USE OF CUCUMBER, SQUASH AND BROAD BEAN LEAVES AS NON-CONVENTIONAL PLANT PROTEIN SOURCES IN NILE TILAPIA (*OREOCHROMIS NILOTICUS*) DIET

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Abstract

This study was conducted to evaluate the suability of cucumber leaves (CL), squash leaves (SL), and broad bean leaves (BBL) meal it as an alternative protein sources for Nile tilapia diet. Four experimental diets were formulated to contain CL, SL, and BBL meal at level of (25%) from soybean meal protein. A total number of 180 Nile tilapia (23 g) were randomly distributed into four experimental treatment groups, each in three replicates, and were fed daily at a rate of 3% of fish live body weight through 13 week experimental period, to study the effect of four diet contained (25-26%) crude protein on growth performance, feed utilization, body composition and economical efficiency. The results showed that soybean meal protein could be replaced by (25%) broad bean leaves meal, and showed that fish groups fed on the diet contained 25% (BBL) had significantly higher growth performance and feed utilization compared to the fish fed on the diet contained 25% (CL) and (SL)meal. Carcass composition affected with different (CL), (SL) and (BBL) substitution levels. Economically, with increasing the (BBL) substitution leaves, the cost of one kg fish gain decreased compared to (CL), and (SL). The study demonstrated that (BBL) could replace 25% of soybean meal protein of Nile tilapia diet to improve growth performance and feed utilization.

Keywords: *Nile tilapia, Cucumber, Squash, Broad bean, growth performance, feed utilization.*

INTRODUCTION

Aquaculture is the fastest growing sector of world human food production and has an annual increase of about 10% (FAO, 1997). To sustain such a high rate of growth, a matching increase in fish feed production is imperative (Francis et *al.*, 2001). On the other hand, the high cost and fluctuating quality of fish meal and soybean meal as well as uncertain availability (Alcerte, 2000) have led to the need to identify alternative protein sources for fish feeds. Considerable emphasis has been focused on the use of conventional plant protein sources, such as mallow (Abdelhamid *et al.*, 2004), and water hyacinth (Abdelhamid *et al.*, 2006). However, their scarcity and competition from other sectors for such conventional crops for livestock and human consumption as well as industrial use make their costs too high and put them for beyond the reach of fish farmers or producers of aqua feeds (Fasakin *et al.*, 1999). Therefore, in order to attain a more economically, environmentally friendly and viable production, research interest has been directed towards the evaluation and use of unconventional protein sources, particular from plant products such as seeds, leaves, and other agricultural by-products (Becker, and makkar, 2001). In Egypt, shortage of feedstuffs is one of the major limiting factors for increasing animal production, however, there are large quantities of un-utilized agricultural by products such as crops, vegetables and fruit residues. Annual quantities residues of carrot-tops, broad beans, squash, cucumber and cowpeas in middle delta governorates were estimated by (Desuki and El-Noubi., 1990) to be 34582, 67145, 5038.2, 15827.2 and 1035 tons, respectively.

This study aimed to investigate the effect of using, cucumber leaves, squash leaves, and broad bean leaves as non-conventional protein sources instead of soybean meal in Nile tilapia diet on growth performance, feed utilization, body composition, and economic efficiency.

MATERIALS AND METHODS

The present work was carried out at the wet lab. in department of animal production during year 2006, Faculty of Agriculture Kafr Elsheikh, Kafr Elshikh University.

1-Fish culture system:

Fingerlings of Nile tilapia (*Oreochromis niloticus*) were collected from Moassasa farms, tolompate 7, kafr El-sheikh prior to the start of the experiment, all collected fish were placed in a fiberglass tank where they were fed a commercial diet for three weeks (acclimation period) under the laboratory conditions. The average body weight of fingerlings was 23g. Fish were graded and divided into four similar groups fed dietary protein ranged between 25.15 to 26.13% CP. Fish were stocked at a rate of 15 fish in each aquarium. Three aquaria as replicates represented each treatment. Each aquarium, which measured (60x35x40 cm) containing 70 L of water was supplied with well aerated and dechlorinated tap water, four air stones were used for aerating the aquaria water. Samples of water from each aquarium were taken weekly to determine dissolved oxygen by oxygen meter model 9070. Analysis of NO2, NO3, PO4, and hardness was carried out using commercial kits (Hach International Co., Cairo, Egypt). Light was controlled by a timer to provide 14-h light: 10h dark as daily photoperiod. Fish feces and residual were removed by siphoning and about 50% of water in each aquarium was daily replaced by well aerated freshwater.

