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NUTRITIONAL STUDIES ON PARTIAL AND TOTAL REPLACEMENT OF SOYBEAN MEAL BY DISTILLER'S DRIED GRAINS WITH SOLUBLE (DDGS) IN DIETS FOR NILE TILAPIA (*OREOCHROMIS NILOTICUS*).

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SUMMARY

This study was carried out to evaluate the effect of replacement of soybean meal (SBM) protein with different levels (0, 20, 40, 60, 80 and 100 %) by distiller's dried grain with soluble (DDGS) protein as an alternative protein source on growth performance, feed and nutrient utilization and carcass composition of Nile tilapia (*Oreochromis niloticus*) fry. Each diet treatment (six treatments) was applied in triplicates of 10 fish (0.64 ±0.03g) per aquaria (100 litres) for 112 days. All of the experimental diets were isocaloric (445.34 Kcal/100g DM) and isonitrogenous (30.11 % crude protein).

At the end of the feeding trial the fish fed on the diet containing 40% DDGS protein exhibited comparable growth performance to those fed SBM protein based diet. There were a significant differences (P = 0.05) in the final individual fish fresh body weights, average daily gain (g/fish/day) specific growth rate (SGR %), feed conversion ratio (FCR), protein efficiency ratio (PER), protein productive value (PPV %) and energy utilization (%) among tested groups. Carcass composition (protein, lipid and energy) of fish was decreased with increasing level of DDGS protein more than 40% replacement of SBM protein. It could be concluded that the partial replacement of 40 % SBM protein by distiller's dried grain proteins was significantly better and economically feasible than the 100% SBM based diet in feeding Nile tilapia.

Keywords: DDGS, Nile tilapia, growth performance, protein efficiency, feed conversion

INTRODUCTION

Protein generally is the most expensive component of feeds for aquatic species. Soybean meal (SBM) is the most studied feedstuff in aquaculture because of its availability, consistent quality high protein content with good amino acid profile and low-cost (Lim and Dominy, 1989). A significant amount of researches have bean conducted on the replacement of FM with SBM as protein sources which now is a major ingredient in commercial tilapia feeds in Egypt (El-Saidy and Gaber, 2002 a and b; El-Sayed *et al.*, 2003 and Nguyen, 2007). Distiller's dried grain with soluble (DDGS), a by-product of the ethanol distillery industry is less expensive than SBM on a per unit protein basis and may be an alternative plant protein source in Nile tilapia (Lim and Aksoy, 2008 and Lim *et al.*, 2008). According to Buchheit (2002), approximately 98% of the DDGS in North America produced by ethanol fuel, while the remaining 1 to 2% produced for the alcohol beverage industry. As a result of the shortage and rising cost of petroleum-based fuel, ethanol for fuel was increased which has been increased the DDGS production in the U.S to be approximately 8 million tons in 2006 (Shurson, 2006). DDGS has relatively high protein content (~ 30% crude protein) without the presence of antinutritional factors commonly found in the most plant protein sources. At present, DDGS is widely used as a protein supplement in terrestrial animal feeds, but its use in fish feed is limited due to its low content of essential amino acids, especially lysine (NRC, 1993). However, according to Webster *et al.*, (1995) the nutritional evaluation studies on DDGS were started as early as the 1940. More recent research has shown that DDGS is a promising feed ingredient for several fish species, such as rainbow trout (Cheng and Hardy 2004), channel catfish (Tidwell *et al.*, 1990; Webster *et al.*, 1991; 1992 and 1993), and tilapia (Wu *et al.*, 1997). Therefore, the aim of this work was to study the partial substitution of SBM by DDGS in diets of Nile tilapia through the determination of growth performance and feed utilization.

MATERIALS AND METHODS

The present study work was carried out at the Department of Animal and Fish Production, Faculty of Agriculture (El-Shatby), Alexandria University, Egypt to determine the influence of inclusion different levels (0, 20, 40, 60, 80 and 100%) of distiller's dried grain with solubles (DDGS) proteins instead of soybean meal (SBM) protein in Nile tilapia diet.

