EFFECT OF REPLACING SOYBEAN MEAL BY SUNFLOWER MEAL IN THE DIETS FOR NILE TILAPIA, *OREOCHROMIS NILOTICUS* (L.)

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Abstract

Five experimental diets were formulated where local soybean meal in the basal diet (D1) was replaced by sunflower meal at graded levels 25, 50, 75 or 100% (D2 to D5 respectively) and fed to Nile tilapia fry for 90 days.

The highest average body weight (16.76 g) was recorded in group 1 which was fed on basal diet followed in a descending order by those fed the diet D3 (15.25 g), D2 (14.89 g), D4 (14.73 g) and D5 (12.62 g), respectively and the differences between these means were significant indicating the possibility of partial replacement of soybean meal by sunflower meal up to 75% without adverse effect on final body weight of Nile tilapia and similar trend was also observed for body length (BL), weight gain (WG), specific growth rate (SGR).

The feed conversion ratio (FCR) at the end of the experimental period ranged from 2.44 for fish fed the basal diet (D1) to 4.05 for fish fed the diet D5 (complete replacement of soybean meal) and the same trend was also observed for protein efficiency ratio (PER) and the differences in FCR and PER for the different treatment were significant ($P<0.05$).

The complete substitution of soybean by sunflower meal showed the highest protein content of whole fish followed in a descending order by those fed the diets D1, D4, D3 and D2, and the differences were significant ($P<0.01$). Ether extract and ash content were not significantly affected by the increased levels of sunflower meal in tilapia diets.

From economic point of view, results of the present study showed that replacing 75% of soybean meal by sunflower meal reduced feeding costs by 15.13%.

INTRODUCTION

Aquaculture has become the fastest-growing food production sector of the world, with an average annual increase of about 10% since 1984 compared with a 3% increase for livestock meat and a 1.6% increase for capture fisheries (FAO, 1997). To sustain such high rate of increase in aquaculture production; similar increase in the levels of fish feed production is required. The intensive use of soybean meal in poultry and fish feeds led to increasing price of soybean meal with its unavailability. In 2003, Egypt imported one million ton of soybean in forms of seeds or meals (Osman and Sadek, 2004). In this context, research efforts have been directed to identify novel, alternative and economically viable plant protein sources for partially or totally replacing soybean meal in the fish feed. One of the possible alternative plant protein sources is sunflower meal.

Since tilapia fish have become a top priority fish for culture in Egypt because of its fast growth, efficient use of natural aquatic foods, propensity to consume a variety of supplemented feeds, resistant to diseases and handling, ease of reproduction in captivity, tolerance to wide range of environmental conditions, Nile tilapia *Oreochromis niloticus* was therefore chosen to carry out this study.

MATERIALS AND METHODS

The present study was carried out at the Laboratory of Fish Nutrition Faculty of Agriculture Benha University. The aim of the experiment is to investigate the effect of replacing the soybean meal by sunflower meal to reduce feed costs of Nile tilapia (*Oreochromis niloticus*).

Experimental conditions

Ten rectangular aquaria 50 × 40 × 50cm (100 liter) were filled by 80 liter freshwater were used to represent five experimental treatments (2 replicates) and each aquarium was stocked with 12 fish with an initial weight ranged from 6.04 to 6.20 g/ fish.

Fish source and Management

Fish were obtained from Abbassa hatchery, Abbassa village, Abu-Hammad district, Sherkia Governorate, Egypt. Fish were transported in a 50 liter plastic bags filled with freshwater and oxygen to the laboratory, and then stocked in fiberglass tanks for two weeks before start the experiment for acclimization where all fish were fed daily on the control diet at a rate of approximately 3% of their average body weight to be adapted to pelleted feeds. After the acclimatization the experimental fish were distributed randomly into the experimental aquaria representing five treatments. At stocking body weight and body length of fingerlings per aquarium were recorded.

The aquaria were cleaned and water was replaced every four days, dissolved oxygen was maintained at 3-6 mg/L by continuous aeration (estimated by using dissolved oxygen meter) and water temperature at 23 to 27°C.