Diet formulations

The Cucumber leaves, Squash leaves, and broad bean leaves were obtained from farm plants in Kafer Elsheikh governorate, the leaves were removed and the rest of the plants were washed with running tap water to minimize the soil contamination, then dried under sunlight, and stored at room temperature until used. Dried CL, SL, and BBL, were added in diets to replace 25% of soybean meal protein. The proximate composition analysis of CL, SL, and BBL meal compared with those of soybean meal are given in Table (1).

A basal diet was formulated from the commercial ingredients (fish meal, soybean meal, yellow corn, wheat bran, Vit. And Min. and oil). The dry ingredients were grounded through a feed grinder to very small particle size (0.15mm). The ingredients were weighed and mixed by a dough mixer for 20 minutes to homogeneity of the ingredients. The estimated amount of oil was gradually added (few drops gradually) and the mixing operation was continued for 20 minutes. After homogenous mixture was obtained, forty ml water per hundred g diet were slowly added to the mixture according to Shimeino *et al.* (1993). The diets were cooked on water evaporator for 20 minutes. The diets were pelleted through fodder machine and the pellets were dried under room temperature. The pellets were collected and saved in plastic bags and stored in refrigerator at 4ċ during the experimental period to avoid the deterioration of nutrients.

The fish were fed the experimental diets at a rate of 3% of live body weight, the daily ration was introduced at 2 equal meals at 8 am and 2 pm through 13 weeks. The fish were weighted at biweekly intervals during the experimental period and the feed quantities were readjusted according to the change in live body weight. The chemical analyses of feed ingredients used in the experimental diets are presented in Table (1). These diets were designated to be isonitrogenous (25.15 % to 26.13 crude proteins) and isocaloric (4008.06 to 4161.98 kcal /Kg DM). Compositions of the mixed diets are presented in Table (2).

Table 1. Proximate analysis of the tested ingredients (% on DM basis).

Ingredients	DM	CP	EE	CF	Ash	NFE%*	GE Kcal/kg**
Fish meal	92.1	72.0	8.7	-	12.6	6.70	512.798
Soybean meal	92.4	44.0	1.2	5.8	6.5	42.5	431.978
Yellow corn	89.2	8.8	3.8	2.6	1.8	83.0	425.452
Wheat bran	88.2	11.9	3.0	11.0	5.0	69.1	378.270
Cucumber leaves	76.12	26.87	3.47	8.51	24.83	36.32	332.140
Squash leaves	75.37	21.11	3.17	9.92	23.35	42.45	322.180
Broad bean leave	88.56	27.45	3.11	10.77	11.93	46.74	374.708

NFE= 100-(CP + EE + CF + Ash).

Gross energy was calculated by multiplication the factors 4.1, 5.6 and 9.44 kcal GE/g DM carbohydrate, protein and fat, respectively (Jobling, 1983).

Table 2. Composition of the experimental diets.

Ingredients	Diets**			
	Diet 1 Control	Diet 2	Diet 3	Diet 4
Fish meal	10	10	10	10
Soybean meal	38.5	27.0	27.0	27.0
Yellow corn	36.0	32.75	31.0	33.0
Wheat bran	10	10	10.0	10.0
Sunflower oil	5	5	5	5
Vit.&Min*	0.5	0.5	0.5	0.5
Cucumber leaves	---	14.75	---	---
Squash leaves	---	---	16.5	---
Broad bean leaves	---	---	---	14.50
Total	100	100	100	100

Vitamin and mineral mixture (product of HEPOMIX) each 2.5 kg contain: 12.000.000 IU Vit.A; 2.000.000 IU Vit . D3; 10 g Vit. E; 2g Vit. K3; 1g Vit. B1 5g Vit. B2;1.5 g Vit. B 6 ; 10g Vit.B12; 30 g Nicotinic acid ; 10 g Pantothenic acid ; 1g Folic acid; 50g Biotin; 250g Choline chloride 50% ; 30g Iron; 10g copper; 50g Zinc; 60g Manganese; 1g Iodine; 0.1g Selenium and Cobalt 0.1g.

