J.Animal and Poultry Prod., Mansoura Univ., Vol.4 (3): 149 - 159, 2013

Utilization of distillers dried grains with solubles in fish nutrition :
1- replacement soybean meal and yellow corn by ddgs graded levels in diet for Nile tilapia fingerlings (*oreochromis niloticus*).

Khalil, F. F. ; A. A. Gabr and Samah E. M. El-Sharkawy
Animal Production, Dept. Fac. of Agric., Mansoura University, Egypt.

ABSTRACT

This study was conducted to evaluate the effect of feeding different levels of DDGS in the diets of tilapia fingerlings on growth performance, feed utilization, chemical composition of the whole fish body, blood hematological and economic efficiency. Therefore, five grading levels of DDGS (0, 5, 10, 15 and 20% (D1- D5)) were used to replace soybean meal and yellow corn protein in approximately five isonitrogenous and isocaloric diets. Fish were stocked in a rearing plastic tank for two weeks adaptation period, then it were stocked at the rate of 5 fish/glass aquarium with initial weight of 6.0 ± 0.14 g/fish. During the experimental period (72 days) the fish were fed diets daily on the rate of 6% from the total weight for six days per week.
The obtained results could be summarized as following:
There was insignificant ($P \geq 0.05$) effect of DDGS levels on all traits of growth performance and feed utilization. The highest values of growth parameters were recorded at 5% and 10% levels of DDGS except FBW. The high levels of DDGS rather than 5% decreased crude protein and increased ash and crude fat content in fish body. The better values of crude protein and energy content were recorded in fish body fed 5% of DDGS in the diet. No significant effect in hepatosomatic index was observed among different levels DDGS. The intestine somatic index was decreased significantly ($p \geq 0.05$) with increasing DDGS level in fish diet. Mean values of blood parameter measurements of the control diet gave the high values compared with the other tested diets. The best values of economic efficiency were recorded with the levels 10% and 5% of DDGS. It may be concluded that replace soybean meal and yellow corn by DDGS until 10% in the diets of tilapia fish had not any adverse effect on most of growth parameters , feed utilization ,chemical composition of fish body, hematological blood parameters and economic efficiency.
Keywords : DDGS , Nile tilapia, SBM, growth performance, protein efficiency, feed conversion. hematological

INTRODUCTION

Distillers dried grains with solubles (DDGS) as a major by-product of the dry mill ethanol industry is currently readily available and competitively priced (on a per unit protein basis) relative to the other conventional alternative protein sources. According to Renewable Fuels Association (2012), the U.S. production of DDGS reached 32.5 million ton in 2010, which is more than 3.5 times that produced in 2005. DDGS derived from corn has a relatively high protein and fat content (approximately 29 and 10%, respectively) and does not contain anti-nutritional factors found in most plant protein sources.

Recently, DDGS is widely used as a protein supplement in terrestrial animal feeds. The DDGS has a moderate protein content (~ 30% crude protein) without the presence of antinutritional factors commonly found in most plant protein sources. A number of studies have shown the utility of DDGS as a protein supplement in fish diets (Webster *et al.* 1991, 1992; Wu *et al.* 1996; Wu, *et al.* 1997; Belyea, *et al.* 2004 and Lim, *et al.* 2007) however, they do not address the possible benefit of enhanced immunity from the yeast component, which may be as much as half the protein in DDGS (Belyea *et al.* 2004 and Ashelby *et al*. 2008).

As compared to fish meal, SBM is a relatively inexpensive protein source and there are a number of fish species (e.g. carp, tilapia and catfish) whose diets are primarily derived from SBM. Over the years, the price of soybean has generally increased. Thus, in diets formulated primarily with SBM, to further reduce costs, one has to look at alternatives to reduce the use of SBM in the diet. There are some products such as cottonseed meal (CSM) and distiller’s dried grains with solubles (DDGS) which can be used as a substitute ingredients. (Zhou, 2009).

Therefore, the present study aimed to evaluate the effect of replacing soybean meal and yellow corn by different levels of DDGS protein on growth performance, feed utilization, chemical composition of the whole fish body, blood hematological parameters, histological examinations and economic efficiency of tilapia (*Oreochromis niloticus*) fingerlings.

