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PARTIAL REPLACEMENT OF SOYBEAN MEAL WITH EITHER RAW OR SPROUTED MUNG BEAN SEEDS IN NILE TILAPIA (*Oreochromis niloticus*) DIETS.

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SUMMARY

Sprouted or raw mung bean seeds were used in Nile tilapia diets to replace 25% or 50% of soybean meal protein (9.3 and 18.7% of total dietary protein) on an iso-nitrogenous basis. Each diet was offered to three replicate groups of ten fish per treatment with a mean initial weight 23.92 ± 1.2 g. Fish were hand fed the experimental diets for a period of 60 days. Results revealed that fish fed diet containing 25% sprouted mung bean seeds had significantly improved growth and, feed conversion ratio, compared to the other diets. The poorest growth performance was exhibited by the group fed diet with 50% raw mung bean seeds. No significant differences were observed regarding the whole body protein and lipid contents among the groups of fish fed the control diet, 25% and 50% sprouted mung bean seeds. Significant reduction occurred in whole body protein and fat contents and significant increase in ash content when fish were fed diet containing 50% raw mung bean seeds. Apparent protein digestibility was significantly improved when fish were fed diet containing 25% sprouted mung bean seeds followed by the control diet and 50% sprouted mung bean seeds, yet slight non significant improvement in protein retention was noticed. On the other hand, groups of fish fed diets containing 25% or 50% raw mung bean seeds showed significant reduction in protein utilization compared to those groups fed the control diet, 25% or 50% sprouted mung bean seeds. Fat retention in fish fed control diet or 25% sprouted mung bean seeds appeared to be similar and both groups showed significantly higher fat retention records than the other dietary groups. Serum parameters represented by total serum cholesterol, LDL, ALT and alkaline phosphatase significantly increased when fish were fed diet containing 50% raw mung bean seeds compared to the other dietary groups. Based on results of this study, it is to recommend replacing up to 50% of soybean meal protein with sprouted mung bean seeds with no adverse effect on fish performance, body composition, and protein utilization. Ratio between essential fatty acids must be considered when formulating diets for Nile tilapia.

Keywords: soybean meal, mung bean, Nile tilapia, growth, protein utilization.

INTRODUCTION

Aquaculture is the fastest growing animal production sector in the world since 1984. Today, aquaculture production accounts for over a 61.5% of total fish production. Egypt, production from cultured tilapia had increased from 9000 ton in 1980 to 595030 ton in 2006 (FAO, 2006).To sustain the high rates of increase in aquaculture production, there should be a matching increase in the levels of production of fish feed.

The development of commercial aqua feed has been traditionally based on fish meal (FM) as the main source of animal protein, due to its high protein content and balanced essential amino acids (EAA) profile. FM is also an excellent source of essential free fatty acids (EFFA), digestible energy, minerals and vitamins (El-Sayed, 1999). However, global FM production coupled with increased demand and competition for its use in livestock and poultry feeds has increased FM prices. Therefore, several attempts have been made to partially or totally replace FM with cheaper available protein sources. Plant proteins are considered to be the most viable alternatives to replace FM for economic fish production in most developing countries. Leguminous seeds, mainly soybeans have been widely used as feed ingredients that partially replace FM in fish diets (Elangovan and Shim, 2000). Yet, the use of soybean meal as an alternative protein source becomes too expensive (the cost range between 2500 – 3000 LE/ton for soybean meal 48% protein in 2007). Due to that, there is necessity to look for another protein source to partially or totally replace soybean meal without competing with human demand and locally available protein sources.

Mung bean *Vigna radiata* is a leguminous crop that can grow in poor and degraded soil. It has been cultivated in Egypt in different areas since year 1997 as a project to evaluate the production of mung bean under Egyptian conditions (Ashour, 1997). Since its introduction, many varieties have been produced in Egypt (kawme -1, Giza -1, VC1000 and VC2719) (Ashour, 2000). Mung bean has not been accepted for human diets (according to Leguminous Institute of the Agriculture Research Center). This has opened the way for using mung bean seeds as fish feed ingredient without competing with human demands. The aim of this study is to investigate the effect of using raw or sprouted mung bean seeds protein as partial replacement for soybean meal protein on Nile tilapia growth performance, body composition and feed utilization.

MATERIALS AND METHODS

Experimental system and fish:

Nile tilapia fingerling *(Oreochromis niloticus)*, mono sex were brought from a fresh water commercial farm in El-Tal El-Kabeer, Esmalia governorate to Fish Experimental Unit of the Regional Laboratory for Food and Feed, Agriculture Research Center, Ministry of Agriculture, Giza, Egypt.

The fish were reared in a static water system composed of 15 fiberglass tanks, (of 85 L water). The tanks were individually aerated from a main compressor and had individual input and output for dechlorinate city water. Water temperature was about 24±1°C. All the experimental treatments were conducted under an artificial photo period equal to natural light/darkness period (12h light: 12h-darkness).

Diet formulation:

Mung bean seeds *Vigna radiata* were brought from National Research Center, Giza governorate. Mung bean seeds were divided into two groups. The first group was used in raw status representing untreated mung bean seeds. Seeds of the second group were sprouted following the procedure of (Tsou *et al.*, 1985) except that the sprouting period lasted for 48 hrs to reduce the effect of antinutritional factors according to (Sharma and Sehgal, 1992) recommendation. After sprouting the seeds were dried in ventilated oven at 50°C for 24 hrs, followed by air drying to stabilize moisture. This group represented sprouted mung bean seeds. The proximate analysis, gross energy (Table 1) and amino acids content (Table 2) of the experimental feed ingredients were determined before diets formulation.

