EVALUATION OF PREBIOTIC AS A FEED SUPPLEMENT FOR NILE TILAPIA (*OREOCHROMIS NILOTICUS*) FRY

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Abstract

The present investigation was conducted to determine the effect of prebiotic fermacto® meal (PFM) addition in feeds on the growth parameters, survival rate, feed utilization and body composition of Nile tilapia (*Oreochromis niloticus*) fry**.** Five diets are containing isonitrogenous (30% crude protein) and isocaloric (4.52 kcal/g diet). Diets were formulated to contain 0.0% (control) 1, 2, 3 or 4 g PFM /kg diet. Diets were fed to triplicate groups of Nile tilapia fry (average weight 1.52 g/fish). Fish were fed on one of five diets at satiation 6 days/week, two times/ day. For 12 weeks growth test, the fish receiving PFM feeds showed significantly higher growth performance (final weight, weight gain, daily weight gain and specific growth rate) and feed utilization parameters (feed conversion ratio, protein efficiency ratio, apparent protein utilization, energy utilization) in comparison with the control group. The best growth performance, feed utilization and survival rate parameters were recorded when fish were maintained at the diet containing 3 g PFM /kg diet. No significant differences were observed in fish body dry matter or ash contents at all treatments. Fish body protein content was increased significantly by increasing levels of PFM. While fish body lipid content was decreased significantly by increasing PFM levels. Additionally, supplemented diets with PFM reduced the feeding cost to produce one kg fish gain. This reduction at 3 g PFM /kg diet was 19.2% as compared to control diet. Conclusion, the best effects have been obtained in the diets containing 3 g PFM /kg diet.

Keywords: Nile tilapia, prebiotic fermacto ® meal, growth performance, feed utilization, body composition, economic evaluation.

INTRODUCTION

Current trends in animal production to reduced use of antibiotic growth promoters and increased use of non antibiotic feed additives Ferket, (2004) Furthermore, high protein prices and environmental concerns have pressured

the industry to reduce dietary protein levels Firman, (1997). The commercially available fermentation product of *Aspergillus orizae*, Fermacto, referred to as *Aspergillus* meal (AM), has no live cells or spores (Freitag *et al*., 1999)

Prebiotics represent substances contained in food (or added to food) which activate growth or the activity of beneficial strains of bacteria occurring in the alimentary tract. Confirmed prebiotic properties are shown by oligosaccharides: derivatives of fructose – inuline, oligofructose, fructooligosaccharides and derivatives of glucose – maltose oligosaccharides. Inulin and oligofructose occur in many plants, e.g. in asparagus, artiichoke, peanuts and particularly in chicory which is the source of obtaining these substances in industrial way (Gibson *et al.* 1995).

Criteria which must be met by prebiotic substances are the following: they can not be hydrolized or aspired in the upper sections of the alimentary tract, must be subjected to a selective fermentation by potentially beneficial bacteria strains existing in the intestine, must favourably modify the microflora system in the intestine and the obtained effect must be advantageous for the host's health. (Mazurkiewicy *et al*., 2008).

Prebiotic fermacto® meal (PFM) is comprised of Aspergillus meal which is derived from an active fermentation of a primary *Aspergillus sp*. It is containing β-glucan and Mannan oligosaccharide (MOS) and the mycelium contained in this totally dead product that allows the monogastric an expansion of its digestive capacity. PFM expands the digestive capacity by establishing a healthy micro flora in the gastro-intestinal tract of the animal. It is the mycelium of the *Aspergillus sp.* that supports the bacteria and allows it to propagate, producing increased levels of short chained organic acids, which may actually reduce pathogenic bacteria. (PET-AG company localized in Elgin, Illinois.)

The commercially available fermentation product of *Aspergillus orizae,* fermacto (PET-AG), referred to as Aspergillus meal (AM), has no live

cells or spores (PET-AG) and is proven to enhance the digestive efficiency of the gut (Harms and Miles, 1988).