(Diet 1 Control)

(Diet 2 Cucumber leaves replace 25% from soybean meal protein)

(Diet 3 Squash leaves replace 25% from soybean meal protein)

(Diet 4 broad bean leaves replace 25% from soybean meal protein.)

Growth parameters

Average total gain (ATG), average daily gain (ADG), specific growth rate (SGR), relative growth rate (RGR %), feed conversion ratio (FCR), protein efficiency ratio (PER %), protein productive value (PPV %) and survival rate (SR) were calculated according to the following equations:

a-ATG (g/fish) = [Average final weight (g) – Average initial weight (g).

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

c- SGR (%/day) = [Ln final body weight–Ln initial body weight] x 100/experimental period (d).

d- RGR = [final weight (g) – initial weight (g)] x100 / initial weight (g).

e- FCR= Feed Intake, dry weight (g)/Live weight gain.

f- PER (%) = Live weight gain (g)/ protein intake (g).

g- PPV (%) = 100[final fish body protein (g) – initial fish body protein (g)/crude protein intake (g).

h- SR = 100[total No. of fish at the end of the experimental /total No. of fish at the start of the experimental.

Proximate analysis

Dry matter, crude protein, ether extract, crude fiber and ash contents of the tested ingredients diets and whole body of fish were at the beginning and at the end of the experiment performed according to A.O.A.C.(1984).

Statistical analysis

The obtained numerical data were statistically analyzed using SPSS (1997) for one-way analysis of variance. When F- test was significant, least significant difference was calculated according to Duncan (1955).

RESULTS AND DISCUSSION

Chemical composition of the experimental diets

Chemical composition and calculated energy of different diets are presented in Table (3). The chemical analysis revealed that no differences were observed between all diets in DM, and CP, while there were some differences observed among different diets in EE, CF, and ash these differences may be related to the ingredients in different diets.

Table 3. Chemical composition of experimental diets (% on dry matter basis).

Ingredients	Diets			
	1 Control	2 (CL)	3 (SL)	4 (BBL)
DM	96.08	97.56	96.24	97.27
CP	26.13	25.83	25.23	25.15
EE	9	8	10.5	8.5
CF	7.34	8.18	9.31	8.87
Ash	12.43	13.93	14.42	12.88
NFE	45.10	44.06	40.54	44.62
Calculated energy value				
GE Kcal/Kg*	4161.98	4008.06	4066.22	4039.08
ME kcal/Kg**	3478.84	3347.95	3400.65	3376.55
P/E***	62.27	64.44	62.04	62.21

GE (gross energy) calculated using the values 4.1 , 5.6 and 9.44 Kcal GE/g DM of carbohydrate , protein and fat, respectively (Jobling, 1983).

ME (Metabolizable energy) calculated using the value of 3.49, 8.1, and 4.5, Kcal/g for carbohydrate, fat, and protein, respectively, according to Pantha (1982).

P/E (protein to energy ratio) = mg crude protein /kcal GE.

The CP content was between 25.15 to 26.13% on DM basis. Such level was within the range suggested by Jauncy and Ross (1982) and NRC (1993). The calculated energy was from 4008.06 to 4161.98 GEKcal/Kg DM), it was higher than that suggested by NRC (1993) for the practical diets. However, it was nearly similar to that used by Hassanen *et al.*,(1995) *and* Abdelhamid *et al.*,(2006).

Water quality parameters

The water quality parameters are shown in Table (4). The ranges of them were 25—26 Ċ, 5-5.5mg/l, 6-8mg/l, 122-135 mg/l, 290-320 mg/l, 0.2-0.5 mg/l, and 0.12-0.15 mg/l and 2-4 mg/l for water temperature, dissolved oxygen, water pH, water alkalinity, water hardness, PO4, NO2, and NO3 concentration, respectively. Such values were within the acceptable limits for Nile tilapia as stated by El-Sayed *et al.* (1996), Milstein *and* Svirsky (1996), and Salem, (2006).

