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EFFECT OF USING PREBIOTIC FERMACTO® MEAL IN IMPROVING PLANT DIETS EFFICIENCY FOR NILE TILAPIA (*Oreochromis niloticus*).

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Abstract

This study was conducted to determine the effect of using different levels of prebiotic fermacto® meal (PFM) to improve the efficiency of plant based diet of Nile tilapia (*Oreochromis niloticus*). Five isonitrogenous and isocaloric diets were formulated to provide 28% protein and 4.30 kcal/ g diets. Each diet was fed in triplicate groups of fry (1.03 g/fish) to apparent satiation for 10 weeks. Treatments were: T1 contained both FM and SBM as a protein source (FM control). T_2 contained SBM as main protein source as a (SBM control). The last three treatments T_3, T_4 and T_5 were (SBM-based diet) supplemented with different levels of PFM (1, 2 and 3 g /kg diet), respectively. Results showed that supplemented fish diets with PFM enhanced fish growth performance over SBM diet control. Highest growth performance parameters ($P < 0.05$) were recorded with fish fed on FM control diet and T_5 (SBM-based diet + 3g PFM/kg diet) followed by fish fed on T_4. Survival rate improved insignificantly with all PFM supplemented groups. Also, best values of feed utilization parameters were recorded with fish fed on FM control diet and fish fed on T_5 and T_4 diets, respectively. No significant differences ($P > 0.05$) were found in body dry matter, protein or lipid content among treatments groups. The results of present study suggested that the inclusion of prebiotic fermacto® meal at 3g/kg diet in plant-based diet enhanced the growth performance and the feed efficiency and reduced the feed cost of Nile tilapia fry.

Keywords: Nile tilapia, prebiotic fermacto® meal, plant diets, growth performance, feed efficiency, economic evaluation.

INTRODUCTION

Development of cost-effective formulated diets for tilapia aquaculture has been a topic of practical value as well as growing interest to producers in recent years. Tilapias are the third most important cultured fish group in the world, after carps and salmonids, with an annual growth rate of about 12.2% and its one of the most important fish species 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.

Fish meal is traditionally the major animal protein supplement in fish diets but it is an expensive ingredient and it is necessary to look for acceptable substitute (Castillo and Gatlin, 2015). In addition, the dwindling fish meal supply can no longer meet the expanding fish feed industry as a result of aquaculture development. It is evident that many developing countries will be unable to depend on fish meal as the major protein source in aqua feeds in the future (Li *et al.,* 2010). Therefore, finding suitable and cheap local protein sources as an alternative to fish meal is important to the aqua feed industry (Peng *et al.,* 2013). Unfortunately, plant proteins have some negative qualities such as poor palatability, low digestibility, ant- nutritional factors and other unknown factors (Gatlin *et al.,* 2007). The improvement of plant protein sources utilization in aqua feeds remains to be an important aspect. Therefore, specific strategies and techniques to increase the use of plant feedstuffs in aqua feeds and limit potentially adverse effects of bioactive compounds on farmed fish are worth research (Lin *et al.,* 2007 and 2010).

Researchers have been studying to replace animal protein sources with proteins derived from plant materials or some feed additives for stimulate the growth in order to reduce the dependence for fishmeal which may provide more economic and environmentally friendly aquaculture (Amer, 2012). One of these additives is prebiotic fermacto® meal (PFM) which can improve the growth of fish related to its components. It is comprised of Aspergillus meal which is derived from an active fermentation of a primary *Aspergillus sp.* It contains of mannan oligosaccharides MOS and β-glucan and the mycelium contained in this totally dead product that allows the monogastric an expansion of its digestive capacity by establishing a healthy micro flora in the gastro-intestinal tract of the animal. The mycelium of the *Aspergillus sp.* 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.) sited in Hassan (2016). Moreover, several authors reported that prebiotic improve nutrients digestibility and providing fish with certain essential nutrients, vitamins, amino acid and digestive enzymes that may help in fish growth promotion (Peterson *et al.,* 2010 and Hassan, 2016).

Rodriguoz *et al.* (2005) stated that *Aspergillus* meal is one of the feed additives used to improve gut health and performance and might offer better results when the level of protein and amino acids is lower than those recommended by NRC or applied in commercial flocks. MOS has shown promise in modulating the immune response, improves feed efficiency, and promotes fish growth (Welker *et al.,* 2007and Mansour *et al.,* 2012). Moreover, the glucans act increasing the activity of macrophages and the phagocytosis by neutrophils, monocytes and lymphocytes (Li and Gatlin, 2003).