Fish and culture facilities

Nile tilapia (*Oreochromis niloticus*) fry obtained from a local Fish Hatchery, El-Behera Governorate used in the present study. A total number of 180 Nile tilapia with average initial bodt weight of 0.64± 0.03g /fish were used in this study that were randomly stocked into each aquarium with dimensions of 100×40×30cm and 100 litre capacity of water /aquarium with triplications per treatment (six treatments). The aquariums cleaned daily and two thirds of the water replaced before feeding. Aeration provided continuously using an air blower; water temperature was thermostatically controlled at 28 ± 1°C throughout the experimental period. Water temperature and dissolved oxygen measured every other day in each using an YSI Model 58 oxygen meter. Total ammonia, nitrate were measured weekly using spectronic 601 spectrophotometer. pH was monitored twice weekly using an electronic pH meter. During the 112 days feeding trial, the water quality parameter averaged (±SD): water temperature 27.8±0.8; dissolved oxygen 4.8±0.4; pH 7.4±0.6; ammonia 0.1±0.04 mg/L; nitrite 0.1±0.05 mg/L; nitrate 1.5±.2 mg/L; alkalinity 181±46 mg/L.

Experimental diets

Distiller's dried grain with soluble (DDGS) obtained from the commercial Egyptian Company, which was dried at 70°C. After that, cooled and saved in plastic bags and stored in refrigerator at 5°C until used to avoid the nutrients deterioration. All materials were finely ground in a house blender and used in the formulation of six experimental diets containing 30% crude protein. Tested diets formulated to contain levels 0, 20, 40, 60, 80 and 100 % DDGS protein instead of SBM protein. The dietary proximate composition of each of the tested diets is given in Table (1).

Table (1): Composition and Proximate analysis (g 100 g-1) of experimental diets with different Levels of (DDG)

Item	Diets [1]					
	1	2	3	4	5	6
Ingredient (g 100g^{-1})						
Fish meal (FM)	17.14	17.14	17.14	17.14	17.14	17.14
Soybean meal (SBM)	34.25	27.40	20.55	13.70	6.85	-
Wheat bran (WB)	22.05	22.05	22.05	22.05	22.05	22.05
DDG	-	11.54	23.08	34.62	46.15	57.70
Yellow corn (YC)	14.85	11.89	8.92	5.97	3.0	-
Corn oil	4.54	3.63	2.72	1.80	0.89	-
Vit [2] and Min.[3] mix.	2.0	2.0	2.0	2.0	2.0	2.0
De-calcium phosphate	1.0	1.0	1.0	1.0	1.0	1.0
Cellulose powder	4.07	3.25	2.44	1.62	0.81	-
Vit. C.	0.1	0.1	0.1	0.1	0.1	0.1
Proximate analysis (%) on DM basis						
Dry matter %	95.17	94.95	94.34	94.75	94.68	94.63
Crude Protein	30.11	30.13	30.13	30.13	30.12	30.14
Ether Extract	7.66	7.64	7.69	7.67	7.67	7.68
Ash	4.18	4.39	5.24	5.41	5.72	5.87
Crude Fiber	8.61	8.45	7.72	7.57	7.29	7.19
Nitrogen free extract	49.44	49.39	49.23	49.22	49.20	49.11
GE (kcal/100g)[4]	445.90	445.62	445.37	445.19	445.06	444.90
P/E ratio[6](mg crude protein/Kcal)	67.53	67.61	67.63	67.68	67.68	67.75

[1]Diets 1, 2,3,4,5 and 6 contained 0, 20, 40, 60, 80 and 100 DDG instead of soybean meal, respectively.
[2]Vitamin mixture/kg premix containing the following: 3300IU vitamin A, vitamin D3, 410 IU vitamin E,2660mg vitamin B1,133mg vitamin B2,580 mg vitamin B6 ,410 mg vitamin B12- 50 mg biotin , 9330 mg Colin chloride, 4000mg vitamin C, 2660 mg Inositol, 330 mg para -amino benzoic acid, 9330 mg niacin, 26.60 mg pantothenic acid.
[3]Mineral mixture/kg premix containing the following 325 mg Manganese, 200mg Iron, 25 mg Copper, 5 mg Iodine, 5mg Cobalt.
[4]GE (Gross Energy): gross energy calculated as 5.64, 9.44 and 4.12 Kcal per gram of protein, lipid and carbohydrate, respectively after (NRC, 1993).

