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Using distillers dried grains as an alternative protein source in Nile tilapia *(Oreochromis niloticus)* feeds.

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ABSTRACT

This work was conducted in the regional laboratory for food and feed, Agriculture Research Center, Giza, Egypt, in a closed recirculation water system for 12 weeks to determine the effect of replacing 0, 10, 20, 30 and 40% soybean meal and yellow corn in tilapia (*Oreochromis niloticus*) diets by Distillers Dried Grains (DDGS) with and without enzyme (Ameco Zyme 2x, 0.25g/kg). Therefore, nine isonitrogenous (30% CP) and isocaloric (3200 kcal GE/kg) experimental diets were formulated, D1, repsant the (control). In the other experimental diets, soybean meal and yellow corn mixture was replaced with DDGS at a rate of 10% (D2), 20% (D3), 30% (D4), 40% (D5), 10% DDGS+ Enzyme (D6), 20% DDGS+Enzyme (D7), 30% DDGS+ Enzyme (D8) and 40% DDGS+ Enzyme (D9). A total number of 405 tilapia fry (0.98 g±0.01) were randomly distributed into 27 tanks (60 liters each) at a stocking rate of 15 fry/tank. After 84 days from the experiment start no significant differences ($P<0.05$) were observed in survival rate, the highest specific growth rate (3.5 %/day) was recorded for fish feed D7, while fish fed D5 showed the lowest value (2.83 %/ day). The best feed conversion ratio (FCR) was occurred when fish fed D6 or D7 while the worst value was recorded by fish group fed D5. Protein efficiency ratios (PER) were found to be high when fish were fed diets containing enzyme. Body crude protein content for fish fed D1, D2, D6 or D7 were significantly higher than the other diets while fish group fed D5 showed the highest significant ($P<0.05$) body fat content compared to fish fed the other diets. The obtained results refers to the possibilities of replacing soybean meal and yellow corn mixture in the control diets with DDGS up to 20% without enzyme and up to 30% with enzyme addition.

Keywords: Nile tilapia, distillers dried grains, commercial enzyme.

INTRODUCTION

In Egypt aquaculture has developed rapidly in the recent years. Tilapia is one of the most widely cultured species in Egypt. The total aquaculture production of tilapia increased from 24916 metric tons in 1990 to 738645 metric tons/year^{-1} in 2012 (GAFRD, 2014) and accounted for 75% of the total production (One million tone year^{-1}). In Egypt, a growing number of fish farms are adopting intensive culture technology, increasing the demand for high quality tilapia feed.

Protein is responsible for a large part of the cost of most prepared feeds, so that it is imperative to incorporate only the amount necessary for normal maintenance and growth. Any excess is considered biologically as well as economically wasteful (Erfanullah, 1995). Soybean meal (SBM) is one of the most studied and widely used as plant protein sources in commercial aquatic feeds for many species, such as tilapia, hybrid striped bass, rainbow trout, Atlantic salmon (*Salmo salar*) and hybrid sunshi bass (*Morone chrysops* × *M. saxatilis*) (Steffens, 1994; Thompson *et al*., 2008; Furuya *et al*., 2004; Rawles *et al*., 2009). Distillers dried grains with soluble (DDGS) is another ingredient. It is the major non fermentable co-product of fuel ethanol production, and is mostly made from corn grain. Compared to other protein sources, such as soybean meal, DDGS is very competitive on a cost per unit protein basis, highly palatable to fish (Lim *et al*., 2009), and does not contain anti-nutritional factors that are present in most pulses. In numerous studies, DDGS has been examined as a potential protein ingredient in fish feed for species such as Nile tilapia Wu *et al*., 1996; and Lim *et al*., 2007, channel catfish Webster *et al*., 1993; and rainbow trout (Cheng & Hardy, 2004). The present study was conducted to evaluate the effect of replacing soybean and yellow corn mixture in the basal diet with Distillers Dried Grains with and without addition enzyme in tilapia diet on growth performance, feed utilization, economical efficiency and body composition of Nile tilapia *(Oreochromis niloticus)*.