Five experimental diets were formulated to contain 30% crude protein and ~3314 Kcal estimated digestible energy according to NRC (1993) (Table 3). The control diet (Diet 1), was formulated to contain fish meal and soybean meal as the primary protein sources. Four experimental diets were formulated to contain mung bean seeds to replace 25% or 50% of the soybean meal protein. Two diets from the previous four diets contained sprouted mung bean seeds while the other two diets contained raw mung bean seeds.

Table (1): Proximate analysis of ingredients used in experimental diets (on DM basis).

Item	fish meal	Mungbean seeds (sprouted)	Mungbean seeds (raw)	Soybean meal	Corn grains	Wheat flour byproduct less than 10% fiber
DM, %	92.40	89.60	89.02	88.70	86.60	88.35
CP, %	77.38	29.35	25.40	55.43	8.78	15.79
EE, %	9.74	0.78	0.82	1.35	2.98	2.94
CF, %	0.49	1.83	4.89	6.10	3.75	9.67
Ash, %	11.90	3.91	3.60	6.52	1.33	4.98
NFE[1] ,%	0.49	64.13	65.29	30.6	83.16	66.62
Total.P[3] %	1.82	0.61	0.50	0.70	0.29	1.38
Av.P[2] %	1.82	0.49	0.35	0.27	0.19	0.69
GE[4] kcal/kg	5264	4476	4438	4751	4420	4349

[1]NFE, nitrogen free extract = 100 – (CP % + CF % + EE % + ash %).
2Total.P total phosphorus
[3]Av.P Available phosphorus = Total phosphorus% – phytate phosphorus% according to (Wheeler and Ferrel, 1971).
[4]GE gross energy content was determined using bomb calorimeter.

Table (2): Essential amino acid content (%) of ingredients used in experimental diets.

Item	fish meal	Mungbean seeds (sprouted)	Mungbean seeds(raw)	Soybean meal	Corn grains	Wheat flour by product less than 10% fiber
Dry matter	92.40	89.60	89.02	88.70	86.60	88.35
CP, %	77.38	29.35	25.40	55.43	8.78	15.79
Arginine	5.02	1.44	1.24	4.07	0.48	1.09
Histidine	1.80	0.89	0.77	1.35	0.29	0.44
Isoleucine	3.41	1.44	1.24	2.73	0.39	0.57
Leucine	5.64	2.59	2.23	4.14	1.37	1.03
Lysine	5.83	2.31	1.99	3.52	0.28	0.65
Methionine	2.27	0.28	0.24	0.79	0.19	0.22
Cystine	0.81	0.12	0.10	0.83	0.25	0.36
Phenylalanine	2.94	1.68	1.44	2.71	0.54	0.62
Tyrosine	2.39	0.72	0.62	1.86	0.43	0.48
Threonine	3.16	0.88	0.75	2.15	0.40	0.51
Tryptophan	0.83	1.33	1.14	0.77	0.09	0.28
Valine	4.66	1.58	1.36	2.82	0.50	0.78

Table (3): Composition (g/ kg DM) and determined chemical composition of experimental diets (on DM basis).

Item	Control	SBM:MBSS[1]		SBM: MBSR[2]	
		75:25	50:50	75:25	50:50
	T1	T2	T3	T4	T5
Fish meal (FM) 72%	144.2	144.2	144.2	144.2	146.2
Mung bean seeds (MBS)	....	95.7	191.8	110.6	221.6
Soybean meal (SBM) 48%	202.8	152	101.4	152	101.4
Corn (crashed seeds)	305.5	196.6	88.1	160	40
Wheat bran	309.5	369.5	429.5	391.2	445.8
Soybean oil	-	4	7	4	7
Vit. & min. premix*	15	15	15	15	15
DL-Methionine	2	2	2	2	2
Di-calcium phosphate	16	16	16	16	16
Cr_2O_3	5	5	5	5	5
Total	100	100	100	100	100
Determined chemical composition					
Digestible energy (Kcal/kg)[3]	3460	3468	3472	3459	3454
Crude protein (%)	30.1	30.4	29.7	30.4	29.9
Ether extract (%)	3.48	3.83	3.80	3.93	4.05
Crude fiber (%)	5.44	5.48	5.52	5.92	6.23
Total (phos.) (%)	1.21	1.26	1.29	1.27	1.31
Available (phos.) (%)[4]	0.913	0.94	0.96	0.95	0.98
Protein energy ratio (mg/kcal)[5]	90.43	90.31	90.33	90.44	90.42

** Vitamin and mineral premix at 1.5% of the diet supplies the following per kg of the diet: vit. A 75000 IU, Vit. D 9000 IU, vit. E 150mg, vit. K 30mg, vit. B_1 26.7mg, vit. B_2 30mg, vit. B_6 24.7mg, vit. B_{12} 75mg, niacin 225mg, pantothenic acid 69mg, folic acid 7.5mg, vit. C 150mg, choline chloride 500mg, DL-methionine 300mg, Mn 204mg, Fe 93mg, Zn 210mg, Cu 11.25mg, I1.02mg.*

[1]MBSS: mung bean seeds sprouted.