Diet preparation and feeding practices

Five experimental diets were formulated as shown in Table (1). Diets of the experiment were prepared by thoroughly mixing the grinded ingredients which composed of fish meal, local soybean meal, sunflower meal, yellow corn, wheat flour, corn oil and wheat bran with different percentage. Water was added to the ingredients of each diet for mixing these ingredients and then dried. After drying, the diets were broken up and then sieved into the convenient pellet size.

Fish were given the diets at a daily rate of 4% of total biomass till the end of experimental period. Fish were fed 6 day/week (twice daily at 9.00 am and 3.00 pm). Every two weeks, total fish of each aquarium were weighed and the amount of feed was readjusted according to the changes in body weight throughout the experimental period (90 days).

Table 1. Composition and chemical analysis of the experimental diets

Feed ingredients	Experimental diets				
	Diet1	Diet2	Diet3	Diet4	Diet5
Fish meal (65%)	16	16	16	16	16
Yellow corn	28	28	28	28	28
Local soybean meal (40%)	40	30	20	10	0
Sunflower meal(40%)	0	10	20	30	40
Wheat bran	10.5	10.5	10.5	10.5	10.5
Vegetable oil	2.5	2.5	2.5	2.5	2.5
Vit. & Min. mixture[1]	3.0	3.0	3.0	3.0	3.0
Sum	100	100	100	100	100
Chemical analysis (determined on dry matter basis)					
Dry matter (DM)	7.44	6.55	6.12	7.15	6.89
Crude protein (CP)	30.18	30.66	30.71	30.80	30.91
Ether extract (EE)	4.44	4.23	4.87	4.20	4.36
Crude fiber (CF)	9.33	10.22	10.10	10.24	10.66
Ash	10.12	10.14	10.33	10.45	10.15
NFE[2]	45.93	44.75	43.99	44.31	43.92
ME (Kcal/kg diet)[3]	2610	2609	2607	2600	2595
P/E ratio[4]	115.63	117.52	117.80	118.46	119.11

[1] Vitamin & mineral mixture/kg premix : Vitamin D_3, 0.8 million IU; A, 4.8 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 , 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] Nitrogen free extract (NFE) =100-(CP+EE+CF+Ash)

[3] Metabolizable energy was calculated from ingredients based on NRC (1993) values for tilapia.

4. Protein to energy ratio as mg protein/Kcal ME.

Growth performance and feed utilization parameters

Live body weight (g) and body length (cm) of individual fish were measured in each aquarium and registered every 14 day (two weeks) during the experimental period. Growth performance parameters were measured by using the following equations:

Condition factor (K) = $(W/L^3) \times 100$

Where: W = weight of fish in "grams" L = total length of fish in "cm"

Specific growth rate (SGR) = $\frac{LnW2 - LnW1}{t} \times 100$

Where: Ln = the natural log, W_1 = first fish weight (g), W2 = the following fish weight (g) and t = period in days.

Weight gain = final weight (g) – initial weight (g)

Feed conversion ratio (FCR) = Feed ingested (g)/Weight gain (g)

Protein efficiency ratio (PER) = Weight gain (g)/Protein ingested (g)

Chemical analysis of fish and experimental diets

At the end of the experiment, three fish were randomly sampled from each aquarium and subjected to the chemical analysis of whole fish body. Dry matter (DM), ether extract (EE), crude protein (CP), crude fiber (CF) and ash content of diets and fish were determined according to the methods described in AOAC (1990).

Statistical analysis

The obtained data were analyzed according to SAS (1996).

The following model was used to analyze the obtained data:

$Y_{ij} = \mu + \alpha i + e_{ij}$ Where: Y_{ij} = the observation on the ij^{th} fish eaten the i^{th} diet; μ = overall mean, α_i= the effect of i^{th} diet and E_{ij} = random error assumed to be independently and randomly distributed (0, δ2 e).