MATERIALS AND METHODS

Experimental diets

Nine isonitrogenous (30% crude protein) and isocaloric (3200 kcal GE/Kg) experimental diets were formulated and the proximate chemical composition of these diets is presented in Table 1. The first is the control diet. In the other eight experimental diets, soybean meal and yellow corn mixture was replaced with DDGS at a rate of 10% (D2), 20% (D3), 30% (D4), 40% (D5), 10% DDGS+ Enzyme (D6), 20% DDGS+Enzyme (D7), 30% DDGS+ Enzyme (D8) and 40% DDGS+ Enzyme (D9).

Table 1: Diet formulation of the experimental diets (g/ 100 g)

Ingredients	D1	D2	D3	D4	D5	D6	D7	D8	D9
Fish meal	11	11	11	11	11	11	11	11	11
Yellow corn	30	25	20	15	10	25	20	15	10
Soybean meal	30	25	20	15	10	25	20	15	10
DDGS	0	10	20	30	40	10	20	30	40
Wheat flour	12	12.5	13	13.5	14	12.5	13	13.5	14
Corn gluten	5	5	5	5	5	5	5	5	5
Wheat bran	6	6	6	6	6	6	6	6	6
Fish oil	1	1	1	1	1	1	1	1	1
Soy oil	2	1.5	1	0.5	-	1.5	1	0.5	0
$CaCo_3$	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Vit&Min mixture *	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Proximate analysis (%) on dry matter basis									
Dry matter	89.68	89.4	89.33	88.78	88.94	89.19	89.75	89.47	89.86
Crude protein	29.91	29.79	29.92	30.01	30.09	29.82	29.89	30.00	30.05
Ether extract	6.40	6.60	6.77	7.01	7.35	6.42	6.90	7.00	7.38
Crude fiber	3.72	3.89	4.14	4.56	4.8	4.07	4.22	4.51	4.77
Ash	6.1	6.21	6.44	6.48	6.63	6.25	6.39	6.47	6.65
NFE**	43.55	42.91	42.06	40.70	40.07	41.72	41.26	41.49	41.01

* Vitamins and minerals premix at 1% of the following per kg of this mixture continents: Vit. A 75000 IU, vit. D 9000 IU, vit. E 150mg, vit K 30mg, vit B_1 26.7mg, vit. $B_2$30mg, vit B_6 24.7mg. vit. B_{12} 75 mg, niacin 225mg, pantothenic acid 69mg, folic acid 7.5mg, vit. C 150mg, choline chloride 500mg, DL-methionine 300mg, Mn 204mg, Fe 93, Zn 210mg, Cu 11.25mg, 11.02mg.

** NFE= 100 - (CP + EE + CF + ASH).

Composition of enzyme mixture presented in Table (2). All dry ingredients of the fish meal, soybean meal, yellow corn, Corn gluten, wheat bran, Wheat flour, DDGS were blended for 5 min and thoroughly mixed with soybean oil and fish oil. The ingredients were mixed well and made into dry pellets using a laboratory pellet mill (California Pellet Mill, San Francisco, CA, USA). The pellets (1-mm die) were dried for 4 h at 60°C and stored at −20°C until use.

Table 2: Composition of enzyme mixture used in the experimental diets (/Kg)

Composition (Each g contains)	
Amylase enzyme	5500IU
Xylanase enzyme	50IU
Protease enzyme	200 IU
Beta-Glucanase enzyme	30 IU
Lipase enzyme	150 IU
Celluase enzyme	15IU
Carrier: fermentation byproduct of corn grain,	
Aluminium silicate (1:4) up to	1 g

2. Experimental Fish and Facilities

Nile tilapia (*O. niloticus*) fry were obtained from Abbassa hatchery, Abu-Hammad, Sharkia Governorate, Egypt and transferred to the regional laboratory for food and feed, Agriculture Research Center, Giza, Egypt. Prior to the beginning of the experiment, fish were acclimatized to the experimental conditions and fed commercial diet (30% crude protein) twice daily to apparent satiation by hand for 15 days.