MATERIALS AND METHODS

Experimental fish and condition:

This study was carried out in Fish Laboratory Research, Animal Production Department, Faculty of Agriculture, Mansoura University, Egypt. during the period from December 28, 2008 to March 8, 2009. The fish were stocked in a rearing tank for two weeks as adaptation period and fed with the basal diet. A total numbers of 75 tilapia fingerlings weighed 6 ± 0.14 g . The fish appeared healthy before its stocked at 5 fish/glass aquarium (90 x 40 x 50 cm) and three replicates aquaria were randomly assigned per dietary treatment (D1 to D5). Each aquarium was supplied with 108 L dechlorinated tap water and an air stone connected with electric small pump to permit suitable level of dissolved oxygen**.** The dissolved oxygen was in normal range (6 – 8 mg/l). Replacement of the aquaria water was done partially every day to re-new the tap water after removing the wastes. Light was controlled by a timer to provide a 14h light: 10h dark as a daily photoperiod.

Experimental diet and feeding:

Five experimental diets approximately isonitrogenous and isocaloric were formulated (D1 – D5) .Soybean meal and yellow corn were replaced by DDGS at the rate of 0, 5, 10, 15 and 20% as shown in Table (1) **.** The DDGS which used contained 26.84% crude protein,11.08% crude fat, 6.30% crude fiber, 10.20% moisture and 4.24% ash. The basal diet was formulated from the local ingredients to be contain 27.82 % CP. The chemical analysis of tested diets (on dry matter basis) is shown in Table (1). All ingredients and additives were milled and mixed, then pressed by pelleting machine (pellets size 1mm) . During the experimental period (72 days), the fish were fed daily on the previous diets at a rate of 6 % of the live body weight, six days a week and twice daily at 8 am and 2 pm. The amount of food was adjusted bi-weekly based on the actual body weight changes.

Table (1): Composition (%) and Chemical analysis of the tested diets (on dry matter basis)

Ingredients (%)	D1 (control)	D2 (5%)	D3 (10%)	D4 (15%)	D5 (20%)
Fish meal	20	20	20	20	20
Soybean meal	32	30	27	24	22
DDGS	0	5	10	15	20
Yellow corn	26	24	22	20	18
Wheat bran	10	9	9	10	9
Corn oil	6	6	6	5	5
Molasses	5	5	5	5	5
*Vit. And Min. premix	1	1	1	1	1
Total	100	100	100	100	100
Chemical analysis					
Dry Matter	90.64	88.82	88.53	88.78	89.26
Ash	11.39	9.49	9.31	9.28	7.61
Crude Protein	27.82	27.30	27.30	26.42	27.65
Crude fat	6.13	5.03	5.56	5.51	5.93
Total carbohydrates	54.66	58.18	57.83	58.79	58.81
**Gross energy (GE) (Kcal/100 g DM)	439.95	441.15	444.70	443.22	454.20
Protein /energy (P/E) ratio (mg CP/Kcal GE)	63.23	61.88	61.38	59.60	60.87

***Vitamin and minerals premix containing A vit. (15 million I.U.), E vit. (15 mg), B1 vit. (1.0 mg), B12 vit. (5.0 mg), K3 vit. (2.5 mg), B6 vit. (2.0 mg), Pantothenic acid (10.0 mg), Folic acid (1.2 mg), Biotin (0.05 mg) and D3 vit. (3.0 million I.U.). Copper (7.0 mg), manganese (100.0 mg), iodine (0.4 mg), Iron (40.0 mg), Zinc (50.0 mg), Selenium (0.15 mg) and anti- oxidant (125.0 mg).**

**** GE (Kcal/100 g DM) = CP x 5.64 + EE x 9.44 + Carbohydrates x 4.12 calculated according to (NRC, 1993).**

***** P/E ratio (mg protein/Kcal gross energy) = CP/GE x 1000**

Water temperature (°C) was recorded every two days by using a thermometer, but water pH-value was measured weekly, using an electric digital pH meter model (Jenway Ltd, model 350-pH meter). Aeration provided continuously using an air blower; water temperature was thermostatically controlled at 27± 1°C throughout the experimental period. Dissolved oxygen measured every other day in each using an YSI model 58 oxygen meter. Total ammonia and, nitrate were measured weekly using spectronic 601 spectrophotometer. During the 72 days of experimental, the water quality parameters averaged (±SD): water temperature 26-27; pH 7.4±0.6; ammonia 0.1±0.04 mg/L; nitrite 0.1±0.05 mg/L; nitrate 1.5±0.2 mg/L and alkalinity 181±46 mg/L. At the end of the experimental period, fish samples were taken and dried at 70 °c for 24 hours and passed through mincer into one composite homogenate per group. Contents of homogenized fish for each experimental diet were assigned to proximate chemical analysis using the methods described by Association of Official Analytical Chemists (A.O.A.C.

