J. Agric. Sci. Mansoura Univ., 27 (6): 3747 - 3753, 2002

# GROWTH RESPONSE OF NILE TILAPIA FINGERLINGS (*Oreochomis niloticus*) FED DIETS CONTAINING DIFFERENT LEVELS OF BETAFIN

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## ABSTRACT

A feeding trial was conducted in Fish Research Laboratory in Kafr El-Sheikh, Faculty of Agriculture, Tanta University to study the effect of supplementing betafin as a pure form of betaine in the diet of monosex Nile tilapia (Oreochromis niloticus) fingerlings on their growth performance and efficiency of feed and protein utilization. A set of 195 fingerlings monosex Nile tilapia with about 22 g average initial weight were taken from the stock of a private hatchary in Kafr El-Sheikh Governorate. The fish were transported into glass aquaria in Kafr El-Sheikh, Faculty of Agriculture and adapted for one month before the beginning of the experiment. The fish were divided into 15 similar groups and randomly distributed into 15 glass aquaria (80 x 35 x 40 cm) with 13 fish in each. A basal diet containing about 29 % crude protein was formulated from the commercial ingredients (Fish meal, soybean meal, yellow corn, wheat bran, cellulose and vitamin and mineral mixture). Betafin was added to the basal diet at 0, 2, 4, 6 and 8 g/Kg deit or 0, 0.2, 0.4 , 0.6 and 0.8 % of the total diet. The basal diet without betafin was considered as a control diet. The experimental diets were fed to fish groups at 3 % of their total biomass for 56 days. The results showed that growth parameters including body weight gain (BWG), average daily gain (ADG) and specific growth rate (SGR) were the highest in the groups fed diet containing 8 g betafin/kg , while the lowest values were obtained in the groups of the control diet . All betafin supplemented diets significantly improved BWG, ADG, SGR, FCR, PER and PPV as compared with the unsupplemented diet (control). Fish body composition was not affected by the supplementation of betafin in the diet.

It is recommended to supplement the diet of Nile tilapia with betafin at 4 g/kg

**Keywords:** Betafin-Nile tilapia, growth, feed efficiency.

## INTRODUCTION

In the last few years, several companies dealing with animal and poultry feeds introduced many of feed additives, some of these contain some benificial microbs such as lactobacillii and yeast, the other including some antibiotics or hormones for promoting the growth of animals, specially the small animals such as poultry, rabbits and fishes. Betafin is one of the feed additives. It is a pure form of natural betaine which is a naturally occuring substance found in a wide variety of plant and animal species. Sugar beet molasses,a by-product of sugar production is a major sourceof betaine .Many workers used feed stimulants containing betaine in the diet of several fish and shrimp species for enhancing growth rates and osmotic adaptation (Virtanen *et al.* 1989; Harpaz, 1992; Gomes *et al.*, 1997; Harpaz, 1997; and Papatryphon and Soares 2000). The aim of this study was to evaluate the growth respose of monosex Nile tilapia fingerlings to different levels of betafin as a feed stimulant and its effect on efficiency of feed and protein utilization.

## MATERIALS AND METHODS

The present investigation was carried out in Fish Research Laboratory in the Department of Animal Production. Kafr El-Sheikh, Faculty of Agriculture, Tanta University to study the effect of adding "betaine" in the form of betafin on growth performance and feed utilization of Nile tilapia (Oreochomis niloticus). The experimental system consisted of 15 glass aquaria (80 x 35 x 40 cm) containing 80 liters of dechlorinated tap water in each. All aquaria were supplied with compressed air through air pumps. One third of the total water volume in each aquarium was replaced by fresh tap water after cleaning and removing the accumulated excreta. Water temperature was adjusted thermostatically and maintained at 25±1C° by electric heaters. A basal diet containing about 29 % crude protein was formulated from ingredients bought from the local market. These ingredients included fish meal, soybean meal, yellow corn, wheat bran and sunflower oil in addition to vitamin and mineral mixture. Betafin(Product of Dansico Animal Nut.,Finnland) was added to the diet at the rate 0, 2, 4, 6 and 8 g/kg diet or 0, 0.2, 0.4, 0.6 and 0.8 % of the total diet. Composition of the experimental diets and proximate analysis of the basal diet are given in tables 1 and 2, respectively.