After acclimatization 405 tilapia fry with an initial body weight of 0.98 g were stocked in 27 tanks (60 L each). Three replicate tanks were randomly assigned to each treatment to represent the nine experimental treatments; each tank was stocked with 15 fish. All dietary treatments were tested in triplicate groups where each aquarium was considered as an experimental unit.

All tanks were supplied with de-chlorinated tap water in a closed recirculation water system and were continuously supplied with compressed air for oxygen requirement. A photoperiod of 12 h light, 12h dark (08.00 to 20.00 h) was used. Fluorescent ceiling lights has supplied the illumination. Fish were fed their respective diets by hand one of nine experimental diets for 84 days. Diets at a daily rate of 1.7% of fish metabolic body size ($w^{0.8}$) was calculated according to Huisman (1976) and divided into two equal amounts and offered two times a day (9:30 and 14.00 h). All fish in each tank were weighed biweekly and the amount of daily allowance feed was adjusted accordingly.

Water temperature, dissolved oxygen, pH, and total ammonia were monitored during the study, to maintain water quality at optimal range for the Nile tilapia. Water temperature was recorded daily at 13.00 h using a mercuric thermometer suspended at 30 cm depth. Dissolved oxygen (DO) was measured daily at 07.00 h using YSI model 56 oxygen meter (YSI Company, Yellow Springs Instrument, Yellow Springs, Ohio, USA) and pH was recorded daily at 09.00 h using a pH meter (Orion pH meter, Abilene, Texas, USA). Total ammonia was measured three times a week according to (APHA, 1992). All tested water quality criteria were suitable and within the acceptable limits for rearing the Nile tilapia *O. niloticus* fingerlings (Boyd, 1992).

At the initiation and termination of the experiment a random sample of five individual fish were sampled from each tank, then oven-dried 105ºC for 24 h, ground, and stored at -20ºC for subsequent analysis. Proximate analysis was conducted on diets and fish samples. Moisture, total lipids, crude protein and ash contents were all determined by the standard (AOAC, 2005). Dry matter was determined after drying the samples in an oven (105ºC) for 24 h. Ash by incineration at 550ºC for 12 h (AOAC, 2005 method number 942.05). Crude protein was determined by micro-Kjeldhal method, N×6.25 (using Kjeltech auto analyzer, Model 1030, Tecator, Höganäs, Sweden) (AOAC, 2005 method number 984.13) and crude fat by Soxhlet extraction with diethyl ether (40–60ºC) (AOAC, 2005 method number 920.39).Crude fiber content was determined using the method of Van Soest *et al*., (1991). Nitrogen-free extract was computed by taking the sum of values for crude protein, crude lipid, crude fiber, ash and moisture then subtracting this sum from 100. The amino acid profile of diets was determined measured by the rise in pH according to the AOAC (2005).

3. Growth indices

Records of initial body weight (IBW) and final body weight (FBW) of each individual fish were determined in all fish for each aquarium at the initiation and the termination of the feeding trail. Weight gain (WG), specific growth rate (SGR %), feed conversion ratio (FCR), protein efficiency ratio (PER) and protein productive value (PPV) were calculated using the following equations:

WG (g/ fish) = *FBW–IBW*; SGR% = [*ln FBW* - *ln* IBW]/t×100, where FBW is final body weight (g); IBW is initial body weight (g); *ln* = natural logarithmic; t=time in days. FCR=*FI* /*WG*, where FI is feed intake (g); PER=*WG*/*protein intake (g).* PPV% = *protein gain* (g)/*protein intake* (g)×100.