Aspergillus meal is a feed additive used to improve gut health and performance. *Aspergillus* meal may offer a protein sparing effect when used with low protein diets. *Aspergillus* meal might offer better results when the level of protein and amino acids is lower than those recommended by NRC or applied in commercial flocks. (Rodriguoz *et al.,* 2005). Mannan oligosaccharida has shown promise in modulating the immune response, improves feed efficiency, and promotes fish growth (Welker *et al.,* 2007; Peterson *et al.,* 2010 and Mansour *et al.,* 2012) .The glucans act increasing the activity of macrophages, the phagocytosis by neutrophils, monocytes and lymphocytes (Li and Gatlin, 2003), and the production of immunoglobulins and lysozymes (Ogier *et al.,* 1996).

Nile tilapia, *O. niloticus* (L.) is one of the most important species within the tilapias in aqyuaculture because of its rapid growth, good survival in high density culture, and disease tolerance (El-Sayed, 2006), that makes it a good choice for the semi-intensive and intensive grow-out strategies. Subsequently, the improving of a practical diet for Nile tilapia is necessary.

A few fish studies have assessed the efficacy of PFM as a feed additive. Therefore, the present study was conducted to investigate the effect of PFM supplementation on growth performance, survival rate, feed utilization and whole-body composition of Nile tilapia. In addition to, the economic evaluation was done.

MATERIALS AND METHODS

Diet preparation:

Prebiotic fermacto® is an American product of PET-AG company localized in Elgin, Illinois. It is an addition to feeds foreseen for all monogastric animals including fish. Composition of PFM dried *(Aspergillus niger*) consisted from mannan oligosaccharides (MOS) and β-glucan (β-GLU). The composition of this preparation remains a secret of the producer. Five

experimental diets were formulated from commercial ingredients to achieve 30% dietary protein level and 8.2% lipid. Diets were formulated to contain 0.0 (control), 1, 2, 3 or 4 g PFM /kg diet. The proximate chemical composition of PFM and main ingredients of the tested diets are shown in Table (1).The ingredients and the proximate chemical analysis of the tested dietsare shown in Tables 2 and 3. The ingredients of each diet were separately blended with additional 100 mL of warm water to make a paste of each diet. The pastes were separately passed through a grinder, and pelleted in a modified paste extruder to form the tested diets. The diets were dried in a drying oven model (Fisher oven 13–261–28A) for 24 hours on 65°C and stored in plastic bags which were kept dry until they were used. Experimental diets were formulated to meet the nutritional requirement of Nile tilapia (NRC, 1993).

Fish and culture technique:

Nile tilapia fry, *Oreochromis niloticus* (L) with an average initial body weight of 1.52 g/fish were obtained from the fish hatchery ponds, Central Laboratory for Aquaculture Research (CLAR). Fish were kept in indoor tank for 2 weeks as an acclimation period to the laboratory conditions. Fish were divided into 5 groups (3 replicates per treatment), each containing 15 fish/aquarium. Each subgroup of fish was transferred at random into a 100 L glass aquarium. De-chlorinated tap water was used throughout the study. In order to avoid accumulation of the metabolites, a one half water of the aquarium was changed daily. Each aquarium was also supplied with air produced by a small electric compressor unionized. The photoperiod was set on a 12 hour light-dark cycle using fluorescent tubes as the light source. During the course of the experiment, all fish from each aquarium were collected every two weeks and collectively weighed. Fish were fed at satiation 6 days/week, two times/day for 12 weeks.

Parameters of growth performance and feed utilization:

Growth and feed utilization parameters were calculated as follows:
Weight gain (g) = $W_2 - W_1$;

Specific growth rate (SGR; (%/ day) = 100 [Ln W_2 – Ln W_1] / T,
Where W_1 and W_2 are the initial and final weights, respectively, and T is the experimental period (days);
Feed conversion ratio (FCR) = feed intake (g) / weight gain (g);
Feed efficiency ratio (FER) = 100 [weight gain (g) / feed intake (g)];
Protein efficiency ratio (PER) = weight gain (g) / protein intake (g);
Apparent protein utilization (APU; %) = 100 [protein gain in fish (g) / protein intake in diet (g)];
Energy utilization (EU; %) = 100 [Energy gain in fish / energy intake in diet].

