Evaluation of Using Some Feed Additives on Growth Performance and Feed Utilization of Monosex NileTilapia (*Oreochromis niloticus*) Fingerlings

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Abstract: An experiment was conducted to evaluate the effect of two different commercial feed additives on growth performance of monosex Nile tilapia fingerlings. Seven treatments were applied, three levels of Biobuds®2-*X* (0.05, 0.075 and 0.1%), Biogen® (0.05, 0.075 and 0.1%). The tested diets were applied in 21 fiberglass tanks each was stocked randomly with 20 Nile tilapia fingerlings with an average initial body weight of 5.0 ± 0.20g. The experiment lasted for 90 days. Generally, growth performance, feed conversion ratio and protein efficiency ratio were improved for tilapia fingerlings fed the diets with commercial feed additives compared to fish fed the control diet. The fish fed the diets with commercial feed additives decreased feed cost required for producing 1Kg weight gain compared to fish fed the control diet. These results revealed that the Biogen® at level of 0.1% was the best in terms of growth performance and economic evaluation.

***Keywords*:** Feed additives, tilapia, growth performance, feed utilization

INTRODUCTION

The demand for animal protein for human consumption is currently on the rise and is largely supplied with terrestrial farm animals. Aquaculture, however, is an increasingly important option in animal protein production. In Egypt, the production of fish coming from aquaculture represented about 60% of total fish production sources (GAFRD 2006). This activity requires high-quality feeds with high protein content which should contain not only necessary nutrients but also complementary feed additives to keep organisms healthy and favor growth. Feed additives are substances which added in trace amounts to diet not only to preserve its nutritional characteristics prior to feeding but also to facilitate ingredient dispersion, growth, feed ingestion, consumer acceptance of the product and to supply essential nutrients in purified form. Some of the most utilized growth-promoting additives include hormones, antibiotics, ionospheres and some salts (Fuller, 1992; Gongora, 1998; Klaenhammer and Kullen, 1999). Thought these do improve growth, their improper use can result in adverse effects in the animal and the final consumer, as well as lead to resistance in pathogenic bacteria in the case of antibiotics. Though probiotics, which are defined as live microbes which may serve as dietary supplements to improve the host intestinal microbial balance and growth performance have received some attention in aquaculture (Gatesoupe, 1999, Diab, *et al.*, 2002, Irianto and Austin 2002, Lara-Flores, *et al.*, 2003, Khattab *et al.*, 2004 and Yanbo and Zirong 2006). Some example of probiotics products are *Aspergillus oryzae, Lactobacillus acidophilus, L. bulgaricus, L.plantarium, Bifidobacterium bifidium, Streptococcus lactis* and *Saccharomyces cerevisiae* (FAO) 2004. Evidence of beneficial effects of probiotics gave birth to concept of prebiotics (Gibson and Roberfroid, 1995; Teitelbaum and Walker, 2002 and Li and Gatlin 2003, 2004 and 2005), which are defined by Gibson and Roberfroid (1995) as a non digestible food ingredient which beneficially affects the host by selectively stimulating the growth and /or activating of the metabolism of one or limited number of health-promoting bacteria in the intestinal tract, thus improving the host's intestinal balance. Example of prebiotics include mannan oligosaccharides (White *et al.*, 2002), lactose (Szilagyi, 2002) as well as oligofructose and inulin (Teitelbaum and Walker, 2002). Information pertaining to prebiotics in aquaculture is still extremely limited. Thus, this study was conducted to determine the effect of using graded levels of feed additives (probiotics) on growth performance, feed utilization, body composition and economic evaluation of feed costs of Nile tilapia (*O. niloticus)* fingerlings.

MATERIALS AND METHODS

Experimental fish

420 mono sex Nile tilapia fingerlings with an average body weight (5g ± 0.2g) which hatched and reared at fish research center, Faculty of Agriculture, Suez Canal University. Fish were acclimated to laboratory conditions for 2 weeks before being randomly divided into seven equal experimental groups (each treatment had three replicate tanks,20 fish each) representing seven nutritional groups. One group served as control and six groups represented the feed additives tested. The experimental fish were weighted every 15 days in order to adjust the daily feed rate which was 5% of the total biomass at three times/ day (8.30, 12.30, and 4.30 pm) for 90 days, except during the last month of the trial in which feeding rate reduced to 3% of the total biomass.