4. Digestibility Study

After two-months from the experimental start, feces were collected from each aquarium once daily every morning for a one-month period prior to feeding. The feces were collected on filter paper for drying. The collected fecal samples were pooled and freeze-dried prior to analyses for a period for 10 days. The chemical analyses were conducted according to AOAC (2005). Ash was used as an inter indicator (Lovell, 1989). Apparent digestibility coefficient (ADC) was determined by using a formula described by Maynard *et al*., (1979) as the following. The indicator used was ash. Apparent digestibility coefficient (ADC)

$$=100-(100\{\frac{\%\ indicator\ in\ feed}{\%\ indicator\ in\ sample}\ x\ \frac{\%\ nutrient\ in\ sample\ in\ feed}{\%\ nutrient\ in\ feed}\})$$

5. Statistical analysis

The statistical analysis was applied according to Steel and Torrie (1980) on the collected data using a SAS program (2006). Differences between means were tested for significance according to Duncan's multiple rang test (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical composition of experimental diets

The Essential amino acids of the experimental diets used in this study are presented in Table (3). As shown in this Table no variations are observed among diets formulated for the study.

The lowest contents of lysine amino acid in D5 (which contained 40% DDGS replacement for soybean meal and yellow corn without addition enzyme). Lim *et al*. (2007) found that Nile tilapia grew bad at low levels of lysine amino acid, when fish fed 400g/kg DDGS diet without lysine supplement.

Table 3: Essential amino acid profile of the experimental diets (%) (as fed basis)

Amino acids	D1	D2	D3	D4	D5	D6	D7	D8	D9	*Requirement
Threonine	1.06	1.08	1.07	1.06	1.08	1.08	1.09	1.07	1.06	1.05
Valine	1.31	1.21	1.39	1.42	1.38	1.33	1.30	1.30	1.25	0.78
Glysine	1.22	1.19	1.24	1.20	1.22	1.24	1.24	1.24	1.19	
Isoleucine	1.13	1.09	1.10	1.11	1.06	1.09	1.09	1.13	1.08	0.87
Leucine	2.33	2.39	2.55	2.54	2.78	2.63	2.58	2.67	2.61	0.95
Phenylalanine	1.52	1.51	1.45	1.56	1.41	1.55	1.51	1.54	1.48	1.05
Histadine	0.74	0.75	0.77	0.79	0.78	0.76	0.78	0.82	0.83	0.48
Arginine	2.16	2.06	2.10	2.06	2.16	2.06	2.14	2.12	2.09	1.18
Methionine + Cystine	1.03	1.07	1.12	1.13	1.11	1.14	1.15	1.18	1.11	0.75
Lysine	1.54	1.49	1.47	1.44	1.34	1.57	1.52	1.44	1.42	1.43

*Santiago & Lovell (19

Nutrients Digestibility

Data in Table (4) indicated that the highest apparent digestion coefficient (ADC) of dry matter (DM) was recorded for D7 (79.52 %) followed by D6 (78.75%) and then D2 (77.07%). The ADC of DM of these groups were significantly (P<0.05) higher than D5 which recorded the lowest value (75.13 %) of average apparent digestion coefficient value of (DM) followed by D8 (75.67%). These results are in agreement with Goda (2008) who reported that adding ginseng G115 (150,200 and 250 mg/kg diet) in Nile tilapia diets improved protein utilization and this may be attributed to that ginseng increase trypsin- like enzyme activates, suggesting higher digestion of containing ginseng herb. Similarly, Qiu *et al.* (2004) reported that diets supplemented with Chinese herb (TCM) significantly increased growth rate, protease activity in intestine and hepatopancreas, apparent protein, and fat digestibility of Allogynogenetic crucian carp (*Carassius auratus*). On other hand, Schaeffer *et al.* (2010) found that feeding of Nile tilapia on 17.5, 20, 22.5, 25 and 27.5 % DDGS in combination of soybean meal and corn did not significantly affected the digestibility of dry matter in Nile tilapia fish.