2000). Also, at the end of the all rearing periods, three fish per replicate within treatment were randomly chosen then individually weighed. Livers and intestine were removed, then it weighed for determine hepatosomatic index (HSI) and intestine somatic index (ISI) as follows**:**

Hepato Somatic Index (HSI):

HSI = (Liver weight/ fish weight) ×100 (Jangaard et al., 1967)

Intestine Index:

ISI = (intestine weight/fish weight) ×100

At the end of the experiment, blood samples were collected from all residual fish from caudal peduncle of the different groups. Adequate amounts of whole blood were taken in small plastic vials containing heparin and used for the determination of hemoglobin (Hb) by using commercial kits (Diamond Diagnostic, Egypt) and the hematocrit (PCV%) was measured according to Stoskopf (1993). Total erythrocytes (RBCs), platelets and total leukocytes (WBCs) were counted according to Dacie and Lewis (1995) on an Ao Bright – Line Haemocytometer model (Neubauer improved, Precicolor HBG, Germany).

The obtained data were statistically analyzed using general linear models procedure according to SAS (2006) for users guide, following a one-way ANOVA. Means of treatments were statistically compared for the significance ($p \leq 0.05$) using Duncan (1955) multiple range test.

RESULTS

Growth performance parameters:

The results in Table (2) indicated that all growth performance parameters were increased insignificantly ($P \leq 0.05$) with increasing the replacement level of DDGS up to 10% DDGS except FBW parameter, then, decreased significantly with increasing replacement level of DDGS compared with the control. However, no significant differences among the control diet and the diets containing 5 or 10 % DDGS were observed.

Table (2): Growth performance parameters for Nile tilapia fingerlings fed different levels of DDGS .

Traits	Level of (DDGS) (%)					SE	Pr > F
	0	5	10	15	20		
IW (g)	5.88	6.03	6.00	5.98	6.09	0.048	0.108
FBW (g)	28.25^{a}	30.01^{a}	24.86^{b}	30.79^{a}	23.06^{b}	0.828	0.0002
TWG (g)	22.37^{a}	23.98^{a}	24.78^{a}	18.88^{b}	16.97^{b}	0.859	0.0003
ADG(g/ fish/ day)	0.319^{a}	0.342^{a}	0.354^{a}	0.269^{b}	0.242^{b}	0.012	0.0003
RGR (%)	380.4^{a}	397.9^{a}	413.5^{a}	315.8^{b}	278.6^{b}	16.71	0.0008
SGR	2.23^{a}	2.29^{a}	2.33^{a}	2.03^{b}	1.90^{b}	0.048	0.0004
Survival (%)	90	95	100	90	100	0.564	0.865

Means in the same rows having different small letters differ significantly ($P \leq 0.05$).

- AWG (g/fish) = [Average final weight (g)–Average initial weight (g)].

- ADG (g/fish/day) = [AWG (g)/experimental period by days (d)].

- RGR = 100 [AWG (g)/Average initial weight (g)].

- SGR (%/day) = 100 [In final body weight - In initial body weight]/ experimental period in days (d).

- SR = 100 [Total No. of fish at the end of the experimental/Total no. of fish at the start of the exsperiment]. (Initial weight (IW), final body weight (FBW), total weight gain (TWG), average daily gain (ADG), relative growth rate (RGR) and specific growth rate (SGR)) .

The highest values of growth performance parameters were found in diet 3, except, FBW value . Incontrast, lowest values were obtained in diet 5. There were no significant differences were recorded in survival of tilapia fed the five experimental diets Generally, survival was high and ranged from 90 to 100% in the present study.

Feed utilization parameters:

The results in Table (3) showed that there were insignificant differences in feed intake (FI) among the different DDGS levels, except diet 4. The FCR ranged from 1.97 to 2.63.The best values of FCR were recorded in the diet containing 5 and 10 % of DDGS, respectively. Another feed utilization parameters (FE, PER, PPV and EU) were decreased significantly (P ≤0.05) with increasing replacement level over than 10% of DDGS. The highest values of feed utilization parameters were found in the diets containing 5 and10 % of DDGS.

