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Effect of Digestrom® on growth performance and feed utilization of red tilapia (*O. niloticus*× *O.mossambicus*)

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Abstract

Our investigation was to study the effect of protein levels 25% and 30% within each level protein that four levels of Digestarom® P.E.P. (0.00, 0.01, 0.02 and 0.03%) on growth performance, feed utilization and economical evaluation of red tilapia fingerlings. Red tilapia fingerlings were fed on eight experimental diets composed of two protein levels a 25 % and 30% crude protein within each protein levels supplemented with Digestarom® P.E.P. at four levels (0.00, 0.01, 0.02 and 0.03%).The results indicated that protein levels 30% and Digestarom® at 0.02% had positive effect on the final weight, weight gain, specific growth rate, feed conversion ratio and feed efficiency ratio. The interactions of Digestarom® and protein levels have a significantly higher in growth performance, feed utilization, survival rate and economical evaluation.

It could be concluded that the best Digestrom® levels was 0.02% Digestrom® in each protein levels 25 and 30 % in terms of growth performance, feed utilization, survival rate and economic evaluation.

Keywords: Digestarom®, Phytogenic, feed additive, PFA; red tilapia, growth performance, feed utilization, economical evaluation.

INTRODUCTION

Increases in production costs have forced producers to examine ways to reduce on-farm costs, including the use of dietary supplements such as probiotics, prebiotics, symbiotic (products that contain both prebiotics and probiotics), and essential oils (aromatic compounds extracted from plants). The use of dietary supplements in aquaculture has recently been reviewed **(Huynh *et al*. 2017).** Consequently, formulating economic tilapiadiets using untraditional and low-cost feedresourcesremainsa majorchallenge for bothtilapia farmersand fisherynutritionists. The red hybrid tilapia *(Oreochromismossambicus×O. niloticus*) is fast gaining popularity among local consumers due to its favorable characteristics such as easy culture management and wide acceptability as a protein source **(Siddiqui and Al-Harbi, 1995).**

Phytogenic feed additives (PFAs) are products derived from plants that are added to the feed to improve the performance of animals Plant essential oils have shown numerous animal effects, such as stimulation of appetite, antimicrobial activity and direct reduction of intestinal bacteria, stimulation of gastric juices, enhancement of the immune system, anti-inflammatory and antioxidant properties **(Lambert *et al*., 2001).**Phytogenic feed additives (PFA) have been gaining considerable interest lately due to their ability to improve performance by sustaining a healthy gut environment. The essential oils present in PFA, which contain most of the active substances of the plant, have been suggested to increase the growth performance, nutrient digestibility and gut health in poultry species **(Giannenas *et al*., 2003, Jamroz*et al*., 2005, Isabel and Santos, 2009 and McReynolds *et al*., 2009).**Recently, a global trend has been developing to stop growth from being included-promoting synthetic hormones in fish diets. In addition, quality, safety and the absence of pollutants or antibiotics were increasingly demanded by the consumers of farmed fish. These rigorous food safety regulations inspire fish nutritionists to search for alternative phyto-compound growth promoters. The present study was conducted to determine the effect of protein levels 25% and 30% within each protein levels four levels of Digestarom® P.E.P. (0.00, 0.01, 0.02 and 0.03%) on growth performance, feed utilization and economical evaluation of red tilapia fingerlings.

MATERIALS and METHODS

Culture Condition

Red tilapia (*O. niloticus*× *O.mossambicus*)fingerlings obtained from a private fish farm El-kantra- Ismailia Governorate. The experiment was done at Privet fish farm, West Elkantra - Ismailia). Fish was weighed every 14 days throughout of experimental period (84 days). Four hundred and eighty red tilapia fingerlings with average initial body weight about 30.0 ±0.12g per fish were stocked in 24 ponds 20 fish/m^2 (2 m in length, 1m in width and 1.25 m in depth).

Water quality parameters

The ponds were supplied with air blowers continuously aerated. Photoperiod was 12h light/ 12h dark regulate. The part of water pond was exchanged daily and totally with fresh water every 10 days. The water quality parameters as water temperature was maintained at (25 ±1ºC), dissolved oxygen concentration (4.7 mg/L) was measured using an apparatus model Lutron 206 (Lutron Taiwan). The water pH value (7.7) was determined using a Lutron 5510 pH meter (Lutron Taiwan). However, ammonia was measured with hana ammonia meter (concentration 0.07mg/L). Other water quality parameters were also within the favorable limits for Tilapia growth (Boyd, 1984).