Experimental unit

The present study was conducted in the fish research center, Faculty of Agriculture, Suez Canal University. The experimental fish were stocked in 21 circle fiber glass tanks (380L) supplied with fresh water through a closed recycling system. Tank waters were aerated continuously by using an air compressor. Water flow rate was maintained at approximately 1.5L/min. Water temperature was maintained at (27 ±1 °C) and water quality parameters were monitored weekly where the ranges of dissolved oxygen was above 6mg /l, the

total ammonia was 0.020-0.030 mg/l and pH was 7 ± 0.5.

Experimental diets

Seven isonitrogenous diets were formulated from practical ingredients (Table1) where the control basal diet was without additives and the other diets were supplemented by 0.05, 0.075 and 0.1% Biobuds®2-*X* for diets 1, 2 and 3 and 0.05, 0.075 and 0.1% Biogen® for diets 4, 5 and 6, respectively. The experimental diets were formulated to contain almost 30% crude protein. The experimental diets were prepared by individually weighing of each component and by thoroughly mixing the mineral, vitamins and additives with corn. This mixture was added to the components together with oil. Water was added until the mixture became suitable for making granules. The wet mixture was passed through CBM granule machine with 2mm diameter. The produced pellets were dried at room temperature and kept frozen until experimental start.

Table (1): Composition and proximate analysis of the experimental diets

Feed Ingredients	Experimental Diet						
	Basal diet (control)	1	2	3	4	5	6
Fish meal	20	20	20	20	20	20	20
Soybean meal	18.5	18.5	18.5	18.5	18.5	18.5	18.5
Corn gluten	14	14	14	14	14	14	14
Wheat bran	18	18	18	18	18	18	18
Yellow corn	20.5	20.45	20.425	20.4	20.45	20.425	20.4
Soy & fish oil	6	6	6	6	6	6	6
Vitamin & Mineral Mix[1]	3	3	3	3	3	3	3
Biobuds®2-*X*[2]	-	0.05	0.075	0.10	-	-	-
Biogen[3]	-	-	-	-	0.05	0.075	0.10
TOTAL	100	100	100	100	100	100	100
Chemical composition							
Moisture	9.4	9.3	9.6	8.9	9.4	8.9	9.5
Crude protein	30	30.1	30.8	30.7	30.9	30.3	30.2
Ether extract	8.7	8.4	8.6	8.6	8.7	8.5	8.7
Crude fiber	6.6	6.2	6.1	5.7	5.9	6.1	6.8
Ash	7	6.8	6.8	6.7	7.1	6.7	6.5
N.F.E[4]	38.3	39.2	38.1	39.4	38	39.5	38.3
Metabolizabae energy Kcal/ 100g[5]	342.7	345.5	344.7	348.8	345.7	346.5	343.6

1- Each Kg vitamin & mineral mixture premix contained Vitamin A, 4.8 million IU: D_3, 0.8 million IU; E, 4 g; K, 0.8 g; B_1, 0.4 g; Riboflavin, 1.6 g; B_6, 0.6 g, B_{12}, 4 mg; Pantothenic acid, 4 g; Nicotinic acid, 8 g; Folic acid, 0.4 g Biotin,20 mg , Mn, 22 g; Zn, 22 g; Fe, 12 g; Cu, 4 g; I, 0.4 g, Selenium, 0.4 g and Co, 4.8 mg.

2- Each kg Biobuds®2-*X* contained: Active dried yeast culture, 200 million live cell yeast (CFU)/gm, dried *saccharomyces Cerevisiae*, fermentation product, roughage products, calcium carbonate, soybean oil,

3- Each kg Biogen contained: Allicin 0.247 micromil/gm, high-unit hydrolytic enzyme 3690 units/gm, (proteolytic- lipolytic-amylolytic and cell separating enzymes), *Bacillus subtilis* Nato 6x 107 cells/gm, Ginseng extract

4-Nitrogen free extract

5-Metabolizabae energy based on 4.5 Kcal/g protein, 8.51 Kcal/g fat & 3.49 Kcal/g carbohydrate (Pantha, 1982).

Diet and fish proximate analysis

The tested diets as well as whole body fish samples were analyzed for crude protein (CP %), ether extract (EE%), crude fiber (CF%), ash (%) and moisture according to the procedures described by A.O.A.C. (1995). The nitrogen free-extract (NFE %) was calculated by differences.

Statistical analysis

All of the data were subjected to one way analysis ($P<0.05$) of variance using the SPSS version 10/CP (Statistical Package Computer Software, Chicago, Illinois, USA, 2001). The treatment means were compared according to method of Duncan new multiple range test (Duncan, 1955).

The used model was $Yij = \mu + Ti + eij$

Where

μ = over all mean.

Yij =the observation of the individual from T treatment

Ti= the fixed effect of T the diet.

Eij= the experimental random error associated with individual J.

