EFFECT OF REPLACING SOYBEAN MEAL PROTEIN BY OTHER PLANT PROTEIN SOURCES ON GROWTH PERFORMANCE AND ECONOMICAL EFFICINCY OF MONO SEX NILE TILAPIA (*OREOCHROMIS NILOTICUS*) CULTURED IN TANKS.

ABDEL-HAKIM, N. F., M. E. LASHIN, A. A. AL-AZAB AND H. M. NAZMI.

1. Department of Animal Production, Faculty of Agriculture, Al-Azhar University

Abstract

The present study was conducted at the fish experimental unit belonging to the Faculty of Agriculture, Al-Azhar University. Nasr City, Cairo, ARE during the period from 1st July to the 3rd of November 2005. The study aimed to investigate the effect of incorporation of dried rumen contents (RC) or sunflower meal (SFM) and sesame seed cake (SSC) to replace 30% of soybean meal protein on growth performance of growing Nile tilapia mono- sex with an initial body weight of 30 ± 0.46 g. The experiment lasted 18 weeks after start and the experiment was performed in circular fiber glass tanks with a total volume of 1 m^3 each. The investigations involved four dietary treatment groups. The first group was fed on a control diet containing 30% protein from fish meal and soybean meal, while the second (RC) contained rumen contents, the third contained SFM and the fourth contained (SSC) to replace 30% of soybean protein in the control diet. Results obtained are summarized in the following:

1- Neither dried rumen contents and sunflower meal nor sesame seed cake and control diet as protein sources had any detrimental effect on the surrounding water of the experimental tanks or on the experimental fish. Accordingly, all fish were in normal being and activity.

2- Replacing 30% of soybean meal protein by sesame seed cake protein improved significantly final body weight of Nile tilapia, however differences among rumen contents, sunflower meal and the control diet in final weights were insignificant.

3- Replacement of 30% of soybean meal protein by dried rumen contents, sunflower meal or sesame seed cake had no significant effects on Nile tilapia final body length.

4- Incorporation of dried rumen contents, sunflower meal or sesame seed cake to replace 30% of soybean meal protein released no significant effects on Nile tilapia total weight gain and average daily gain.

5- Relative growth rate of groups fed on diets containing sunflower meal and sesame seed cake was significantly higher compared to those fed on diets containing dried rumen contents. The same trend was observed in the specific growth rate.

6- Groups fed the control, sunflower meal and sesame seed cake showed significantly higher condition factor compared to the group fed on dried rumen contents diet.

7- Incorporation of dried rumen contents, sunflower meal or sesame seed cake to replace 30% of soybean meal protein in tilapia diets had no significant effects on feed intake, feed conversion ratio and feed efficiency.

8- Group fed on sesame seed cake had shown the highest economical efficiency and followed by groups fed on dried rumen contents and sunflower meal, while the group fed on control diet was had the lowest economical efficiency.

Based on the obtained results it is worthy to recommend the incorporation of dried rumen contents, sesame seed cake or sunflower meal to replace 30% of soybean protein to reduce feed costs without any adverse effects on growth performance and feed utilization of Nile tilapia.

Key words: Nile tilapia monosex, Growth performance, Dried rumen contents, Sunflower meal, Sesame seed cake, Soybean meal protein.

INTRODUCTION

Fish feed costs represent almost 65 to 70% of the intensive fish culture inputs, attempts have been done to reduce the feed costs by using cheaper alternative sources of protein and/or energy of that so called non- traditional ingredients or by- products which may be of great value in producing cheap fish diets (Abd El-Hakim *et al*., 2003).

Although dried rumen contents have been tested as a dietary non traditional feed ingredient for poultry and rabbits (Camps and Salas, 1987, Abd El-Rahman and El-Sayaad, 1989), little informations exist on its use in fish feeding. Sesame seed meal (Tacon, 1993) and sunflower meal (Jackson *et al.,* 1982) represent plant protein sources which may substitute soybean meal in fish diets to reduce the feed costs.

Hassan (1989) reported that no significant differences were observed in total gain, average daily gain and specific growth rate of fish fed diets contained different levels of dried rumen liquor. Hegazy (1990) noticed that no significant differences in total gain, average daily gain, and specific growth rate of tilapia fed on the diets containing different levels of dried rumen liquor. And reported that growth performance of tilapia was significantly improved when they fed on diets contained a mixture of 20% poultry dropping and dried rumen liquor (1: 1).

Also, Hegazy (1990) showed that better growth performance parameters were obtained for tilapia fed diets containing fish meal with dried rumen liquor (DRL) than those fed meat meal with DRL. However, the differences were not significant.

Omar Eglal *et al*., (1993) conducted trials to evaluate the nutrition value of dried rumen liquor (DRL) as a dietary replacement for soybean byproduct meal in ration for common carp (Cyprinus carpio, linne) Nile tilapia (*Oreochromis niloticus*, Linne) and mullet (*Mugil cephalus*) fishes. The level of dietary replacement of DRL as percentage of SBBP was 50 and 100%, equivalent to 15 and 30% of the total

diet on dry weight basis, they showed that average daily gain and specific growth rate of both carp and mullet were significantly reduced by feeding DRL while tilapia growth was not affected by dietary treatment at any replacement level. Carcass crude protein decreased and ether extract and ash increased within all species when DRL was fed with the exception of ash within tilapia. Differences in average daily gain and specific growth rate observed in carp and mullet were related to differences in DM and nutrient intake. They concluded that DRL could be incorporated in diets for tilapia at level of 15 and 30% as a dietary replacement SBBP without having an adverse effect on growth performance, feed utilization or body composition.