RESULTS AND DISCUSSION

Growth performance

No significant differences (P>0.05) were observed between fish groups (6.04 – 6.2 g/ fish) at the beginning of the experimental period (90 days). The highest average BW (16.76 g), at the end of the experiment was recorded in group 1 which was fed the basal diet.

In previous study, Sanz *et al.,* (1994) evaluated the nutritive potential of sunflower meal protein as compared to soybean meal and fish meal protein in trout diets and they found that, sunflower meal protein could replace up to 40% of fish meal protein or soybean meal protein in the diet without any negative effect on fish body weight. In another study, Abdul-Aziz *et al.,* (1999) showed the possibility of partial substitution of soybean protein by sunflower protein up to 50% without adverse effect on body weight of Nile tilapia fingerlings.

In recent studies, some attempts were carried out to replace the high cost animal protein source by sunflower meal (low costs plant protein). Fagbenro and Davies (2000) found that, replacement of 67% of fish meal by sunflower meal in tilapia diets did not significantly altered fish final weight.

In this respect, Olvera-Novoa *et al.*, (2002) showed the possibility to replace animal protein source in tilapia fry diets with sunflower seed meal up to 20% without significant effect on body weigh of Nile tilapia fry, while the highest replacing levels significantly decreased the body weight. In another study, El-Saidy and Gaber (2002) found that up to 50% dehulled sunflower meal protein could be used to replace fish meal as a protein source in the diet of Nile tilapia, *Oreochromis niloticus* without significant effect on the fish body weight.

Abbas *et al.*, (2005) found that the gradual rise in replacement level of fish meal by sunflower meal negatively affected growth performance of major carps and the minimum decrease in fish production was recorded at 25% replacement level while the maximum decrease was recorded at 75% replacing level of fish meal by sunflower meal.

Table 2. Effect of increasing levels of sunflower in the diets on body weight (BW), body length (BL) and condition factor (K) of Nile tilapia.

Diets	No	Body weight (BW)/gm		Body length (BL)/cm		Condition factor	
		Initial	Final	Initial	Final	Initial	Final
D1 (0% SFM)	24	6.12±0.5	16.76±0.9 a	7.06±0.2	10.12±0.2 a	1.75±0.04	1.72±0.01 b
D2 (25% SFM)	24	6.16±0.5	14.89±0.9 a	7.06±0.2	10.36±0.2 a	1.75±0.04	1.82±0.01 b
D3 (50% SFM)	24	6.05±0.5	15.25±0.9 a	7.04±0.2	10.54±0.2 a	1.74±0.04	1.76±0.01 b
D4 (75% SFM)	24	6.04±0.5	14.73±0.9 a	7.05±0.2	10.47±0.2 a	1.73±0.04	1.74±0.01 b
D5 (100 SFM)	24	6.20±0.5	12.62±0.9 b	7.08±0.2	8.35±0.2 b	1.75±0.04	2.17±0.01 a

Averages within each column followed by different letters are significantly different (P<0.05)

Average BL at the beginning of the experiment among the different treatments ranged between 7.04 and 7.08 cm without insignificant differences between the different experimental treatments (Table 2). At the experiment termination, complete replacement of soybean meal by sunflower meal released the lowest significant (P<0.05) BL value (8.35 cm) while fish fed diet (D3) gained the longest BL value (10.54 cm) and the differences among other groups were not significant (P>0.05).

Results of tilapia BL affected by replacing sunflower meal instead of soybean indicated that replacing soybean meal by sunflower meal in tilapia diets up to 75% did not affected the final BL while the complete replacement significantly reduced the BL of tilapia and these results relatively similar to those obtained for BW (Table 2).

At the start of the experiment average values of condition factor (K) ranged between 1.73 and 1.75 and the differences among the experimental groups were not significant (P>0.05) while at experimental termination, fish group fed diet D5 showed the highest K value (2.17) and this value is significantly different (P<0.05) from those recorded for the other experimental diets, D1 (1.72), D2 (1.82), D3, (1.76), and D4 (1.74).

In the study of Abdul-Aziz *et al.*, (1999) who reported that condition factor did not significantly affect when 25 or 50% of soybean meal was replaced by sunflower meal in tilapia diet.