Proximate chemical analysis:

Diets and fish were analyzed according to standard methods (AOAC, 1990) for moisture, crude protein, total lipids, and ash. Moisture content was estimated by drying samples in an oven at 85◦C until constant weight was achieved. Nitrogen content was measured using a micro-Kjeldahl apparatus, and crude protein was estimated by multiplying total nitrogen content by 6.25. Total lipid content was determined by ether extraction for 16 h, and ash was determined by combusting samples in a muffle furnace at 550◦C for 6 h. Crude fiber was estimated according to Goering and Van Soest, (1970). Gross energy was calculated according to (NRC, 1993).

Water analysis:

Water samples were collected biweekly for chemical analysis. Dissolved oxygen and temperature were measured on site using an oxygen meter (YSI, model 58, Yellow Spring Instrument Co., Yellow Spring, OH). Unionized ammonia was measured using a HACH kit (HACH Co., Loveland, CO). The pH was measured using a pH–meter (Fisher Scientific, Denver, CO)**.**

Statistical analysis:

The obtained data were subjected to one-way ANOVA to evaluate the effect of PFM supplement. Differences between means were tested at the 5% probability level using Duncan Multiple Range test. All the statistical analyses

were done using SPSS program version 18 (SPSS, Richmond, VA, USA) as described by Dytham (1999).

Economical evaluation:

The cost of feed required to produce a unit of fish biomass was estimated using a simple economic analysis. The estimation was based on local retail sale market price of all the dietary ingredients at the time of the study. These prices (in L E / kg) were as follows: herring fish meal, 16; soybean meal, 3.75; corn meal, 2.50; wheat bran, 2.25; starch, 6.0; fish oil, 60.0; corn oil, 10.0; vitamin premix, 10.0; mineral mixture, 7.0; PFM, 48 L E/kg.

RESULTS AND DISCUSSION

During the course of rearing period, the water quality parameters were nearly in all treatments, dissolved oxygen concentrations range was 5.8 -6. 9 mg/L, pH range was 7.7 – 8.1, and unionized ammonia concentration range was 0.07-0.16 mg/L. All parameters remained within the acceptable ranges required for normal growth of tilapia (Boyd, 1984).

Fermacto is comprised of *Aspergillus* meal. Aspergillus meal is derived from an active fermentation of a primary *Aspergillus niger.* It is contains β-glucan and MOS and the mycelium contained in this totally dead product that allows the monogastric an expansion of its digestive capacity.

Growth performance (final weight, weight gain, daily weight gain and specific growth rate) increased significantly ($P < 0.05$) with the increase in PFM levels in fish diets (Table 4). Also, the obtained data showed that Nile tilapia fed PFM exhibited better growth than those fed the control diet and fish fed 3 and 4g/kg diet exhibits the highest growth performance (Table 4) whereas the control diet produced the lowest fish growth. The enhanced Nile tilapia growth may be due to the palatability or attractiveness of the diets (which in turn cause increased feed intake and fish growth), when PFM was used at high levels.

This improvement in growth may be related to the two main important constituents of PFM (MOS and β-glucan) improve nutrients digestibility and/or providing fish with certain essential nutrients, vitamins, amino acid and digestive enzymes. Similar positive effects of dietary PFM supplementation on growth for Nile tilapia, *O. niloticus* were obtained by Mazurkiewicy *et al*. (2008) reported that common carp (*Cyprinus carpio* L.) fry fed diet containing different levels of PFM showed significantly higher mean individual body weight and specific growth rate ($p \leq 0.05$) in comparison with the control group. Fermacto (*Aspergillus*) meal is a feed additive used to improve fish gut health and performance. Trials reported here indicate that *Aspergillus* meal may offer a protein sparing effect when used with low protein diets. (Rodriguez *et al*., 2005). Moreover, PFM contains several nutrients especially vitamins and minerals that may help in fish growth promotion and with Staykov *et al.,* (2007) who added 2 g/kg MOS® to fish diet and evaluated its effect on growth performance of rainbow trout (*Oncorhynchus mykiss*). By the way, many studies found improvements in growth performance due to (MOS®) and β–glucan supplements in other fish species such as rainbow trout *(O. mykiss)* (Sealey *et al.,* 2008), seabass (*Dicentrarchus labrax*) (Zhao *et al.* 2011) and Nile tilapia (*O. niloticus*) (Whittington *et al.* 2005) they found significant improve in growth performance when fed diet containing β–glucan. Similarly, Ahmad *et al.* (2014) reported that growth performance increased significantly when fish fed 0.2% Bio-Mos supplementation diet. Also, El-Mousallamy *et al.* (2014) indicated that dietary supplementation of β–glucan improved significantly the growth performance in comparison to the control diet. Ahmad *et al.* (2015) found that growth performance for Nile tilapia fed a diet containing prebiotic Power top® were improved significantly with increasing the level of prebiotic Power top® than the control diet.