Table (3): Feed utilization parameters of Nile tilapia fingerlings fed different levels of DDGS.

Traits	Levels of DDGS %					SE	Pr > F
	0	5	10	15	20		
FI (g)	48.83^{ab}	47.32^{ab}	49.90^{a}	42.25^{c}	44.72^{bc}	1.274	0.01
FCR	2.18^{bc}	1.97^{d}	2.02^{cd}	2.23^{b}	2.63^{a}	0.054	<.0001
FE (%)	45.79^{bc}	50.64^{a}	49.67^{ab}	44.71^{c}	37.94^{d}	1.262	0.0002
PER	1.64^{a}	1.85^{a}	1.82^{a}	1.69^{a}	1.37^{b}	0.07	0.0045
PPV (%)	21.82^{ab}	23.84^{a}	22.53^{a}	20.01^{b}	14.93^{c}	0.679	<.0001
EU (%)	12.63^{bc}	13.98^{a}	13.17^{ab}	11.93^{c}	9.47^{d}	0.331	<.0001

Means in the same rows having different small letters differ significantly (P ≤ 0.05).

- FCR = Feed Intake, (g)/Live weight gain (g). - FE = 100 [Live weight gain (g)/Feed Intake, (g)].

-PER = Live weight gain (g)/protein intake (g). -PPV (%) = 100 [Final fish body protein content (g) – Initial fish body protein content (g)]/crude protein intake (g).

- EU (%) = Retained energy x 100/consumed feed energy. Feed utilization parameters (feed intake (FI), feed conversion ratio (FCR) and feed efficiency (FE) and protein efficiency rate (PER), protein productive value (PPV) and energy utilization (EU)).

Chemical composition of the whole fish body:

The overall means of the chemical composition on dry matter basis (as the whole fish body components) for Nile tilapia fingerlings fed different levels of DDGS at the start and the end of the experimental period are presented in Table (4). The results indicated that DM , CP and EC, percentages decreased significantly (P ≤ 0.05) with increasing of DDGS. The crude fat (%) was increased significantly (P ≤ 0.05) by increasing of DDGS levels. The highest value of DM percentage observed in fish fed the control diet, while, the highest crude protein and energy content (EC) was measured in fish fed 5 % of DDGS diet. The highest values of ash and crude fat% observed in fish fed 20 % of DDGS.

Table (4): Chemical composition on dry matter basis (as the whole fish body components) for Nile tilapia fingerlings fed different levels of DDGS .

Treat.	DM %	% On Dry matter basis			
		CP (%)	EE (%)	Ash (%)	EC (Kcal/100 g)
At the start of the experiment					
	18.48	56.99	19.81	23.20	508.4
At the end of the experiment					
Levels of DDGS%					
0	20.70[a]	61.30[ab]	20.96[b]	17.73[bc]	543.6[b]
5	19.72[b]	62.82[a]	21.19[b]	15.99[d]	554.4[a]
10	19.64[c]	61.08[b]	21.92[b]	16.99[c]	551.5[ab]
15	19.43[d]	59.28[c]	22.44[b]	18.28[b]	546.1[b]
20	19.15[e]	56.33[d]	24.19[a]	19.48[a]	546.1[b]
SE	**0.000**	**0.505**	**0.454**	**0.256**	**2.322**
Pr < F	**< 0.0001**	**< 0.0001**	**0.0036**	**< 0 .0001**	**0.0448**

Means in the same column having different small letters differ significantly (P ≤ 0.05).
DM = Dry matter (%) CP = Crude protein (%) EE = Ether extract (%)
EC = Energy content (Kcal/100 g), calculated according to NRC (1993).
SE = Standard Error P- value = Probability value

Indices of body organs:

Table (5) shows hepatosomatic index (HSI) and intestine somatic index (ISI) of Nile tilapia fingerlings fed different levels of DDGS. These results indicated that there were no significant differences in HSI among different levels of DDGS, while the ISI was decreased significantly (P ≤ 0.05) with increasing of DDGS levels. The best value of ISI were observed in fish fed 5 % of DDGS.

Table (5): Hepatosomatic index (HSI) and intestine somatic index (ISI) for Nile tilapia fingerlings fed different levels of DDGS .