Experimental diets:

Eight experimental diets were formulated with two protein levels (25% and 30%) inside each protein level four level of Digestarom® (Digest.) (0.00, 0.01, 0.02 and 0.03%). Digestarom® was obtained from (Dakahlia Poultry company) in a powder form was added to ingredients according to the ascending increase in quantities. All ingredients were first ground to a small particle size. Dry ingredients of the diets were thoroughly mixed prior to adding water. The diets were processed by a mixer with die into 3-mm diameter, sun-dried and stored in plastic bags when completed drying in a deep freezer at −2ºC until use. Fish in each pond were fed the experimental diets twice daily to satiety.

Composition and Proximate analysis of experimental diets used in study was shown in Table 1.

Experimental Methodology

Growth performance parameters:

Weight Gain (AWG) = final weight (g) –initial weight (g)

Weight gain (WG%) =(Final weight–initial weight)/initial weight×100

Average daily gain (ADG) = final weight (g) –initial weight (g)/ time

Specific Growth Rate (SGR)=100 [(Ln final weight–Ln initial weight)/time]

Feed utilization parameters:

Feed Intake (FI) = Amount of consumed feed per period(g)

Feed Conversion Ratio (FCR)= Total feed consumption (g)/ weight gain (g)

Feed Efficiency Ratio (FER) = weight gain (g) / Total feed consumption (g)

Table (1): Composition and Proximate analysis of experimental diets used in the study.

Ingredients	25% protein				30% protein			
	T1 Con. 0.00% Digest.	T2 0.01% Digest.	T3 0.02% Digest.	T4 0.03% Digest.	T5 Con. 0.00% Digest.	T6 0.01 % Digest.	T7 0.02% Digest.	T8 0.03% Digest.
Fish meal (60%) protein	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Soybean meal (45%) protein	25.00	25.00	25.00	25.00	30.00	30.00	30.00	30.00
Corn Gluten (60%) protein	9.00	9.00	9.00	9.00	15.00	15.00	15.00	15.00
Rice bran	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00
Yellow corn	43.00	42.99	42.98	42.97	32.00	31.99	31.98	31.97
Digestrom®	0.00	0.01	0.02	0.03	0.00	0.01	0.02	0.03
Sun flour oil	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Mineral mixture[1]	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Vitamin mixture[2]	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Total	100	100	100	100	100	100	100	100
Proximate analysis								
Moisture	9.50	9.75	9.020	9.34	9.63	9.51	9.20	9.44
Protein	24.86	24.86	24.86	24.86	29.70	29.70	29.70	29.70
Lipids	7.60	7.60	7.60	7.60	7.11	7.11	7.11	7.11
Ash	5.63	5.63	5.63	5.63	5.35	5.35	5.35	5.35
Fibers	6.12	6.12	6.12	6.12	7.49	7.49	7.49	7.49
NFE[3]	46.29	46.04	46.77	46.45	40.72	40.84	41.15	40.91
Gross energy[4] (Kcal /100g)	402.53	401.50	404.50	403.19	402.35	402.85	404.12	403.13
Cost /Kg (L.E)	7.64	7.66	7.68	7.70	8.44	8.46	8.48	8.50

1- Each Kg mineral mixture premix contained 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 Vitamin & contained Vitamin A, 4.8 million IU, D3, 0.8 million IU; E, 4 g; K, 0.8 g; B1, 0.4 g; Riboflavin, 1.6 g; B6, 0.6 g, B12, 4 mg; Pantothenic acid, 4 g; Nicotinic acid, 8 g; Folic acid, 0.4 g Biotin,20 mg,. Ascorbic acid (49.00) – Thiamine (0.08) –Riboflavin (0.03) – Niacin (0.02)

3- Nitrogen Free Extract = 100 – (**%Moisture** + %Protein + %Fat + %Fiber + %Ash).

4- Gross Energy based on protein (5.65 Kcal/g), fat (9.45 Kcal/g) and carbohydrate (4.11Kcal/g). According to (NRC, 2011).