[2]MBSR: mung bean seeds raw.

[3]Gross energy content was calculated using the values 5.65, 4.2 and 9.45 Kcal/ gm for protein, carbohydrate and lipid, respectively and applying the coefficient of 0.75 to convert gross energy to digestible energy according to Hepher et al.,, (1983).

[4]Available phosphorus = Total phosphorus% – phytate phosphorus% according to (Wheeler and Ferrel, 1971).

[5]Protein energy ratio (P/E ratio) = crude protein x 10000 / digestible energy, according to Hepher et al., (1983).

Experimental procedure:

One hundred and eighty Nile tilapia fingerlings *(Oreochromis niloticus)* mono sex of an average initial weight (23.92 ± 1.2g) were randomly distributed on 15 open system 85 liter tanks, where each tank contained 12 fingerlings. Two fish at the beginning of the experiment were randomly taken from each tank for determination of initial body composition, so that each tank during the growth trial contained ten fingerlings. Each three tanks (replicates) represented an experimental treatment. The first 15 days of the experiment were considered as habituation period and thereafter the growth trials were carried out for 60 days. All the diets contained 0.5% Cr_2O_3 as a marker to determine the apparent digestibility of protein. Diets were randomly assigned to the experimental units.

Fish were hand fed the experimental diets at three% rate of body weight for six days weekly, four times per day (Jauncey and Ross, 1982 and Coche, 1982). Fish were individually weighed once a week. At the end of the experimental period, three fecal samples were collected in six days period from each treatment. The samples were collected using siphon technique to determine the apparent digestibility of protein according to (Riche and Brown, 1996). Likewise, five fish were randomly taken from each tank at the end of the experimental period, then frozen at -20°C and kept for final body proximate analysis (Eya and Lovell, 1997).

Chemical analysis:

Proximate analysis of feed ingredients, experimental diets and whole body chemical composition as well as amino acids in feed ingredients and in experimental diets, were determined according to AOAC (2005). Gross energy of both ingredients and diets was determined using a bomb calorimeter (IKA C7000, Germany) with benzoic acid as a standard. Total phosphorus and phytic acid were determined using spectrophotometer (Unicam, England) following the photometric procedure of (AOAC, 2005) and (Wheeler and Ferrel, 1971), respectively. Chromic oxide in both diet and fecal samples were determined according to the procedure of (Edwards and Gillis, 1959). Total serum cholesterol, low density lipoprotein cholesterol (LDL), alanine amino transferase (ALT) and alkaline phosphatase were determined colorimetrically in serum using the methods described in the corresponding commercial kits of Diasys Diagnostic systems GmbH Germany.

Growth parameters and nutrient utilization:

Growth and nutrient utilization parameters were monitored and analyzed in terms of final body weight (FBW), weight gain (WG), feed conversion ratio (FCR), relative growth rate (RGR), specific growth rate (SGR), apparent protein digestibility (APD). Protein retention ($R_{protein}$) and fat retention (R_{fat}) were calculated as $R_n = (W_1 * C_{n1} - W_0 * C_{n0}) / FCR * (W_1 - W_0) * D_n$ (Einen, *et al.,* 1995). Where (R_n) is proportion of the element retained in growth, W_1, W_0 are the final and initial average live body weight, respectively. C_{n1}, C_{n0} the final and initial average element concentrations of the fish bodies, respectively. D_n is element n (protein or fat) in g per g diet.

Statistical analysis:

The data obtained were subjected to a one way analysis of variance using the linear model (GLM) of SAS (SAS Institute, 1991). Means were compared using Duncan's new multiple range test ($P<0.05$) (Duncan, 1955). It is worthy to note that percentages were transformed to their arc sign values before analysis. The original percentages though, are listed in the tables.

RESULTS AND DISCUSSION

Chemical composition of the experimental diets:

Determined chemical composition (Table 3) of the experimental diets showed limited variations among these diets; also there was limited variation in the amino acids profile (Table 4) between the different experimental diets.

Table (4): Essential amino acid (%) content of the experimental diets[1] (on DM basis).

Item	Control	FM : MBSS		FM: MBSR	
		75:25	50:50	75:25	50:50
	T1	T2	T3	T4	T5
Arginine	2.28	2.21	2.15	2.23	2.15
Histidine	0.85	0.86	0.87	0.87	0.87
Isoleucine	1.5	1.49	1.48	1.49	1.48
Leucine	2.68	2.62	2.56	2.59	2.50
Lysine	2.07	2.12	2.17	2.13	2.18
Methionine	1.11	1.16	1.14	1.17	1.15
Cystine	0.53	0.49	0.45	0.49	0.44
Phenylalanine	1.50	1.49	1.49	1.48	1.48
Tyrosine	1.13	1.07	1.02	1.08	1.03
Threonine	1.32	1.27	1.23	1.26	1.24
Tryptophan	0.44	0.54	0.64	0.55	0.65
Valine	1.84	1.83	1.85	1.84	1.83

[1]Amino acid requirements of tilapia (as % of diet) are as following: Arginine1.18, Histidine 0.48, Isoleucine 0.87, Leucine 0.95, Lysine 1.43, Methionine 0.75, Cystine 0.15, Phenylalanine 1.05, Tyrosine 0.5, Tryptophan 0.28, and Valine 0.78 (NRC, 1993).