The objectives of the present study were to evaluate the effects of using different levels of prebiotic fermacto® meal (PFM) in improve the efficiency of plant based diet, growth performance and reduced fish feed cost of Nile tilapia (*O. niloticus*) fry.

MATERIALS AND METHODS

Experimental Diets:

Five isonitrogenous and isocaloric diets were formulated with natural ingredients to provide 28% protein and 4.30 kcal/ g diet (Table 2). Prebiotic fermacto® meal (PFM) 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. Treatments were: T_1 contained both herring fishmeal (FM) and soybean meal (SBM) as the main protein source to serve as a FM control. T_2 contained soybean meal as the main protein source in diet without any additions served as a SBM control. The last three treatments were soybean-based diets (SBM-based) with different prebiotic fermacto® meal (PFM) levels as follow: T_3 contained (SBM-based +1g PFM/ kg diet), T_4 contained (SBM-based +2g PFM /kg diet) and T_5 contained (SBM-based +3g PFM /kg diet). The ingredients and the proximate chemical analysis of the tested diets are shown in Tables 1, 2 and 3. Dietary ingredients were homogeneously ground to 500 µm, thoroughly mixed. 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 85°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 culture technique:

Nile tilapia (*Oreochromis niloticus*) were obtained from fish hatchery, central laboratory for aquaculture research, CLAR, Abbassa, Abo-Hammad, Sharqia, Egypt, and kept for two weeks in an indoor tank for acclimation where fish were fed a commercial diet containing 30% crude protein. Hundred fish were frozen at − 20 °C for proximate analysis initially. Acclimated fish with an average initial body weight of 1.03 g were distributed randomly at a rate of 20 fish per 100-L aquarium. Each aquarium was supplied with compressed air via air-stones using aquarium air pumps. Settled fish wastes with one half of aquaria water were siphoned daily and water volume was replaced by aerated tap water from a storage tank. Fish were fed on the tested diets at apparent satiation and the diets were offered to each aquarium three times daily; 6 days a week for 10 weeks. Fish were collected from each aquarium every two weeks and collectively weighed.

Chemical analysis of diets and fish:

The tested diets and fish from each treatment were analyzed according to the standard methods of AOAC (1990) for moisture, protein, fat, ash and fiber. Moisture content was estimated by heating samples in an oven at 85ºC until constant weight and calculating weight loss. Nitrogen content was measured using a micro kjeldahl apparatus and crude protein was estimated by multiplying nitrogen content by 6.25. Total lipids content was determined by ether extraction and ash was determined by combusting samples in a muffle furnace at 550ºC for 6 hours. Crude fiber was estimated according to Goering & Van Soest (1970). Gross energy was calculated according to NRC (1993) as 5.65, 9.45, and 4.11 kcal/g for protein, lipid, and carbohydrates, respectively.

Water quality analysis:

Water samples were collected every two weeks at 15 cm depth from each aquarium. Dissolved oxygen and temperature were measured on site with an oxygen meter (YSI model 58, Yellow Spring Instrument Co., Yellow Springs, OH, USA). Unionized ammonia was measured using DREL/2 HACH kits (HACH Co., Loveland, CO, USA). pH degree was measured using a pH-meter (Digital Mini-pH Meter, model 55, Fisher Scientific, Denver, CO, USA).

Growth and feed utilization parameters:

Weight gain (WG) = W_2- W_1

Daily gain (DG) = W_2 - W_1 /T;

Where, W_2 = average final body weight (g), W_1 = average initial body weight (g) and T = the experimental period (days).

Specific growth rate (SGR%/day) = $[(\text{Ln } W_1 - \text{Ln } W_0) / T] \times 100$.

Where, Ln = natural log, W_0 = Initial body weight (g), W_1= Final body weight (g) and T= Time (day).

Feed conversion ratio (FCR) = feed intake (g)/body weight gain (g);

Protein efficiency ratio (PER) = gain in weight (g)/protein intake in feed (g);

Apparent protein utilization (APU %) = 100 [protein gain in fish (g)/protein intake in feed (g)].

Energy utilization (EU%) = [energy gain in fish/energy intake in feed] x 100.

