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EFFECT OF PARTIAL AND TOTAL REPLACEMENT OF DIETARY FISH MEAL WITH BOILED FULL-FAT SOYBEANS ON PRODUCTION AND BIOCHEMICAL COMPOSITION OF NILE TILAPIA.

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SUMMARY

Nile tilapia grow-out with an average initial weight of 24.3 gm were reared in 10 concrete ponds (8m2 each) during a period of 18 weeks. The reared fish was stocked at a rate of 8 fish /m^2 and fed on 5 artificial diets with different levels of soybeans as partial and total fish meal replacer in these diets.

At the end of cultured period, the weight gain was gradually increased with increasing the rearing period and the total weight gain in diet 2 (75% FM and 25% BFS) has a value of 107.3 gm/ fish which is nearly to the control diet (100% FM). The total fish production was 4.19 Kg /pond and 0.52 Kg/ m^2 which is also approximately equal the values of control diet (4.43 kg /pond and 0.55 kg/m^2). This indicates that, the full-fat soybeans is a promising feed ingredients for replacement the animal protein at 25% dietary protein in Nile tilapia diets. The results also cleared that, the highest values of profit index (2.65,2.51) were obtained from fish fed diets 2,3 (25% and 50% BFS).

With respect to the biochemical analysis, it was noticed that at diet 2 (75% FM and 25% BFS) the percent of protein in liver and muscle of fish take its suitable values (21, 96 gm/100 gm liver tissue and 67.20% in dry matter of fish flesh). While the hepatic lipid and crude fat in muscle reached its lowest values (7.94 gm / 100 gm liver tissue and 17.75% in dry matter) for fish fed same diet. The energy content also has its optimum values in fish fed diets 2,3 (25% and 50% BFS fish meal replacers).

INTRODUCTION

Fish culture has greatly developed not only in Egypt but also allover the world countries in order to improve the quality and quantity of different types of farmed fish, specially tilapia species which is most important fish cultured in developing countries including Egypt (Hassanen, 1986 and Siddiqui et al ., 1988). The fish culture require artificial diets relatively high in the protein content because of their poor utilization of carbohydrates as energy sources (Degani et al., 1989). Formulation of fish diets with different levels of protein and energy depend mostly on fish meal which is a rather expensive feed ingredient. Therefore many investigations have been devoted concerning the dietary replacement of fish meal with other feed ingredients as dietary protein sources. Among them; Wassef (1991) replaced the fish meal of artificial diets by fermented fish silage for fed *Sparus auratus*. Fagbenro et al. (1994) reared juveniles *Oreochromis niloticus* and *Clarias gariepinus* on diets containing dried lactic acid fermented fish silage and soybean meal.

Other attentions has also been given to the use of ground nut, sunflower, rape seeds and plan kernel as oil seed meals in the diets (Balogun & Fagbenro, 1995). Osman et al. (1996) used of leucaena leaf meal as a fish meal replacer in tilapia cultured ponds and noticed the same result as in diets contain fish meal. Similarly, Mohamed (1998) studied on the evaluation nutritional value of the dehydrated leaves waste of some vegetable crops in diets of Nile tilapia. On the other hand, Gobran (2000) reared *Oreochromis aureus* and *O. niloticus* on artificial diets containing acid fish silage and soybean.

Generally, there is a great need to identify and utilize locally available feed ingredient sources, wherever possible, so as to minimize imports and reduced feed costs. Therefore, the present study was conducted, to also show the effect of boiled full-fat soybean as fish meal replacer on production and biochemical composition of Nile tilapia (*O.niloticus*).

MATERIALS AND METHODS

Site of work and fish used:

The experimental work conducted in 10 rectangular concrete ponds (8 m^2 each with 1.2 m depth) located outdoors at El-Kanater El-Khayria Research Station (NIOF), 60 km north of Cairo. The ponds were dried and cleaned from predators and aquatic plants, then filled with freshwater originally from a Nile branch passed through a 1-mm screen mesh.

Fish used in this experiment were obtained from the wild, acclimated to pond conditions and fed commercial feed for one week before the feeding trails. Experimental fish has an initial length of

10.19 cm and initial weight of 23.45 gm, randomly stocked in duplicate treatments into the test ponds at a rate of 8 fish /m^2. Fish were hand-fed to visual satiety (about 3% of biomass), twice daily at 0900 and 1600h for 6 days a week, the feeding trails started in 1st April and lasted for 18 weeks.

Preparation of experimental diets:

The boiled full-fat soybeans (BFS) was prepared by boiling the raw soybeans for one hour and then dried into an oven at 48°C for 20 minutes then milled and sieved (Wee and Shu,1989). The experimental diets were formulated using different levels (25%, 50% and 100%) of boiled full-fat soybeans (BFS) as a fish meal replacer, while the control diet containing 100% fish meal (FM). The other ingredients and chemical composition of the test diets are given in table (1). These diets were supplied as pellets by using California Pellet Meal (CPM) machine.

Sample collection and biochemical analysis:

At the end of experimental period (18 weeks), the growth of length (cm) and weight (gm) were measured at two - weekly intervals. Food given and mortality were recorded daily, while the total fish production was calculated after the rearing period.