Growth performance:

Growth performance (Table 5), showed that the group fed sprouted mung bean seeds at 25% replacement level of soybean meal protein had significantly (P<0.001) higher growth performance parameters than the control group and the other three treatment groups. This was represented by better feed conversion ratio and higher final body weight, relative growth rate and specific growth rate (2.70±0.06 (g/g), 37.16± 0.34g, 55.83±1.17% and 0.77±0.11 (g/g), respectively).

The final body weight, weight gain, feed conversion ratio, relative growth rate and specific growth rate of the control group and the group fed sprouted mung bean seeds protein at 50% replacement level of soybean meal protein were almost similar.

Final body weight was not significantly different between the group fed the control diet and the group fed 25% raw mung bean seeds. However, weight gain, feed conversion ratio, relative growth rate and specific growth rate were significantly different (P<0.001) among both groups.

There was no significant difference between the group fed 50% sprouted mung bean seeds and the group fed 25% raw mung bean seeds in final body weight and weight gain, while they showed a highly significant difference (P<0.001) in feed conversion, relative growth rate and specific growth rate.

The poorest growth performance was exhibited by the group fed 50% raw mung bean seeds. No mortality occurred from neutralization on the experimental diets. It is clear from the above results that sprouted mung bean seeds could successfully replace 50% of soybean meal protein without any adverse effects on growth performance. This agrees with the finding of Siddhuraju and Becker, (2001) who found that growth performance of common carp was relatively improved after mucuna seed (leguminous seeds) was soaked and autoclaved, while significant reduction in growth performance had occurred when fish were fed diets containing more than 13% raw mucuna meal. They attributed the reduction in growth to the presence of various antinutrients. According to (Tacon, 1993; and liener, 1994), increasing the inclusion percentage of raw leguminous plant protein sources in fish diets was limited by the presence of a number of antinutritional factors and poor content of sulfur amino acids. The effect of antinutritional factors was quiet clear from the results of growth performance in the groups fed raw mung bean seeds either at 25% replacement of soybean meal protein or 50% replacement level. Sprouting is one of the common processing techniques including soaking, germinating and dehulling, which helps in decreasing polyphenols content by 70% (Ramakrishna *et al.*, 2006), trypsin inhibitor by about 64.5 to 75.5 %, tannin content by 71.5 to 90.5% (Sharma and Sehgal, 1992), phytate content by 50% (Abdus Sattar *et al.*, 1989) and haemagglutinin by 79% (Mubarak, 2005).

Accordingly, sprouting is a successful technique that improved mung bean seeds utility; this is reflected on the growth performance of the groups of fish fed the diets containing the sprouted seeds.

Table (5): Effect of partial replacement for SBM protein with sprouted and raw MBS on tilapia growth performance[1].

Experimental treatments	% replacement of SBM protein	IBW2	FBW3	WG4	FCR5	RGR6	SGR7
Control	-	23.93 ±0.21	35.82[b] ±0.17	11.88[ab] ±0.29	3.00[c] ±0.07	49.60[b] ±1.58	0.69[b] ±0.012
Sprouted MBS	25	23.85 ±0.3	37.16[a] ±0.34	13.31[a] ±0.2	2.70[d] ±0.06	55.83[a] ±1.17	0.77[a] ±0.011
	50	23.99 ±0.43	35.28[b] ±0.72	11.29[bc] ±0.42	3.10[c] ±0.08	47.03[b] ±1.62	0.66[b] ±0.025
Raw MBS	25	24.55 ±0.3	35.36[b] ±0.46	10.81[c] ±0.21	3.27[b] ±0.05	44.03[c] ±0.7	0.63[c] ±0.011
	50	23.70 ±0.59	33.26[c] ±0.82	9.56[d] ±0.59	3.54[a] ±0.11	40.33[d] ±1.75	0.58[d] ±0.026
Probability	-	>0.05	<0.001	<0.001	<0.001	<0.001	<0.001

[1]*values are the mean of triplicate groups of fish. Mean values in columns with different superscripts are significantly different (P<0.05).*
[2]*IBW Initial body weight (g).* [3]*FBW Final body weight (g).* [4]*WG weight gain (g).* [5]*FCR Feed conversion ratio (g/g).*
[6]*RGR Relative growth rate (%).* [7]*SGR Specific growth rate (%)*

Whole body composition:

There was no significant difference in protein content of the whole body between the groups fed the sprouted mung bean seeds and the control group (Table 6), while there was a significant difference (P<0.01) between the groups fed raw mung bean seeds and the control group. The lowest body protein content (60.02±0.90%) was recorded in the group fed raw mung bean seeds in replacement of 50% of soybean meal protein. This agrees with the finding of Siddhuraju and Becker (2001) who found that, increasing the inclusion percentage of raw mucuna seeds more than 13% had significantly reduced body protein content.