Statistical analysis:

The obtained data were subjected to one-way ANOVA to evaluate the different treatments. 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 were as follows: herring fish meal, 17.00; soybean meal, 4.00; yellow corn meal, 2.50; wheat bran, 2.25; corn oil, 12.00; fish oil 30; starch 6.00; vitamins mixture,10; minerals mixture, 4.50 and PFM, 50 LE/Kg.

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

Items %	PFM	HFM	SBM	WB	CM
Dry matter	93.9	92.0	92.6	91.4	91.2
Crude protein	15.8	72.1	44.1	14.6	9.5
Total lipids	1.1	14.6	1.1	4.60	3.6
Crude fiber	39.5	0.7	4.8	10.4	4.9
Ash	2.2	11.9	5.5	3.6	1.9
NFE [1]	41.4	0.7	44.5	66.8	80.1
Gross energy [2] (kcal/100g)	269.8	548.3	442.5	400.5	416.9

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

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

Table 2. Formulation of different experimental diets used in this experiment.

Ingredients	FM-based diet T_1	SBM-based diet T_2	SBM-based diet + PFM g/kg		
			1 g	2 g	3 g
			T_3	T_4	T_5
Herring Fish meal	10.50	0.00	0.00	0.00	0.00
Soybean meal	35.00	55.00	55.00	55.00	55.00
Yellow corn	27.50	20.00	20.00	20.00	20.00
Wheat bran	16.20	13.00	13.00	13.00	13.00
Corn oil	3.90	4.00	4.00	4.00	4.00
Cod liver oil	1.00	2.00	2.00	2.00	2.00
Starch	3.00	3.00	2.90	2.80	2.70
Vitamins premix [1]	1.00	1.00	1.00	1.00	1.00
Minerals premix [2]	2.00	2.00	2.00	2.00	2.00
Prebiotic fermacto®	0.00	0.00	0.10	0.20	0.30

[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. Chemical analysis of experimental diets used in this experiment.

Proximate analysis %	FM-based diet T_1	SBM-based diet T_2	SBM-based diet + PFM g/kg		
			1 g	2 g	3 g
			T_3	T_4	T_5
Dry matter	89.88	89.86	89.65	89.75	89.85
Crude protein	28.06	28.03	27.97	28.15	27.95
Crude fat	8.16	8.42	8.13	8.30	8.23
Crude fiber	6.24	6.15	6.12	6.32	6.27
Ash	10.14	10.13	10.17	10.16	10.10
NFE	47.4	47.27	47.61	47.07	47.45
GE (kcal/100g)	430.46	432.22	430.54	430.95	430.71

RESULTS AND DISCUSSION

During the running of this experiment, water temperature range was 25 to 27 °C, the dissolved oxygen concentration range was 4.9–5.8 mg/L, the pH range was 7.6 to 7.9 and the unionized ammonia concentration range was 0.13 to 0.18 mg/L. All the previous water quality parameters are within the acceptable ranges for fish growth (Boyd, 1984).

In the present study data of growth performance parameters are shown in (Table 4). It could be noticed that, values of final body weight (FBW), weight gain (WG), daily weight gain (DWG) and specific growth rate (SGR%/day) of the experimental groups were significantly ($P<0.05$) affected by different treatments. The highest ($P<0.05$) FBW, WG, DWG and SGR values were obtained in fish fed at FM-based diet and T_5 diet (SBM-based diet supplemented with PFM 3g/kg diet) without significant differences between two treatments, while the lowest ($P<0.05$) values were found in fish group maintained at SBM-based diet control. The results obtained from this study clearly point out that PFM has a positive effect on growth performance of Nile tilapia. This increasing suggested that using PFM in diet may be due to the palatability or attractiveness of the diets which in turn cause increased the feed intake and fish growth. Also, the improvement in growth parameters may be related to the two main important constituents of PFM (MOS and β-glucan) which improve nutrients digestibility and/or providing fish with certain essential nutrients, vitamins, amino acid and digestive enzymes. These results are in agreement with those found by Rodriguez *et al*. (2005) who indicated that *Aspergillus* meal may offer a protein sparing effect when used with low protein diets. Moreover, these results agree with those reported by several authors 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*) (El-Mousallamy *et al.,* 2014). They reported that PFM contains MOS and β–glucan and several nutrients especially vitamins and minerals that may help in fish growth promotion. 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 with increasing the level of prebiotic Power top® in the diet of Nile tilapia, growth performance improved significantly than fish fed on control diet. Also, these results agree with that obtained by Hassan (2016) who reported that growth performance of Nile tilapia improved significantly when fish fed on diet contain PFM than fish fed on control diet.