Each ingredient was ground and thoroughly mixed with the other ingredients, vitamins, minerals mix. , were then added with continuous mixing. A few drops of soybean oil was added at the same time of mixing warm distilled water (45°C) which was slowly added until the diets began to clump. Diets were processed by a California pellet mill machine and dried for 48 hrs at 70°C in a drying oven. The experimental pellets were soft enough for the fish to take and retain. The processed diet particle size was 0.6 mm diameter and 2 mm length. The experimental fish fed the test diets for a one week as adaptation period to adapt them to these test diets. After the adaptation period was completed, fish in each aquarium reweighed, and their initial weights recorded. The test diets fed to triplicate groups of fish twice daily a week (six days a week) at a rate of 6% body weight during the first six weeks. Thus, feeding fish gradually reduced to 4% body weight until the end of the trial. Each group of fish weighted at the beginning and every two weeks throughout the experimental period.

Body composition analysis

At the start of the experiments, about twenty fish were collected and immediately frozen and reserved for initial proximate body chemical analysis. At the termination of the study, all fish in each aquarium were netted, weighed, frozen and kept for final body composition analyses. Fish samples were pulverized, and homogenized with Ultra-Tunax. The homogenized samples were oven dried at 60 - 80°C for 48 hrs. Proximate analyses of whole body, protein, lipid, and ash performed according to standard AOAC, (2000) methods .

Measurements of growth and feed utilization

Total weight gain, average daily gain, specific growth rate, feed conversion ratio protein and energy utilization determined according to Recker (1975) and Castell and Tiews, (1980):

1-Total gain (g/fish) = (WF-WI) Where: WF, Average of Final weight (g) and WI: Average of Initial weight (g)

2- ADG (Average daily gain, g/fish/day) = total gain / duration period

3- SGR (Specific growth rate, % / day) = 100 × (Ln WF- Ln WI) / duration period.
Where: Ln, Natural log and n is the duration period.

4-Feed conversion ratio (FCR) = dry matter intake (g) / total gain (g)

5-Protein efficiency ratio (PER) = total gain (g) / protein intake (g).

Statistical methods

Calculations of growth and feed utilization parameters conducted according to Cho and Kaushik (1985). The data were analyzed by analysis of variance (ANOVA) using the SAS ANOVA procedure (SAS, 1993). Duncan's multiple rang test (Duncan, 1955) was used to compare differences among individual means. Treatment effects considered significant at P=0.05. All percentages and ratio data transformed to arcsine values before analysis (Zar, 1984).

RESULTS AND DISCUSSION

Water quality

All values of the water quality parameters in the present experiment were in the range suitable for rearing Nile tilapia as indicated by the following figures obtained from periodical examination of. Determined water quality parameters in the experimental glass aquaria: Temperature (28 ± 0.5°C), dissolved oxygen (6.3 ± 0.4 mg L-1), total ammonia (0.089 ± 0.11 mg L-1), nitrite (0.04 ± 0.01 mg L-1), total alkalinity (173 ± 27 mg L-1), chlorides (524 ± 126 mg L-1) and pH (8.7 ± 0.12). Water quality parameters were within the acceptable range for Nile tilapia growth (Stickney, 1979).

Experimental diets

The proximate chemical analysis (%) of DDGS 88.20 % dry matter, 29.48 % crude protein, 10.43% ether extract, 4.42 % ash, 11.22 % crude fiber, 44.45 % nitrogen free extract and 448.26 kcal gross energy /100g. Total and partially replaced SBM (93.20, dry matter,42.99 % crude protein, 2.36 % ether extract, 10.41 % ash , 5.15 % crude fiber, 39.09 % nitrogen free extract and 426.24 kcal gross energy /100g) as a plant protein source. Dry matter, crude protein and Ash of DDGS was lower than SBM .On the other hand ether extract, ash, crude fiber, nitrogen free extract content, and gross energy were higher than SBM. Contrary to the results obtained by Wilson and Poe (1985) and Shiau *et al.* (1987). The composition and proximate analysis (%) of the six experimental diets used the experiment are shown in Table 1. The experimental diets were almost isonitrogenous, isocaloric about 30.12 %, 445.34 Kcal /100 g diet crude protein, and gross energy, respectively. The mean value of protein to energy ratio was 67.65 mg protein /kcal gross energy.