RESULTS AND DISCUSSION

Growth performance

The growth performance parameters of Nile tilapia *Oreochromis niloticus* fingerlings which fed diets supplemented with either feed additives of (Biobuds®2-*X*) or (Biogen®) are shown in Table (2). Average initial body weight of Nile tilapia fingerlings fed the experimental diets at the start did not differ, indicating that groups were homogenous. At the end of the experimental period (90 days), the group of fish fed the

supplemented diets grew as well or better than the group of fish fed the basal diet. Whereas the final body weight of the fish groups fed on diets 6 and 5 had significantly ($P<0.05$) higher final body weight than the rest of the experimental groups. However, the lowest final body weight (80.7g) was achieved by the group of fish fed the basal diet. Analysis of variance for weight gain followed the same trend as in final body weights. On the other hand the fish groups fed on diets 6, 5, 3 and 2 had significantly ($P<0.05$) higher SGR than the rest of experimental groups. However at the end of the trial, SGR values were 3.04 (basal diet), 3.13, 3.32, 3.38, 3.29, 3.37 and 3.37 %/d for fish groups fed on diets containing 0.05, 0.075 and 0.1% (Biobuds®2-*X*) and 0.05,0.075 and 0.1% (Biogen®), respectively. These results are in agreement with the results of Mehrim (2001), and Diab, *et al.* (2002) for tilapia. Khattab *et al.* (2004) reported that the Nile tilapia (*O. niloticus)* fingerlings fed on diets supplemented by probiotics exhibited greater growth than those fed with the control diet. Also, they reported that the diet contain 30% protein supplemented with Biogen at level of 0.1% produced the best growth performance and feed efficiency, suggesting that Biogen® is an appropriate growth-stimulating additive in tilapia cultivation. Similar results were reported using bacteria as a probiotics by Kozasa (1986) for yellowtail, Gatesoupe (1989 and 1991) and Gatesoupe *et al.* (1989) for Turbot and Japanese flounder, in addition Carnevali *et al.* (2006) for sea bass *Dicentrarchus labrax*, Decamp and Moriarty (2006) for shrimp and Yanbo and Zirong (2006) for common carp (*Cyprinus carpio*). Similar trend was found, in this respect with Noh *et al.* (1994) and Bogut *et al.* (1998) who studied the effect of supplementing common carp feeds with different additives, including antibiotics, yeast (*S. cerevisiae*) and bacteria (*S. faecium*). They observed better growth with probiotic-supplemented diets but obtained the best growth with the bacterium not the yeast. In contrary with these findings Abdelhamid *et al.* (2002) who found that Biogen® suplumentation did not significantly improve growth performance in tilapia fish. Furthermore, Lara-Flores *et al.* (2003) who reported that fry tilapia fed diets containing 40% protein supplemented with yeast produced the greater performance and feed efficiency than bacteria.

Feed utilization

Results of feed utilization in terms of FCR, PER and FE are presented in (Table2). The average of feed conversion ratio (FCR) in fish groups fed on diets 6 and 5 followed by groups of fish fed on diets 3 and 2 were significantly ($P<0.05$) improved in comparison with the other groups and better than the basal diet. The FCR was found to be 1.73 (Basal diet), 1.65, 1.45, 1.44, 1.55, 1.44 and 1.41, respectively. These results indicated that the best ($P<0.05$) FCR values were obtained by groups of fish fed on diet 6 followed by diets 5, 3 and 2. The best FCR values observed with probiotic-supplemented diets suggest that addition of probiotics improved feed utilization, with bacteria being the most effective of the supplements tested in the present study. Similar results have been reported for probiotics containing bacteria (Biogen®) use in diets for tilapia fingerling by Khattab *et al.* (2004). In practical terms, this means that the use of probiotics can decrease the amount of feed necessary for animal growth which could result in reductions of production cost. The same trend was observed in PER where the fish groups fed on diets 6 and 5 showed better ($P<0.05$) PER values compared with the other groups. The PER was found to be 1.92 (Basal diet), 2.01, 2.23, 2.26, 2.07, 2.29 and 2.34 respectively. The protein efficiency ratio results indicate that supplementing diets with probiotics significantly ($P<0.05$) improved protein utilization in tilapia. This contributes to optimize protein use for growth, a significant quality given that protein is the most expensive feed nutrient. Proboitics might improve digestibility of protein which explained the better feed efficiency seen with the supplemented diets.

Also, the results of feed efficiency followed the same trend as FCR and PER which was found to be 0.71 for diet 6, 0.69 for diet 5 and 0.69 for diet 3. In the present study, the commercial feed additives (probiotics) used significantly ($P<0.05$) enhanced feed efficiency and the results are in agreements with the findings of Khattab *et al.* (2004) and Bomba *et al.* (2002).