Table 4. Ranges of some important measured physico-chemical parameters of fish rearing water throughout the experimental period.

Temperature ċ	PH value	DO ppm	Alkalinity mg/l	Hardness mg/l	Po4 mg/l	NO2 mg/l	NO3 mg/l
25-26	6-8	5-5.5	122-135	290-320	0.2-0.5	0.12-0.15	2-4

Effect of replacement soybean meal protein with some un-traditional feedstuffs on Growth performance

Data concerning body weight, (BW) average total gain (ATG), average daily gain (ADG), specific growth rate (SGR) and relative growth rate (RGR), and survival rate (SR) are presented in Table (5). The results indicated that average weight gains of fish groups fed, the control diet and the diet containing (BBL) were significantly higher than those containing (CL) and (SL), but there were no significant differences either between the control diet and (BBL) containing diet or between the diets containing (CL) and (SL). The results suggested that 25% of soybean meal protein could be replaced by (BBL) in *Nile tilapia* diet without any adverse effect on the average weight gain. The superiority of (BBL) in producing similar weight gain of tilapia may be due to its higher content of some essential amino acids as lysine (2.75%) and treptophane (0.69%) as compared with 2.61% and 0.51% in (CL) or 2.20% and 0.52% in (SL), respectively, (Richter *et al.* 2003).

Table 5. Effect of replacement of soybean meal protein with some plant leaves (CL, SL, and BBL) on growth performance parameters of Nile tilapia diet (means ± SE).

Treatment	Initial Weight g/fish	Final Weight g/fish	ATG g/fish	ADG g/fish/day	SGR, %/day	RGR%	Survival rate, %
Control	23.30	45.76 ^{a} ±1.58	22.46 ^{a} ±1.58	0.25 ^{a} ±0.510	0.74^a ±0.07	96.39 ^{a} ±0.03	100
Cucumber leaves	23.30	41.77 ^{b} ±0.24	18.47 ^{b} ±0.24	0.20 ^{b} ±0.004	0.64 ^{b} ±0.01	79.27 ^{b} ±0.07	99
Squash leaves	23.30	41.13 ^{b} ±0.45	17.83 ^{b} ±0.45	0.19 ^{b} ±0.005	0.62 ^{b} ±0.018	76.52 ^{b} ±0.01	98
Broad bean leaves	23.30	44.43 ^{a} ±1.44	21.13 ^{a} ±0.67	0.23 ^{a} ±0.005	0.71^a ±0.03	90.68 ^{a} ±0.09	98.8

a, b, c, d means in the same column bearing different letters differ significantly at 0.05 level.

These results are in partial agreement with the results of Viola, et al. (1988) and Hughes, (1991), who reported that it is possible to partially replace fish meal with Lupines albus seed meal without affecting the growth of tilapia. The successful use of *Oreochromis aureus* (De-Silva and Gunasekera, 1989), *p.munyo* and *vigna catiang* (keembiyehetty and de-silva, 1993) has been reported for tilapia feeding. Other legume seeds such as *Canavalia ensiformis* and *Sesbania grand* flora have given satisfactory results (Olvera *et. al.*, (1988). In this connection, Ogino *et. al.* (1978) showed that the inclusion of a protein concentrate derived from rye grass leaves up to 43% of the total protein for common carp and up to 40% for rainbow trout, respectively had beneficial effects on the growth performance as compared to a control diet. The use of leave protein concentrate as a potential dietary feed ingredient has also been evaluated with regard to tropical and subtropical plant leaves. Nova *et. al.* (1990) showed that 35% replacement of fish meal with purified alfalfa protein concentrate had no adverse effect on Mozambique tilapia. Successful replacement of 25% proceeds (Sodked) Lucerne leaf meal has also been recorded for Nile tilapia (Ogino *et al*, 1978). However, only limited information is available on the utilization prospects of foliages directly as alternative or additional protein sources as fish feed. Furthermore, Richter *et. al.*, (2003) reported that diets containing higher levels (30%) of Moringa leaf meal depressed growth performance of Nile tilapia compared to control diet and the diet containing 20% of *Moringa oleifera* leaf meal.