Results in Table (3) showed that, after 90 days of the experimental start, the averages of weight gain (WG) were found to be 10.64, 8.74, 9.20, 8.70 and 6.42 g / fish for the experimental diets D1, D2, D3, D4 and D5, respectively.

Table 3. Effect of increasing levels of sunflower in the diets on body weight gain (WG) and specific growth rate (SGR) of Nile tilapia fed experimental diets

Diets	Weight gain (g/fish)	Specific growth rate
D1 (0% SFM)	10.64±0.62 a	1.12±0.05 a
D2 (25% SFM)	8.74±0.62 ab	0.98±0.05 a
D3 (50% SFM)	9.20±0.62 a	1.03±0.05 a
D4 (75% SFM)	8.70±0.62 ab	0.99±0.05 a
D5 (100 SFM)	6.42±0.62 b	0.79±0.05 b

Averages within each column followed by different letters are significantly different (P<0.05) + Average of two replicates (aquaria)

Sanz *et al.*, (1994) found that, sunflower meal protein could replace up to 40% of fish meal protein or soybean meal protein in trout diets without significant effect on weight gain. Also, El-Saidy and Gaber (2002) showed that up to 50% dehulled sunflower meal protein could be used to replace fish meal as a protein source in the diet of Nile tilapia, *Oreochromis niloticus* without significant effect on weight gain of Nile tilapia.

On the other hand, Fagbenro and Davies (2000) found that replacing 67% of fish meal by sunflower meal significantly (P<0.05) decreased WG of Nile tilapia. In the same respect, Furuya *et al.*, (2000) concluded that, increasing sunflower meal in tilapia diets resulted in quadratic effect (P<0.05) on WG of Nile tilapia. Also, Olvera-Novoa *et al.*, (2002) showed that it is possible to replace animal protein source by sunflower seed meal up to 20% without significant effect on WG of Nile tilapia fry while higher replacing levels significantly decreased the final WG of Nile tilapia fry.

Average values of SGR found to be 1.12, 0.98, 1.03, 0.99 and 0.79 (Table 3) for the different experimental diets D1, D2, D3, D4 and D5, respectively.

The highest value of SGR (1.12) was recorded for fish group fed the basal diet and this may be attributed to the positive effect of balanced amino acid composition of soybean meal compared to sunflower meal.

In the study of El-Saidy and Gaber (2002) found that up to 50% dehulled sunflower meal protein could be used to replace fish meal in the diet of Nile tilapia without significant effect on SGR while the highest replacing levels (75 or 100%) significantly decreased SGR.

On the other hand, Fagbenro and Davies (2000) found that replacing 67% of fish meal by sunflower meal significantly ($P<0.05$) reduced SGR of Nile tilapia. In this respect, Sanz, *et al.*, (1994) concluded that, up to 40% of the fish meal in trout diets could be replaced by sunflower meal without significant effect on SGR. Also, Shipton and Britz (2001) found no significant differences in growth rates between control diet (100% fish meal) and diets in which 30% fish meal had been replaced by sunflower meal.

In another study, Olvera-Novoa *et al.*, (2002) showed that replacement of fish meal in tilapia fry diets with sunflower seed meal up to 20% did not significantly affected SGR of Nile tilapia fry while the higher replacing levels significantly decreased SGR of Nile tilapia fry.

Sunflower meal has been reported to contain a lot of endogenous anti-nutritional factors, such as a protease inhibitor, an arginase inhibitor and the polyphenolic tannin chlorogenic acid (Tacon *et al.*, 1984). It has relatively high crude fiber content, which can reduce the pelleting quality and protein digestibility of the feed included at high levels (Kamarudin et al., 1989). Sunflower meal also contains low levels of lysine. Despite these drawbacks, sunflower meal has been reported to be a good protein source for Nile tilapia, *Oreochromis niloticus* even at 696 g/kg of the diet (Jackson *et al.*, 1982).