Whole body composition

An average of whole body composition including crude protein, ether extracts, crude fiber and ash estimated (as wet weight basis) are presented in Table (3). No significant differences were observed in whole body moisture, crude fiber and ash. Crude protein and ether extracts contents in whole fish body were not significantly with diets 1, 2 and 3 in comparison with basal diet. Concerning crude protein in whole fish body were significantly increased ($P<0.05$) while ether extracts were significantly decreased with Biogen® levels for diets 4, 5 and 6. These results are in close agreement with the results of Mehrim (2001) and Khattab *et al.* (2004).

Economic evaluation

Calculations of economical efficiency of the tested diets based on the cost of feed, costs of one Kg gain in weight and its ratio with the control group are shown in Table (4). As described in this Table feed costs and cost per kg gain (LE) were the highest for the control Basal diet (4.41 LE) and gradually decreased with increasing the levels of feed additives (Biobuds®2-*X* Biobuds®2-*X* and Biogen®). The lowest relative percentages of feed cost/ kg fish being to be 96, 86, 86, 91, 85 and 83 for diets 1, 2, 3, 4, 5 and 6, respectively. Moreover, the relative percentage of feed cost/ kg gain was found to be 4.22, 3.75, 3.74, 3.95, 3.70 and 3.64 LE for diets 1, 2, 3, 4, 5 and 6, respectively. These results indicate the effect of Biobuds®2-*X* and Biogen® which improved growth and feed utilization parameters of mono sex Nile tilapia fingerlings as noted in Table (2). On the other hand, the incorporation of Biobuds®2-*X* in mono sex Nile tilapia fingerlings diets seemed to be not economic at incorporation level 0.05% but increasing its level to 0.075 and 0.1% sharply decreased feed cost by 3.75 and 3.74 L.E. Also, the incorporation of Biogen® at levels of 0.05, 0.075 and 0.1% seemed to be more efficiently

economic. The reduction of feed costs was easily observed for the feed cost/Kg weight gain which decreased with the increasing incorporation levels of Biogen® up to 0.1% with diet 6 for mono sex fingerling Nile tilapia. These results were in agreement with Mehrim (2001), Khattab *et al.* (2004) and Carnevali *et al.* (2006).

In addition, Survival rate (%) shown in Table (2) illustrated that mortalities were not effected with treatmenis supplemented by the application of commercial feed additives (Biobuds®2-*X* and Biogen®).

CONCLUSION

From the previous results, it could be concluded that the positive influence of proboitics additions (Biobuds®2-*X* and Biogen®) on growth performance of monosex fingerlings Nile tilapia diets showed desirable effect for Aquaculture production. From feed utilization data and the economical point of view the diet supplemented with 0.1% Biogen® was the best treatment.

Table (2): Growth Performance and feed utilization of **O.** *niloticus* fingerlings fed the experimental diets

Parameters	Experimental Diets						
	Basal diet (control)	1	2	3	4	5	6
Initial avg. wt. (g)	5.2	5.2	5.2	5.0	4.9	5.1	5.1
final avg. wt. (g)	80.7^{d}	87.5^{c}	104^{a}	104.4^{a}	95^{b}	105.7^{a}	106^{a}
Weight gain (g)	75.5^{e}	82.3^{d}	98.8^{b}	99.4^{a}	90.1^{c}	100.6^{a}	100.9^{a}
SGR%/d	3.04^{d}	3.13^{c}	3.32^{a}	3.38^{a}	3.29^{b}	3.37^{a}	3.37^{a}
FCR	1.73^{d}	1.65^{c}	1.45^{a}	1.44^{a}	1.55^{b}	1.44^{a}	1.41^{a}
PER	1.92^{d}	2.01^{c}	2.23^{b}	2.26^{b}	2.07^{c}	2.29^{b}	2.34^{a}
FE	0.57^{c}	0.61^{b}	0.68^{a}	0.69^{a}	0.64^{b}	0.69^{a}	0.71^{a}
Feed intake (g)	131.2	135.5	143.5	143.1	140.5	144.9	142.3
Survival rate (%)	95	100	100	100	100	100	100

Values in the same row with a common superscript are not significantly different (P<0.05)

1- Body weight (BW): individual fish were weighted every 15 day to the nearest g.
2- Weight gain (WG) = average final weight (g) - average initial weight (g)
3- Specific growth rate (SGR) = (Ln. Final body weight- Ln. Initial body weight) x 100/ experimental period (days)
4- Feed conversion ratio (FCR) = feed intake (g) / body weight gain (g)
5- Protein efficiency ratio (PER) = weight gain (g) / protein intake (g)
6- Feed efficiency = (Body weight gain (g)/ feed intake (g)
7- Survival rate =No of survive fish/total No. of fishX100.