Traits	Level of (DDGS)%					SE	Pr > F
	0	5	10	15	20		
HIS	1.97	1.96	1.91	1.51	1.11	0.228	0.0889
ISI	3.13[bc]	5.23[a]	3.32[b]	2.53[d]	2.63[cd]	0.1613	<.0001

Means in the same rows having different small letters differ significantly (P ≤ 0.05).
HSI = (Liver weight/ fish weight) ×100 (Jangaard et al., 1967).
ISI = (intestine weight/fish weight) ×100.

Blood profile :

Data of blood hematological parameters are given in Table (6) . There were no significant (P ≥ 0.05) effects of the different levels of DDGS in the tested diets on blood hematological parameters comparing with the control diet , except the hemoglobin and mean corpuscular hemoglobin concentration (MCHC) which were significantly different among treatments. The hemoglobin values were increased significantly (P ≥ 0.05) with increasing replacing level of DDGS until level 15% of DDGS compared with the other diets , then it was decreased in the level 20 %of DDGS. On the other hand, the MCHC values decreased significantly as compared with control diet (P ≥ 0.05) with increasing the level of DDGS.

Table (6): Effect of different levels of DDGS replaced with (SBM) and (YC) on blood hematological parameters for Nile tilapia fingerlings diets.

Traits	Level of (DDGS)%					SE	Pr > F
	0	5	10	15	20		
Hb (g/dl)	4.55^{b}	4.35^{ab}	4.45^{ab}	4.65^{a}	4.00^{b}	**0.483**	**0.02**
RBC ($\times10^{6}mm^{-3}$)	1.19	1.26	1.15	1.86	1.2	**0.207**	**0.164**
WBC ($\times10^{3}mm^{-3}$)	128.5	107.7	108.2	108.1	114.5	**20.45**	**0.124**
Hematocrit %	15.25	15.5	14	19.15	12.5	**1.788**	**0.185**
MCV (□^{3})	129	122.5	121.5	107.8	113.5	**5.695**	**0.153**
MCH (pg)	38.3	34.4	38.67	38.9	34.27	**2.07**	**0.334**
MCHC(%)	36.40^{a}	30.7^{d}	32.00^{bc}	36.00^{ab}	31.00^{cd}	**1.271**	**0.003**
Plates ($\times10^{3}mm^{-3}$)	103.2	106.5	101.5	156.5	118.5	**46.27**	**0.075**

Means in the same rows having different small letters differ significantly (P ≤ 0.05).
Hb = Hemoglobin RBCs= Red blood cells (Erythrocytes) WBC= white blood cells
MCV= Mean corpuscular volume MCH= Mean corpuscular hemoglobin
MCHC= Mean corpuscular hemoglobin concentration Platelets= Blood platelets (Thrombocytes)

Economic efficiency:

Economic efficiency of replacement of soybean meal and yellow corn by different levels of DDGS on tilapia fingerlings is shown in Table (7). Total output, total feed cost, net return, economic efficiency and relative economic efficiency were significantly different (P ≤ 0.05) among treatments. The highest values of economic efficiency parameters were recorded with the level 5 and 10 % of DDGS.

Table (7): Economic efficiency parameters of Nile tilapia fingerlings fed different levels of DDGS.

Traits.	Level of (DDGS)%					SE	Pr > F
	0	5	10	15	20		
Total outputs[1]	0.447^{a}	0.479^{a}	0.495^{a}	0.377^{b}	0.339^{b}	**0.017**	**0.0003**
Total feed costs[2]	0.127^{a}	0.121^{a}	0.125^{a}	0.103^{b}	0.107^{b}	**0.003**	**0.0013**
Net return[3]	0.320^{bc}	0.358^{ab}	0.370^{a}	0.274^{cd}	0.232^{d}	**0.015**	**0.0003**
Economic efficiency[4] (%)	250.8^{b}	295.6^{a}	295.8^{a}	264.9^{ab}	214.8^{c}	**10.1**	**0.001**
Relative economic efficiency	100^{b}	117^{a}	118^{a}	105^{ab}	85^{c}	**4.326**	**0.0017**

Means in the same rows having different small letters differ significantly (P ≤ 0.05).
Total feed costs per treatment (LE/Kg diet) = feed costs per one kg diet X feed intake
1-Total outputs per treatment (LE/Kg) = fish price X total fish production*
2-Total fish production per treatment = final number of fish X fish weight gain
3-Net return per treatment (LE) = total outputs – total feed costs
4-Economic efficiency per treatment (%) = (net return/ total feed costs) X 100