The survival rate was slightly enhanced due to the inclusion of PFM in Nile tilapia diets with non-significant difference and it is ranged from 93.33 to 97.78 % ($P > 0.05$; Table 4). Similar results were obtained by (Ai *et al.* 2007) who showed that there were insignificant differences observed among dietary

β–glucan in comparison to control diet, but the survival rate improvement with increasing dietary glucan in large yellow croaker (*Pseudosciaena crocea*). El-Mousallamy *et al.* (2014) showed that the survival rate of fish fed different β–glucan levels (100%) was much higher than that fish fed the control diet (93.3%). On the other hand, Ahmad *et al*. (2015) found that the survival of Nile tilapia fed PFM supplemented diets was higher than survival of Nile tilapia fed the diets without PFM supplement.

Table (5) showed that feed intake increased significantly with the increase of PFM levels in Nile tilapia diets ($P < 0.05$). The highest feed intake was obtained at fish fed 3 or 4 g/kg diet, while the lowest one was obtained at control group. Contrarily, FCR value decreased significantly ($P < 0.05$) at fish groups fed 3 or 4 g/kg diet, while the highest FCR values were obtained at control. (Table 5). This may be related to PFM (β–glucan and MOS) improved the enzymatic digestion of complex polysaccharides including cellulose, organic phosphrous (phytic acid) utilization, and fiber digestion (Tewary and Patra, 2011).

Similarly, APU and EU increased significantly ($P < 0.05$) due to the increase in PFM in fish diets (Table 5). The highest APU and EU was obtained at fish fed 3 or 4g (PFM) g/kg diet, while the lowest one was obtained at control group. The improvement in feed utilization parameters in Power- top® supplemented groups might be related to the presence of PFM (β–glucan and MOS) which has been literally reported to improve the enzymatic digestion of a complex polysaccharide including cellulose; organic phosphorus (phytic acid) utilization and fiber digestion have the ability to produce an essential vitamin-B complex particularly Biotin and Vitamin B12. The results of the present work agree with Ebrahimi *et al.* (2012) showed a significant ($P < 0.05$) dependent increase in feed efficiency ratio, protein efficiency ratio, protein utilization, and energy utilization. Akbar *et al.* (2013) reported that, diet containing 0.2 g/kg dietary PFM was the best for growth performance and feed utilization parameters for rainbow trout *(Oncorhynchus mykiss)* fingerlings. Also, Ahmad *et al.* (2014) reported that there were no significant difference in PER, APU and

EU among all Bio-Mos®. Similarly El-Mousallamy *et al.* (2014) indicated that PER, PU increased significantly of the fish groups fed diets with β–glucan than fish fed the control diet. Ahmad *et al*. (2015) show that, the best feed utilization parameters were obtained on fish fed diet containing 0.15% prebiotic Power-top®.

Results in Table (6) showed that proximate chemical analysis of whole body of Nile tilapia fry fed diets containing different levels of PFM. Dry matter content was not significantly differed ($P > 0.05$) due to the inclusion of PFM in fish diets. Crude protein increased significantly, while total lipids decreased significantly with the increase levels of PFM in fish diets ($P < 0.05$). The highest content of crude protein was obtained at fish group fed 3 or 4 g/kg diets, while the lowest one was obtained at control group. The highest content of total lipids was obtained at control group, while the lowest one was obtained at fish groups fed 2, 3 or 4 g/kg diet. No significant difference was observed in ash content among different treatments ($P > 0.05$).