There was no significant difference in body fat content (EE) between fish groups fed the control diet, sprouted mung bean seeds and 25% raw mung bean seeds. While there was a significant difference (P<0.05) between the group fed the control diet and the group fed 50% raw mung bean seeds. On the other hand, there was no significant difference in body fat content between the groups fed the sprouted mung bean seeds and raw mung bean seeds at either of the replacement levels. This agrees with finding of Siddhuraju and

Becker (2001) who did not find significant difference in body fat content of common carp between the respective fish fed the control diet and the autoclaved mucuna seed. Feeding diets containing more than 13% raw mucuna bean seeds protein caused a significant depression in carcass fat content. Hossain *et al.* (2001), found significant ($P<0.05$) reduction in carcass fat and gross energy content, when common carp was fed diets containing more than 12% raw sesbania seeds, they referred this depression to the presence of antinutrients specially tannins. According to (Liener, 1989; cited by Francis *et al.*, 2001), the antinutritional effect of tannins results from the interference with the digestive processes either by binding the enzymes or by binding to feed components like proteins or lipids. Tannins content in raw mung bean seeds varies from 330 mg/ 100g sample (Mubarak, 2005) to 780 mg/ 100g sample (Vasagam *et al.*, 2007). It might be possible in this study; that by increasing the replacement percentage of raw mung bean seeds from 25% to 50% of soybean meal protein, the tannins content of mung bean seeds had increased, which might have affected fat deposit.

Table (6): Effect of partial replacement of SBM protein with treated and untreated MBS on whole body chemical composition of Nile tilapia (DM basis)[1].

Experimental treatments	% replacement of SBM protein	CP[2] (%)	EE[3] (%)	Ash (%)
Control	----	61.50[a] ±0.72	23.75[a] ±0.48	14.74[c] ±0.24
Treated MBS	25	61.78[a] ±0.59	23.10[ab] ±0.75	15.93[b] ±0.17
	50	61.15[ab] ±1.52	22.95[ab] ±0.94	15.90[b] ±0.64
Untreated MBS	25	60.65[b] ±0.56	23.08[ab] ±0.25	16.27[ab] ±0.40
	50	60.02[c] ±0.90	22.39[b] ±0.70	16.89[a] ±0.57
Probability	----	<0.01	<0.05	<0.001

[1]values are the mean of triplicate groups of fish. Mean values in columns with different superscripts are significantly different ($P< 0.05$).
[2]CP crude protein. [3]EE ether extract.

There was no significant difference in body ash content between the groups fed raw mung bean seeds, although a significant increase ($P<0.001$) in body ash has occurred in the group fed 50% raw mung bean seeds (16.89±0.57%) compared to both groups fed sprouted mung bean seeds (25% or 50% replacement) and the control group (15.93±0.17%, 15.90±0.64%, 14.74±0.24%, respectively). There was no significant difference in body ash between the group fed 25% raw mung bean seeds (16.27%) and both groups fed sprouted mung bean seeds, while there was a significant difference ($P<0.001$) between these groups and the control group. These results agree with finding of Mubarak, (2005);and Vasagam *et al.*, (2007) who cited a significant ($P<0.05$) reduction in ash content when mung bean seeds were dehulled, soaked and germinated (3.60%, 3.32%, 3.55%, 3.60%, 3.70% and 3.50%, respectively) compared with raw mung bean seeds (3.76% and 3.80%, respectively). They referred this reduction to the probable leaching of minerals to processing media. Mubarak, (2005) added, that even though ash content of mung bean seeds was reduced by processing, the availability of minerals have increased.

The above obtained results confirmed our previous findings that sprouted mung bean seeds have improved the body composition of Nile tilapia compared to those groups fed raw mung bean seeds.

Protein utilization and fat retention:

Groups fed diet containing 25% sprouted mung bean seeds protein gave the highest significant (P<0.001) apparent protein digestibility (87.71±0.5%) (Table 7), followed by the control group (82.81±0.88%). There was no significant difference in apparent protein digestibility between group fed diet containing 50% sprouted mung bean seeds and the group fed diet containing 25% raw mung bean seeds (78.40±0.98 and 77.48±1.29%, respectively). The lowest apparent protein digestibility was noted in the group fed diet containing 50% raw mung bean seeds (60.95±2.82%). This agrees with the finding of (Wiryawan *et al.,* 1997) who reported that apparent protein digestibility of finishing pig had declined from 79.51% (control group soybean meal) to 77.05 for the group fed 30% replacement of soybean meal by mung bean seeds. Mubarak (2005) found significant (P<0.05) improvement in *in vitro* apparent protein digestibility of processed mung bean seeds (dehulled 84.3%, soaked 87.4%, germinated 89.1% and boiled 87.7%, successively) compared to raw mung bean seeds (80.2%). He referred this improvement to possible denaturation of protein, destruction of the trypsin inhibitor or reduction of tannins and phytic acids.

Table (7): Effect of partial replacement of SBM protein with treated and untreated MBS on Feed utilization by Nile tilapia[1].

Experimental treatments	% replacement of SBM protein	APD[2] (%)	3R$_{protein}$	4R$_{fat}$
Control	-----	82.81^{b} ±0.88	0.77^{a} ±0.01	1.12^{a}±0.04
Treated MBS	**25**	87.71^{a} ±0.5	0.81^{a}±0.025	1.10^{a}±0.14
	50	78.40^{c} ±0.98	0.74^{a}±0.06	0.48^{b}±0.14
Untreated MBS	**25**	77.48^{c} ±1.29	0.66^{b}±0.02	0.53^{b}±0.09
	50	60.95^{d} ±2.82	0.63^{b}±0.03	0.33^{b}±0.08
Probability	-	<0.001	<0.001	<0.001

[1]*values are the mean of triplicate groups of fish. Mean values in columns with different superscripts are significantly different (P< 0.05).*