The proximate composition of fish and diets was determined according to AOAC standard methods (AOAC, 1980). The biochemical analysis of liver was carried out by homogenized the tissue and determined these metabolites; liver glycogen by using Anthrone reagent (Handel,1965), liver lipid using method of Zollner and Kirsch (1962) and liver protein using kits described by Gornall et al. (1949). The energy contents (gross energy, metabolizable energy and protein energy ratio) was calculated according to NRC (1983) and Omar (1993).

Statistical analysis and economics:

Results were subjected to one-way ANOVA and Duncan's multiple range test was used to compare means of the experimental date (Steel and Torrie, 1980). The significant level was established at $p < 0.05$. The final cost and profitability of rearing Nile tilapia grow-out were measured using method of Mohamed (1998) as follows:

Incident cost = Cost of food / Fish production.
Profit index = Price of fish produced/ Feed cost.

RESULTS AND DISCUSSION

Feed represent the major variable operating costs in fish farming and optimizing their use repre-

sents an opportunity for many farmers to increase and maintain the profitability of their farms. The conventional diet were mainly depended on fish meal as a source of protein which is a rather expensive item for raising fish. Soybean meal is one of the most abundant of the oilseed meals used widely in animal and fish nutrition.

The present results shown in table (2) indicated that, the average values of fish weight gain were slightly increased with increasing the rearing period. While, the total weight gain has a value of 107.3 gm for fish fed diet 2 (75% FM + 25% BFS) and when the BFS level increased to 100% in the diet, the total weight gain reduced to 74.87gm/ fish. Similarly, the previous investigations showed that a reduction of the fish growth has been reported when fishmeal was replaced with increasing levels of soybean meal (Shiau et al., 1990, Webster et al., 1992; Gallagher, 1994 and Robaina et al., 1995).

However raw soybean meal or inadequately heat-

Table (1): Formulation of five diets with different levels of boited full-fat soybeans and its chemical composition.

Ingredient	Diet 1 (control) 100% FM		Diet2 75% FM 25% BFS		Diet 3 50% FM 50% BFS		Diet 4 25% FM 75% BFS		Diet 5 100% BFS	
	Weight (gm)	Protein (%)	Weight (gm)	Protein (%)	Weight (gm)	Protein (%)	Weight (gm)	Protein (%)	Weight (gm)	Protein (%)
Fishmeal	14.00	8.54	10.50	6.41	7.00	4.24	3.50	2.14	-	-
BFS	-	-	3.50	1.54	7.00	3.08	10.50	4.62	14.00	6.16
Soybem meal	25.00	11.00	25.00	11.00	25.00	11.00	25.00	11.00	25.00	11.00
Rice bran	30.70	5.22	30.70	5.22	30.70	5.22	30.70	5.22	30.70	5.22
Wheat bran	29.20	3.50	29.20	3.50	29.20	3.50	29.20	3.50	29.20	3.50
Sunflower oil	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
Vit and Min premix	0.10	-	0.10	-	0.10	-	0.10	-	0.10	-
Total	100.0	28.26	100.0	27.67	100.0	27.04	100.0	26.48	100.0	25.88
Crude protein (%)	28.26		27.67		27.07		26.48		25.88	
Crude fat (%)	3.77		3.52		3.27		3.02		2.78	
Ash content (%)	10.26		9.81		9.37		8.92		8.48	
Water content (%)	5.67		8.78		8.88		8.97		9.07	
G. energy (kcal/kg)	1952.49		1895.26		1838.42		1758.13		1724.53	
P/E ration*	144.77		146.02		147.28		150.63		150.03	

* Protein/energy ration (P/E ratio) = Crude protein (mg/Kg)/ Gross energy (K cal/Kg).
FM = Fish meal. * BFS = Boiled full-fat soybean.

Table (2) Variations of weight gain(gm) of Nile tilapia (grow-out) fed diets containing different levels of BFS for 18 weeks

Rearing period (week)	Diet 1 (control) 100% FM	Diet2 75% FM 25% BFS	Diet 3 50% FM 50% BFS	Diet 4 25% FM 75% BFS	Diet 5 100% BFS
	MW ± SD	MW ± SD	MW ± SD	MW ± SD	MW ± SD
0 (Initial MW)	24.30±4.91	24.30±4.80	24.30±4.66	24.30±5.03	24.30±1.81
2	29.80±6.76	29.71±6.36	28.90±5.86	27.90±5.69	26.85±5.63
4	36.70±10.11	36.05±9.39	34.00±7.90	33.00±7.87	30.70±6.48
6	46.00±13.14	45.10±12.41	42.90±10.75	40.87±9.83	37.10±910
8	61.50±16.53	56.00±15.70	52.13±13.64	50.90±12.64	47.00±11.72
10	76.00±18.21	69.20±17.69	63.70±15.64	60.61±14.61	56.46±13.73
12	90.00±19.90	82.00±18.86	71.17±17.53	67.23±16.43	62.18±15.37
14	106.00±22.19	96.60±20.97	80.23±18.32	75.15±18.22	69.35±17.44
16	119.00±23.77	108.30±22.33	90.41±19.61	84.94±19.57	79.24±18.84
18 (Final MW)	143.10±26.01	131.60±24.62	114.18±22.07	107.35±22.09	99.17±20.93
Weight gain (gm)	118.80	107.30	89.88	83.05	74.87

* MW= Mean of weight (gm). * SD= Standard deviation.

ed soybean meal contains higher activity of trypsin protease inhibitors causing growth reduction (Wilson and Poe, 1985). Therefore, soybean should be either properly heated by boiling or defatted or germinated prior roasting before inclusion as meals in aquafeeds (Wassef et al., 1988 and Wee & Shu, 1989).