Growth performance and Survival rate

The effects of dietary DDGS replacement levels instead of SBM protein on growth performance of Nile tilapia fingerlings are illustrated in Table (2). Growth performance measured as final weight (g/fish) differed among all treatments with significantly (P<0.05). The best significant final weight (116.90 ± 0.03g/fish) was obtained by fish fed diet 3 where 40 % DDGS protein instead of SBM protein followed by fish fed on diet 2 , where fish fed diet with 20 % DDGS protein instead of SBM protein, respectively. The lowest final weight (76.88± 0.71 g/fish) was obtained with diet 6 where 100 % DDGS Protein instead of SBM protein. Fish fed on diet 3 obtained the best ADG (1.04±0.00g/fish /day).

Fish fed on the control diet obtained the lower significant ADG (0.68 ± 0.06g /fish /day). This result also is applied to specific growth rate (SGR %/ day). The present results are in agreement with the findings of (Webster *et al.*, 1993 and Tidwell *et al.*, 1990), that 30 -40 % DDGS can be added in a channel cat fish diet without a diverse effect's on performance of fish. Carl *et al.* (1993) indicate that DGS can be used in a least-cost diet formulation for channel catfish at rates of up to 30%. In addition, Coyle et al. (2004) found that diets without fishmeal containing 30% DDGS in combination with Meat bone meal and soybean meal provide good growth in tilapia. A diet without animal protein did not support acceptable growth. Shelby (2008) reported that the significantly poorer weight, weight gain and FER of Diet 4 (60% DDGS without added lysine) suggests that lysine was a limiting factor in the diet containing 60% DDGS. This observation is in agreement with this previous research in which lysine was a limiting factor in Nile tilapia diets containing 40% DDGS (Lim *et al.* 2007). Interestingly, the addition of lysine to the 60% DDGS diet improved weight gains, which were not statistically significantly, suggesting that levels higher than 40% DDGS may be incorporated into tilapia diets.

This study suggests that survival rate (%) of Nile tilapia were not affected when fish were fed all diets and was high and in agreement with (Lim *et al.*, 2007 ; Abo-State *et al.*, 2009 and Tahoun *et al.*, 2009).

Table (2): Effect of different levels of DDG on growth performance of Nile tilapia fry.

Experimental Diets	Live weight (g/fish) Initial	Live weight (g/fish) Final	Weight gain (g/fish)	ADG[2]	SGR[3] (%/day)	Survival rate (%)
1	0.64 ± 0.02	83.12[d] ± 1.55	82.48[d] ± 0.54	0.74[c] ±0.01	4.34[c] ±0.02	97
2	0.65 ± 0.03	94.01[b] ± 0.75	93.36[b] ±0.76	0.83[b] ±0.01	4.44[b] ±0.02	98
3	0.65 ± 0.03	116.90[a] ± 0.03	116.30[a] ±0.03	1.04[a] ±0.00	4.64[a] ±0.03	100
4	0.64 ± 0.03	92.92[b] ± 0.29	92.28[b] ±0.30	0.83[b] ±0.34	4.45[b] ±0.03	97
5	0.63 ± 0.03	88.83[c] ± 0.29	88.20[c] ± 0.29	0.79[b] ± 0.01	4.42[b] ± 0.02	98
6	0.63 ± 0.03	76.88[e] ± 0.71	76.25[e] ± 0.71	0.68[d] ± 0.06	4.27[d] ± 0.01	98
LSD (P<0.05)[4]	NS	2.393	2.397	0.4284	0.7856	NS

[1]Diets 1, 2,3,4,5 and 6 contained 0, 20, 40, 60, 80 and 100 DDG instead of soybean meal.
[2]ADG=Average daily gain (g/day/fish)
[3]SGR=Specific growth rate (%/day)
[4]a, b, c, Mean bearing the same letters within each column do not differ significantly ($p \leq 0.05$).