Moreover, survival rate at the end of the experiment showed that there were insignificant differences (P>0.05) among treatments. The best survival rate was observed when fish was maintained at FM-based diet control followed by fish maintained at SBM-based diets+3g PFM/kg diet (T_5), while the lowest value of survival rate was found with fish maintained at the SBM-based diet control. Similar results were obtained by (Ai *et al.*, 2007) who showed that there were insignificant differences in survival rate among treatments fed on dietary β–glucan or control diet in large yellow croaker *Pseudosciaena crocea*. On the other hand, El-Mousallamy *et al.* (2014) showed that the survival rate of fish fed different β–glucan levels was much higher (100%) than fish fed control diet (93.3%). Also, Ahmad *et al*. (2015) found that the survival rate of Nile tilapia fed on PFM supplemented diets was higher than fish fed on control diet.

Values of feed and nutrient utilization parameters (FCR, PER, PPV and EU) are shows in Table (5). The highest values were observed in fish fed at FM- control and SBM + 3g PFM/kg diet(T_5) which were significantly (p<0.05) higher than other treatments. Best FCR values (p<0.05) were found in fish maintained on FM-based diet control and SBM +3g PFM/kg diet (T_5), while the worst FCR value was found in fish maintained on SBM-based diet (T_2). These results indicated that plant diets supplementation with the PFM had a positive effect on FCR values. This may be related to (β–glucan and MOS) in PFM which improved the enzymatic digestion of complex poly saccharides including cellulose, organic phosphrous (phytic acid) utilization, and fiber digestion (Tewary and Patra, 2011).

Results of PER showed that highest values were obtained in fish maintained on FM diet control and SBM +3g PFM/kg diet (T_5) without any significant differences ($P>0.05$) between there, while the worst ($P<0.05$) PER was observed in fish maintained on SBM-based diet control (T_2). Concerning with PPV% and EU% values, results showed that highest values were noticed with fish maintained on FM diet control followed by the fish maintained on SBM +3g PFM/kg diet (T_5) and SBM +2g/kg diet (T_4), respectively, while the lowest values of PPV% and EU% were found with fish maintained on SBM-based diet control (T_2). These results explain that fish fed on plant diets supplemented with PFM were improved feed utilization parameters (PER, PPV and EU) significantly ($P<0.05$). Ahmad *et al*. (2015) reported that the best feed utilization parameters were obtained in fish fed on diet containing 0.15% prebiotic Power- top® and they demonstrate that prebiotics could enhance amino acid utilization by killing intestinal infectious micro-flora, thereby increasing amino acid utilization in host. Although it is not clear how PFM affects fish growth, it is generally assumed that PFM enhanced energy utilization through promotion of fatty acid oxidation and accordingly, sparing dietary protein for somatic growth. Also, these results agree with that obtained by El-Mousallamy *et al.* (2014). They indicated that PER and EU increased significantly in fish groups fed on diets containing β–glucan than fish fed on control diet. Ahmad *et al.* (2014) indicated that the improvement in feed utilization parameters in fish fed on diets supplemented with prebiotics might be related to the presence of β–glucan and MOS which has been literally reported to improve the enzymatic digestion of a complex polysaccharide including cellulose; organic phosphorus utilization and fiber digestion which have the ability to produce an essential vitamin-B complex particularly Biotin and Vitamin B12. Also, Hassan (2016) found that the best growth performance, feed utilization and survival rate parameters were recorded when fish were maintained on diet containing PFM. Akbar *et al.* (2013) found that diet containing 0.2 g PFM /kg diet was the best for growth performance and feed utilization parameters for rainbow trout (*Oncorhynchus mykiss*) fingerlings.