These results suggested that PFM (β–glucan and MOS) supplementation plays a role in enhancing feed intake with a subsequent enhancement of fish body composition as in other animal species Rawles *et al. (*1997). Moreover, due to prebiotics have been reported to enhance amino acid utilization by killing intestinal infectious micro-flora, thereby increasing amino acid utilization in host. These results agreed with those found by Ahmad *et al.* (2014) who reported that increased Bio-Mos® supplementation in fish diet increased protein content and decreased the lipid content significantly in diets for Nile tilapia (*O. niloticus*). Similarly, El-Mousallamy *et al.* (2014) indicated that, there were no significant differences among dietary β-glucan levels for whole-body moisture and ash. Meanwhile, by increasing levels of β-glucan in diets, the crude protein of whole body fish increased and total lipids of whole body fish decreased in comparison to the control diet of Nile tilapia (*O. niloticus*). Ahmad *et al.* (2015) found that total protein contents of fish increased, while total lipid decreased insignificantly by increasing levels of

prebiotic Power- top® in the experimental diets. While, moisture and ash contents weren't significantly affected.

Data in Table (7) showed that feed cost and feed cost/kg gain were high in the control group than diets containing PFM. Feed cost decreased as inclusion levels of PFM increased. The reduction in feed cost compared with the control diet to produce one kg fish gain was higher in treatment containing 3 g/kg diet was 19.2% than 4 g/kg PFM diet was 18.71%.These results agreed with Ahmad *et al.* (2014) who found that the reduction in feed cost of treatment containing 0.2% Bio-Mos® diet levels was 20.36% compared with the control diet to produce one kg fish gain. El-Mousallamy *et al.* (2014) reported that feed cost to produce one kg fish gain was reduced as β-glucan levels increased and this reduction when fish fed 0.2% β-glucan was 23.16%. Also, Ahmad *et al.* (2015) reported that the reduction in feed cost compared with the control diet to produce one kg fish gain was higher in treatment containing 0.15 % prebiotic (Power- top®) diet was 12.28 % than 0.2 prebiotic Power- top® was 11.98%.

CONCLUSION

Feeding of Nile tilapia fry on diets containing different levels of the PFM improved growth performance, survival rate, feed utilization and reduced the feeding cost to produce one kg fish gain. The optimal addition of PFM in the feeds for Nile tilapia fry is 3.0 g / kg of the diet.

Table 1. Proximate chemical analysis (on dry matter basis) prebiotic fermacto® meal (PFM), herring fish meal (HFM), soybean meal (SBM), wheat bran (WB), and corn meal (CNM).

Items %	PFM	HF	SBM	WB	CN
Dry matter	94.3	91.82	92.90	91.80	91.70
Crude protein	16	72.02	44.11	14.58	9.50
Total lipids	1	14.80	1.1	4.60	3.66
Crude fiber	40	0.66	5.42	10.84	5.43
Ash	2	12.10	5.55	3.74	1.80
NFE [1]	41	0.42	43.82	66.24	79.61
Gross energy [2] (kcal/100g)	267.99	548.5	371.6	398.1	415.47

[1] Nitrogen-free extract (NFE) =100–(protein% + lipid% + ash% + fiber %).

[2] Gross was calculated after NRC (1993) as 5.65, 9.45, and 4.11 kcal/g for protein, lipid, and carbohydrates, respectively.

Table 2. Ingredients of the experimental diets (on dry matter basis) containing different levels of prebiotic fermacto®.

Ingredients %	PFM levels (g/kg)				
	0.0	**1.0**	**2.0**	**3.0**	**4.0**
Herring fish meal	9.0	9.0	9.0	9.0	9.0
Soybean meal	43.0	43.0	43.0	43.0	43.0
corn flour	24.0	24.0	24.0	24.0	24.0
Wheat brean	12.0	12.0	12.0	12.0	12.0
Cod liver oil	2.8	2.8	2.8	2.8	2.8
Corn oil	2.2	2.2	2.2	2.2	2.2
Starch	4.0	3.0	2.0	1.0	0.0
Vit. premix [1]	1.0	1.0	1.0	1.0	1.0
Min. premix [2]	2.0	2.0	2.0	2.0	2.0
P. Fermacto	00.0	1.0	2.0	3.0	4.0
Total	100	100	100	100	100