Protein Efficiency Ratio (PER) = body weight gain (g)/ protein intake (g)

Survival Rate (SR %) = 100 × (final number of fish survived in tank/initial number of fish survived in tank)

Chemical composition of fish and diet:

At the end of the experimental period, 5 fish were randomly taken from each experimental pond. Fish samples were taken to determine chemical analysis of body composition. Chemical analysis of diets and fish was performed to determine crud protein (CP %) ether extract (EE %), Crude fiber (CF %) for diets only, Ash (%) and moisture. The nitrogen free-extract (NFE %) was calculated by differences for diets only. All chemical analyses were carried out in three replicates according to (AOAC, 2019).

Economical Evaluation:

The cost of feed to raise unit biomass of fish was estimated by a simple economic analysis. The estimation of cost of 1 kg ingredients was based on local retail sale market price of all the dietary ingredients at the time of the study (end of 2018 and started 2019) and were calculated by L.E, Egypt pound.

Cost /kg diet (LE) = Cost per Kg diet L.E.

Consumed feed to produce 1kg fish (kg) = $\frac{\text{Feed intake per fish per period (kg)}}{\text{Final weight per fish (kg)}}$

Feed cost per kg fresh fish (LE) = Step 1 × step 2

Relative % of feed cost/ kg fish = Respective figures for step 3/ highest figure in this step.

Feed cost /1Kg gain (LE) = Feed intake per Kg gain × step 1.

Relative % of feed cost of Kg gain = Respective figures for step 5/ highest figure in this step.

Statistical analysis:

The obtained data were statistically analyzed by factorial experiment (2×4) analysis of variance (SAS, 2000). Individual differences ($p \leq 0.05$) among treatment means were separated using Duncan's multiple range test (Duncan, 1955).

Where: $Y_{ij} = \mu + T_i + B_j + E_{ij}$

μ = The overall mean.

Ti = The effect of treatment.

Bj =The effect of blocks.

Eij = The random error.

RESULTS and DISCUSSION

Growth performance

Concerning the effect of Growth performance, feed utilization and survival rate parameters of red tilapia fingerlings fed different Digestrom® levels at two protein levels (25 and 30% crude protein) throughout experimental period (84 days) are shown in **Table (2).**Belong the effect of the protein level, the results revealed that there was a significant difference (P<0.05) within protein levels (25 and 30%). The highest a significant difference (p<0.05) in final body weight, weight gain, weight gain%, average daily gain and specific growth rate were recorded on group of fish fed on diet contained 30% protein. There was no significant difference (p<0.05) in survival rate in comparison protein levels. Some studies on tilapia nutrition and feeding show conflicting results. For instance, **El-Sayed and Teshima (1992),** dietary protein requirements decreased with increasing fish size, and age. **De Silva *et al.* (1989)** demonstrated that the most economical dietary protein requirement for young tilapia (1 to 5 g) was 28%. These results are similar to the findings of some studies on tilapia species **(Bahnasawy, 2009).**

Belong the effect of the Digestrom® level, the results showed that there was a significant difference (p<0.05) within Digestrom® levels(0.00, 0.01, 0.02 and 0.03%). The group of fish fed on diet supplemented with 0.02% Digestrom® had highest a significant difference (p<0.05) in final body weight (FBW), weight gain (WG), weight gain% (WG %) and specific growth rate (SGR). There was a significant difference (p<0.05) in survival rate and the highest survival rate in fish fed on 0.02% Digestrom® in comparison to 0.00% Digestrom®.In agreement with **Zheng *et al*. (2009)** they observed that a significantly higher (P<0.05) average daily growth, specific growth rate and protein utilization in fish fed diet containing 0.02% Digestrom®. The use of dietary supplements 0.02% Digestrom® improved growth performance and feed utilization. It was found that addition 0.02% Digestrom® have shown to exert multiple effects on fish, such as stimulate appetite, antimicrobial action and direct reduction of gut bacteria, stimulation of gastric juices, enhance immune-system, anti-inflammatory and anti-oxidant properties (**Nerio *et al*., 2010, Saravanan *et al*.,2012** and **Peterson *et al*., 2015)**. The results of this study are also contrary to other studies that fed carvacrol and thymol to catfish (**Zheng *et al*., 2009**) and rainbow trout **(Giannenas *et al*., 2012)** when fed carvacrol and thymol to rainbow trout for 8 weeks and found no significant differences (P<0.05) in weight gain, food intake, or survival. An improvement of growth has been detected in red seabream *(Pagrus major*) (**Dawood *et al.,* 2015 and 2017**), mirror carp (*C. carpio L*.) (**Kühlwein *et al*., 2014**), cyprinid rohu (**Misra *et al*., 2006)** and Nile tilapia (**Misra *et al*., 2006; Dalmo and** Bøgwald**, 2008).** In the other hand, **Peterson *et al*. (2014)** did not found any improvement in growth performance or disease resistance with the addition of essential oils that contained thymol and carvacrol these aromatic compounds on channel catfish diets. A possible mode of action of the 0.02% Digestrom® supplemented and that was tested at this experiment, is that it improves intestinal conditions and promotes nutrients absorption through an antimicrobial effect. Due to its balanced and rounded flavor, Digestarom® enhances the palatability of livestock diets, thus encouraging feed intake.