Table 4: Effect of treatments on apparent digestion coefficient (ADC) of DM, CP and EE (%) digestibility

Diets	D M	C P	E E
D1	75.67^{b}	86.31^{d}	88.91^{d}
D2	77.07^{b}	88.02^{c}	89.78^{cd}
D3	76.69^{c}	87.78^{c}	90.63^{bac}
D4	76.16^{b}	87.21^{cd}	89.91^{bcd}
D5	75.13^{c}	84.75^{e}	88.90^{d}
D6	78.75^{a}	90.92^{a}	91.41^{ab}
D7	79.52^{a}	91.07^{a}	92.09^{a}
D8	76.65^{b}	89.57^{b}	92.11^{a}
D9	76.50^{b}	88.33^{bc}	89.40^{cd}

Means within each column followed by different letter were significantly different at (P <0.05)

Concerning CP apparent digestion coefficient statistical evaluation of results revealed that the highs CP apparent digestibility was recorded by D7 (91.07%) followed in a significant (P<0.05) decreasing order by D8 (89.57 %); D9 (88.33%), D2 (88.02); D3 (87.78%); D4 (87.21%); D1 (86.31%) and D5 (84.75%), respectively. Schaeffer *et al.* (2010) found that substitution of soybean meal and yellow corn with DDGS by 17.5, 20, 22.5, 25 and 27.5 % DDGS did not significantly affected the digestibility of crude protein in Nile tilapia diets. Also, Goda (2008) reported that adding ginseng G115 (150,200 and 250 mg/kg diet) in Nile tilapia diet improved protein utilization.

Results of Table (4) also indicated that, the highest significant (P<0.05ADC for ether extract (EE) was recorded for D8 (92.11%) followed by D7 (92.09 %) while D5 recorded the lowest (88.90%) ADC value. Data of table (4) also indicated in general that diets supplemented with lipase enzyme (D7 and D8) showed highest ADC of EE comparing to the other treatments while D5 had lowest ADC of DM, CP and EE comparing to other treatments. On other hand, Schaeffer *et al.* (2010) found that feeding of Nile tilapia on 17.5, 20, 22.5, 25 and 27.5 % DDGS in combination of soybean meal and corn did not significantly affected the digestibility of fat in Nile tilapia fish.

Growth performance, feed utilization and survival rate

Growth performance, feed utilization parameters and fish survivability for the different treatments are shown in Table (5). There were no significant differences (P>0.05) between the initial individual weights of the all experimental groups indicating that fish at stocking were homogeneously distributed among treatments and replicates. Significant variations (P<0.05) were observed in the final body weight and average daily gain among the different treatments (Table 5). The highest significant (P<0.05) final body weight and average daily gain were recorded by fish fed D6 and D7, while fish fed D5 showed the lowest growth performance values; these may be due to the lower contents of lysine amino acid (D5) as shown in Table (4). Lim *et al.* (2007) found that Nile tilapia grew bad at low levels of lysine amino acid, when fish fed 400g/kg DDGS diet without lysine supplement. Also Li *et al.* (2011) found that Nile tilapia showed similar final weight and average daily gain when 40% wheat DDGS replacement for soybean meal and corn without addition lysine supplement in its diets. The present results are in agreement with that obtained by (Shelby *et al.*, 2008) for catfish, (Robinson and Li 2008) and (Lim *et al.*, 2009).

Table 5: Parameters of growth performance, feed utilization and survival rate of Nile tilapia fed the experimental diets containing DDGS.

	Treatments								
	D1	D2	D3	D4	D5	D6	D7	D8	D9
IBW (g)	0.98	0.97	0.99	0.98	0.98	0.98	0.98	0.98	0.98
FBW(g)	14.21^{b}	15.92^{b}	15.12^{b}	14.33^{b}	10.38^{c}	18.12^{a}	18.84^{a}	14.96^{b}	14.67^{b}
ADG	0.157^{b}	0.178^{b}	0.168^{b}	0.159^{b}	0.112^{c}	0.204^{a}	0.213^{a}	0.166^{b}	0.163^{b}
SGR	3.16^{c}	3.30^{b}	3.23^{bc}	3.17^{c}	2.83^{d}	3.45^{a}	3.50^{a}	3.22^{c}	3.20^{c}
FCR	1.24^{bc}	1.18^{c}	1.22^{bc}	1.24^{bc}	1.44^{a}	1.11^{d}	1.10^{d}	1.22^{bc}	1.26^{b}
PER	2.69^{c}	2.82^{b}	2.73^{bc}	2.75^{bc}	2.30^{d}	3.00^{a}	3.04^{a}	2.71^{bc}	2.65^{c}
SR (%)	96.65	100	96.65	100	96.65	96.65	100	100	96.65

Means within the same row having different superscript are significantly different (P<0.05).