The aim of the present study was to investigate the effect of replacing soybean meal protein with dried rumen contents, sesame seed cake or sunflower meal in Tilapia diets on its growth performance and nutrient utilization.

MATERIALS AND METHODS

This study was performed at a fish culture tank system with closed water recirculation belonging to the fish experimental system, Department of Animal production, faculty of Agriculture, AL-Azhar University, Cairo, Egypt. The experiment lasted 18 weeks after start. The experiment started at first of July, 2005 and lasted at 3rd of November, 2005.

Rearing system

The experimental rearing system consisted of series of four circular fiber glasses each of one cubic meter water volume was used in the present study. The four tanks represented four nutritional treatments including the control soybean meal diet (C), rumen contents diet (RC) where rumen contents replaced 30% of soybean meal protein, sunflower meal diet (SFM) to replace 30% soybean meal protein and sesame seed cake diet (SSC) to replace 30% of soybean meal protein. The water supply of these tanks was the drinking tap water which derived from the mechanical filter reservoir via a pump to another two fiberglass tanks 5 M^3 capacity.

The series of the fiberglass tanks are connected together with a tap dechlorinated water supply as well as a drainage system which is connected with the mechanical filter. All experimental tanks were supplied with air through an aeration system which connected with an oil free air compress of (3 hu).

Experimental fish

Nile tilapia (*Oreochromis nilticus*) all male fingerlings (sex reversed with hormone treatment) were used in the present study. The fish were transported at early morning using a special fish transport car with aeration facilities. Fish were acclimated to the experimental system for 7 days before starting the experiment. Thereafter the fish were randomly distributed into four groups representing one of the dietary treatments cited above and stocked in the experimental tanks at a rate of 30 fish/ m3, the initial weight and length were 30 g. and 11.8 cm, respectively. The experiment lasted 18 weeks after start.

Water quality

Water temperature and pH were measured weekly at 6^{00} am and 12^{00} pm using thermometer, pH meter (model Corning 345). Determinations of water quality parameters (Salinity, hardness, alkalinity and ammonia) were carried out every month according to the method of Boyd (1979). Electric conductivity (µmohs/cm) was carried out using a salinometer model (YSI, 33 Yellow spring instruments Co., USA).

Experimental diets

Chemical proximate analyses of feed ingredients used in the presents study are presented in Table (1). Four experimental diets were formulated to contain 30% crude protein and almost 4600 Kcal gross energy /kg (table 2). The first diet had served as a control diet containing protein from fish meal and soybean meal. The second diet contained dried rumen contents to replace 30% of soybean meal protein. The third diet contained sunflower meal to replace 30% of soybean protein and the fourth diet contained sesame seed cake to replace 30% of the soybean meal protein. The experimental diets were prepared by fine grinding of the dietary ingredients. Thereafter all ingredients included in each experimental diet were mixed thoroughly and produced in a pelleted form (0.2 cm. in diameter) using mincing machine after mixing with 25% of water. The experimental pellets were sun dried and stored in good storage conditions till the experimental start. The experimental diets were fed to the fish at a rate of 3% of the tank fish biomass twice daily at 8^{00} o'clock am. and 3^{00} pm. daily. The amounts of feed were adjusted every two weeks according to the last body weight after weighing.

Table 1. Chemical analysis of the ingredients used in the experimental diets on DM basis.

Ingredient	DM%	CP%	EE%	CF%	Ash%	NFE %*	GE**(Kcal/KgDM)
Fish meal	92.21	72.00	8.8	0.6	10.2	8.4	5259.6
Soybean meal	90.57	44.00	2.1	7.4	6.5	40	4580.45
Yellow corn	87.30	7.7	4.1	2.5	1.3	84.4	4298.5
Corn gluten	91.26	60.00	2.9	1.6	2	33.5	5068.05
Rice bran	91.18	12.8	14.00	11	11.3	50.9	4522.2
Sunflower meal	92.45	34.00	5.6	14.2	6.9	39.3	4590.2
Sesame seed cake	91.76	33.00	9	7	9.5	41.5	4655
Dried rumen contents	89.00	11.20	1	18.1	17	52.7	3559.3

Calculated by differences

Estimated according to Jobiling (1983). Using the factor 5.65, 9.45 and 4 for crude protein, ether extract and carbohydrate, respectively.

Table 2. Composition of the experimental Diets (on DM basis)

	Experiment Diets			
	Control	T_1	T_2	T_3
Fish meal herring	11.00	11.00	11.00	11.00
Corn gluten	14.00	16.22	14.00	14.00
Soybean meal	25.00	17.50	17.50	17.50
Dried rumen contents	-	29.46	-	-
Sunflower meal	-	-	9.71	-
Sesame seed cake	-	-	-	10
Yellow corn	41.30	17.20	42.07	42.10
Rice bran	3.00	3.00	3.00	3.00
Corn oil	3.10	4.62	1.40	1.40
Celluose powder	1.60	-	0.32	-
Fish premix*	1.00	1.00	1.00	1.00
Total	100	100	100	100
Chemical analysis of the experimental diets (on DM basis)				
Dry matter%	90.78	92.10	91.35	91.26
Crude protein %	30.88	30.36	30.91	30.94
Ether extract %	8.15	9.58	7.87	8.61
Crude fiber %	6.02	8.24	5.90	5.13
Ash %	7.69	11.45	7.94	8.37
**NFE %	47.26	40.37	47.38	46.95
*** Grass Energy (Kcal/ kg)	4646.10	4565.05	4621.33	4644.96