[1] Vitamins premix (per kg of premix): thiamine, 2.5 g; riboflavin, 2.5 g; pyridoxine, 2.0 g; inositol, 100.0 g; biotin, 0.3 g; pantothenic acid, 100.0 g; folic acid, 0.75 g; para-aminobenzoic acid, 2.5 g; choline, 200.0 g; nicotinic acid, 10.0 g; cyanocobalamine, 0.005 g; α-tocopherol acetate, 20.1 g; menadione, 2.0 g; retinol palmitate, 100,000 IU; cholecalciferol, 500,000 IU.

[2] Minerals premix (g/kg of premix): CaHPO4.2H2O, 727.2; MgCO4.7H2O, 127.5; KCl 50.0; NaCl, 60.0; FeC6H5O7.3H2O, 25.0; ZnCO3, 5.5; MnCl2.4H2O, 2.5; Cu(OAc)2.H2O, 0.785; CoCl3. 6H2O,0.477; CaIO3.6H2O, 0.295; CrCl3.6H2O, 0.128; AlCl3. 6H2O, 0.54; Na2SeO3, 0.03.

Table 3. Proximate chemical analysis (%) on dry matter basis of the experimental diets.

Parameters %	PFM levels (g/kg)				
	0.0	**1.0**	**2.0**	**3.0**	**4.0**
Dry matter	91.6	91.8	91.7	91.8	91.6
Protein	30.1	29.9	30.0	30.2	29.9
Fat	8.1	8.2	8.0	8.2	8.1
Fiber	5.6	5.3	5.5	5.4	5.6
Ash	6.3	6.4	6.2	6.4	6.3
NFE [1]	49.9	50.2	50.3	49.8	50.1
GE (kcal/100g)[2]	451.7	452.7	451.8	452.8	451.3

[1]Nitrogen-Free Extract (calculated by difference) = 100 – (protein + lipid + ash + fiber).

[2]Gross energy (GE) was calculated according to NRC (1993) as 5.65, 9.45, and4.11 kcal/g of protein, lipid, and carbohydrates, respectively.

Table 4. Growth performance of Nile tilapia fry fed different prebiotic fermacto® levels for 12 weeks.

Items	PFM levels (g/kg)				
	0.0	**1.0**	**2.0**	**3.0**	**4.0**
Initial body weight	1.51±0.01	1.52±0.01	1.51±0.01	1.52±0.01	1.53±0.01
Final body weight	17.59±0.3 ^{d}	18.99±0.1^{c}	20.67±0.5^{b}	23.52±0.5^{a}	23.68±0.6^{a}
Weight gain	16.08±0.3^{d}	17.47±0.1^{c}	19.16±0.3^{b}	22.0±0.4^{a}	22.15±0.3^{a}
Daily weight gain	0.19±0.003^{d}	0.21±0.003^{c}	0.23±0.003^{b}	0.26±0.003^{a}	0.26±0.003^{a}
Specific growth rate	2.92±0.02^{d}	3.00±0.01^{c}	3.11±0..02^{b}	3.22±0.04^{a}	3.26±0.02^{a}
Survival%	93.33±3.9	95.55±2.22	95.55±2.22	97.78±2.22	97.78±2.22

Means with different superscripts in the same row are significantly different (P<0.05).

Table 5. Feed utilization of Nile tilapia fry fed different prebiotic fermacto® levels for 12 weeks.

Items	PFM levels (g/kg)				
	0.0	**1.0**	**2.0**	**3.0**	**4.0**
Feed intake	27.85±0.33^{c}	28.97±0.14^{b}	29.15±0.17^{b}	30.16±0.32^{a}	30.28±0.34^{a}
FCR	1.73±0.01^{a}	1.66±0.01^{b}	1.52±0.03^{c}	1.37±0.02^{d}	1.37±0.02^{d}
PER	2.09±0.03^{c}	2.19±0.01^{c}	2.39±0.04^{b}	2.70±0.06^{a}	2.66±0.04^{a}
APU%	32.56±0.62^{d}	34.92±0.61^{c}	38.78±0.53^{b}	42.70±0.46^{a}	42.56±0.69^{a}
EU%	20.38±0.56^{c}	21.18±0.53^{c}	23.17±0.59^{b}	25.06±0.54^{a}	25.53±0.56^{a}

Means with different superscripts in the same row are significantly different (P<0.05). fed diets containing different levels (PFM).