[2]*APD . Apparent protein digestibility*

[3]*R$_{protein}$ Proportion of protein retained due to growth (gm protein retained in body / gm protein in diet)*

[4]*R$_{fat}$ Proportion of fat retained due to growth (gm fat retained in body /gm fat in diet)*

Fat retention in fish fed the control diet and in the group receiving 25% replacement by sprouted mung bean seeds appeared to be similar and significantly (P<0.001) higher than the other dietary groups. A slight increase in fat retention had been observed for the group fed 25% raw mung bean seeds (0.53±0.09g/g) compared with the two groups fed 50% replacement, whether sprouted (0.48±0.14g/g) or raw (0.33±0.08g/g). The depression in fat retention of the group fed 50% sprouted mung bean seeds might have resulted from change in the ratio between essential fatty acids, even though all diets were formulated to be isonitrogenous and isocaloric. This agrees with the finding of (Hanley, 1991) who reported that there was no significant effect of adding 5, 9 or 12% of lipid to tilapia diets, on growth and feed conversion. He concluded that improving tilapia diets may be better achieved through the quality and level of lipid rather than the quantity of lipid. Bell *et al.*, (1986) explained the role of essential fatty acids in metabolic functions; and said that essential fatty acids function as components of phospholipids in all biomembranes. Biomembranes must be in a fluid state to function properly at various temperatures. Membrane fluidity depends on the proper balance of saturated and unsaturated fatty acids.

Depression in fat retention in the groups fed raw mung bean seeds might have been resulted from both limitation and change in the ratio between essential fatty acids. Limitation of essential fatty acids might have resulted from the presence of antinutritional factors. This agrees with the finding of (Siddhuraju and Becker, 2001; Hossain *et al.*, 2001) who reported a significant ($P<0.05$) reduction in energy retention when common carp was fed more than 13% raw mucuna seeds or 12% raw sesbania seeds, respectively. They attributed this reduction to the presence of various antinutritional factors.

It is clear from the above results that sprouted mung bean seeds could successfully replace 50% of soybean meal protein with no adverse effect on protein utilization; yet, it must be kept in mind the quality and the quantity of fatty acids in the formulated diet.

Serum parameters:

Tabulated results (Table 8) showed that, there was a significant ($P<0.001$) increase in serum total cholesterol, LDL and liver enzymes in the group fed 50% raw mung bean seeds compared to the other groups fed the other experimental diets. The lowest serum total cholesterol, LDL and liver enzymes resulted from the groups fed either the control diet or 25% sprouted mung bean seeds. In this respects Hussein (1989) cited a significant increase in GPT (ALT) and GOT (AST) when comparing groups of rats fed raw mung bean seeds with groups fed the control diet or cooked mung bean seeds. The authors attributed this increase to toxic products resulting from the presence of antinutritional factors. In this connection, Peace *et al.*, (1991) reported that rats fed dietary soybean-trypsin-inhibitors, had a decrease in weight gain, feed efficiency, protein digestibility and increase in serum urea nitrogen, triglycerides, alkaline phosphatase and glutamate pyruvate transaminase. They added that, combination between two or more antinutritional factors caused increase in the deficiency symptoms for the groups of rats utilized the diets containing these factors.

Table (8): Effect of partial replacement of SBM protein with sprouted and raw MBS on serum total cholesterol, LDL, GPT and alkaline phosphatase enzymes of Nile tilapia[1].

Experimental treatments	% replacement of SBM protein	Total serum Cholesterol (Mg/dl)	2LDL (Mg/dl)	3ALT (U/L)	Alkaline phosphatase (U/L)
Control	——	109.93^{b} ±13.4	17.30^{c} ±2.0	74.0^{a} ±3.0	35.0^{a} ±2.5
Treated MBS	25	104.42^{b} ±10	19.00^{c} ±2.64	43.0^{d} ±1.0	30.0^{d} ±2.0
	50	119.28^{b} ±4.0	23.90^{b} ±2.0	83.0^{b} ±0.5	110.0^{c} ±5.0
Untreated MBS	25	122.60^{b} ±6.61	22.97^{b} ±1.70	83.5^{d} ±4.0	118.67^{b} ±3.21
	50	184.50^{a} ±5.90	35.73^{a} ±2.41	153.5^{a} ±0.5	183.3^{a} ±1.52
Probability	-	<0.001	<0.001	<0.001	<0.001

[1]*values are the mean of triplicate groups of fish. Mean values in columns with different superscripts are significantly different (P< 0.05).*
[2]*LDL Low density lipoprotein.*
[3]*ALT alanine amino transferase.*

From the above results it is clear that. using sprouted mung bean seeds in fish diets had no adverse effect on liver enzymes. On the other. hand using 25% replacement level had significantly improved liver function and decreased serum cholesterol content.

In conclusion. sprouted mung bean seeds protein could successfully replace up till 50% of soybean meal protein without adverse effect on growth performance, body composition, feed utilization and fish liver enzymes.

REFERENCES

Abdus, S. S. K. Durrani, F. Mahmood, A. Ahmed and I. Khan (1989). Effect of soaking and germination temperatures on selected nutrients and antinutrients of mung bean. Food Chemistry.. 34 (2): 111-120.

Ashour, N. I. (1997). Project to evaluate the productivity of mung bean under Egypt conditions: workshop "mung bean crop and its future in Egypt". National Research Center. Egypt in 13 of May 1997.