***Fish premix** (each 1 kg contains: vitamin A, 2.5 m.i.u., vitamin D_3, 1.25 m.i.u., vitamin E. 125000 mg, vitamin K, 5000 mg, vitamin B_1, 7500mg, vitamin B_2, 5000 mg, vitamin B_6, 25000 mg, vitamin B_{12}, 10 mg, pantothenic acid, 10000 mg, Nicotinic acid, 100000, folic acid, 5000 mg, biotin, 750 mg, choline chloride, 2000000mg, copper, 3000 mg, Iodine, 125 mg, Iron, 75000 mg, Manganese, 6000 mg, Zinc, 65000 mg, Selenium, 150 mg).

** Calculated by differences

*** Estimated according to Jobiling (1983). Using the factor 5.65, 9.45 and 4 for crude protein, ether extract and carbohydrate, respectively.

Records maintained

Live body weight and body length

Live body weight (LBW), g and body length (BL), cm of individual fish of each experimental tank were recorded every 2 weeks (14 days) during the experimental period.

Total weight gain (TWG)

TWG (g/fish) = final weight – initial weight.

Average Daily Gain (ADG) ADG (g/fish/d) = total weight gain (g)/period (day).

Specific growth rate (SGR)

$$SGR = \frac{LnW_2 - LnW_1}{t} \times 100$$

Where:

Ln = the natural log

W_2 = final weight at certain period (g)

W_1 = Initial weight at the same period (g)

t = period of experiment (day).

Relative growth rate (RGR)

$$RGR (\%) = \frac{\text{Total weight gain (g)}}{\text{Initial weight (g)}} \times 100$$

Condition factor (K)

It represents the relationship between W and L of the fish. It is calculated as follows:

W/L3

Where:

W = fish weight "grams"

L = fish length "cm"

Feed intake: calculated as the amount of consumed feed during the experiment.

Feed conversion ratio

Feed conversion ratio (FCR) = feed intake (g)/ weight gain (g)

Economical efficiency

$$EE = \frac{\text{Total income (L.E.)}}{\text{Total costs (L.E.)}} \times 100$$

Statistical Analysis

The data were analyzed using the SAS computer program (1996). Comparison between treatments was conduct according to Duncan (1955).

The used model was: Xi = μ + Ti + Ei

Where: Xi is the observation on i treatment

μ is the overall mean

Ti is the effect of i treatment

Ei is the experimental error

RESULTS AND DISCUSSION

Water quality parameters

Averages of water quality parameters measured during the experimental period are illustrated in Table (3). Results of this table revealed that averages of water temperature ranged between 25.5 to 28.3°C, averages water pH values ranged between 7.1 and 7.6 degree, electrical conductivity (μmoh/cm) had ranged between 390 to 470. Salinity (ppt), total water alkalinity (mg/L) and total hardness (mg/L) had ranged between 0.2, 148- 166, 180- 190, respectively.

As presented in the same table total water ammonia (NH_3 + NH_4 mg/L) and NO_2 (mg/L) ranged between 0.11 to 0.37 and 0.19 to 0.34 mg/L respectively. All water parameters tested were within the permissible levels for tilapia maximum growth. These results are in accordance with the finding of El**-** Hammady (2001) working with hybrid Nile Tilapia.

Table 3. Water quality parameters of the rearing units during the experiment

Treatments	Water temperature	pH (ppm)	E.C. (M (mhos/cm)	Sat. (ppt)	Total alkalinity (mg/L)	Total hardness (mg/L)	NH_4+NH_3 (mg/L)	NO_2 (mg/L)
Well	27.2	7.3	400	0.2	185	166	0.11	0.19
Control	25.5	7.1	390	0.2	180	162	0.37	0.34
RC	25.8	7.4	440	0.2	190	156	0.2	0.27
SFM	27.5	7.6	470	0.2	187.5	148	0.14	0.25
SSC	28.3	7.4	420	0.2	180	151	0.25	0.22

Body weight

Averaged of BW of Nile Tilapia during the experimental periods as affected with replacing 30% of soybean protein (SBP) by rumen contents (RC), sunflower meal (SFM) or sesame seed cake (SSC) are presented in Table (4) . Results revealed that averages of initial weights at the experimental start had ranged between 29.28 g and 30.74 g. with insignificant differences among the experimental indicating the complete random distribution of individual fish among the experimental groups at the start of the experiment. At termination of the

experiment (i.e 18 weeks after start), averages of final weight for the C, RC, SFM and SSC groups were found to be 152.41, 153.27, 157.62 and 164.11 g, respectively and averages of final weights relative to the control group (100%) were 100.56, 103.42 and 107.68% for RC, SFM and SSC groups, respectively.