Results of Table (5) revealed that averages of daily gain of Nile tilapia fed on the control ,(CL) , (SL) and (BBL) diets were 0.25 ; 0.20 ; 0.19 and 0.23 g/day, respectively. Control group as well as (BBL) groups showed significantly ($P<0.05$) higher ADG records compared to (CL) and (SL) groups. As presented in the same Table (5), averages of SGR% and relative growth rate (RGR%) were found be 0.74 ; 0.64 ; 0.62 and 0.71% and 96.39 ; 79.27 ; 76.52 and 90.68% for the control; (CL); (SL) and (BBL) groups, respectively. Analysis of variance for SGR and RGR revealed that both control and broad bean leaves (BBL) group were significantly ($P<0.05$) superior in SGR and RGR records compared to (CL) and (SL) groups. There results indicate clearly that broad bean leaves could replace 25% of soybean protein without any hazards in growth performance of Nile tilapia. However, lower replacement levels of (CL) or (SL) should be further examined. These results are in partial agreement with the findings of Richter *et al.* (2003) and Abdelhamid *et al.*(2004 and 2006) who reported that incorporation of moringa leaf, mallow and water hyacinth leaf in Nile tilapia diets at a 20% level had no significant effect on SGR of this fish compared to higher levels 30% which depressed growth performance of Nile tilapia. Also, Ogino *et. al.* (1978) showed that the inclusion of protein concentrate derived from rye grass leaves of up to 43% of total protein for common carp and 40% for rainbow trout, respectively, had beneficial effects on the growth performance as compared to the control diet.

Survival rate (SR)

Average of SR% of Nile tilapia during the whole experimental period (13 weeks) for the control, (CL), (SL) and (BBL) groups were 100, 99, 98 and 98.8%, respectively (Table 5). The mortalities observed in (CL); (SL) and (BBL) groups were within the permissible levels and may due mainly to the effects of fish handling. These results are in accordance with those reported by Richter *et al.* (2003) and Abdelhamid *et al.* (2006) who reported that no feed-related mortalities was observed in the whole experimental period in Nile tilapia fed diets containing 20 or 30% dried moringa leaf meal and water hyacinth leaf .

Efficiency of feed and protein utilization

Averages of FCR calculated as the amount of feed (g)/ weight gain (Table 6) were found to be 2.20, 2.73, 2.84 and 2.49 g for the control, (CL), (SL) and (BBL) groups, respectively. These results indicate that the group fed the control diet showed significantly (P<0.05) improved FCR followed in a significant (P<0.05) order by the (BBL), (CL) and (SL) groups, respectively.

Averages of PER, and PPV of Niles tilapia fed on the control , (CL) , (SL) and (BBL) (Table 6) were 1.73 , 1.41 , 1.39 and 1.70 and 21.17, 37.28, 27.84 and 22.26 respectively. The statistical evaluation of results revealed that tilapia fed on the (BBL) diets showed the highest (P<0.05) PFR values followed in a decreasing order by (CL) and (SL) groups, respectively. There results are in partial agreement with the findings of Richater (2003), who reported that the control diet and the diet containing 10% of dried moringa leaf meal fed to Nile tilapia produced significantly higher PER and PPV values compared to diets containing higher (20 or 30%) levels of dried moringa leaf meal. In this connection Nova *et al.* (1990) reported that incorporation of cowpea protein concentrate in replacement with fish meal at 40% level improved protein efficiency ratio of Nile tilapia compared with 10; 20; 30 and 50% inclusion levels.

Table 6. Effect of replacement of soybean meal protein with some plant leaves (CL, SL, and BBL) on feed utilization parameters of Nile tilapia diet.

Treatment	Feed Intake (g)	FCR (mean ± SE)	PER (mean ± SE)	PPV (mean ± SE)
Control	49.50	2.20© ± 0.060	1.73(a) ± 0.021	21.17© ± 0.011
Cucumber leaves	50.60	2.73(a) ± 0.075	1.41© ± 0.010	37.28(a) ± 0.018
Squash leaves	50.80	2.84(a) ± 0.077	1.39© ± 0.012	27.84(b) ± 0.016
Broad bean leaves	49.00	2.49(b) ± 0.014	1.70(b) ± 0.036	22.26© ± 0.012

a, b, c means in the same column bearing different letters differ significantly at 0.05 level.