Ashour, N. I. (2000). "mung bean and its future in Egypt". Final report of the project of evaluation of mung bean production under Egypt conditions. January 2000. Egypt, 179pp.

A.O.A.C. (2005). "Official methods of analysis of the Association of official Analytical Chemists", 18th. Ed. Vol. 1, published by the A.O.A.C., Benjamin Francklin station, Washington, DC.

Bell, J. C. B.J.S. Pirie, J.W. Adron and C.B. Cowey (1986). Some effects of selenium deficiency on glutathione peroxidase (EC1.11.1.9.) activity and tissue pathology in rainbow trout (Salmo gairdneri). British Journal of Nutrition, 55: 305-311.

Coche, A. G. (1982). Cage culture of tilapias. In: the Biology and Culture of Tilapia, eds. R.S.V. Pullin and R.H. Lowe-McConnel. Manila, Philippines: ICLARM. Cited by Lovell, T. (1989).

Duncan, D. B. (1955). Multiple range and Multiple F test. Biometrics, 11: 1 – 42.

Edwards, H. M. Jr. and M.B. Gillis (1959). A chromic oxide balance method for determining phosphate availability. Poultry. Sci., 569 – 574.

Einen, O. I. Holmefjord, T. Åsgård and C. Talbot (1995). Auditing nutrient discharges from fish farms: theoretical and practical considerations. Aquaculture Research. 26: 701-713.

Elangovan, A. and K.F. Shim (2000). The influence of replacing fish meal partially in the diet with soybean meal on growth and body composition of juvenile tin foil barb Barbodes altus. Aquaculture, 189: 133-144.

El-Sayed, A. F.M. (1999). Alternative dietary protein sources for farmed tilapia, Oreochromis spp. Aquaculture, 179: 149-168.

Eya, J. C. and R.T. Lovell (1997). Available phosphorus requirements of food- size channel catfish Ictalurus punctatus fed practical diets in ponds. Aquaculture, 154: 283-291.

FAO, (2006). Food and Agriculture Organization of the United Nations). Fisheries and Aquaculture Information and Statistics Service. FAO. Rome. Italy.. http.//wwwFAO.org/fishery/countrysector/FI-CP.EG/3.

Francis, G.; H.P.S. Makkar and K. Becker (2001). Antinutritional factors present in plant-derived alternate fish feed ingredients and their effects in fish. Aquaculture. 199: 197-227

Hanley, F. (1991). Effects of feeding supplementary diets contanining varying levels of lipid on growth, food conversion, and body composition of Nile tilapia. Oreochromis niloticus (L.). Aquaculture, 93: 323-334

Hepher, B., I.C. Liao, S.H. Cheng and C.S. Haseih (1983). Food utilization by red tilapia. Effect of diet compostion, feeding level and temperature on utilization efficiency for maintenance and growth. Aquaculture, 32: 255 – 272.

Hossain, M. A., U. Focken and K. Becker (2001). Evaluation of an unconventional legume seed, Sesbania aculeate, as a dietary protein source for common carp, Cyprinus carpio L. Aquaculture, 198: 129-140.

Hussein, I.M. Hemmat (1989). Comparative studies on the chemical and biological values of some legume seeds. PhD. Thesis, Fac. of Agric. Cairo Univ. Cited by El-Alfy, M.A. (1998).

Jauncey, K. and B.R. Ross (1982). "A guide to tilapia feeds and feeding". Institute of Aquaculture, University of Striling. FKA, Scotland, V.K.L., 9: 68.

Liener, I. E. (1989). Antinutritional factors in legume seeds: State of the Art. In: Huisman, J. Van der Poel, A.F.B. Liener, I.E. (Eds.), Recent Advances of Research in Antinutritional Factors in Legume Seeds. Pudoc, Wageningen, pp. 6-14. Cited by Francis et al., (2001).

Liener, I. E. (1994). Implications of antinutritional components in soybean food. Crit. Rev. Food Sci. Nuti., 34: 31-67.

Mubarak, A. E. (2005). Nutritional composition and antinutritional factors of mung bean seeds Phaseolous aureus as affected by some home traditional processes. Food Chemistry., 89 (4): 489-495.

NRC (1993). National research council. Nutrient requirements of fish.National Academy Press, Washington D.C., 114pp.

Peace, R. W., D.G. Sarwar, S.P. Touchburn and H.G. Botting (1991). Effects of soybean trypsin inhibitors and DL- methionine on growth and serum parameters in young rats. Nutrition Research., 11 (10): 1197-1208.

Ramakrishna, V., P. Jhansi Rani and R.P. Ramakrishna (2006). Antinutritional factors during germination in Indian bean Dolichos lablab L. seeds. World Journal of Dairy and Food sciences., 1 (1): 6-11.

Riche, M. and P.B. Brown (1996). Availability of phosphorus from feedstuffs fed to rainbow trout, Oncorhynchus mykiss. Aquaculture, 142: 269 – 282.

SAS (1991). SAS / STAT User's guide. SAS Institute, Cary, NC, USA, 1028.

Sharma, A. and S. Sehgal (1992). Effect of domestic processing, cooking and germination on the trypsin inhibitor activity and tannin content of faba bean Vicia faba springer Netherlands. Plant Foods for Human Nutrition. 42 (2): 127-133.