A group of 195 monosex Nile tilapia (Oreochromis niloticus) fingerlings with about 22 g/fish average initial body weight were obtained from the stock of a private fish hatchery in Kafr El-Sheikh Governorate and transported into fish Research Laboratory in Kafr El-Sheikh, Faculty of Agriculture. The experimental fish were lasted in the glass aquaria one month before the beginning of the experiment for the adaptation on the new environment. The fish were divided, thereafter, into 15 equal groups and distributed into the aquaria (13 fish/aquarium).

**Table (1): Composition of the experimental and control diets(% on DM basis).**

| Ingredients % | Diet No. | | | | Control |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | |
| Fish meal | 15 | 15 | 15 | 15 | 15 |
| Soybean meal | 42 | 42 | 42 | 42 | 42 |
| Wheat bran | 10 | 10 | 10 | 10 | 10 |
| Yellow corn | 26.7 | 26.7 | 26.7 | 26.7 | 26.7 |
| Sunflower oil | 5 | 5 | 5 | 5 | 5 |
| Cellulose | 0.6 | 0.4 | 0.2 | - | 0.8 |
| Vit & Min mixture* | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Betafin | 0.2 | 0.4 | 0.6 | 0.8 | - |

* Vitamin and Mineral mixture (Productio of IBEX international Co. Cairo, Egypt). Each kg contains: 6 million IU, vit.A, 1.2 million IU, vit. $D_3$, 6000 mg vit.E, 1000 mg vit.$K_3$k 400 mg, vit.$B_1$, 2000 , vit.$B_2$, 800 mg, vit.$B_6$, 4.8 mg, vit.$B_{12}$, 20 mg Biotin, 4000 mg Pantothenic acid, 14000 Nicotinic acid, 4800 mg Folic acid, 2800 mg copper, 160 mg iodine, 32000 mg Mangan 12000 mg Iron, 20000 mg Zinc, 60 mg Selenium and 50000 mg Anti-oxidant.

**Table (2): Chemical analysis and energy content of the basal diet.**

| Item | % |
|---|---|
| Dry matter (DM) | 89.45 |
| Crude protein (CP) | 29.01 |
| Ether extract (EE) | 5.90 |
| Ash | 12.18 |
| Crude fiber (CF) | 4.21 |
| Nitrogen free extract (NFE) | 48.7 |
| Metabolizable energy (Kcal/kg)* | 3483.0 |

*** Metabolizabel energy (ME) was calculated by using 3. 49, 8.1 and 4.5 Kcal/g for carbohydrate, fat and protein, respectively according to Pantha (1982).**

The fish were fed on the control and test diets at 3% of total biomoss daily for 56 days. The fish were weighed weekly and the amount of food was adjusted according to the new fish biomass. Photo period was controlled and maintained to provie 14 h light : 10 h dark.

**Chemical analysis:**

Representative fish samples from each group were taken at the end of the experiment and dried in a forced air oven at 60 C° for 48 h and then prepared for the chemical analysis. Dry matter, CP, EE , CF and Ash in the basal diet and in fish body were carried out according to the methods described by A.O.A.C. (1990).

**Statistical analysis:**

Analysis of variance was carried out according to Snedecor and Chochran, 1982, while the comparisons among treatment means were made following the method of Dancan (1955).

## RESULTS AND DISCUSSION

**Growth performance:**

Average initial weight, average final weight, body weight gain (BWG), average daily gain (ADG) and specific growth rate (SGR) are presented in Table 3.