Feed utilization

Reduced growth response in Nile tilapia fed diets in which soybean meal was completely replaced by sunflower meal have been explained by sub-optimal amino acid balance, inadequate levels of phosphorus, inadequate levels of energy, low feed intake caused by palatability, presence of high content of endogenous anti-nutrients (Lim and Dominy, 1991). Lower growth at the complete replacement of soybean meal by sunflower meal in the present study may be caused by one or some of these factors.

The final FCR at the end of the experimental period were ranged from 2.44 for fish fed the basal diet (D1) to 4.05 for fish fed the diet D5 (complete replacement of soybean meal).

The present results are in a good agreement with those obtained by Furuya *et al.*, (2000) who concluded that, increasing sunflower meal in tilapia diets resulted a quadratic effect (P<0.05) on feed conversion ratio of Nile tilapia.

Abdul-Aziz *et al.*, (1999) found that, replacement of soybean meal by sunflower meal at replacing levels of 25% or 50% significantly adversed FCR of Nile tilapia. Also, Olvera-Novoa *et al.*, (2002) showed that replacement of fish meal source by sunflower seed meal up to 50% in tilapia fry diets improved FCR of Nile tilapia fry. In the study of El-Saidy and Gaber (2002) who found that up to 50% dehulled sunflower meal protein could be used to replace fish meal as a protein source in the diet of Nile tilapia without significant effect on the FCR of Nile tilapia, *O. niloticus* while the higher replacing levels significantly adversed FCR of Nile tilapia. Fagbenro and Davies (2000) found that, replacement of 67% of fish meal by sunflower meal in tilapia diets did not significantly altered the FCR of Nile tilapia fish.

Protein Efficiency Ratio (PER) for fish group fed the basal diet released the highest value and increasing the inclusion levels of sunflower meal in tilapia diets significantly decreased the values of PER (Table 4).

In the study of Martinez (1986) sunflower meal replaced completely soybean meal in trout diet and he decided that sunflower meal can replace soybean meal without negative effects.

Furuya *et al.*, (2000) concluded that, increasing sunflower meal in tilapia diets resulted a quadratic effect (P<0.05) on PER of Nile tilapia.

Table 4. Effect of increasing levels of sunflower in the diets on feed conversion ratio FCR and protein efficiency ratio (PER) of Nile tilapia fed the experimental diets.

Diets	Feed conversion ratio (FCR)	Protein efficiency ratio (PER)
D1 (0% SFM)	2.44±0.30 c	1.36±0.06 a
D2 (25% SFM)	2.97±0.30 b	1.10±0.06 b
D3 (50% SFM)	2.83±0.30 ab	1.15±0.06 b
D4 (75% SFM)	2.99±0.30 ab	1.09±0.06 b
D5 (100 SFM)	4.05±0.30 a	0.80±0.06 c

Averages within each column followed by different letters are significantly different (P<0.05)

In the study of Abdul-Aziz *et al.*, (1999) showed that 25% of soybean meal could be replaced by sunflower meal without significant effect on PER of Nile tilapia. Also, Olvera-Novoa *et al.*, (2002) showed that replacement of fish meal by sunflower seed meal up to 50% in tilapia fry diets improved PER of Nile tilapia fry.

On the other hand, Fagbenro and Davies (2000) found that replacing 67% of fish meal by sunflower meal significantly (P<0.05) reduced PER of Nile tilapia. Also, Sanz *et al.*, (1994) found that replacement of fish meal by each of soybean meal or sunflower meal up to 40% significantly reduced SGR of trout.

Chemical composition of fish

Results of body composition of whole fish body are shown in Table (5), where dry matter (DM) of whole fish in three groups (D2 and the second group included fish fed the diet D3 while the third one included fish groups fed the diets D1, D4 and D5. The differences between each of the first (D2) or the second group (D3) and the third group were not significant (P>0.05).

The complete substitution of soybean by sunflower meal released the highest crude protein content (60.05%) of whole fish, followed in a descending order by those fed the diets D1 (52.16%), D4 (50.94%), D3 (48.94%) and D2 (42.78%), and the differences between fish groups for protein content were significant (P<0.01).