Feed and nutrient utilization

The effects of different levels of DDGS replacement levels instead of SBM on Feed intake , feed conversion ratio (FCR), protein efficiency ratio (PER) ,Protein productive Value (%) and Energy utilization (%) of *O. niloticus* fingerlings are illustrated in Table (3). The results indicated that there were significant differences in feed intake ($P<0.05$) between all treatments. The highest value of feed intake was obtained by fish fed on diet 3 which containing 40 % DDGS. However, No significant differences between fish fed on diet 3, 4 and 5, 6, respectively.

Table (3): Effect of different levels of DDGS on Feed and nutrients utilization of Nile tilapia fry.

Diets [1]	Feed utilization		Protein utilization		EU[6]
	Feed intake (g/fish)	FCR[2]	PER[3]	PPV[4] %	%
1	157.38^{d} ±0.97	1.91^{d} ±0.05	1.74^{b} ±0.03	29.27^{b} ±0.48	18.56^{b} ±0.31
2	172.73^{c} ±3.15	1.85^{d} ±0.02	1.79^{b} ±0.01	28.23^{b} ±0.16	18.15^{b} ±0.10
3	190.66^{b} ±4.17	1.64^{e} ±0.03	2.03^{a} ±0.02	33.54^{a} ±0.41	21.44^{a} ±0.27
4	200.21^{b} ±6.68	2.17^{c} ±0.08	1.53^{c} ±0.04	24.20^{c} ±0.60	15.56^{c} ±0.30
5	2.38.99^{a} ±10.21	2.71^{b} ±0.06	1.23^{d} ±0.12	19.11^{d} ±0.31	12.12^{d} ±0.20
6	245.49^{a} ±3.73	3.22^{a} ±0.05	1.03^{e} ±0.01	16.18^{e} ±0.18	10.29^{e} ±0.12
LSD (P<0.0)[7]	11.960	0.1391	0.08956	1.399	0.81094

[1]Diets 1, 2,3,4,5 and 6 contained 0, 20,40 ,60 , 80 and 100 DDG instead of soybean meal , respectively.
[2]FCR=feed conversion ratio [3]PER=protein efficiency ratio [4] PPV=protein productive value [5]EU =energy utilization
[7]a, b, c, Mean bearing the same letters within each column do not differ significantly (P≤0.05).

The highest value (2.14) of feed conversion ratio (FCR) was obtained by the diet 3 followed by diet 2 and the control diet, respectively and the lowest FCR value (3.72) was observed with diet 6 which containing 100 % DDGS protein instead of SBM protein. Protein efficiency ratio (PER) was significantly better on diet 3 (1.55) which containing 40 % DDGS instead of SBM protein and the lowest protein productive value (PPV %) was observed with the diet 6 (14.00) which containing 100 % DDGS protein instead of SBM protein. The same trend was obtained with the energy utilization (EU %).The present results indicated better growth performance for diets with DDGS as opposing the results reported by Abo-State *et al.* (2009) in their work on including DDGS in *O.niloticus* diets where no apparent effect or growth performance and feed utilization were observed. However, these results are in agreement with the results of Coyle *et al.* (2004); Shelby *et al.* (2008) ; Thahoun *et al.*(2009) ; Abo-State *et al.* (2009) reported that the *O. niloticus* fingerlings fed on diets containing DDGS without or with phytase or Lysine greater growth than those fed with the control diet.

Carcass composition of fish

The chemical composition of whole body parameters of *O. niloticus* fingerlings which fed diets contained 0, 20, 40, 60, 80 and 100% DDGS instead of SBM protein summarized in Table (4). Values of dry matter (DM %), crude protein (CP %), ether extract (EE %), Ash content and energy content were significantly (P<0.05) different between all groups. Gradual increase in the replacement level of DDGS instead of SBM protein up to 40 % resulted in gradual increase in fish body content of dry matter, crude protein, ether extract and energy content while, ash content decreased. These results are in close agreement with the results of Lim *et al.* (2007) and Tahoun *et al.* (2008). In contrast, Carl *et al.* (1993) found that increase in the replacement level of DDGS instead of SBM protein up to 30 %

resulted in gradual decrease in catfish body content of dry matter, crude protein, while, ash content and ether extract increased.