These results indicate that replacing 30% of SBP with dried rumen contents (RC) or sunflower meal (SFM) and sesame seed cake (SSC) showed positive effects on body weights of growing Nile tilapia and the improvement in BW was more pronounced in the groups fed the diets containing SSC to replace 30% of soybean meal protein. These results are in accordance with the findings of Abd El- Hakim *et al.* (2003) who reported that replacing 50% of soybean meal with sesame seeds had no harmful effects on growth performance and feed utilization of hybrid tilapia (*O. niloticus* X *O. aureus*). Concerning results of rumen contents, the results of table (4) are in accordance with that reported by Hegazy (1990), who showed that growth performance of tilapia fed diets containing fish meal with dried rumen liquor (DRL) were improved compared to those fed meat meal with DRL. However, the differences were not significant. On the other hand, Hassan (1989) showed that the performance parameters of carp fish were deceased with increasing dried rumen liquor in their diets. Ibrahim (1985) showed that diets supplemented with 20% rumen contents (represented 6.7% of dried protein) depressed growth, feed efficiency and energy digestibility. However, feed efficiency of rainbow trout was improved with supplementing 10% dried rumen content in a diet contained 40% crude protein (32% from fish meal protein and 8% of soybean meal protein).

In this connection, Omar Eglal *et al.* (1993) replaced soybean by products meal by dried rumen liquor (DRL) at 0, 15 and 30% of the total diet of common carp, Nile tilapia and mullet. They showed that average daily gain and specific growth rate of both carp and mullet were significantly reduced by feeding DRL while tilapia growth was not effected by dietary treatment at any replacement level.

Concerning sunflower meal, results of table (4) are in agreement with the findings of Jackson *et al.* (1982) who obtained reasonable growth rates when up to 50% of a 30% protein diet was replaced with sunflower seed meal and fed to *S. mossambicus*. However, when Kamara (1982) replaced 75% and 80% of the fish meal in 30% protein diets with sunflower seed meal, the growth rates of *S. mossambicus* and *S. niloticus* fingerlings were only half those fed the control diets where all of the protein was supplied by fish meal. Olukunle (1982) also obtained poor growth rates when half of the fish meal was replaced by sunflower seed meal in a 45% protein diet for *S. niloticus* fry. Also, Olvera Novoa *et al.* (2002) tested

during a 70 day feeding period diets containing 10 and 20, 30, 40 and 50% sunflower seed meal as a dietary protein replacement for fish meal in practical diets for Nile tilapia fingerlings, they reported that, best growth and feed efficiency results with values similar to those of the control diet based on fish meal as a sole protein source were provided with diets containing sunflower seed meal at 10 and 20% levels. Also, results of Abu Sinna (2006) are in partial agreement with results of (table, 4) concerning (SFM). The author reported that incorporation of fish meal with linseed or sunflower meals asmajor plant protein sourses produced the largest harves weights of Nile tilapia.

Body length (BL)

Results of body length (Table 4) indicated that replacing soybean protein at a ratio of 30% with rumen contents or sunflower meal or sesame seed cake had no significant effects on final weights of Nile tilapia. These results are in accordance with the findings of Jackson *et al.*(1982), while Abdel-Hakim(2003) reported contradictory results using sesame full-fet seeds in diets of Nile tilapia.

Total gain in weight Condition Factor (K), Relative Growth Rate (RGR) and Specific Growth Rate (SGR)

Results presented in Table (4) and show that averages of gain in total weight and length during the whole experimental period were 122.87, 122.67, 128.34 and 133.37 g for the C, RC, SFM and SSC groups, respectively. The analysis of variance for total gain in weight showed that incorporation of RC, SFM and SSC in growing Nile tilapia diets released no significant effects of total gain in weight and length. However, incorporation of SFM and SSC at 30% level of soybean meal protein tended to increase total gain in weight compared to the control group. Averages of condition factor (K) for the C, RC, SFM and SSC groups were 1.82, 1.77, 1.81 and 1.84 during the whole experimental period, respectively. The statistical evaluation of data revealed that RC group showed significantly ($P < 0.05$) lower K values compared to the other treatment groups among them differences in K values were insignificant (Table, 4). There results revealed that incorporation of rumen contents in tilapia diets enhanced the growth of fish in length rather than in weight.

Averages of relative growth rate (RGR) during the whole experimental period for C, RC, SFM and SSC groups were 415.94, 400.88, 438.32 and 433.86% respectively. Analysis of variance for RGR indicated that groups SFM and SSC had higher RGR compared to that of group RC; however differences in this trial among SSC, SFM and C groups were insignificant (Table, 4).

Results of Table (4) revealed that the highest average of daily gain (g/fish/day) was recorded by the group SSC (1.06 g/day) and the lowest was

observed with the RC group (0.97 g/day) with insignificant differences among the treatment groups in this trial. Regarding SGR% averages of SGR% were found to be 1.30, 1.28, 1.34 and 1.33% for the C, RC, SFM and SSC groups, respectively. Results of SGR showed that SFM and SSC groups had significantly ($P < 0.05$) higher SGR records compared to the RC groups. These results in general indicated that incorporation of dried rumen contents or sunflower meal or sesame seed cake in growing tilapia diets to replace 30% of soybean meal protein released no adverse effect on growth performance of Nile tilapia.

These results are in agreement with the findings of Hassan (1989) and Hegazy (1990), who reported no significant differences in total gain, average daily gain and specific growth rate were observed in tilapia fish fed diets contained different levels of rumen liquor. Also, Hegazy (1990) reported that better growth performance were obtained for tilapia fed on diets containing fish meal with dried rumen liquor than those fed diets with meat meal and containing dried rumen liquor. On the other hand, Ibrahim (1985) showed that rainbow trout diets supplemented with 20% rumen contents (represented 6.7% of dried protein) depressed growth, feed efficiency and energy digestibility. However, feed efficiency of rainbow trout were improved with supplemented 10% dried rumen content when diet contained 40% crude protein (32% fish meal protein and 8% of soybean meal protein).