Table 6. Proximate chemical analysis (%) on dry matter basis of whole body of Nile tilapia fry fed different prebiotic fermacto® levels for 12 weeks.

Items	PFM levels (g/kg)				
	0.0	**1.0**	**2.0**	**3.0**	**4.0**
Dry matter	24.78±0.32	24.89±0.21	24.99±0.29	25.11±0.14	25.21±0.33
Crude protein	61.65±0.44^{c}	62.69±0.48^{bc}	63.71±0.32^{b}	64.83±0.61^{a}	64.72±0.4^{a}
Ether extract	23.85±0.27^{a}	23.09±0.11^{a}	22.00±0.43^{b}	21.06±0.42^{b}	21.24±0.38^{b}
Ash	14.36±0.31	14.21±0.48	145.05±0.43	14.26±0.36	14.31±0.29

Means with different superscripts in the same row are significantly different (P<0.05).

Table 7. Economic efficiency for producing one Kg gain of Nile tilapia fry fed diets containing different levels of prebiotic fermacto®.

Items	PFM levels (g/kg)				
	0.0	**1.0**	**2.0**	**3.0**	**4.0**
Price/ kg feed P.T	5.90	5.92	5.98	6.02	6.06
FCR kg feed/kg gain)	1.73	1.66	1.52	1.37	1.37
Feed cost / kg gain L.E.	10.21	9.83	9.09	8.25	8.3
Reduction cost in kg gain	0.0	3.72	10.97	19.2	18.71

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تقييم إضافة البريبيوتك فى علائق زريعة البلطى النيلى

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الملخص العربى

أجريت هذه الدراسة لتقييم تأثير إضافة البريبيوتك (فرماكتو) فى علائق زريعة البلطى النيلى على معدلات النمو ونسبة الإعاشة والاستفادة من الغذاء وتركيب الجسم. قسمت العلائق الى خمسة معاملات نسبة البروتين فيها٣٠% ،الطاقة ٤.٥٢ كيلو كالورى/جم عليقة. تم إضافة مسحوق فرماكتو إلى العلائق بنسب: صفر (كنترول) ١،٢،٣،٤ جم/ كجم عليقة. تم تغذية الأسماك وزن ١.٥٢ جم/سمكة فى ثلاث مكررات لكل معاملة حتى الشبع مرتين يوميا ستة أيام فى الأسبوع طوال فترة التجربة (١٢ أسبوع). الأسماك المغذاة على علائق مضاف إليها فرماكتو أعطت زيادة معنوية فى معدلات النمو (الوزن النهائى والنمو اليومى ومعدل النمو النوعى) وكذا معدلات الاستفادة من الغذاء (معامل التحويل الغذائى ،والاستفادة من البروتين والطاقة) مقارنة بالكنترول. وكانت أفضل معدلات نمو واستفادة من الغذاء والإعاشة سجلتها الأسماك المغذاة على عليقه تحتوى ٣جم فرماكتو /كجم. لم يلاحظ أى اختلافات معنوية فى محتوى الجسم من المادة الجافة ، الرماد بين المعاملات بينما ارتفع محتوى الجسم من البروتين وانخفض محتواه من الدهن معنويا مع زيادة نسبة الفرماكتو فى العليقة. بالإضافة لذلك فإن إضافة الفرماكتو لعلائق البلطى النيلى أدت إلى خفض تكاليف الغذاء لإنتاج ١ كجم أسماك وكانت أفضل نسبة ١٩,٢% مع العليقة المضاف إليها ٣جم فرماكتو /كجم عليقة مقارنة بالكنترول.

مما سبق توصى هذه الدراسة بان أفضل مستوى لإضافة الفرماكتو لعلائق البلطى هو ٣جم فرماكتو/ كجم عليقة.