Belong the effect of the interaction levelof protein and Digestrom®, the result revealed that fish fed on T3 and T7 supplemented with 0.02% Digestrom® at 25% and 30% protein, respectively, had the highest a significant different (p < 0.05) on final body weight (FBW), weight gain (WG), weight gain% (WG %) and specific growth rate (SGR). There was a significant difference (p<0.05) in survival rate and the highest survival rate in fish fed on 0.02% Digestrom® at both of protein levels 25 and 30%. Positive effects of different phytogenic products and protein levels in agreement with **Abo-State *et al.,* 2017**. Some studies suggested that a phytogenic product can have different levels of efficacy when used in different forms and doses. With channel catfish, rainbow trout and sturgeon, significant improvements in fish growth were reported with diets containing either carvacrol, thymol or their combination at different doses and feeding duration **(Zheng *et al.,* 2009; Ahmadifar *et al.,* 2011; Ahmadifar *et al.,* 2014)**. Conversely, no significant improvement in somatic growth of sea bass (*Dicentrarchus labrax*) and rainbow trout was found following feeding on diets supplemented with carvacrol at 250 ppm and 500 ppm for sea bass **(Volpatti *et al*., 2012)** or 1000, 3000 and 5000 ppm for rainbow trout **(**Yılmaz***et al*., 2014).**

Feed utilization:

Feed and protein utilization parameters expressed as Feed Intake (FI), Feed Conversion Ratio (FCR), Feed Efficiency Ratio (FER) and Protein Efficiency Ratio (PER), are given in **Table 2.** Belong the effect of the protein level, the results revealed that there was a significant difference

(P<0.05) within protein levels (25 and 30%). The highest a significant difference (p<0.05) in FI, FCR and PER recorded at fish fed 25% protein while FER was highest recorded at fish fed 30% protein. In the present study, PER was significantly affected by protein levels and noticeable that protein utilization was obtained at low protein level. High protein utilization of low protein diets has been observed in many fish species including tilapia **(Ahmad *et al*., 2004 and Abbas and Siddiqui, 2013).** Moreover, **Dabrowski (1977)** reported different patterns of changes in PER in relation to dietary protein level and found that the relationship between dietary protein and PER differ from species to species. This indicates that Red tilapia could have efficiently utilized the low protein diet for protein synthesis, thus increasing PER value and suggesting a compensatory mechanism **(Bahnasawy, 2009).**

Belong the effect of the Digestrom® level, the results showed that there was a significant difference (p<0.05) between Digestrom® levels (0.00, 0.01, 0.02 and 0.03%). The group of fish fed on diet supplemented with 0.03% Digestrom® had highest a significant difference (p<0.05) in FI in comparison to 0.00% Digestrom®. The group of fish fed on diet supplemented with 0.02% Digestrom® had highest a significant difference (p<0.05) in FER,PER and survival rate while lowest FCR in comparison to 0.00% Digestrom®. Similar results were observed in other species, such as gilthead sea bream (Fountoulaki et al., 2009) and channel catfish (Zheng et al., 2009). In addition, the supplementation of feeds with carvacrol, a combination of carvacrol and thymol and oregano essential oil enhanced weight gain. Similarly, tilapia fed probiotics showed improved growth rates and feed efficiency (Gobi et al., 2018 and Elsabagh et al., 2018). In contrast, catfish fed oregano essential oil showed improved FCR followed by fish fed carvacrol by itself and thymol and carvacrol fed in combination (Zheng et al.,2009). In the rainbow trout study, fish fed thymol showed improved FCR followed by fish fed carvacrol compared to control (1.59 vs. 1.73 vs. 1.78) (Giannenas et al.,2012). Additionally, high PER correspondingly indicated improved body protein content, mainly in synbiotic group over the control. The aquafeeds industry has recognized that the utilization and expansion of plant products for fish diets are essential for future development of aquaculture (Gatlin et al., 2007).