Ether extract and ash content of whole fish body found to be 16.92, 14.63, 13.92, 14.03 and 15.42% and 14.63, 15.39, 14.68, 13.61 and 15.02%, respectively for D1, D2, D3, D4 and D5 and the differences in ether extract or ash contents among fish groups fed the diets contained the graded levels of sunflower meal were not significant.

Table 5. Means and standard error for the effect of increasing levels of sunflower in the diets on chemical composition of Nile tilapia

Diets	Dry matter (%)	Crude protein (%)	Ether extract (%)	Ash (%)
D1 (0% SFM)	25.66±0.46 ab	52.16±1.62 b	16.92±1.50	14.63±0.61
D2 (25% SFM)	26.24±0.46 a	42.78±1.62 c	14.63±1.50	15.39±0.61
D3 (50% SFM)	24.41±0.46 b	48.94±1.62 b	13.92±1.50	14.68±0.61
D4 (75% SFM)	25.85±0.46 ab	50.94±1.62 b	14.03±1.50	13.61±0.61
D5 (100 SFM)	25.57±0.46 ab	60.05±1.62 a	15.42±1.50	15.02±0.61

Averages within each column followed by different letters are significantly different (P<0.05)

Economical efficiency

The current investigation highlights the potential of using sunflower meal for partial or complete replacement for soybean meal in Nile tilapia diets. Generally, results of the present study showed the possibility of replacing of soybean meal by sunflower meal up to 75% with no adverse effect on growth performance and feed utilization.

Feed cost is considered to be the highest recurrent cost in aquaculture, often ranging from 30 to 60%, depending on the intensity of the operation. Any reduction in feed costs either through diet development, improved husbandry or other direct or indirect means is therefore decreased the total production investment and increased the net return (Collins and Delmendo, 1979; Green; 1992 and De Silva and Anderson, 1995).

All other costs are almost constant, therefore, the feeding costs required to produce one kg gain in weight could be used to compare the economical efficiency of different experimental treatments.

As shown in Tables (6 and 7), feed costs (LE/ton) decreased gradually with increasing substitution level of soybean meal by sunflower meal. Data presented in the same Table showed that, increasing substitution level of soybean meal by sunflower meal at 25, 50, 75 and 100% decreased feed costs by 5.04, 10.08, 15.13 and 20.17%, respectively. Compared to the control diet, feed costs (LE/kg WG) were decreased for all substitution levels of soybean meal by sunflower meal and the experimental diet D5 released the lowest feed costs while the control diet released the highest one. In conclusion, replacing 75% of soybean meal by sunflower meal reduced feeding costs by 15.13%.

Table 6. Feed costs (L.E) for producing one kg weight gain by fish fed the experimental diets.

Diets	Costs (L.E)/ ton	Relative to control (%)	Decrease in feed cost (%)
D1 (0%SFM)	2975	100	0
D2 (25%SFM)	2825	94.96	5.04
D3 (50%SFM)	2675	89.92	10.08
D4 (75%SFM)	2525	84.87	15.13
D5 (100 SFM)	2375	79.83	20.17

* Feed costs/kg weight gain = FCR × costs of kg feed.

Table 7. Local market price (L.E./ton) for feed ingredients used for formulating the experimental diets when the experiment was started

Ingredients	Price (L.E.) / ton
Fish meal	7000
Yellow corn	1250
Soybean meal	2500
Sunflower meal	1000
Wheat bran	1000
Corn oil	4000
Vit. & Min. Mixture	10000