Specific growth rate (SGR) of fish group fed D6 or D7 significantly higher than that of the all other treatments (P<0.05) followed by D2 and D3, respectively. The lowest SGR values were obtained by D5 where, 40% DDGS soybean and yellow corn mixture was replaced by DDGS without addition enzyme. Lim *et al*. (2007) found that Nile tilapia fed on diets containing 400g/kg DDGS diet without lysine supplement showed diminished growth and decreased intestinal Specific growth rate. Similar results were also reported by Shelby *et al*., (2008) and Li *et al*. (2011), Robinson and Li (2008), Lim *et al*., (2009) and Li *et al*., (2010).

As described in Table (5) the best feed conversion ratio (FCR) was detected for fish fed D7 and D6 than fish fed with the other diets (P>0.05) and the worst feed conversion ratio (FCR) was detected for fish fed D5. Similar results were obtained by Li *et al.* (2011), who found significant decrease (P<0.05) in growth rate and FCR when 40% soybean meal and corn without addition lysine was replaced with wheat DDGS in tilapia diets.

Protein efficiency ratios (PER) of fish fed D7 and D6 were significantly higher than that of all other treatments (P<0.05). The lowest PER values were obtained by fish fed D5 where, 40% of soybean meal and corn without addition enzyme was replaced DDGS in the diet. These results are in agreement with the results of Lim *et al.* (2007), Shelby *et al.*, (2008) and Li *et al.* (2011) for tilapia, Robinson and Li (2008), Lim *et al.*, (2009) and Li *et al.*, (2010) for catfish.

Fish survival rate was ranged from 96.65% to 100% and did not significantly different among the experimental treatments. The highest survival rates (100 %) were recorded for D2, D4, D7 and D8. However, the lowest survival rates (96.65%) were recorded by fish fed D1, D3, D5, D6 and D9. These results are in agreement with the results of Lim *et al.* (2007) who reported that the survival rate of juvenile Nile tilapia was not significantly affected by dietary level of DDGS (10, 20 and 40%) as a partial replacements of a combination of soybean meal and corn meal on an equal protein basis. In addition Ibrahim et *al.* (2012) found that, the replacement of 20% and 30% soybean meal and yellow corn by DDGS with and without addition of ginseng, were not significantly different among the experimental treatments.

Proximate composition of whole tilapia fish

Dry matter, crude protein, ether extract, ash and energy content for Nile tilapia *(Oreochromis, niloticus)* during the experiment are presented in Table (6). The highest value of dry matter was recorded by fish fed D7 (26.78%), whereas the lowest value was noticed for D5 (24.29 %).

Table 6: Chemical composition of whole fish body

	Diets								
	D1	D2	D3	D4	D5	D6	D7	D8	D9
DM	25.53^{c}	25.93^{bac}	26.62^{ab}	25.56^{c}	24.29^{d}	25.89^{bac}	26.78^{a}	25.73^{bc}	25.42^{c}
CP	61.53^{ab}	61.42^{bac}	60.63^{bc}	61.68^{ab}	59.98^{c}	62.61^{a}	62.03^{ab}	61.98^{ab}	60.81^{bc}
EE	16.56^{d}	17.48^{bc}	17.94^{ab}	18.40^{a}	18.51^{a}	16.87^{cd}	17.32^{bc}	17.09^{cd}	18.32^{a}
Ash	14.81^{c}	15.2^{bc}	15.60^{ba}	16.00^{a}	15.73^{ba}	14.25^{d}	13.99^{d}	15.20^{bc}	15.78^{ba}

Means within the same row having different superscript are significantly different (p<0.05).