The data in this table indicated that growth parameters (BWG, ADG and SGR) were the highest in the groups fed diet supplemented with 8 g betafin/kg (diet 4). There were no significant differences between diet 4 and each of diet 3 (6 g betafin/kg) and diet 2 (4 g betafin/kg). There were significant differences between control diet and all diets supplemented with betafin except diet 1 (2 g betafin/kg). It could be concluded that adding betafin at 2 - 8 g/kg significantly improved growth parameters as compared with the control. Body weight gain increased by increasing the level of betafin in the diet. It increased by 17.9, 46.7, 47.6 and 71.5 % as betafin was supplemented in the diet at 2, 4, 6 and 8 g/kg, respectively. The highest response in growth parameters was observed at the high level of betafin. Papatryphon (2000) found that weight gain was significantly improved in

striped bass fed feeding stimulant which contained a mixture of some amino acids and betaine. This improvement increased as the level of feeding stimulant increased from 2 to 4 %, which was in agreement with the present results. The positive effect of Finnstim supplementation (a commercial product with betaine as the main component) on growth of rainbow trout was observed in the results of Virtanen *et al.* (1994), where the highest response was obtained at 1% Finnstim in the diet, with a 60% reduction in mortality and 12% increase in specific growth rate after fish transfer in the seawater. The results of Dy-Penaflorida and Virtanen (1996) indicated, also that juvenile shrimp (Penaeus monodon) fed diet containing 1% betaine/amino acids additive had a significantly higher weight gain than the those fed the other diets containing betaine/amino acid mixture up to 2%, The optimum level of betaine found by Dy-Penaflorida and Virtanen (1996) that produce the highest weight gain in shrimp was lower than that obtained for Nile tilapia in the present study. Several studies conducted with different fish and shrimp species showed the benificial effect of supplemented betaine in enhancing growth rates and osmotic adaptation (Virtanen *et al.*, 1989; Harpaz, 1992; Kanazawa, 1992; Harpaz, 1997 and Gomes *et al.*, 1997).

**Table (3): Effect of betafin on growth parameters of Nile tilapia.**

| | Betafin level | Initial weight g/fish | Final weight g/fish | BWG(1) g/fish | ADG(2) g/fish/d | SGR(3) %/d |
|---|---|---|---|---|---|---|
| 1 | 2g/kg | 22.08 | 40.76 | $18.68^{ab}$ | $0.33^{ab}$ | $1.09^{ab}$ |
| 2 | 4g/kg | 22.02 | 45.26 | $23.24^{bc}$ | $0.42^{bc}$ | $1.29^{bc}$ |
| 3 | 6g/kg | 21.95 | 45.33 | $23.38^{bc}$ | $0.42^{bc}$ | $1.30^{bc}$ |
| 4 | 8g/kg | 22.05 | 49.21 | $27.16^{c}$ | $0.49^{c}$ | $1.43^{c}$ |
| Control | 0g/kg | 22.05 | 37.89 | $15.84^{a}$ | $0.28^{a}$ | $0.97^{a}$ |

**a, b, c, Means in the same column bearing different letters differ significantly at 0.05 level.**
**(1) Body weight gain (BWG) = Average final weight (g) – Average initial weight (g).**
**(2) Average daily gain (ADG) = Average weight gain (g) / Experimental period (d).**
**(3) Specific growth rate (SGR) = [(ln final weight (g) – ln initial weight (g)/time (d)] x 100.**

Papatryphone and Soares (2000) believe that betaine have a response as a palatability enhancer as well as a methyle donor and osmoprotectant. Moreover, the same investigators postulated hypothetically that the increased performance of striped bass fed betaine supplemented diet was not only a result of increased feed intake but also due to additional improvements in the digestive and/or metabolic capabilities.

**Efficiency of feed and protein utilization:**

Feed utilization expressed as feed conversion ratio (FCR), and protein utilization expressed as protein efficiency ratio (PER) and protein productive value (PPV%) are shown in Table 4.