DISCUSSION

The obtained results indicated that all growth performance and feed utilization parameters were not significantly (P ≤ 0.05) different when increasing replacement level of DDGS up to 10% of DDGS except FBW, then, decreased significantly with increasing replacement level of DDGS. However, no significant differences between the control diet and replacement of 5 and 10 % of DDGS except FBW value . In this respect, the lowest values of growth performance parameters were found in replacement of 20 %

DDGS. These results are in agreement with those of Hughes (1987) who found that 8% DDGS can be included in lake trout (*Salvelinus namaycush*) diets. Several studies have found varying results when using DDGS in Nile tilapia feeds. The nutritional response of fish to inclusion level of dietary DDGS was highly variable and influenced by fish species, size, dietary DDGS replacement level, dietary protein level and culture system (Lim and Yildrim-Akosy, 2008) . In this respect , Coyle *et al.* (2004) found that Nile tilapia fed a combination of 30% DDGS (+ 8% fishmeal) did not significantly differ in growth performance from a reference diet while fish fed a diet containing 30% DDGS (+ 46% soybean meal) had significantly lower WG , PER and signficantly FCR. Although, Schaeffer *et al.* (2009) found that the WG and FCR of fish fed the 20% DDGS diet were similar to that of the control diet. These values were significantly better than those fed diets with 30 or 40% DDGS (Salama *et al.* 2010) . They concluded that the partial replacement of 40% (SBM) protein by DDGS was significantly better and economically feasible than the 100 % (SBM) based diet in feeding Nile tilapia. Furthermore, Goda *et al.* (2011) indicated that diets in which up to 60% of the SBM were replaced by DDGS for 84 days enhanced growth performance, diet utilization efficiency were as cost effective, as the control diet. Inclusion of dietary DDGS increased or tended to increase feed intake and feed efficiency in Nile tilapia (Lim *et al*. 2007and 2008). There were no significant differences in survival of tilapia fed the five diets. Generally, survival rate was high and ranged from 90 % to 100%. These results are in agreement with those of Coyle *et al.* (2004) who found no significant differences in survival of tilapia which was approximately 100% for fish fed all diets containing different levels of DDGS. In another study, feeding DDGS to tilapia showed an improvement on survival rate when DDGS was included in the diet (Tangendjaja and Chien, 2007).

The obtained results of chemical composition of fish body indicated that dry matter, crude protein % and energy concentration were decreased significantly ($P \leq 0.05$) with increasing of DDGS, level. Meanwhile, the ash and crude fat increased significantly ($P \leq 0.05$) with increasing DDGS of diets levels. The highest value of DM percentage observed in fish fed the control diet, as well as, the highest values of crude protein and energy content were observed at in levels 5 % of DDGS. The highest values of ash and crude fat percentage observed in level 20 % DDGS. Lim *et al.* (2009) found that whole-body protein and ash content of juvenile channel catfish were not influenced by dietary levels of DDGS. However, fish fed diets containing DDGS had increased body fat. Moreover, Salama *et al.* (2010) found that carcass composition (protein, lipid, and energy) of fish was decreased with increasing the level of DDGS more than 40% DDGS. On the other hand, Goda *et al.* (2011) indicated that no significant differences among testaments were detected for whole body moisture, protein, fat, ash and gross energy contents when 60% of SBM was replaced by DDGS in the diets of Nile tilapia.

In aquaculture operations, feeding costs can account for over 50% of the production with protein compromising the most expensive dietary constituent (Coyle *et at.,* 2004). The results in this study indicated that the total output, total feed cost, net return, economic efficiency and relative economic efficiency were significantly ($P \leq 0.05$) different among treatments, which improved significantly with increasing the level of DDGS up to10 % then, decreased with increasing the level of DDGS. The highest values of economic efficiency parameters were observed with 5 and 10 % of DDGS. In this respect, Salama *et al.* (2010) concluded that the partial replacement of 40% (SBM) protein by DDGS was significantly better and economically feasible than the 100 % (SBM) based diet in feeding Nile tilapia. This results were in agreement with the use of plant derived protein sources which are cheaper than SBM could be explored to further reduce the cost of fish feeds (Amayaet *et al*. 2007). In addition, DDGS is cheaper and more palatable to fish than soybean-corn combinations. Substituting soybean-corn combinations with a cheaper protein source could reduce the cost of fish feed, thereby reducing overall production costs (Tangendjaja, 2008).