The highest value of crude protein content was recorded for D6 (62.61 %) followed in descending order by D7 (62.03%), D8 (61.98%), D1 (61.68%) then D1 (61.53%), respectively. While D5 showed the lowest significant (P<0.05) body protein content (59.98%). Lim *et al.,* (2007) reported similar result for whole body protein in Nile tilapia fed diets containing 0, 100, 200, 400 g/kg DDGS diet without lysine supplement and 400 g/kg DDGS diet with lysine supplement. However the decreased protein content in fish fed the 400 g/kg DDGS diet without lysine supplement was attributed to smaller size fish which had less flesh and/ or the imbalance of dietary essential amino acid, such as deficiency of lysine, which may contribute to reduce protein synthesis.

Body fat content of fish fed D5 was significantly higher than that of the other treatments (P<0.05), while the lowest value was found in D1 which was fed the control diet control (D1).

The highest value of body ash content was recorded for fish fed D4 (16.00 %), whereas the lowest value was noticed for D7 (13.99 %).

Economical efficiency

Feeding costs in fish production represent about 70% of the running production cost (Collins and Delmendo, 1979). Under the present experimental conditions all other costs are constant. The feeding costs to produce one Kg gain in weight could be used for the comparison among treatments. The price lists for experimental ingredients used in the present study are shown in Table (7). The cost of Kg mixed feed and the cost of producing Kg fish gain in LE in the dietary treatments are presented in Table (7). The present data show that the lowest cost of 1kg diet in this study was obtained by D5 (4.65 LE) followed by D4, D3 and D2 (4.87 LE) whereas the highest cost of 1kg diet was obtained by D6 (5.12 LE) followed by D7 (5.05 LE).

Table 7: Effect of treatments on economical efficiency

Treatments	Cost of 1 ton diet	Cost of 1 Kg diet	FCR	Cost of Kg fish gain (L.E.)
D1	4950	4.95	1.24	6.14
D2	4870	4.87	1.18	5.75
D3	4800	4.80	1.22	5.86
D4	4730	4.73	1.24	5.87
D5	4650	4.65	1.44	6.70
D6	5120	5.12	1.11	5.68
D7	5050	5.05	1.10	5.56
D8	4980	4.98	1.22	6.08
D9	4900	4.90	1.25	6.13

*Price list for the experimental ingredients according to the local market, September 2014 Egyptian L.E: Yellow corn= 1.8, corn gluten=7, DDGS=2.8, Fish meal (72% CP) =14,
Wheat flour meddling =2.2, Vitamins mixture =25, Enzyme mixture=50, Soybean meal=4.4, Soybean oil =8 and fish oil =12.

The lowest consumed feed (kg) to produce 1kg fish was obtained by D7 (1.10) then D6 (1.11) while the highest value of consumed feed 1kg to produce 1kg fish was obtained by D5 (1.44).The lowest cost of producing Kg fish gain was obtained when fish were reared on D7 (5.56 LE/kg gain), however, the highest cost was recorded by D5 (6.70 LE/ kg gain). The use of plant derived protein sources cheaper than soybean meal could be explored to further reduce the cost of fish feeds (Amaya *et al*., 2007).

From the previous results it could the possibility of substituting 20% of soybean meal and yellow corn mixture with DDGS in tilapia diet without addition the enzyme mixture while supplementation the diet with enzymes increased the substitution of soybean meal and yellow corn mixture with DDGS in tilapia diet up to 30%.

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ARABIC SUMMARY

استخدام النواتج العرضية لتقطير الحبوب كمصدر بروتين بديل فى علائق اسماك البلطى النيلى

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أجريت تجربة التغذية داخل نظام مغلق وذلك لفترة ١٢ أسبوع بغرض تقييم تغذية اصبعيات اسماك البلطى النيلى على نسب مختلفة (١٠ و ٢٠ و ٣٠ و ٤٠ %) من نواتج تقطير الأذرة الصفراء بدلا من كسب فول الصويا والأذرة الصفراء مع او بدون اضافة ملتى انزيم على معاملات الهضم و الأداء الإنتاجى والتركيب الكيماوي للأسماك.