Table (3) indicated that, the total fish production was 4.19kg/ pond (0.52 km / m^2) for fish fed diet 2 (75% FM + 25% BFS) with not significantly different from those fed control diet (100% FM). Same observations were also found by Shiau et al. (1990) when experimented BTS as a partial replacement for FM in tilapia hybrid (*O.niloticus* X *O. aureus*). This may be attributed to the fact that, the deamination process of dietary protein was increased by increasing the substitution of fish meal by soybean meal (Robaina et al., 1995). On the other hand, table (3) cleared that the incident cost was significantly increased ($p<0.05$) for fish fed the diet incorporating 100% BFS (diet 5). While the maximum profit index (2.65) was recorded for fish fed diets containing 75% FM and 25% BFS

with significantly difference ($p< 0.05$) when compared with control diet (100% FM). This may be agree with that postulated by Khalifah (1995) and Atwa (1997) in their studies on the evaluation of Nile tilapia diets.

As shown in table (4) the values of hepatic protein and glycogen were not clear any difference at different levels of BFS as fish meal replacers, while the total lipid in liver was gradually increased with increasing of BFS percent in the diets. Similarly, in case of body composition, the crude protein in dry matter of fish flesh was not varied with BFS level in the diets, while the crude fat reached its highest value (22.48%) in fish fed diet 5 (100% BSF). The same observation were also noticed at determination of the energy content and P/E ratio. Similar findings were also detected by Siddiqui et al. (1988), El-Ghobashy (1990) and Sweilum (1995) in their studies on

Table (3) Production, survival rate and profitability of Nile tilapia (grow-out) fed diets containing different levels of BFS

Items	Diet 1 (control) 100% FM	Diet2 75% FM 25% BFS	Diet 3 50% FM 50% BFS	Diet 4 25% FM 75% BFS	Diet 5 100% BFS
Initial weight/fish (gm)	24.30	24.30	24.30	24.30	24.30
Final weigh/fish (gm)	143.10	131.60	114.18	107.35	99.17
Total weight gain/fish(gm)	118.80	107.30	89.88	83.05	74.87
Weight gain/fish/day (gm)	0.94	0.85	0.71	0.66	0.59
Number of fish/pond	40	40	40	40	40
Number of fish lossed	1	1	1	2	1
Survival rat (%)	97.50	97.50	97.50	95.00	97.50
Total production/pond (Kg)	4.43	4.19	3.51	3.16	2.92
Production/m^2 (Kg)	0.55	0.52	0.44	0.40	0.37
Total food given (Kg)	10.61	9.85	8.78	8.37	7.80
Incident cost (%)	2.85	2.64*	2.78	2.84	2.75*
Profit index (%)	2.46	2.65*	2.51*	2.47	2.54

* Significant at level of $P < 0.05$ - Rearing period of 18 weeks or 126 days.

rearing of *Oreochromis niloticus* with different experimental diets.

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Table (4) Liver metabolites, carcass composition and energy content of Nile tilapia (grow-out) fed diets containing different levels of BFS.

Items	Diet 1 (control) 100% FM	Diet2 75% FM 25% BFS	Diet 3 50% FM 50% BFS	Diet 4 25% FM 75% BFS	Diet 5 100% BFS
	M ± SD	M ± SD	M ± SD	M ± SD	M ± SD
Liver metabolites:					
Protein (gm/100gm tissue)	22.23±1.95	21.96±1.76	21.60±1.51	20.92±1.28	20.58±1.09
Lipid (gm/100gm tissue)	8.40±0.40	7.94±0.30	8.65±0.40	10.03±0.50	10.51±0.50
Glycogen (gm/100gm tissue)	3.41±0.28	2.69±0.20	2.41±0.20	2.33±0.16	2.10±0.17
Carcass composition:					
Crude protein (%)	71.11±0.79	67.20±1.47*	66.97±1.40*	64.87±2.65*	63.49±2.28*
Crude protein (%)	18.11±1.98	17.75±0.76	17.92±0.32	20.68±1.57*	22.48±2.13*
Ash content (%)	10.78±0.98	15.05±0.74*	15.11±1.07*	14.54±1.08*	12.85±0.91*
Water content	74.70±3.98	73.93±3.28	75.20±4.69	75.29±4.70*	78.15±5.17*

* Significant at level of $P<0.05$
- The values expressed as mean (M) ± Standard deviation (SE)

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