In this connection, Camps *et al.* (1987) indicated that rumen content could be added at 9% to the diet of broiler chickens to replace 6% maize meal and 3% soybean meal.

Results of Table (4) show that incorporation of sunflower meal or sesame seed cake to replace 30% of soybean meal protein released no hazardous effects on Nile tilapia growth performance. These results matched good with those reported by Hossain and Jauncey (1989), who substituted fish meal by oil seed meals of mustard, linseed or sesame at levels of 25, 50 and 75% of dietary protein. The authors reported that, on the basis of observed growth rate, feed conversion ratio, protein efficiency ratio and apparent net protein utilization, the control diet produced significantly ($P < 0.05$) the best growth performance. Growth responses were significantly affected by both type and inclusion level of oilseed protein. They added that of the oilseed proteins tested, the 25% mustard protein and 25% linseed protein diets produced significantly ($P < 0.05$) better growth performance than higher inclusion levels tested.

Furthermore, results of present study are in agreement with that reported by Mukhopadhyay and Ray (2001) showed that sesame seed meal can be

incorporated at a higher level (up to 40%) in the diet of Rohu fingerlings after suitable processing (fermentation using lactobacillus acidophilus).

Results concerning sunflower meal (Table, 4) are also in agreement with the findings of Tacon *et al.* (1984), Martinez (1986) and Sanz *et al.* (1994) who showed that sunflower seed meal is known to be used effectively by trout at low level and by tilapia (Jackson *et al.,* 1982) at higher levels with the addition of methionine. However, there is a paucity of information on the nutrient digestibility of dehulled sunflower meal as potential feed ingredient for Nile tilapia. In this connection Jackson *et al.* (1982) obtained reasonable growth rates when up to 50% of a 30% protein diet was replaced with sunflower seed meal and fed to *S. mossambicus*. However, when Kamara (1982) replaced 75% and 80% of the fish meal in 30% protein diets with sunflower seed meal, the growth rates of *S. mossambicus* and *S. niloticus* fingerlings were only half of those fed the control diets where all of the protein was supplied by fish meal. OluKunle (1982) also obtained poor growth rates when half of the fish meal was replaced by sunflower seed meal in a 45% protein diet for *S. niloticus* fry. Results of the present study are in partial agreement with the findings of Olvera Novoa *et al.* (2002), who showed that Nile tilapia diets containing 10 and 20% sunflower seed meal provided the best growth performance and feed efficiency.

Table 4. Effect of the dietary treatments on growth performance Parameters and condition factor of mono sex Nile tilapia (Means ± S.E.)

	Replaced treatments			
	Control	RC	SFM	SSC
Ave. initial weight (g)	29.54 ± 0.50^{a}	30.60 ± 0.49^{a}	29.28 ± 0.40^{a}	30.74 ± 0.44^{a}
Aver. final weight (g)	152.41 ± 1.84^{b}	153.27 ± 1.48^{b}	157.62 ± 2.12^{b}	164.11 ± 1.69^{a}
Ave. final weight % of the control	100	100.56	103.42	107.68
Ave. initial length (cm)	11.79 ± 0.11^{a}	11.91 ± 0.13^{a}	11.77 ± 0.11^{a}	11.89 ± 0.16^{a}
Aver. final length (cm)	20.12 ± 0.15^{a}	20.48 ± 0.14^{a}	20.43 ± 0.21^{a}	20.59 ± 0.19^{a}
Total weight gain (g/fish)	122.87 ± 2.15^{a}	122.67 ± 2.07^{a}	128.34 ± 2.23^{a}	133.37 ± 2.28^{a}
Average daily gain (g/fish/day)	0.98 ± 0.15^{a}	0.97 ± 0.15^{a}	1.02 ± 0.16^{a}	1.06 ± 0.16^{a}
Relative growth rate (%)	415.94 ± 1.6^{ab}	400.88 ± 1.7^{b}	438.32 ± 2.5^{a}	433.86 ± 2.8^{a}
Specific growth rate (%/day)	1.3 ± 0.01^{ab}	1.28 ± 0.01^{b}	1.34 ± 0.02^{a}	1.33 ± 0.02^{a}
Condition factor (K)	1.82 ± 0.01^{a}	1.77 ± 0.01^{b}	1.81 ± 0.01^{a}	1.84 ± 0.01^{a}

a,b.c…: Meaning within the same row with different superscripts are significantly different (P< 0.05)

Feed Intake (FI) and Feed Conversion Ratio (FCR)

These results indicated that replacing 30% of soybean meal protein by rumen contents or sunflower meal or sesame seed cake had no adverse effect on FCR and FER of growing Nile tilapia. These results are in complete agreement with the findings of Hegazy (1990) and Omar *et al.* (1993) working with rumen liquor. Also, Salama (1996) reported that partial replacement of fish meal with layers manure up to 15% did not affect feed intake and FCR of Nile tilapia. Moreover, Hassan (1989) reported that no significant differences were observed in feed

intake, total weight gain, average daily gain and specific growth rate of fish fed diets contained different levels of dried rumen liquor. On the other hand, Ibrahim (1985) showed that diets supplemented with 20% rumen contents (represented 6.7% of diet protein) depressed growth, feed intake, feed efficiency and energy digestibility of rainbow trout. In this connection, Fowler (1973) reported that channel catfish fed a ration containing 25% dried poultry manure (droppings) grew better and consumed the diet normally than the control group.