تم توزيع ٤٠٥ أصبعية عشوائيا بمتوسط وزن (٠.٩٨جم/سمك) علي ٢٧ حوض سعة ٦٠ لترللحوض بحيث احتوي الحوض الواحد علي ١٥ أصبعية و بحيث اشتملت المعاملة الواحدة علي ثلاث مكررات استخدم معدل تغذية قدره ١.٧% من وزن الجسم التمثيلي لعليقة متزنة في محتواها من البروتين (٣٠%) والطاقة (٣٢٠٠ كيلو كالوري/كج عليقة).وتم تكوين ٩ علائق(معاملات) لاجراءالتجربة وكانت كالتالى:

١- العليقة الأولى(كنترول) وهى ٣٠% كسب فول صويا ،٣٠% اذرة .
٢- العليقة الثانية تم احلال ١٠% من نواتج تقطير الاذرة بدلا من كسب فول الصويا والأذرة الصفراء .
٣- العليقة الثالثة تم احلال ٢٠% من نواتج تقطير الاذرة بدلا من كسب فول الصويا والأذرة الصفراء .
٤- العليقة الرابعة تم احلال ٣٠% من نواتج تقطير الاذرة بدلا من كسب فول الصويا والأذرة الصفراء .
٥- العليقة الخامسة تم احلال ٤٠% من نواتج تقطير الاذرة بدلا من كسب فول الصويا والأذرة الصفراء
٦- العليقة السادسة تم احلال ١٠% من نواتج تقطير الاذرة مع اضافة ملتى انزيم بدلا من كسب فول الصويا والأذرة الصفراء .
٧- العليقة السابعة تم احلال ٢٠% من نواتج تقطير الاذرة مع اضافة ملتى انزيم بدلا من كسب فول الصويا والأذرة الصفراء .
٨- العليقة الثامنة تم احلال ٣٠% من نواتج تقطير الاذرة مع اضافة ملتى انزيم بدلا من كسب فول الصويا والأذرة الصفراء .
٩- العليقة التاسعة تم احلال ٤٠% من نواتج تقطير الاذرة مع اضافة ملتى انزيم بدلا من كسب فول الصويا والأذرة الصفراء .

أظهرت النتائج عدم وجود اختلافات معنوية في معدل الحيوية وأظهرت أن أعلي معدل نمو نوعي (٣.٥% يوميا) قد سجل في المعاملة رقم (٧) بينما كان اقل معدل نمو نوعي (٢.٨٣% يوميا) من نصيب المعاملة رقم (٥) علي التوالي.

أفضل معدل للتحويل الغذائي للأسماك المغذاة فى المعاملات رقم ٦ و ٧ بينما أسوء معدل تحويل غذائي في المعاملة رقم ٥ وكانت الفروق معنوية ($P<0.05$).

لوحظ تحسن معامل الاستفادة النسبي من البروتين عند تغذية الأسماك على علائق احتوت على مخلوط الإنزيم وأسوء مدل في المعاملة رقم ٥ ، زاد محتوي الجسم في البروتين زيادة معنوية عند تغذية الأسماك علي معاملات رقم ٦ و٧ و ١ و ٢ مقارنة بباقي المعاملات في التجربة، بينما كانت الزيادة معنوية($P<0.05$) في محتوي الجسم من الدهون في نصيب الأسماك التي تغذت علي المعاملة رقم (٥). وعليه فانه ومن خلال النتائج يمكن ادخال ٢٠% من نواتج تقطير الاذرة الصفراء فى العليقة بدلا من كسب الصويا والاذرة الصفراء بدون اضافة الانزيم وحتى ٣٠% من العليقة بعد اضافة الانزيم دون حدوث اى تأثير سلبي علي معدلات نمو الأسماك، معدلات التحويل الغذائي وصفات الجسم للأسماك البلطي النيلي.