 1(control), diets 2, 3, 4 and 5 containing different levels (0.0, 0.05, 0.10, 0.15 and 0.20 %) of Tyrosine, respectively.

[2]a and b means in the same rows bearing different letters differ significantly at 0.05 levels. Standard error of the mean derived from the analysis of variance.

***7- Preliminary economical efficiency***

Preliminary economical efficiency of fish fed different levels of tyrosine is presented in Table (8).

Table (8): Effect of tyrosine levels on cost of feed required to produce one Kg gain of Nile tilapia at the present experiment.

| Items | Diets No.(on DM basis, %)[1] | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Cost of one ton of feed (L.E) | 3208 | 3407 | 3606 | 3805 | 4004 |
| Feed cost relative to control | 100 | 106 | 112 | 119 | 125 |
| Cost of one kg fish gain (L.E) | 5.69 | 5.11 | 4.97 | 5.39 | 5.77 |
| Cost of one kg fish gain relative to control | 100 | 89.81 | 87.35 | 94.73 | 101.41 |

[1]Diet 1(control), diets 2, 3, 4 and 5 containing different levels (0.0, 0.05, 0.10, 0.15 and 0.20 %) of Tyrosine, respectively.

Results indicated that, feed cost per kg weight gain of fish decreased by 10.19, 12.65 and 5.27 % of the control diet for fish fed diets containing 0.05, 0.10 and 0.15 % tyrosine, respectively. While, this cost was increased by feeding fish diet contained 0.20 % tyrosine by 1.41 % of the control diet.

It was concluded that diet containing 0.10% tyrosine was economically superior to the other tested diets. It reduced feeding cost per unit of fish by12.65% compared with control diet.

## CONCLUSION

The results of the present study demonstrated that, diet containing 0.10% tyrosine was economically superior to the other experimental diets. It reduced about 12.65% of feeding cost per unit of fish compared with unsupplemented one. Also, tyrosine can be profitably used even up to 0.15% in Nile tilapia diets because of its positive response on growth performance, feed conversion, nutrient utilization, protein efficiency and economical efficiency.

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## الملخص العربي

## أداء النمو لاصبعيات البلطي النيلى المغذاة على علائق مضاف لها نسب مختلفة من التيروسين

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في تجربة غذائية استمرت ٩٨ يوم بغرض دراسة تأثير إضافة مستويات مختلفة من الحامض الامينى التيروسين (صفر و٠,٠٥و ٠,١٠و

٠,١٥ و ٠,٢٠ % ) على أداء النمو وكفاءة تمثيل الغذاء والجلوكوز والبروتينات الكلية والدهون الكلية لبلازما الدم وتقدير إنزيمات الكبد والتركيب الكيماوي لجسم الأسماك وكذلك التعرف على أحسن نسبة إضافة يمكن بها تحقيق أحسن عائد اقتصادي للتعرف على الكفاءة الاقتصادية . تم استخدام عدد ١٥٠ سمكة (بمتوسط وزن ١٠ جم) تم توزيعها عشوائيا في خمسة معاملات كل معاملة في ثلاث مكررات وذلك فى أحواض زجاجية سعة ٧٠ لتر وكانت تتم التغذية بمعدل ٣% من الوزن الحي يوميا خلال ١٤أسبوع .

أظهرت النتائج وجود اختلافات معنوية في معدل الوزن النهائي ومعدلات الزيادة اليومية و الكلية للأسماك وكذلك في معدل النمو النوعي وكفاءة التحويل الغذائي وكفاءة تمثيل البروتين وذلك بين الأسماك التي غذيت على علائق تحتوى على مستويات مختلفة من التيروسين (علائق من ٢- ٥ ) والأسماك التي غذيت على العليقة الاساسية (عليقة ١) . لم يلاحظ وجود اى اختلافات أحصائيه بين جميع الأسماك المختبرة والكنترول وذلك في محتوى الجسم من المادة الجافة والرماد والطاقة ، بينما ازداد محتوى جسم الأسماك المختبرة من البروتين والدهون مقارنة بمجموعة الكنترول . كما أوضحت النتائج عدم وجود أختلافات معنوية بين المجاميع المختبرة ومجموعة الكنترول بالنسبة لمكونات بلازما الدم من الجلوكوز والبروتين الكلى والدهون الكلية بينما أدت إضافة التيروسين بمستوياته المختلفة على خفض نشاط أنزيمات الكبد معنويا مقارنة بمجموعة الكنترول .

**ومن خلال النتائج السابقة فقد وجد أن العليقة التي تحتوى على ٠,١٠% تيروسين ( عليقه ٣) كانت أفضل العلائق من الناحية الاقتصادية حيث أنها أعطت اعلى معدلات نمو وافضل كفاءة غذائيه ووفرت حوالي ١٢,٦٥ % من تكاليف التغذية اللازمة لإنتاج كجم من الأسماك وذلك مقارنة بالعليقة الاساسية .**