Table (4): Effect of different levels of DDG on chemical composition (%) of Nile tilapia fry.

Diets [1]	Dry Matter %	CP[2] %	EE[3] %	Ash %	E.Co[4] (kcal/100g)
At the start	23.70 ±0.02	53.98 ±0.04	19.80 ±0.11	26.22 ±0.12	486.15 ±0.15
At the end					
1	28.66[a] ±0.25	58.54[a] ±0.10	23.26[a] ±0.13	18.09[c] ±0.08	550.00[a] ±0.29
2	27.63[b] ±0.23	57.42[b] ±0.07	23.32[a] ±0.19	19.26[b] ±0.10	544.2[b] ±0.20
3	28.79[a] ±0.24	58.89[a] ±0.03	23.23[a] ±0.25	17.88[c] ±0.32	551.70[a] ±0.51
4	27.58[b] ±0.23	57.16[b] ±0.03	23.48[a] ±0.20	19.07[b] ±0.27	544.30[b] ±1.42
5	27.52[b] ±0.08	56.87[b] ±0.08	22.39[b] ±0.13	20.74[a] ±0.21	532.30[c] ±1.81
6	27.47[b] ±0.09	56.56[b] ±0.08	22.50[b] ±0.20	20.78[a] ±0.28	531.60[c] ±3.16
LSD($P<0.05$)[5]	0.5512	1.027	0.5737	0.7026	4.966

[1]Diets 1, 2,3,4,5 and 6 contained 0, 20,40 ,60 , 80 and 100 DDG instead of soybean meal , respectively
[2]CP=crude protein
[3]EE=Ether extract
[4]Eco=Energy content (Kcal /100g)
[5]a, b, c, Mean bearing the same letters within each column do not differ significantly ($P<0.05$)

Economic evaluation

Calculations of economical efficiency of the tested diets based on the cost of feed and cost of one kg gain in weight of Nile tilapia its ratio with the control group are shown in Table (5). Feed costs and cost per kg gain (L.E) were the highest for the control diet (5.81L.E) and gradually decreased with the increasing levels of DDGS protein instead of SBM protein. At the 40 % level of DDGS, Nile tilapia could be produced cheaper than fish fed on the control diet. The lowest relative percentage of feed cost/ kg fish being to be 94.60, 81.71, 104.36, 127.00 and 146.69 for diets 2, 3, 4, 5 and 6, respectively. Moreover, the relative percentage of feed cost/ kg gain was 5.46, 4.72, 6.05, 7.34, and 8.50 (L.E) for diets 2, 3, 4, 5 and 6, respectively. These results indicate that the effect of replacement different levels of DDGS instead of SBM improving growth and feed utilization parameters of Nile tilapia fingerlings as noted in Table (2). On the other hand, the incorporation DDGS in Nile tilapia fingerlings diets seemed to be economic at incorporation level 40% but increasing its level to 60, 80 and 100 % sharply increased feed cost by 7.45, 8.70 and 9.82 L.E. The feed cost/Kg weight gain decreased with the increasing incorporation levels of 40% DDGS instead of SBM protein for Nile tilapia fingerling diets in agreement with Gaber (2006) and Soltan (2005a and b).

Table (5): Cost of feeds required for producing one Kg gain of *O. niloticus* fingerlings fed the experimental diets.

Item	Diets[1]					
	1	2	3	4	5	6
Cost /kg diet (LE)[2]	3.04	2.95	2.88	2.79	2.71	2.64
Consumed feed to produce 1kg fish (kg)[3]	1.89	1.84	1.63	2.15	2.69	3.19
Feed cost per kg fresh fish (LE)[4]	5.74	5.43	4.69	5.99	7.29	8.42
Relative % of feed cost/ kg fish[5]	100	94.6	81.7	104.4	127.0	146.7
Feed cost /1Kg gain(LE)[6]	5.81	5.46	4.72	6.05	7.34	8.50
Relative % of feed cost of Kg gain[7]	100	94.0	81.2	104.1	126.3	146.3