REFERENCES

1. Abbas, K., I. Ahmed and H. Rehman. 2005. Growth performance as influenced by partial replacement of fish meal with plant proteins in the diet of major carps. Indus Journal of Biological Science, 2(2):219-226.
2. Abdul-Aziz, G. M., M. A. El-Nady, A. S. Shalaby and S. H. Mohmoud. 1999. Partial substitution of soybean meal protein by different plant protein sources in diets for Nile tilapia fingerlings. Bull. Fac. Agric. Cairo Univ., 50:189-202.
3. AOAC 1990. Official Methods of Analysis. Association of official Analytical chemists. Washington, D. C.
4. Collins, R. A. and M. N. Delmendo. 1979. Comparative economics of aquaculture in cages, raceways and enclosures. In: Advance in aquaculture, England, Fishing News Books.
5. De-Silva, S. S. and T. A. Anderson. 1995. Fish nutrition in aquaculture. CHAPMAN edaw & HALL, London.
6. Duncan, D. B. 1955. Multiple ranges and Multiple test. Biometerics, 11: 1-42.
7. El-Saidy, D. M. and M. M. Gaber. 2002. Evaluation of dehulled sunflower meal as a partial and complete replacement for fish meal in Nile tilapia, *Oreochromis niloticus* (L.) diets. Proc. 1st Ann. Sci. Conf. Anim. & Fish prod. Mansoura, 24-25 Sep. 2002.
8. FAO. 1997. Review of the state of world aquaculture. FAO Fisheries circular, 886, Rev. 1, 163, FAO, Rome, Italy.
9. Fagbenro, O. A. and S. J. Davies. 2000. Use of oilseed meals as fish meal replacer in tilapia diets. Proc.5th Inter. Symp. On Tilapia in Aquaculture, Rio De Janeiro-Brazil, 3-7 September, 2000.
10. Furuya, V. R. B., W. M. Furuya, C. Hayashi and C. M. Soares. 2000. Inclusion levels of sunflower meal in diets for juvenile Nile tilapia (*Oreochromis niloticus*). Zootecnia Tropical, 18(1):91-106.

11. Green, B. W. 1992. Substitution of organic manure for pelleted feed in tilapia production. Aquaculture, 101:213-222.
12. Jackson, A. J., B. S. Capper and A. J. Matty. 1982. Evaluation of some plant proteins in complete diets for the tilapia, *S. Mossambicus*. Aquaculture, 27:97-109.
13. Kamarudin, M. S., k. M. Kaliapan and S. S. Siraj. 1989. The digestibility of several feedstuffs in red tilapia. Pp.118-122, in S.S. De Silva (ed.). Fish Nutrition Research in Asia. Proc. 3rd Asian Fish Nutrition network Meeting. Asian Fisheries Society, Manila, Philippines.
14. Lim, C. and W. Dominy. 1991. Utilization of plant proteins by warm water fish. Pp. 163-172, in D. M. Akiyama and R. K. H. Tan (eds.). Proc. Of the Aquaculture Feed Processing and Nutrition Workshop. American Soybean Association, Singapore.
15. Martinez, C. A. 1986. Advances in the substitution of fishmeal and soybean meal by sunflower meal in diets of rainbow trout (Salmo gairdneri (L.). An. Inst. Cienc. Mar. Limnol. Univ. Nac. Auton. Mex. 13:345-352.
16. NRC (National Research Council) .1993. Nutrient requirement of fish. National Academy Press Washington D.C.
17. Olvera-Novoa, M., L. Olivera-Castillo and C. A. Martinez-Palacion. 2002. Sunflower seed meal as a protein source in diets for *Tilpaia rendalli* (Boulanger, 1896) fingerlings. Aquaculture Research, 33:223-229.
18. Osman, M. F. and S. S. Sadek. 2004. An overview of fish feed industry in Egypt-challenges and opportunities. Expert Consultation on Fish Nutrition Research and Feed Technology in Egypt. World Fish Culture Center, Abbassa, Sharkia, Egypt, 2nd December, 2004.
19. Sanz, A., A. E. Morales, M. De la Higuera and G. Cardenete. 1994. Sunflower meal compared with soybean meal as partial substitutes for fish meal in rainbow trout (*Oncorhynchus mykiss*) diets: protein and energy utilization. Aquaculture, 128:287-300.
20. SAS. 1996. SAS Procedure Guide "version 6.12 Ed". SAS Institute Inc., Cary, NC, USA.
21. Shipton, T. A. and P. J. Britz. 2001. The partial and total replacement of fish meal with selected plant protein sources in diets for South African abalone, Haliotis midae L. Journal of shellfish Research, 20(2):637-645.
22. Tacon, A. G. J., J. L. Webster and C. A. Martinez. 1984. Use of solvent extracted sunflower seed meal in complete diets for fingerlings rainbow trout (*Salmo gairdneri* Richardson). Aquaculture, 43:381-389.