Siddhuraju, P. and K. Becker (2001). Preliminary nutritional evaluation of mucuna seed meal (Mucuna pruriens. Var. Utilis) in common carp (Cyprinus carpio L.): an assessment by growth performance and feed utilization. Aquaculture., 196: 105-123.

Tacon, A. G. J. (1993). Feed ingredients for warm water fish: fish meal and other processed feed stuffs. FAO Fisheries Circular No. 856. FAO., Rome. 64pp.

Tsou, S. C. S., K.K. Kan and Y.H. Lee (1985). Introduction of soybean processing products and preparation of mung bean sprouts. TVIS News., 1(2): 2-3.

Vasagam, K. P. K., T. Balasubramanian and R. Venkatesan (2007). Apparent digestibility of differently processed grain legumes, cow pea and mung bean in black tiger shrimp, Penaeus monodon. Fabricus and associated histological anomalies in hepatopancreas and mid gut. Animal Feed Science and Technology. 132 (3-4): 250-266.

Wheeler, E. L. and R.E. Ferrel (1971). A method for phytic acid determination in wheat and wheat fractions. American Association of Cereal Chemistry. 48: 312 – 320.

Wiryawan, K. G., H.M. Miller and J.H.G. Holmes (1997). Mung beans (Phaseolus aureus) for finishing pigs. Animal Feed Science and Technology.

الإحلال الجزئي لكسب فول الصويا سواء ببذور فول المانج الخام أو المنبتة في علائق اسماك البلطى النيلى

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استخدمت بذور فول المانج (*Vigana radiate*) سواء الخام أو المنبتة كبديل لبروتين كسب فول الصويا فى علائق البلطى النيلى. حيث اجرى احلال كل منهما بنسبة ٢٥، ٥٠ ٪ من بروتين كسب الصويا(٩٫٣، ١٨٫٧ ٪ من بروتين العليقة) فى علائق شبة متساوية فى محتواها من البروتين والطاقة. اشتملت كل معاملة على ثلاث مكررات، واحتوى المكرر الواحد على عشر سمكات، بحيث كان متوسط وزن الاسماك ٢٣٫٩٢ ±١٫٢ جم غذيت الاسماك يدويا بمعدل ثلاثة فى المئة من وزن الجسم، وذلك على مدار ستة ايام فى الاسبوع، اربع مرات يوميا، واستمرت التجربة لمدة ٦٠ يوم بناء على معطيات معدل النمو، تكوين الجسم، معدل الاستفادة من بروتين الغذاء، تخزين الدهن فى الجسم وقياسات الدم.

وجد أن:

الاسماك المغذاة على العليقة المحتوية على ٢٥٪ بذور مانج منبتة حققت زيادة معنوية فى وزن الجسم النهائى، معدل التحويل الغذائى، معدل النمو النسبى ومعدل النمو النوعى مقارنة بالاسماك المغذاة على العلائق الاخرى. بينما حققت العليقة المحتوية على ٥٠٪ بذور فول المانج أدنى معدلات نمو.

لم يكن فروق معنوية فى محتوى الجسم من البروتين والدهون بين الاسماك التى تغذت على العليقة القياسية، ٢٥، ٥٠٪ بذور فول مانج منبتة بينما كان هناك انخفاض معنوى فى محتوى الجسم من البروتين والدهن وزيادة معنوية فى محتوى جسم الاسماك من الرماد عندما تغذت على عليقة تحتوى ٥٠٪ فول مانج.

حدث تحسن فى معامل الهضم الظاهرى للبروتين عند تغذية الاسماك على العليقة المحتوية على ٢٥٪ بذور فول مانج منبتة تلاها العليقة القياسية ثم العليقة المحتوية على ٥٠٪ بذور فول مانج منبتة، الا أن معدل اختزان البروتين داخل لم يحقق الا تحسن بسيط فى المقابل حققت الاسماك التى تغذت على علائق محتوية على ٢٥ أو ٥٠٪ بذور فول مانج خام حققت انخفاض معنوى فى معدل الاستفادة من بروتين الغذاء مقارنة بالاسماك التى تغذت على العلائق القياسية، ٢٥ ، ٥٠٪ بذور فول مانج المنبتة.

اظهرت النتائج تساوى الاسماك المغذاة على العليقة القياسية وتلك المغذاة على العليقة المحتوية على ٢٥٪ بنور فول مانج منبتة فى قدرتها على تخزين الدهن داخل الجسم، بينما كان هناك زيادة معنوية فى قدرة العلائق السالف ذكرها على اختزان الدهن مقارنة بباقى العلائق المستخدمة فى التجربة.

اوضحت قياسات الدم متمثلة فى الكوليسترول الكلى فى الدم، LDL وانزيمات وظائف الكبد(ALT and Alkaline phosphatase) ارتفاع معنوى عند تغذية الاسماك على العليقة المحتوية على ٥٠٪ بنور فول مانج خام مقارنة بباقى العلائق.

وعلية ومن خلال نتائج تلك الدراسة نجد انة يمكن استبدال حتى ٥٠٪ من بروتين كسب الصويا ببروتين فول المانج المستنبت دون حدوث تأثيرات سلبية على كل من نمو الاسماك، مكونات جسم السمكة والاستفادة من البروتين، كما يجب مراعاة النسب بين الاحماض الدهنية الضرورية عند تركيب علائق اسماك البلطى.