Belong the effect of the interaction between protein and Digestrom®, levels the result revealed that fish fed on T3 and T7 supplemented with 0.02% Digestrom® at 25% and 30% protein, respectively, had the highest a significant different (p < 0.05) on FI,FER and PER compared

Table (2): Growth performance, feed utilization and survival rate parameters red tilapia fingerlings fed different Digestrom® levels at two protein levels (25 and 30% crude protein) throughout experimental period (84 days).

Treatments		InitialWeight	Final Weight	Weight Gain G	Weight Gain %	Average Daily Gain	Specific Growth Rate
Effect of dietary protein level							
25%		30.03^{a} ±0.21	89.57^{b} ±0.11	59.54^{b} ±0.01	198.65^{b} ±0.01	0.70^{b} ±0.01	1.30^{b}±0.01
30%		30.11^{a} ±0.32	92.16^{a} ±0.20	62.06^{a} ±0.01	208.64^{a} ±0.03	0.74^{a} ±0.01	1.33^{a}±0.01
Effect of digestrom supplementation level							
T1 cont.0.00%		30.10^{a} ±0.12	81.27^{c} ±0.30	51.18^{c} ±0.02	170.12^{d} ±0.02	0.59b ±0.01	1.18^{b}±0.01
T2 0.01%		30.24^{a} ±0.32	86.56^{b} ±0.13	56.33^{b} ±0.01	186.36^{c} ±0.01	0.67b ±0.01	1.27^{b}±0.00
T3 0.02%		29.93^{a} ±0.52	98.24^{a} ±0.10	68.31^{a} ±0.03	233.36^{a} ±0.04	0.82a ±0.01	1.42^{a}±0.01
T4 0.03%		30.00^{a} ±0.30	97.39^{a} ±0.22	67.39^{a} ±0.01	224.64^{b} ±0.02	0.80a ±0.01	1.41^{a}±0.01
Effect of interaction between dietary protein level and digestrom supplementation level							
25% Protein	**T1 Cont.0.0%**	30.33^{a} ±0.41	79.30^{e} ±0.31	48.97^{e} ±0.01	161.46^{g} ±0.04	0.55d ±0.01	1.14^{c}±0.01
	T2 0.01%	30.37^{a} ±0.35	82.42^{d} ±0.14	52.05^{d} ±0.01	171.39^{f} ±0.01	0.62cd ±0.01	1.22^{bc}±0.00
	T3 0.02%	29.6^{a} ±0.22	98.58^{a} ±0.09	68.98^{a} ±0.01	233.04^{a} ±0.01	0.82^{a} ±0.01	1.43^{a}±0.01
	T4 0.03%	29.8^{a} ±0.28	97.96^{ab} ±0.16	68.16^{ab} ±0.04	228.72^{b} ±0.00	0.81^{a} ±0.01	1.42^{a}±0.01
30 % Protein	**T5 Cont.0.0%**	29.86^{a} ±0.19	83.24^{d} ±0.21	53.38^{d} ±0.02	178.77^{e} ±0.00	0.64^{bcd} ±0.01	1.22^{bc}±0.02
	T6 0.01%	30.1^{a} ±0.34	90.70^{c} ±0.12	60.60^{c} ±0.04	201.33^{d} ±0.02	0.72^{abc} ±0.01	1.31^{abc}±0.01
	T7 0.02%	30.26^{a} ±0.37	97.89^{ab} ±0.40	67.63^{ab} ±0.05	233.50^{a} ±0.01	0.81^{a} ±0.01	1.40^{ab}±0.03
	T8 0.03%	30.2^{a} ±0.15	96.81^{b} ±0.28	66.61^{b} ±0.01	220.65^{c} ±0.01	0.79^{ab} ±0.01	1.39^{ab}±0.01