[1]Diets 1, 2,3,4,5 and 6 contained 0, 20, 40, 60, 80 and 100 DDG instead of soybean meal, respectively
[2]Cost of 1 kg ingredients used were 7 L.E for fish meal, 2.25 L.E for SBM, 1.75 L.E for YC, 1.10 L.E for wheat bran , 2 L.E for DDG, 7 L.E for Sunflower oil , and 8 L.E for Vit & Min.2 L.E. for De-calcium phosphate;5 L.E Cellulose powder and 50 L.E Vita.C. Egypt Feed Ingredients price at start of 2009.
[3]Feed intake per fish per period/ final weight per fish Kg/Kg
[4]Feed cost per kg fresh fish (LE) = Cost /kg diet (LE) X consumed feed to produce 1kg fish (kg)2
[5]Respective figures for step 3/ highest figure in this step.
[6]Feed cost /1Kg gain (LE) = Feed intake per Kg gain (FCR) X Cost /kg diet (LE)
[7]Respective figures for step 5/ highest figure in this step.

CONCLUSION

From feed utilization data and the economical point of view the diet contained 40 % DDGS instead of SBM protein could be recommended as feed for Nile tilapia (O.niloticus) fingerlings.

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دراسات غذائية على الإستبدال الجزئي والكلي لمسحوق فول الصويا بالنواتج العرضية المجففة لتقطير الأذرة في علائق أسماك البلطى النيلى

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أجريت هذه التجربة لدراسة اثر احلال نسب مختلفة من بروتين النواتج العرضية لتقطير الأذرة (المجففة مع ذوانبها) لتحل محل ٠ ، ٢٠ ، ٤٠ ، ٦٠ ، ٨٠ و ١٠٠ ٪ من بروتين مسحوق فول الصويا فى ستة علانق تجريبيةعلى التوالى على أداء النمو وكفاءة الاستفادة الغذائية وتركيب جسم أصبعيات أسماك البلطي النيلي وجميع العلائق المختبرة كانت متزنة فى البروتين و الطاقة و تحتوى على ٤,٤٥ كيلو كالورى /جم مادة جافة و ٣٠,١١% بروتين الخام . وتم أستخدم ثمانية عشرة حوضاً زجاجيا(سعة الحوض ١٠٠ لتر وبابعاد ١٠٠× ٤٠ × ٣٠ سم) خزن فى كل منها عشرة أصبعيات من أسماك البلطي النيلى (متوسط وزن مبدنى ٠,٦٤ ± ٠,٠٣ جرام / سمكة) وثلاث مكررات لكل معاملة حيث غذيت الأسماك على العلائق التجريبية لمدة ١١٢ يوم.

وأظهرت النتائج المتحصل عليها أن هناك اختلافات معنوية (درجة معنوية ٥ %) لكل من الوزن النهائى ومعدل النمو النوعى والغذاء المستهلك وكفاءة التحويل الغذائى ، وكفاءة الأستفادة من البروتين والطاقة لأصبعيات البلطى النيلى نتيجة أحلال نسب مختلفة من بروتين النواتج العرضية (المجففة مع ذوانبها) لتقطير الأذرة بدلا من بروتين مسحوق فول الصويا. وان تغذية الأصبعيات على العلائق المحتوية على ٤٠% بروتين النواتج العرضية لتقطير الأذرة ادت الى ارتفاع معدلات النمو عند مقارنتها بالأسماك التى غذيت على بروتين مسحوق فول الصويا (كنترول) فى حين أن تحليل جسم الأسماك من المادة الجافة والبروتين والدهن والطاقة قد زادت مع زيادة معدلات أستبدال بروتين النواتج العرضية لتقطير الأذرة حتى مستوى أحلال ٤٠ % ثم أنخفضت هذه القيم بزيادة الأحلال الى ١٠٠ % وعلى النقيض من ذلك محتوى جسم الأسماك من الرماد زاد بزيادة الأحلال الى ١٠٠ %.

ويمكن الاستتتاج بامكانية احلال بروتين النواتج العرضية (المجففة مع ذوانبها) لتقطير الأذرة بنسبة ٤٠% محل بروتين مسحوق الصويا فى علانق أصبعيات البلطى النيلى لتقليل تكاليف التغذية وبدون أى تأثيرات ضارة على صحةالأسماك و آداء النمو أومعدلات الاستفادة الغذائية.