Concerning results of incorporation of sunflower meal and sesame seed cake in growing tilapia diets, results of Table (5) revealed the replacing 30% of soybean meal protein by both feedstuffs cited above released insignificant effects on feed intake as well feed conversion ratio, which is in complete agreement with the findings of Hossain and Jauncey (1989), Gobl (1981), Mukho- Padhyay and Ray (1999) and El- Saidy and Gaber (2003), who reported that partial substitution of soybean meal or sesame meal had no significant effects on feed intake or feed conversion of fish.

Table 5. Effect of the dietary treatments on nutrient utilization of mono sex Nile tilapia (Means ± S.E.)

	Replaced treatments			
	Control	RC	SFM	SSC
Total weight gain (g/fish)	122.87 ± 2.15a	122.67 ± 2.07a	128.34 ± 2.23a	133.37 ± 2.28a
Feed intake (g/fish)	222.45 ± 4.06a	227.30 ± 4.06a	227.39 ± 4.25a	238.21 ± 4.43a
Feed conversion ratio	1.81 ± 0.01a	1.85 ± 0.02a	1.77 ± 0.02a	1.79 ± 0.03a
Feed efficiency ratio	0.55 ± 0.01a	0.54 ± 0.01a	0.56 ± 0.01a	0.56 ± 0.01a

a,b.c…. Meaning within the same row with different superscripts are significantly different (P< 0.05)

Economical Study

Results of inputs and outputs of the experimental treatments are presented in Table (6). Prices of experimental diets based on feed ingredients in the local market during the experiment were 2.02, 1.71, 1.84 and 1.97 LE for the control, RC, SFM and SSC diets, respectively, which indicated that incorporation of RC, SFM or SSC in tilapia diets to replace 30% of soybean protein reduced the feed price. Total feed costs during the whole experimental period were 13.47, 11.68, 12.53 and 12.78 L.E. for the same experimental groups cited above, respectively. Total costs (feed + fry) were found to be 19.47, 17.68, 18.53 and 18.78 LE for the experimental groups C, RC, SFM and SSC groups, respectively and the differences had due to differences in feed costs, thus price of the fry was the same for all treatments.

As presented in the same table, total gains in weight per tank for C, RC, SFM and SSC groups were 3.686, 3.680, 3.850 and 4.001 kg and total incomes per tank

were 25.8, 25.76, 26.95 and 28.01 LE, thus the sale price during the experimental period was 7 LE/ kg. Economical efficiency (calculated as percentage of revenue to total costs) for C, RC, SFM and SSC treatments were 132.51, 145.70, 145.44 and 149.15 percent respectively. These results indicated that the highest economical efficiency was reported by the SSC group followed in a decreasing order by RC, SFM and control group, respectively. These results indicated that, dried rumen contents or sunflower meal or sesame seed cake can be incorporated in tilapia diets to replace 30% of soybean meal for better economical efficiency results as well as better growth performance and nutrient utilization. In this connection, Saleh (2001), reported that incorporation of hatchery by product meal or Brewers's dried grain as alternative protein sources in tilapia diets reduced costs of one ton feed mixture. Who reported also that similar trend was obtained when yellow corn was replaced by either date stone meal or potato by products meal.

Table 6. The economical efficiency of the experimental diets

Treatment	Control	RC	SFM	SSC
Initial weight (Kg)	0.886	0.918	0.878	0.922
Final weight (Kg)	4.572	4.598	4.729	4.923
Total amount of feed intake (Kg)	6.674	6.819	6.822	7.146
Price of one kg of ration (L.E.)	2.02	1.71	1.84	1.79
Total feed costs (L.E.)	13.47	11.68	12.53	12.78
Cost of the fingerlings per tank (L.E)	6.00	6.00	6.00	6.00
Total costs (L.E)	19.47	17.68	18.53	18.78
Total fish weight gain per tank (Kg)	3.686	3.680	3.850	4.001
Sale price Kg fish (L.E)	7.00	7.00	7.00	7.00
Total income per tank for fish weight gain (L.E)	25.80	25.76	26.95	28.01
Revenues (L.E)	6.33	8.08	8.42	9.23
Economical efficiency %	132.51	145.70	145.44	149.15

The local market prices of the used ingredients were/ ton of: soybean meal, 1350 L,E,, fish meal, 5800 L.E., corn oil, 3250 L.E., yellow corn, 750 L.E., corn Gluten, 2600 L.E., Rice bran, 600 L.E., sunflower meal, 1000 L.E., sesame seed cake, 800 L.E., rumen content, 100 L.E., cellulose powder, 10000 L.E., fish premix (vit & min.), 9000 L.E.

In this connection, Ali (2004) reported that the highest economical efficiency of tilapia was obtained using diets containing 25% rumen contents or 25% sunflower seed meal.

REFERENCES

1. Abd El- Hakim, N. F., A. A. Al- Azab and A. A. El- Kholy. 2003."Effect of feeding some full fat oil seeds on performance of tilapia hybrid (*Oreochrornis niloticus* X *O. aureus*) reared in tanks." Egyptian J. Nutrition and feeds, 6 (Special Issue): 389- 403.
2. Abd El- Rahman, G. A. and G. A. El – Sayaad. 1989. "Inclusion of rumen

contents in rations for rabbits." In the 3rd Egg. Brit. Conf. Anim. Fish and Poult. Prod. Alex. 7- 10 Oct. 1009- 1015.