Means within the same column with different superscripts are significantly different ($P<0.05$)

Treatments		Feed Intake	Feed Conversion Ratio	Feed Efficiency Ratio	Protein Efficiency Ratio	Survival Rate
Effect of dietary protein level						
25%		118.07^{a} ±0.10	1.98^{a} ±0.01	0.50^{b} ±0.01	2.03^{a}±0.01	95^{a} ±0.11
30%		117.83^{b} ±0.23	1.89^{b} ±0.01	0.52^{a} ±0.01	1.77^{b}±0.01	95^{a} ±0.12
Effect of digestrom supplementation level						
T1 cont.0.00%		110.58^{d} ±0.31	2.16^{a} ±0.04	0.45^{a} ±0.00	1.71^{c}±0.01	93^{c}±0.14
T2 0.01%		115.05^{c} ±0.12	2.06^{a} ±0.05	0.49^{ab} ±0.00	1.80^{c}±0.00	95^{b} ±0.11
T3 0.02%		117.81^{b} ±0.41	1.73^{c} ±0.02	0.58^{a} ±0.01	2.15^{a} ±0.00	98^{a} ±0.12
T4 0.03%		128.35^{a} ±0.20	1.91^{b}±0.01	0.53^{ab} ±0.01	1.94^{b} ±0.00	95^{b} ±0.10
Effect of interaction between dietary protein level and digestrom supplementation level						
25% Protein	**T1Cont.0.0%**	109.38^{g} ±0.19	2.23^{a} ±0.01	0.42^{a} ±0.02	1.80^{c} ±0.01	93^{c} ±0.11
	T2 0.01%	114.53^{e} ±0.21	2.20^{a} ±0.02	0.45^{ab} ±0.05	1.83^{c}±0.00	95^{b} ±0.13
	T3 0.02%	117.27^{cd} ±0.24	1.70^{d} ±0.01	0.59^{a} ±0.02	2.37^{a}±0.01	98^{b} ±0.10
	T4 0.03%	131.08^{a} ±0.41	1.92^{bc} ±0.01	0.52^{a} ±0.00	2.09^{b} ±0.01	95^{b} ±0.17
30 % Protein	**T5Cont.0.0%**	111.78^{f} ±0.35	2.09^{ab} ±0.02	0.48^{b} ±0.01	1.61^{d} ±0.04	93^{c} ±0.12
	T60.01%	115.57^{de} ±0.22	1.91^{c} ±0.01	0.52^{ab}±0.01	1.77^{cd} ±0.02	95^{b} ±0.11
	T7 0.02%	118.35^{c} ±0.36	1.75^{cd} ±0.00	0.57^{ab}±0.02	1.92^{bc} ±0.04	98^{b} ±0.09
	T8 0.03%	125.61^{b} ±0.32	1.89^{c} ±0.01	0.53^{ab} ±0.01	1.79^{c}±0.0١	95^{b} ±0.11

Means within the same column with different superscripts are significantly different ($P<0.05$)

other treatments. There was a significant difference (p<0.05) in survival rate and the lowest in FCR in fish fed on 0.02% Digestrom® at both of protein levels 25 and 30%.(Zheng et al.,2009).

Body chemical composition

Body chemical composition (on dry matter basis) of red tilapia fed on two protein levels (25 and 30% crude protein) within each levelfour Digestrom® levels(0.00, 0.01, 0.02 and 0.03%) throughout experimental period (84 days)are presented in Table 3. Belong the effect of the protein level, the results revealed that there was a significant difference (P<0.05) between protein levels (25 and 30%) in body content on moisture protein, lipid and ash. When dietary protein level increased, lipid content decreased as in sea bass (Ballestrazzi et al., 1994), tilapia (Al-hafedh, 1999), grass carp (Dabrowski, 1977), guppy (Fah and Leng, 1986) . The increase in whole body protein and decrease in lipid content with increasing dietary protein levels may be endorsed to the high carbohydrate and low protein content in the diet having low protein concentration.