Whole body chemical composition

Averages of dry matter (DM), crude protein (CP), ether extract (EE), ash and nitrogen free extract (NFE) calculated as % of the dry matter are presented in Table (7). As presented in this table, the control group and (BBL) group showed significantly ($P<0.05$) higher DM contents in the whole bodies of Nile tilapia compared to (SL) and (CL) groups. On the other hand, CP% in tilapia whole bodies of the (CL) group was significantly ($P<0.05$) higher compared to the other treatment groups, followed in a significant ($P<0.05$) decreasing order by (SL), (BBL) and control groups, respectively. Ether extract contents of the control group was significantly ($P<0.05$) higher than the other treatment groups and followed in a significant ($P<0.05$) decreasing order by (CL), (SL) and (BBL) groups, respectively.

Table 7. Effect of replacing soybean meal protein with some plant leaves (CL, SL and BBL) on the whole body chemical composition of Nile tilapia.

Treatment	DM % mean ± SE	CP % Mean ± SE	EE % mean ± SE	Ash % mean ± SE	NFE % mean ± SE	Energy*, kcal/kg mean ± SE
Control	27.13 ^{a} ± 0.09	56.35 ^{d} ± 0.09	19.331 ^{a} ± 0.33	14.85 ^{c} ± 0.03	9.47^a ± 0.03	5269.3 ^{b} ± 0.73
Cucumber leaves	26.09 ^{b} ± 0.56	58.87 ^{a} ± 0.06	18.840 ^{c} ± 0.28	13.79 ^{d} ± 0.05	8.50 ^{b} ± 0.12	5325.4 ^{a} ± 0.36
Squash leaves	26.70 ^{b} ± 0.67	57.58 ^{b} ± 0.06	19.020 ^{b} ± 0.33	15.17 ^{b} ± 0.06	8.23^d ± 0.33	5210.5 ^{c} ± 0.42
Broad bean leave	27.24 ^{a} ± 0.44	56.85 ^{c} ± 0.04	18.450 ^{c} ± 0.19	16.29 ^{a} ± 0.09	8.41 ^{c} ± 0.09	5169.2 ^{d} ± 0.45

a, b, c, d means in the same column bearing different letters differ significantly at 0.05 level.
DM: Dray matter, %CP: Crude protein EE: Ether extracts NFE: N-free extract
Calculated according to Pantha (1982).

As presented in Table (7), (BBL) group recorded the highest ash contents ($P<0.05$) in the whole body of tilapia while the lowest the value was observed by (CL) group. Furthermore NFE% in whole body of Nile tilapia recorded its highest value in the control group followed by (SL), (CL) and (BBL) groups, respectively. Averages gross energy contents of tilapia were found to be 5269.3; 5325.4 ; 5210.5 and 5169.2 kcal/kg dry matter for control, (CL), (SL) and (BBL), respectively (Table 7). These results indicate that fish fed the diet with (CL) deposited more energy ($p<0.05$) than the other treatment groups followed in a decreasing order by (SL) and (BBL) groups, respectively. These results are in a partial agreement with the findings of Olivera *et. al.* (1988), who reported that incorporation of protein concentrate of cowpea (CPC) at levels up to 50% in Nile tilapia diets affected all body composition parameters. They added that, as the concentration of CPC increased in the diet, the carcass water content was reduced. Protein content was improved by the inclusion of protein concentrate at substitution levels from 20 to 50%. Ether extract content was significantly higher for fish fed the CPC50 diet. The lowest fat and highest ash contents were recorded in the fish fed the CPC20 diet. Furthermore, Richter *et. al.* (2003) and Abdelhamid *et al.* (2004) studied the effect of dried moringa leaf meal and water hyacinth inclusion level (20 and 30%) as alternative protein source for Nile tilapia on body chemical composition. They reported that increasing the level of moringa leaves in the diets increased moisture body, while lipid and gross energy values decreased significantly ($P<0.05$). Crude protein and crude ash contents remained constant in all experimental groups.