3. Abu Sinna, G. I. D. 2006. "Effect of dietary protein source on some blood parameters and growth Nile tilapia." Master of Science, Thesis Animal Production Department, Faculty of Agriculture, Cairo University.
4. Ali, Abo El-Makarem. 2004. "Nutritional studies on fish performance under intensive production conditions." Ph. D. Thesis Animal Production Department, Faculty of Agriculture, Ain Shams University.
5. Boyd, C. E. 1979. "Water quality in warm water fish ponds." Ed. Claude E. Boyd, Third Ed., 1984, Pub. Auburn Univ., Agric. Exp. Station, AID/Dsan G.G., 0039, pp. 359.
6. Camps, D. M. and S. Salas. 1987. "Rumen meal in broiler feeding." Lab. Investigaciones de Nutricion Y Zootecnia, Barandilla, Marianao, Havana, Cuba., 31 (2): 113- 119.
7. Duncan, D. B. 1955. "Multiple range test and multiple F tests." Biometrics, 11 (1): 1-42.
8. El- Hammady, A. I. 2001. "Nutritive values of corn Gluten meal and sesame seed meal in feed for hybrid tilapia (Oreochromis niloticus X Oreochromis aureus)." Egyptian J. Nutrition and Feed, 4 (1): 47- 66.
9. El- Saidy, D. M. S. and M. A. Gaber. 2003. "Replacement of fish meal with a mixture of different plant protein sources in juvenile Nile tilapia, Oreochromis niloticus (L.) Diets." Aquaculture research. 34, 1119- 1127.
10. Fowler, C. J. 1973. "Poultry pointers." Southwestern Poultry Times, April 14.
11. Gobi, B. 1981. "Tropical feeds." Food and Agricultural Organization of the United Nations, Rome.
12. Hassan, H. M. 1989. "The use of poultry droppings and dried rumen liquor in feed of Common Carp (Cyprious carpio L)." Ph. D. Thesis, Alex. Univ.
13. Hegazy, M. R. 1990. "Utilization of poultry droppings and dried liquor in feeds of Nile Tilapia (O. niloticus)." Ph. D., Thesis, Alex. Univ.
14. Hossain, M. A. and K. Jauncey. 1989. "Nutritional evaluation of some Bangladeshi oilseeds meals as partial substitutes for fish meal in the diet of common carp, Cyprinus carpio L." Aquaculture and Fisheries Management, 20: 225-260.
15. Ibrahim, G. D. 1985. "Supplemented levels of rumen contents in rainbow trout diets (cited by M. R., Hegazy. 1990." Ph. D. Thesis. Alex. Univ. (Review of Literature).
16. 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.
17. Jobling, M. 1983. "A short review and critique of methodology used in fish

growth and nutrition studies." J. Fish Biol., 23: 685-703

18. Kamara, B. K. A. 1982 "Evaluation of some oilseed meal proteins in complete diets for the tilapia (Oreochromis niloticus)." MSc. Thesis, Univ. of Stirling.
19. Martinez, C. A. 1986. 'Advances in the substitution of fish meal and soybean meal by sunflower meal in diets of rainbow trout (Salmo gairdneri, L)." An. Inst. Cienc. Mar. Limnol. Univ. Auton. Mexico, 13: 345-352.
20. Mukhopadhyay, N. and A. K. Ray. 2001. "Effect of fermentation on apparent total and nutrient digestibility of sesame (Seasamum indicum) seed meal in Rohu, Labeo Rohita (Hamilton) fingerlings." Abbrev. Acta Ichthyol. Piscat., 31 (2): 19- 28.
21. Mukhopadhyay, N. and A. K. Ray. 1999. "Utilization of copra meal in the formulation of compound dies for rohu, Labeo rohita, fingerlings." J. AppI. lchthyol., 15: 127-131.
22. Olukunle, O. A. 1982. "Partial plant substitution in diets of first feeding stage fry of tilapia: Orcochromis, Sarotherodon, Mossambicus." M.Sc. thesis, Univ. of Sterling.
23. Olvera- Novoa *et al*. 2002. "Sunflower seed meal as a protein source in diets for Tilapia rendalli (Boulanger, 1896) fingerlings." Aquaculture research, 33: 223-229.
24. Omar Eglal A., M. F. Osman and A. M. Nour. 1993. "Effect of replacing dried rumen liquor in diets of carp, tilapia and mullet on growth performance, feed utilization and carcass composition." 4th Conf., Agric. Dev. Ras., Ain-Shams Univ., Cairo, Feb. 13- 18, 1993. Annuals Agri. Sci.. Sp. Issue, 1, 47- 55.
25. SAS 1996. "SAS Procedure Guide "version 6.12 Ed"." SAS Institute Inc., Cary, NC, USA.
26. Salama, F. Abd El- Hay. 1996. "Effect of replacing fish meal with untraditional protein sources in tilapia diets." Master. Thesis Faculty of Agriculture, Ain Shams University.
27. Saleh, H. D. T. 2001. "The use of non- conventional Energy and protein feed sources in Nile tilapia diets." Ph. D. Thesis Animal Production Department, Faculty of Agriculture, Cairo University.
28. Sanz, A., Morales, M., De a Higuera and G. Cardenete. 1994. "Sunflower meal in rainbow trout (Cncorhynchus mykiss) diets: Protein and energy utilization." Aquaculture, 128: 287- 300.
29. Tacon, A. G. J. 1993. "Feed ingredient for warm water fish: Fishmeal and other processed feedstuffs." FAO Fisheries Circular No. 856. FAO, Rome.
30. Tacon, A. G. J. and A. M. P. Rodrigus. 1984. "Comparison of chromic oxide, crude fiber, polyethelene and acid-insoluble ash as dietary markers for the estimation of apparent digestibility coefficients in rainbow trout." Aquacult., 43: 391-399.