Belong the effect of the Digestrom® level, the results showed that there was a significant difference (p<0.05) between Digestrom® (0.00, 0.01, 0.02 and 0.03%). The group of fish fed on diet supplemented with 0.02 and 0.03% Digestrom® had no significant difference (p<0.05) in moisture content in comparison to 0.00% Digestrom®. The group of fish fed on diet supplemented with 0.03% Digestrom® had highest a significant difference (p<0.05) in protein content which increased by Digestrom® levels while lowest lipid content which decreased by Digestrom® levels in comparison to 0.00% Digestrom®.There was no significant in ash body content in comparison to fish fed on Digestrom® diets. Although the increased whole-body protein content observed in red tilapia fed Digestrom®-supplemented diets which increases nutrient utilization and protein synthesis and, ultimately, fish protein content (Freccia et al., 2014 and Dada, 2015).

Belong the effect of the interaction levelof protein and Digestrom®, the result revealed that fish fed on T٤ and T٨ supplemented with 0.03% Digestrom® at 25% and 30% protein, respectively, had the highest a significant different (p < 0.05) on moisture and protein content which increased with Digestrom® and protein levels while the lowest lipid content compared other treatments. There was no significant difference (p<0.05) in ash body content compared to Digestrom® levels at both of protein levels 25 and 30% diets. Similar results were obtained by Teves and Ragaza (2016).

Table (3): Body chemical composition (on dry matter basis) of red tilapia fingerlings fed on different Digestrom® levels at two protein levels (25 and 30% crude protein) throughout experimental period (84 days)

Treatments		Moisture	Crude protein	Ether extract	Ash
Effect of dietary protein level					
25%		73.85[a]±2.11	63.00[b]±0.53	23.75[a]±0.71	13.25[a] ±0.81
30%		73.92[a]±1.11	64.96[a]±0.10	22.93[b]±0.91	13.12[b] ±0.26
Effect of digestrom supplementation level					
T1 cont.0.0%		72.54[c] ±0.11	62.38[d] ±0.61	24.36[a] ±0.31	13.27[b] ±0.64
T2 0.01%		73.67[b] ±0.89	63.42[c] ±0.45	23.26[ab] ±0.82	13.33[a] ±0.35
T3 0.02%		74.46[a] ±0.11	64.52[b] ±0.44	22.42[b] ±0.72	13.07[d] ±0.51
T4 0.03%		74.88[a] ±0.11	65.62[a] ±0.30	21.31[c] ±0.95	13.08[c] ±0.20
Effect of interaction between dietary protein level and digestrom supplementation level					
25% Protein	T1cont.0.0%	72.54[d] ±0.77	62.40e[f] ±0.31	24.10[ab] ±0.78	13.50[a] ±0.91
	T2 0.01%	73.50[c] ±0.99	63.60[cde] ±0.50	23.07[abcd] ±0.19	13.33[b] ±0.11
	T3 0.02%	74.52[ab] ±0.38	64.70[bc] ±0.52	22.27[cde] ±0.76	13.03[f] ±0.64
	T4 0.03%	74.83[a] ±0.30	65.30[ab] ±0.74	21.55[de] ±0.82	13.15[d] ±0.29
30% Protein	T5 cont.0.0%	72.53[d] ±0.11	62.35[f] ±0.15	24.62[a] ±0.64	13.03[f] ±0.11
	T6 0.01%	73.83[bc] ±0.75	63.23[def] ±0.10	23.45[abc] ±0.42	13.32[c] ±0.72
	T7 0.02%	74.39[ab] ±0.02	64.34[bcd] ±0.33	22.56[bcde] ±0.25	13.10[e] ±0.93
	T8 0.03%	74.92[a] ±0.51	65.93[a] ±0.76	21.06[e] ±0.22	13.01[g] ±0.78

Means within the same column with different superscripts are significantly different ($p<0.05$)

Economical Evaluation:

Economical evaluation of experimental diets two levels of protein (25% and 30%) supplemented with four levels of Digestrom® at 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).