تأثير استبدال كسب فول الصويا بكسب عباد الشمس بعلائق البلطي النيلي

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أجريت هذه الدراسة بمعمل تغذية الأسماك – قسم الإنتاج الحيواني- كلية الزراعة جامعة بنها بهدف دراسة تأثير استبدال كسب فول الصويا بكسب عباد الشمس المقشور بنسب متزايدة (صفر، ٢٥ ، ٥٠ ، ٧٥ ، ١٠٠%) في علائق أسماك البلطي النيلي لخفض تكاليف التغذية. وقد استخدمت(عشرة أحواض زجاجية) مكررين لكل معاملة وكانت مده البحث ٩٠ يوما وكان من أهم النتائج المتحصل عليها مايلى:

في نهاية فترة التجربة وجد أن أعلى متوسط لوزن الجسم قد وصل إلى ١٦,٧٦ جم قد حققته مجموعة الكنترول التي غذيت على العليقة الأساسية ثم أسماك المجموعة الثالثة (١٥,٢٥ جم) تلاها المجموعة الثانية (١٤,٨٩ جم) والأسماك في المجموعة الرابعة (١٤,٧٣ جم) وأخيراً المجموعة الخامسة (١٢,٦٢ جم)، على الترتيب كما كانت نتائج مقاييس طول الجسم والزيادة في وزن الجسم ومعدل النمو النسبي نتائج مشابهة لوزن الجسم و الاختلافات بين متوسطات هذه الصفات والراجعة لعملية الإحلال معنوية ويوضح ذلك إمكانية إحلال جزء من بروتين كسب الفول الصويا ببروتين كسب عباد الشمس المقشور حتى ٧٥% بدون تأثير معنوي على صفات النمو.

تراوحت قيم معدل التحويل الغذائي خلال فترة التجربة بين ٢,٤٤ للأسماك المغذاة على العليقة الأساسية إلى ٤,٠٥ للأسماك المغذاة على العليقة الخامسة (التي تم فيها الإحلال الكامل لكسب فول الصويا بكسب عباد الشمس) وكانت الاختلافات في قيم معدل التحويل الغذائي للمعاملات المختلفة معنوية. بالنسبة لكفاءة تحويل البروتين فقد وجد أن قيمه قد تراوحت بين ٠,٨ (للعليقة الخامسة التي تم فيها الإحلال التام لكسب فول الصويا بكسب عباد الشمس) إلى ١,٣٦% (للعليقة الأساسية). وكانت الفروق بين المعاملات المختلفة معنوية عند مستوى معنوية ٠,٠١ هذا وقد أظهرت النتائج أن كفاءة تحويل البروتين لمجموعة الأسماك التي كانت تتغذى على العليقة الأساسية أعطت أعلى القيم.

أظهرت نتائج التحليل الكيميائي للأسماك بعد إنتهاء فترة التجربة أن الإحلال الكامل لكسب فول الصويا بكسب عباد الشمس المقشور اظهر أعلى محتوى من البروتين في كل الأسماك ثم باقي المجموعات الأولى والرابعة والثالثة ثم الثانية على التوالي وكانت الاختلافات معنوية. أما بالنسبة لمحتوى الجسم من الدهن والرماد فقد أظهرت النتائج عدم وجود فروق معنوية بين المعاملات المختلفة.

ومن النتائج المتحصل عليها في هذه التجربة يمكن التوصية بإحلال ٧٥% من كسب فول الصويا بكسب عباد الشمس المقشور والذي سيؤدى إلى خفض تكاليف الغذاء بنسبة ١٥,١٣%.