Results of the proximate chemical analyses of whole body contents of Nile tilapia are showed in Table (6). Results showed that no significant differences ($P>0.05$) were observed in fish body contents at all treatments. Rawles *et al.* (1997) suggested that β–glucan and MOS supplementation could play a role in enhancing feed intake with a subsequent enhancement of fish body composition as in other animal species. Nearly results were observed by Ahmad *et al.* (2015). They found that total protein contents of fish increased, while total lipid decreased insignificantly by increasing levels of prebiotic Power- top® in the diets, while moisture and ash contents weren't affected significantly. Also, Hassan (2016) showed that fish body protein content increased significantly by increasing the level of PFM in fish diet, while fish body lipid decreased. Ahmad *et al.* (2014) reported that with increasing Bio-Mos® supplementation in fish diet protein content increased and lipid content decreased significantly in Nile tilapia (*O. niloticus*).

Economic evaluation of the experimental diets is shown in Table (7). The reduction in feed cost to produce one kg fish gain at diet containing SBM-based diet supplemented with 3g PFM/kg diet was 14.74% compared to fish fed control diet (FM-based diet). These findings suggest that the efficiency of inclusion of PFM in all plant- based diets of Nile tilapia is economic and sharply reduced fish feed cost. These results agree with that found by Ahmad *et al.* (2014). They found a reduction in feed cost by 20.36% compared with control diet when fish fed on the diet containing 0.2% Bio-Mos®. Also, Ahmad *et al.* (2015) reported that the reduction in feed cost to produce one kg fish gain was 12.28 % in fish fed on diet containing 0.15 % prebiotic (Power- top®) compared with fish fed on control diet. Also, Hassan (2016) found that the reduction in feed cost was higher in treatment containing 3 g of PFM g/kg diet (19.2%) compared with fish fed on control diet of Nile tilapia.

In conclusion, the results of the present study showed that inclusion of prebiotic fermacto® meal at 3g/kg diet in plant-based diet have a beneficial effects on improving growth performance and feed efficiency of Nile tilapia *Oreochromis niloticus*. Moreover, it is economic and sharply reduced the fish feed cost.

Table 4. Growth performance parameters (means ± SE) of Nile tilapia (*O. niloticus*) fry fed at different experimental diets.

Items	FM-based diet T_1	SBM-based diet T_2	SBM-based diet + PFM g/kg		
			1g T_3	2g T_4	3g T_5
IBW (g)	1.04±0.02	1.03±0.01	1.02±0.01	1.03±0.01	1.03±0.01
FBW (g)	20.08±0.64^{a}	16.61±0.5^{c}	17.42±0.48^{bc}	18.30±0. 36^{b}	19.99±0.36^{a}
WG (g)	19.04±0.61^{a}	15.58±0.52^{c}	16.40±0.48^{bc}	17.27±0.64^{b}	18.96±0.60^{a}
DWG (g)	0.27±0.01^{a}	0.22±0.01 ^{c}	0.23±0.01^{bc}	0.24±0.01^{b}	0.27±0.01^{a}
SGR %/day	3.81±0.01^{a}	3.62±0.03^{c}	3.67±0.03^{c}	3.74±0.01^{b}	3.87±0.01^{a}
Survival rate %	96.67 ±1.67	93.33±1.67	95.00±2.89	96.67±1.67	96.67±1.67

Mean values with the different superscript in the same row are significantly different ($p<0.05$).

Table 5. Feed utilization parameters (means ± SE) of Nile tilapia (*O. niloticus*) fry fed at different experimental diets.

Items	FM-based diet T_1	SBM-based diet T_2	SBM-based diet + PFM g/kg		
			1g T_3	2g T_4	3g T_5
Feed intake (g)	29.84±0.79	26.77±0.98	27.54±1.00	27.83±1.00	29.07±1.15
FCR	1.56±0.02^{d}	1.71±0.01^{a}	1.67±0.01^{b}	1.61±0.00^{c}	1.53±0.01^{d}
PER	2.27±0.02^{a}	2.08±0.01^{c}	2.13±0.01^{c}	2.22±0.10^{b}	2.34±0.05^{a}
PPV%	37.41±0.06^{a}	31.71±0.26^{d}	32.76±0.54^{cd}	34.19±1.73^{bc}	36.26±1.33^{b}
EU %	23.49±0.05^{a}	20.42±0.20^{d}	21.18±0.21^{cd}	22.38±1.07^{bc}	23.77±0.92^{ab}

Mean values with the different superscript in the same row are significantly different ($p<0.05$).

Table 6. Body composition (means ± SE)) % on dry weight basis of Nile tilapia (*O. niloticus*) fry fed at different experimental diets.