Application with Digestrom®, generally, led to reduction in the cost and amount of the food consumed to produce one kg product, feed cost /kg gain and the relative percent of feed cost of kg gain. This trend was confirmed with all treatments either contained 25% protein or 30% protein in their diets components. T3 having the lowest feed cost, Relative % of feed cost/ g fish, consumed feed to produce 1 Kg gain (Kg), Feed cost /1Kg gain (LE) and Relative % of feed cost of Kg gain. The highest T5 feed consumed feed cost, Relative % of feed cost/ g fish, consumed feed to produce 1 Kg gain (Kg), Feed cost /1Kg gain (LE) and Relative % of feed cost of Kg gain. The obtained results are in a general agreement with that mentioned by (Dada, 2015 and Kristina et al., 2015).

Table (4): Economical evaluation of experimental diets supplemented with different Digestrom® levels at two protein levels (25 and 30% crude protein).

Items	25% protein				30% protein			
	T1 Con. 0.00 %	T2 0.01%	T3 0.02%	T4 0.03%	T5 Con. 0.00%	T6 0.01 %	T7 0.02%	T8 0.03%
Cost /kg diet (LE)1	7.64	7.66	7.68	7.70	8.44	8.46	8.48	8.50
Consumed feed to produce 1kg fish (kg)2	1.38	1.39	1.19	1.34	1.34	1.27	1.21	1.30
Feed cost per kg fresh fish (LE)3	10.54	10.64	9.14	10.30	11.33	10.78	10.25	11.03
Relative % of feed cost/ g fish4	93.01	93.95	80.64	90.94	100	95.14	90.49	97.34
Consumed feed to produce 1 Kg gain (Kg)	2.23	2.20	1.70	1.92	2.09	1.91	1.75	1.89
Feed cost /1Kg gain(LE)5	17.04	16.85	13.06	14.78	17.64	16.16	14.84	16.07
Relative % of feed cost of Kg gain6	96.58	95.53	74.01	83.81	100	91.60	84.13	91.07

1-Cost /kg diet (LE) = Cost per Kg diet L.E.
2-Consumed feed to produce 1kg fish (kg) = Feed intake per fish per period/ final weight per fish Kg/Kg
3-Feed cost per kg fresh fish (LE) = Step 1X step 2
4-Relative % of feed cost/ kg fish = Respective figures for step 3/ highest figure in this step
5-Feed cost /1Kg gain (LE) = Feed intake per Kg Gain X step 1
6-Relative % of feed cost of Kg gain = Respective figures for step 5/ highest figure in this step.

CONCLUSIONS

It could be concluded that the best Digestrom® levels was 0.02% Digestrom® in each protein levels 25 and ٣٠ % in term growth performance and feed utilization, survival rate and economic evaluation under the experimental condition.

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تاثير الديجستيروم على اداء النمو والاستفاده الغذائية لسمك البلطى الاحمر

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الملخص العربي

يهدف هذا البحث الي دراسة تأثير مستوى البروتين (٢٥ و ٣٠٪) داخل كل مستوى من البروتين و اربعة مستويات من الديجستروم ®Digestrom (٠,٠٠، ٠,٠١، ٠,٠٢ و ٠,٠٣ %) علي أداء النمو ، والكفاءه الغذائيه ، ومعدلات الاعاشة والتقييم الاقتصادي لإصبعيات البلطي الأحمر.

تم تغذية اصبعيات البلطي الأحمر على ثمانية علائق تجريبية تحتوى على مستويين من البروتين الخام (٢٥ و ٣٠٪) داخل كل مستوى من البروتين اربع مستويات من الديجستروم ®Digestrom (٠,٠٠، ٠,٠١، ٠,٠٢ و ٠,٠٣ %).

اظهرت النتائج ان نسبة البروتين ٣٠٪ واضافة ٠,٠٢٪ من الديجستروم لهما تأثير ايجابي على الوزن النهائى و الوزن المكتسب ومعدل النمو النوعي ونسبة كفاءة البروتين. والتداخل بين الديجستروم ومستويات البروتين ادى الى تحسن معنوى عالى من حيث اداء النمو والاستفادة الغذائية، ومعدلات الاعاشة والتقييم الاقتصادي.

نستنتج من هذه الدراسة أن افضل مستوى من الديجستروم هو ٠,٠٢٪ تحت كلا من مستويين البروتين ٢٥- ٣٠٪ بروتين من حيث اداء النمو والاستفادة الغذائية، ومعدلات الاعاشة والتقييم الاقتصادي.