Economic efficiency

The economic parameters of the tested diets are presenters in Table (8). The calculation depends on the average price of dietary ingredients at year (2006) of the local market, where, vit. and min. 7000 LE, cucumber leaves 250LE, squash leaves 250LE, broad bean leaves 250LE, fish meal 4000LE soybean meal 2000LE, yellow corn 900LE wheat bran 900LE, and sunflower oil 400LE ton. The calculated figures showed lower cost of one ton of all diets containing CL, SL, and BBL. However, the control diet recorded the highest price being 1801.5 LE/ton. The diets containing (25% BBL) showed the highest fish gain comparing with the group levels (25%CL and 25%SL)). Therefore, diets no. (3) Showed high cost/kg gain being (4.58LE), but the levels of 25% BBL gave the lowest feed cost/kg gain being (3.69LE).

Table 8. Data of the economical efficiency due to feeding fish on graded levels of CL, SL and BBL.

Treatment	Feed intake g/fish	Cost (LE) of one ton diet	Decrease in feed cost (LE)	Total gain g/fish	Feed cost/kg gain (LE*)
1- control	49.50	1801.5	00.0	22.46	3.97
2- CL	50.60	1606.5	195	18.47	4.40
3- SL	50.80	1608.5	193	17.83	4.58
4- BBL	49.00	1595.2	206.3	21.13	3.69

Feed cost/kg gain (LE) =feed intake x cost (LE) of one ton feed/1000xtotal gain

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استخدام أوراق كل من نبات الخيار والكوسة والفول كمصادر غير تقليدية للبروتين النباتي في علائق أسماك البلطي النيلى.

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تم إجراء هذا البحث بغرض دراسة كيفية استخدام بعض المصادر غير التقليدية للبروتين النباتي في علائق أسماك البلطي النيلى والمتمثلة في مسحوق أوراق كل من (نبات الخيار- نبات الكوسة - ونبات الفول) وهذا من اجل التخلص من بعض الملوثات البيئية والحصول على علائق رخيصة الثمن. وتم إجراء البحث عن طريق تصنيع أربعة علائق مضاف إليها مسحوق هذه الأوراق بنسب ٢٥% من بروتين فول الصويا. واستخدم ١٨٠ سمكة بوزن ابتدائي ٢٣ جرام موزعة على الأحواض الزجاجية في ثلاثة مكررات لكل معاملة. وتم تغذية الأسماك على هذة العلائق بمعدل ٣% من الوزن ألحى للأسماك يوميا وذلك لمدة ١٣ أسبوع وكانت نسبة البروتين في العلائق المستخدمة (٢٦%). ومن أهم النتائج التي تم التوصل إليها من هذا البحث هو انه يمكن استخدام أوراق نبات الفول بمعدل ٢٥% من بروتين فول الصويا وأتضح أيضا أنة حدث زيادة في معدلات النمو والاستفادة من الغذاء في الأسماك التي تغذت على العلائق المحتوية على مسحوق أوراق نبات الفول وذلك بالمقارنة بباقي المعاملات الأخرى. أما بالنسبة للتركيب الكيماوي لجسم الأسماك في التجربة فانة حدث اختلافات بسيطة في محتوى الجسم من بروتين ودهن ورماد. أما بالنسبة للتحليل الاقتصادي فقد وجد من خلال هذة الدراسة أنه حدث انخفاض في تكلفة تصنيع طن العليقة في الأسماك التي تغذت على علائق محتوية على مسحوق أوراق الفول وذلك بالمقارنة بباقي المعاملات الأخرى. لذلك يمكننا من خلال هذا البحث أن ننصح بأنه يمكن استخدام أوراق نبات الفول كمصدر غير تقليدي للبروتين النباتي في علائق أسماك البلطي بنسبة تصل إلى ٢٥% من بروتين فول الصويا وبذلك نتمكن من التخلص من بعض المخلفات الزراعية التي يمكن أن تكون ملوثة للبيئة وأيضا حققنا غرض اقتصادي في الحصول على طن عليقة مصنع رخيص الثمن.