From the foregoing results, it may be concluded that the partial replacement of 10 % of SBM and YC protein by DDGS was significantly better and economically feasible based diet in feeding Nile tilapia .

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الإستفادة من مستخلصات تقطير الحبوب الجافة والذائبات فى تغذية الأسماك
١-إستبدال كسب فول الصويا والذرة الصفراء بواسطة مستويات مختلفة من النواتج العرضية لتقطيرالأذرة فى علائق إصبعيات أسماك البلطى النيلى.

فتحى فتوح خليل ، أحمد عبد الرزاق جبرو سماح السيد محمد الشرقاوى
كلية الزراعة-جامعة المنصورة، مصر

أجريت هذه الدراسة لتقييم تأثير التغذية بمستويات مختلفة من بروتين النواتج العرضية لتقطير الأذرة (المجففة مع ذوائبها) فى تغذيه إصبعيات أسماك البلطي وآثر ذلك على أداء النمو، ومعدل الإستفادة من الأعلاف، والتركيب الكيميائي لجسم السمكة بأكملها، وتركيب الدم و والكفاءة الاقتصادية. تم إستخدام مستويات مختلفة من بروتين النواتج العرضية لتقطير الأذرة بمستويات (٠، ٥، ١٠، ١٥و٢٠%) ليحل محل فول الصويا والذرة الصفراء فى علائق تحتوى على بروتين خام بنسبة ٢٧.٨٢٪ والعلائق المختبرة كانت متزنة فى البروتين والطاقة. الأسماك كانت مخزنة في خزان بلاستيك للتربية خلال فترة الأقلمة التى إستغرقت أسبوعين،الأسماك كانت مخزنة في الحوض بمعدل ٥سمكة / حوض ، متوسط وزن السمكة ٦.٠ ± ٠.١٤ جم / سمكة. وخلال الفترة التجريبية التى إستغرقت ٧٢ يوم تغذية الأسماك كانت يوميا بمعدل ٦٪من وزن الجسم، وستة أيام في الأسبوع.

ويمكن تلخيص النتائج المتحصل عليها على النحوالتالي:

أظهرت النتائج المتحصل عليها أنه لا توجد إختلافات معنوية فى جميع الصفات من أداء النمو وإستهلاك الأعلاف نتيجة إحلال نسب مختلفة من بروتين النواتج العرضية لتقطير الأذرة. وسجلت أعلى النتائج لهذه الصفات عند مستويات ٥٪ أو ١٠٪ فيما عدا الوزن النهائى للجسم نتيجة لإستخدام بروتين النواتج العرضية لتقطير الأذرة.سجلت أعلى فروق عند إستخدام زيادة مستويات عالية مقارنة بمستوى٥٪ حيث انخفض البروتين الخام والرماد ونسبة الدهون في الجسم الخام للأسماك، على التوالي. أفضل قيم للبروتين الخام ومحتوى الطاقة فى الجسم سجلت عند إستخدام مستوى ٥٪ من بروتين النواتج العرضية لتقطير الأذرة في النظام الغذائي. لم يلاحظ أي تأثير كبير في مؤشر دليل الكبد بين بروتين النواتج العرضية لتقطير الأذرة فى مختلف المستويات. وانخفض مؤشر دليل الأمعاء معنويا مع زيادة مستويات بروتين النواتج العرضية لتقطير الأذرة في تغذية الأسماك. أعلى القيم فى تركيب الدم سجلت عند عليقة الكنترول حيث أعطت أعلى القيم مقارنة بباقى العلائق التجريبية. أفضل قيم الكفاءة الاقتصادية سجلت مع مستويات ١٠٪ و ٥٪ من بروتين النواتج العرضية لتقطير الأذرة ، على التوالي. ويمكن الإستنتاج أنه يمكن إحلال بروتين النواتج العرضية لتقطير الأذرة محل وجبة فول الصويا والذرة الصفراء حتى ١٠٪ في علائق اسماك البلطي النيلى بدون أى تأثير سلبي على معظم مقاييس النمو، والإستفادة من الأعلاف، التركيب الكيميائي لجسم السمك، مكونات الدم والكفاءة الاقتصادية.

قام بتحكيم البحث

أ.د / محمود يوسف العايق	**كلية الزراعة – جامعة المنصورة**
أ.د / فوزى ابراهيم معجوز	**كلية الزراعة – جامعة كفر الشيخ**