Table (3): Chemical composition of whole body *O. niloticus* fingerlings fed the experimental diets (As wet basis)

Chemical composition	Initial	Experimental diets						
		Basal diet (control)	1	2	3	4	5	6
Moisture	77.43	70.50^{a}	70.60^{a}	70.48^{a}	70.47^{a}	70.50^{a}	70.62^{a}	70.64^{a}
Crude protein	13.55	15.15^{a}	15.25^{a}	15.24^{a}	15.27^{a}	16.22^{b}	16.25^{b}	16.24^{b}
Ether extract	4.5	7.73^{a}	7.47^{a}	7.50^{a}	7.48^{a}	6.52^{b}	6.49^{b}	6.51^{b}
Crude fiber	0.55	1.02^{a}	1.03^{a}	1.00^{a}	1.03^{a}	1.03^{a}	1.02^{a}	1.01^{a}
Ash	3.97	5.60^{a}	5.65^{a}	5.78^{a}	5.75^{a}	5.73^{a}	5.62^{a}	5.60^{a}

Values in the same row with a common superscript are not significantly different (P<0.05).

Table (4): Cost of feed required for producing one Kg gain of O. niloticus fingerlings fed the experimental diets.

ITEM	Basal diet (control)	Experimental Diets					
		1	2	3	4	5	6
Cost /kg diet (LE)	2.55	2.56	2.59	2.60	2.55	2.57	2.58
Consumed feed to produce 1kg fish (kg)	1.62	1.55	1.38	1.37	1.48	1.37	1.34
Feed cost per kg fresh fish (LE)	4.13	3.97	3.57	3.56	3.77	3.52	3.46
Relative % of feed cost/ kg fish	100	96	86	86	91	85	83
Feed cost /1Kg gain(LE)	4.41	4.22	3.75	3.74	3.95	3.70	3.64
Relative % of feed cost of Kg gain	100	95	85	84	89	84	82

1- Cost per Kg diet L.E.
2- Feed intake per fish per period/ final weight per fish Kg/Kg
3- Step 1X step 2
4- Respective figures for step 3/ highest figure in this step
5- Feed intake per Kg gain X step 1
6- Respective figures for step 5/ highest figure in this step
*Cost of 1 kg ingredients used were 5.6L.E for fish meal, 1.76 L.E for soybean meal, 2.70 L.E for corn gluten, 0.95 L.E for wheat bran, 0.85 L.E for corn,4 L.E for oil, 5L.E for Vit & Min, 55 L.E for Biobuds®2-*X* and 35 L.E for Biogen®.
Feed Ingredients price of 2006.

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تقييم استخدام بعض الإضافات الغذائية على آداء النمو والإستفادة الغذائية فى إصبعيات أسماك البلطى النيلى وحيد الجنس

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أجريت تجربة لتقييم تأثير نوعين مختلفين من الإضافات الغذائية التجارية على آداء النمو فى إصبعيات أسماك البلطي النيلى وحيد الجنس. تم تطبيق سبع معاملات: ثلاث مستويات من البيوبادز (٠,٠٥ ، ٠,٠٧٥ و ٠,١٪) ، ومن البيوجين (٠,٠٥ ، ٠,٠٧٥ و ٠,١٪) بالإضافة الى معاملة الكنترول. تم تطبيق العلائق المختبرة فى ٢١حوض من الفيبرجلاس حيث تم التخزين بمعدل ٢٠ من إصبعيات أسماك البلطي موزعه عشوائياً بمتوسط وزن ٥ ± ٠,٢٠ جرام. استمرت التجربة لمدة ٩٠ يوما. وقد كان أفضل أداء للنمو و معدل تحويل غذائي وكفاءة تمثيل البروتين فى أصبعيات أسماك البلطي التى غذيت على العلائق المضاف اليها الإضافات الغذائية التجارية بالمقارنة بمجموعة الأسماك التى غذيت على عليقة الكنترول. انخفضت تكاليف التغذية اللازمة لانتاج واحد كيلو جرام من الاسماك التى غذيت على العلائق المضاف اليها الإضافات الغذائية التجارية بالمقارنة بالعليقة الكنترول. اظهرت هذه النتائج أن استخدام البيوجين بتركيز ٠,١٪ كان أفضل المعاملات من حيث القيمة الإقتصادية وأداء النمو.