Items	FM-based diet T_1	SBM-based diet T_2	SBM-based diet + PFM g/kg 1g T_3	2g T_3	3g T_3
Dry matter	25.10±0.05	25.43±0.01	25.39±0.31	25.15±0.16	24.46±9.05
Protein	61.7±0.89	60.36±0.39	61.57±0.67	61.67±0.21	63.57±1.56
Lipid	20.28±0.17	20.09±0.48	21.49±0.84	21.31±1.35	22.49±1.12
Ash	15.19±0.06 ^{bc}	15.38±0.14^{ab}	15.13±0.08^{bc}	15.34±0.07^{ab}	15.14±0.10^{bc}

Mean values with the different superscript in the same row are significantly different (p<0.05).

Table 7. Economic efficiency for production of one kg gain of Nile tilapia (*O. niloticus*) fry fed at different experimental diets.

Items	FM-based diet T_1	SBM- based diet T_2	SBM-based diet + PFM g/kg 1g T_3	2g T_3	3g T_3
Price/ kg feed (L.E)	5.40	4.40	4.45	4.50	4.55
FCR	1.57	1.72	1.68	1.64	1.59
Feed cost/kg gain(L.E)	8.48	7.57	7.47	7.38	7.23
Reduction in feed cost/ kg gain %	0.00	10.73	11.91	12.97	14.74

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تأثير استخدام بريبايوتك فيرماكتو على تحسين كفاءة العلائق النباتية لأسماك البلطى النيلى

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الملخص العربى

تم إجراء هذه التجربة لدراسة تأثير استخدام مستويات مختلفة من بريبايوتك فيرماكتو علي تحسين أداء العلائق نباتية المصدر لأسماك البلطى النيلى ذات الوزن الابتدائى ١.٠٣ جرام . تم إعداد خمس علائق متساوية فى كل من نسب البروتين (٢٨٪) والطاقة (٤.٣٠ كيلو كالورى/ جم غذاء) وكانت المعاملات كالآتى: العليقة الأولى تحتوى على مسحوق السمك كمصدرأساسى للبروتين (كنترول ١)، العليقة الثانية (نباتية) تحتوى على مسحوق فول الصويا كمصدر للبروتين (كنترول ٢)، العلائق الثالثة و الرابعة والخامسة (نباتية) مضافاً إليها ١ أو ٢ أو ٣ جرام بريبايوتك فيرماكتو لكل كيلو جرام عليقة على التوالى ، وزعت كل معاملة في ثلاث مكررات، وتمت التغذية مرتين يومياً حتى الإشباع لمدة عشرأسابيع. أوضحت النتائج أن إضافة بريبايوتك فيرماكتو للعلائق النباتية قد حسّن من أداء نمو أسماك البلطى النيلى، كما أظهرت النتائج أن أعلى قيم معنوية بالنسبة لقياسات النمو وأداء الأسماك كانت مع العليقة التى تحتوى على مسحوق السمك (كنترول١) والعليقة النباتية المضاف إليها بريبايوتك فيرماكتو بنسبة ٣ جم / كجم عليقة وبدون وجود أى فروق معنوية بينهم ، بينما ظهرت أقل قيم مع الأسماك التى تغذت على العليقة النباتية (كنترول ٢) ، كما تحسن معدل إعاشة الأسماك تحسن غير معنوى مع جميع الأسماك التى تغذت على بريبايوتك فيرماكتو، أيضا أظهرت النتائج أن أعلى قيم معنوية بالنسبة للقياسات الخاصة بكفاءة الغذاء قد سجلت مع الأسماك التى تغذت على العليقة التى تحتوى على مسحوق السمك والعليقة النباتية المضاف إليها بريبايوتك فيرماكتو بنسبة ٣ جم و ٢ جم /كجم عليقة وبدون وجود فروق معنوية بينهم. لا توجد أى فروق معنوية فى تركيب جسم الأسماك فيما بين المعاملات. مما سبق يمكن التوصية بأن إضافة بريبايوتك فيرماكتو إلى العلائق النباتية بمعدل ٣ جم / كجم غذاء يحسّن من أداء نمو أسماك البلطى النيلى كما يرفع من كفاءة استخدام الغذاء وفي نفس الوقت يخفض من التكلفة الكلية للغذاء .