تأثير استبدال بروتين كسب فول الصويا بمصادر بروتينية نباتية أخرى على أداء النمو والكفاءة الاقتصادية فى أسماك البلطى النيلى وحيد الجنس المستزرع فى تنكات

نبيل فهمى عبدالحكيم ، محمد السعيد لاشين ، الدسوقى السيد محمد العزب ، هانى محمد نظمى

قسم الإنتاج الحيوانى - كلية الزراعة – جامعة الأزهر - القاهرة

أجريت هذه الدراسة فى المزرعة السمكية البحثية التجريبية الخاصة بكلية الزراعة جامعة الأزهر– مدينة نصر – القاهرة – جمهورية مصر العربية ، خلال الفترة من الأول من يولية وحتى الثالث من نوفمبر سنة 2005.

هدفت هذه الدراسة إلى تقييم أثر إحلال كل من محتويات الكرش الجافة أو كسب زهرة الشمس أو كسب السمسم لتحل محل 30% من بروتين كسب فول الصويا على أداء النمو لإسماك البلطى النيلى وحيد الجنس النامية بمتوسط وزن إبتدائى 30 جم.

استمرت التجربة لمدة 18 إسبوع بعد بدايتها وأجريت التجربة فى أحواض مستديرة من الفيبرجلاس حجم الحوض الكلى1 م^3.

- المعاملة الأولى: تم تغذيتها على عليقة ضابطة (مقارنة) احتوت على 30% بروتين مصدره مسحوق السمك المجفف وكسب فول الصويا.
- المعاملة الثانية: احتوت العليقة على محتويات الكرش الجافة.
- المعاملة الثالثة: احتوت العليقة على كسب زهرة الشمس.
- المعاملة الرابعة: احتوت العليقة على كسب السمسم.
- لتحل محل 30% من بروتين فول الصويا الموجود فى العليقة الضابطة على التوالى ويمكن تلخيص النتائج التى تم التحصل عليها فى الآتى:

1- لم يكن استخدام العلائق المحتوية على علائق محتويات الكرش أو كسب زهرة الشمس أو كسب السمسم أو العليقة الضابطة أى آثار ضارة على البيئة المائية بالأحواض التى بها الأسماك التجريبية وبناءا عليه قد كانت الأسماك التجريبية فى حالة طبيعية وأظهرت نشاطا طبيعيا.

2- إحلال 30% من بروتين فول الصويا ببروتين كسب السمسم أدى إلى تحسن معنوى فى أوزان أسماك البلطى النيلى النهائية فى حين لم تكن هناك فروقا معنوية بين معاملات محتويات الكرش وكسب زهرة الشمس والعليقة الضابطة فى صفة الأوزان النهائية.

3- إحلال 30% من بروتين كسب فول الصويا بمحتويات الكرش الجافة أو كسب زهرة الشمس أو كسب السمسم لم يؤثر معنويا على طول أسماك البلطى النيلى النهائية.

4- إحلال كل من محتويات الكرش الجافة أو كسب زهرة الشمس أو كسب السمسم لتحل محل 30% من كسب فول الصويا لم يؤدى إلى أى آثار معنوية على معدل النمو الكلى ومعدل النمو اليومى لأسماك البلطى النيلى.

5- معدل النمو النسبى لمجاميع الأسماك التى غذيت على علائق تحتوى على كسب زهرة الشمس و كسب السمسم كان أكبر معنويا مقارنا بالأسماك التى غذيت على علائق تحتوي على محتويات الكرش الجافة. وقد أظهرت النتائج نفس الإتجاه فى معدل النمو النوعى.

6- المجاميع التى غذيت على العليقة الضابطة والعليقة المحتوية على كسب زهرة الشمس والعليقة المحتوية على كسب السمسم اظهرت معنوية عالية فى معامل الحالة مقارنتاً بالمجموعة التى

غذيت على العليقة المحتوية على محتويات الكرش الجافة

7- المجاميع التى غذيت على العليقة الضابطة والعليقة المحتوية على كسب زهرة الشمس والعليقة المحتوية على كسب السمسم لتحل محل 30% من بروتين فول الصويا فى علائق أسماك البلطى لم تؤثر معنويا على كل من معدل استهلاك الغذاء و معامل التحويل الغذائى وكفاءة التحويل الغذائى.

8- أظهرت النتائج أن المجموعة المغذاه على العليقة المحتوية على كسب السمسم أعلى كفاءة اقتصادية تلاها المجموعة المغذاه على محتويات الكرش الجافة والمجموعة المغذاة على كسب زهرة الشمس فى حين أظهرت العليقة المقارنة (الضابطة) أقل كفاءة إقتصادية.

بناء على النتائج المتحصل عليها فإن إحلال 30% من بروتين محتويات الكرش الجافة أو كسب عباد الشمس أو كسب بذرة السمسم محل نفس النسبة من بروتين فول الصويا ليس له تأثير سلبى على أداء النمو وكفاءة الاستفادة من الغذاء فى أسماك البلطى النيلى .