The best FCR was found in fish groups fed diet containing 8 g betafin/kg. The worst FCR was observed in those fed the control diet. Supplementing of betafin significantly improved FCR as compared with the control. There were no significant differences in FCR among the diet containing betafin at 4, 6 and 8 g/kg. Protein efficiency ratio and PPV%

showed the same trend. It could be observed that protein was utilized more efficiently as betafin was added to the diet and the improvement in feed and protein utilization insignificantly increased as the level of betafin in the diet increased.

The improvement in feed efficiency as a result of betafin supplementation have been previously observed in Japanese eel (Takii *et al.*, 1986), gilthead bream (Tandler *et al.*, 1982), European Seabass (Gomes *et al.*, 1997) and Striped bass (Papatryphon and Soares, 2000).

**Table (4): Effect of betafin on feed and protein efficiency of Nile tilapia .**

| Diet No. | Betafin level | FCR(1) | PER(2) | PPV%(3) |
|---|---|---|---|---|
| 1 | 2g/kg | $2.43^{a}$ | $1.42^{a}$ | $27.7^{ab}$ |
| 2 | 4g/kg | $1.94^{b}$ | $1.79^{b}$ | $29.2^{bc}$ |
| 3 | 6g/kg | $1.89^{b}$ | $1.82^{b}$ | $30.2^{c}$ |
| 4 | 8g/kg | $1.75^{b}$ | $1.97^{b}$ | $31.4^{c}$ |
| Control | 0g/kg | $2.58^{a}$ | $1.35^{a}$ | $24.8^{a}$ |

a, b, c = Means in the same column bearing the same letter do not differ significantly (P>0.05).

1- Feed conversion ratio (FCR) = g dry feed/g live weight gain.

2- Protein efficiency ratio (PER) = g live weight gain/g protein intake.

3- Protein productive value (PPV%) = (g protein gain/g protein intake) x 100.

**Effect of betafin on the chemical composition of fish body.**

Body content including dry matter (DM), crude protein (CP), ether extract (EE) and ash are given in table 5.

From this table, it can be seen that there were no significant differences in DM, CP, EE and ash among the experimental diets in most cases. The values flactuated and it seems that the addition of betafin did not significantly influence the body composition, where no clear trend was observed. No data in the literature concerning the effect of betafin on fish body composition were available to compare the results of the present study with the previous studies.

**Table (5): Effect of betafin on body chemical composition of Nile tilapia.**

| Diet No. | Betafin level | DM % | % on DM basis | | |
|---|---|---|---|---|---|
| | | | CP | EE | Ash |
| 1 | 2g/kg | $27.04^{a}$ | $53.95^{ab}$ | $29.85^{a}$ | $14.68^{a}$ |
| 2 | 4g/kg | $28.14^{ab}$ | $54.80^{b}$ | $31.70^{ab}$ | $16.43^{c}$ |
| 3 | 6g/kg | $29.13^{b}$ | $53.80^{ab}$ | $32.60^{b}$ | $15.01^{ab}$ |
| 4 | 8g/kg | $26.89^{a}$ | $54.95^{b}$ | $32.56^{b}$ | $16.63^{c}$ |
| Control | 0g/kg | $27.95^{ab}$ | $52.33^{a}$ | $32.56^{b}$ | $15.94^{bc}$ |

a, b, c, Means in the same column bearing different letters differ significantly at 0.05 level.

From the results obtained in this study, it could be concluded that supplying the diet of Nile tilapia with betafin at a rate of 8 g/kg significantly improved growth and feed utilization, but from the economical point of view, it is recommended to use, betafin at 4 g/kg diet to reduce the cost of feeding, specially the differences between this level and the diet containing 8 g/kg in growth were not significant.

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J. Agric. Sci. Mansoura Univ., 27 (6), June, 2002

# استجابة النمو لأسماك البلطى النيلى المغذاة على علائق تحتوى علـــى مســـتويات مختلفة من البيتافين.

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أجرى هذا البحث فى معمل بحوث الأسماك بكلية الزراعة بكفر الشيخ – جامعـــة طنطـــا لدراسة تأثير أضافة البيتافين Betafin كصورة نقية للبيتائين Betaine فى عليقـــة اصبعيـــات البلطى النيلى وحيد الجنس على أداء النمو وكفاءة تحويل الغذاء وكفاءة استخدام البروتين. تم اجراء البحث فى احواض زجاجية مقاس ٨٠ × ٣٥ × ٤٠ سم يحتوى كل منها على ٨٠ لتر من المـــاء المنزوع منه الكلور. استخدم عدد ١٩٥ اصبعية من اسماك البلطى النيلى وحيد الجنس تم الحصول عليها من مفرخ خاص فى محافظة كفر الشيخ . وتم تقسيمها إلى ١٥ مجموعة متماثلة بكل منـــها ١٣ سمكة وزعت على الأحواض الزجاجية بطريقة عشوائية وتم اقلمة هذه الأسماك فى الأحواض الزجاجية لمدة شهر قبل بدء التجربة . تم تكوين عليقة اساسية تحتوى على حوالى ٢٩% بروتيـــن من المواد التجارية الموجودة فى السوق المحلية والتى اشتملت على مسحوق سمك- كســـب فـــول الصويا- أذرة صفراء- رجيع الكون- سيليلوز ومخلوط أملاح وفيتامينات . تم اضافة البيتافين إلى العليقة الأساسية بمعدل ٢، ٤، ٦، ٨ جم/كجم عليقة أو ٠,٢، ٠,٤، ٠,٦، ٠,٨ % من العليقة الكلية لتكوين أربعة علائق تجريبية بالإضافة إلى عليقة الكنترول التى لم تحتوى على البيتافين . غذيـــت الأسماك على العلائق التجريبية بمعدل ٣% من وزن الأسماك يومياً لمدة ٥٦ يوم وتم تكرار كـــل عليقة مختبرة فى ثلاثة أحواض وتم تقدير الزيادة فى الوزن- الزيادة اليومية فـــى وزن الجســـم- معدل النمو النوعى- نسبة كفاءة البروتين- القيمة الإنتاجية للبروتين- نسبة تحويل الغذاء وتقديـــر مكونات جسم الأسماك.

**وقد اسفرت النتائج عن الآتى:**

كانت أعلى زيادة فى الوزن وأعلى زيادة يومية وأعلى نمو نوعى فى الأسماك التى غذيـــت على العليقة المحتوية على ٨ جم بيتافين/كيلوجرام عليقة، بينما كانت أقـــل قيـــم لمقـــاييس النمـــو المذكورة فى مجموعات الأسماك التى غذيت على عليقة الكنترول والتى لم يضاف إليها البيتـــافين. وقد حسنت كل العلائق المحتوية على البيتافين بمستويات من ٢ – ٨ جم/كيلوجرام معدل الزيـــادة فى الوزن ومعدل الزيادة اليومية ومعدل النمو النوعى ونسبة تحويل الغذاء ونسبة كفاءة اســـتخدام البروتين والقيمة الإنتاجية للبروتين بالمقارنة بالكنترول. لم يتأثر تركيب جســـم الأســـماك معنويـــاً بإضافة البيتافين إلى العلائق ولم يكن هناك اتجاه واضح لهذا التأثر.

من نتائج هذا البحث يمكن استنتاج أن اضافة ٨% بيتافين إلى عليقة أسماك البلطى النيلى هى التى حققت أعلى معدلات النمو والكفاءة الغذائية ولكن لم يكن هناك فروق معنويـــة بينـــها وبيـــن العلائق المحتوية على البيتافين بمعدل ٤، ٦ جم/كيلوجرام عليقة ولذلك ينصح بإستخدام البيتـــافين بمعدل ٤ جم/كيلوجرام عليقة لتقليل تكاليف التغذية.