J. Agric. Sci. Mansoura Univ., 33 (9): 6363 - 6372, 2008

PARTIAL REPLACEMENT OF FEED PROTEIN WITH SHRIMP WASTE MEAL IN NILE TILAPIA (*Oreochromis niloticus*) DIETS.

Mahmoud, S.H; Hayam D. Tonsy; Faiza A. Salama and M.A. El-Garhy
Animal Production Research Institute, By-products utilization Dept. Agric. Research Center, Dokki; Giza, Egypt.

ABSTRACT

Partial replacement of feed protein with shrimp waste meal was done in four experimental diets for Nile tilapia fry (*Oreochromis niloticus* L.) at 0, 10, 20 and 30% substitution levels (T_1, T_2, T_3 and T_4, respectively). The experimental diets were applied for 180 tilapia each of 1.4 g initial weight which were stocked randomly in to 12 aerated aquaria (60 × 40 × 30 cm) during the experiment period of 64 days.

Results indicated that, chemical analysis of shrimp meal showed that it contains high percentages of CP (49%) and ash (26.35); however, it contains low contents of EE (3.32%), CF (10.48%) and NFE (10.85%).

Also, the final weight of Nile tilapia decreased significantly ($P < 0.05$) with increasing shrimp meal level in the tested diets up to 30% as a replace of feed protein. The results showed that the highest weight gain, SGR, PER, PPV and EU% was achieved with T_1, T_2 and T_3 compared with T_4.

In conclusion, shrimp meal from the nutritionally and economically points of view is a non-conventional animal protein source in Nile tilapia feeding up to 20% of feed protein.

Keywords: Nile tilapia, Shrimp waste meal, Growth performance, Body composition, Economic evaluation.

INTRODUCTION

Nutrition plays an important role in intensive fish aquaculture depending upon the type and cost of available feeds. To minimize the feeding cost which exceeds 50% of operation costs (Scharoder, 1977), emphasis is being laid on research into use of non-conventional feed sources to replace other expensive protein sources as well as to reduce hazard of pollution resulting from these waste products (Steffens, 1994).

Increasing of fish meal prices, make researchers (Shiau *et al.*, 1990; Robina *et al.*, 1995; Refsite *et al.*, 1998; Soliman 2000 a, b and Al-Azab 2005) conduct different studies on the replacement of expensive fish meal proteins with lower cost alternative ingredients. Most of animal by-product meals (poultry by-product meal, blood meal, meat and bone meal, hatchery by-product, Cray fish and shrimp meal have high protein contents (NRC, 1983 and Agouz and Tonsi, 2003). However, these feeds may be deficient in one or more of the EAAs, especially lysine, Isoleucine and methionine (Tacon and Jackson, 1985).

Soliman (2000a), reported that replacement of fish meal with dried shrimp wastes (Squella mantis) at levels of 25, 50, 75 and 100% reduced growth performance parameters of Nile tilapia as compared to the control diet containing fish meal.

The same findings were observed by Al-Azab (2005) who reported that final weights of Nile tilapia reduced significantly with increasing shrimp waste meal in diets. The decrease was more cleared at incorporation levels of 50 and 100% in replacement with fish meal in the tested diets.

Therefore, the present study was conducted to evaluate the partial replacement of commercial protein sources by shrimp waste meal (unmarketable) in practical diets of Nile tilapia (*O. niloticus*) fry.

MATERIALS AND METHODS

1- Diets preparation and procedure:

The present experiment was carried out in Faculty of Agriculture, Menofiya University to study the effect of partial replacement of feed protein by shrimp waste meal in tilapia diets whereas, shrimp waste meal was obtained from Cairo local markets. The proximate analysis of shrimp waste meal is presented in Table (1).

Table (1): Proximate analysis of the shrimp waste meal (% day matter basis).

Item	Shrimp waste meal (%)
Dry Matter (DM)	91.79
Crude protein (CP)	49.0
Ether extract (EE)	3.32
Crude fiber (CF)	10.48
Ash	26.35
NFE*	10.85
GE** (Kcal/Kg)	3935

*calculated by difference

**based upon the factors 5.65, 9.45, 4.0 and 4.0 Kcal/Kg of protein, ether extract, crude fiber and nitrogen free extract, respectively (Jobling, 1983).

Table (2) showed that the experimental diets (T_1, T_2, T_3 and T_4) were formulated to contain about 4400 kcal/kg and 32% crude protein which replaced by shrimp waste meal (0, 10, 20 and 30%, respectively) .

Each diet was mechanically mixed and then treated with boiling water at 30% of the total amount of the mixture and pressure pelleted using meat mixer mincer provided with 2 mm die then air dried for 24 hours and stored in glass bottles to prevent any undesirable changes.

2- Fish and feeding:

Nile tilapia fry with an initial body weight of 1.4 g which were obtained from El-Wafaa farm, El-Giza Governorate, Egypt were adapted to laboratory conditions for two weeks in aerated aquaria. At the beginning of the experiment, each treatment was carried out at three replicate groups of fifteen Nile tilapia each. Treatment groups were randomly stocked into 12 glass aquariums (each of 60 x 40 x 30 cm and 72 liters volume) which were

Table (3): Growth performances well as feed protein and energy utilization of tilapia fed different levels of shrimp waste meal (Mean ± SE).

Item	Experimental diets			
	T_1 (control)	T_2 (10% SM)	T_3 (20% SM)	T_4 (30% SM)
Initial weight (g/fish)	1.43^{a} ±0.01	1.41^{a} ±0.01	1.42^{a} ±0.01	1.44^{a} ±0.01
Final weight (g/fish)	3.75^{a} ±0.23	3.63^{a} ±0.30	3.38^{ab} ±0.23	2.66^{b} ±0.42
Total gain (g/fish)	2.33^{a} ±0.30	2.22^{a} ±0.30	1.96^{ab} ±0.22	1.22^{b} ±0.43
SGR (%/d)	1.502^{a} ±0.13	1.464^{a} ±0.13	1.346^{ab} ±0.10	0.923^{b} ±0.24
Feed Intake (g/fish)	4.68^{a} ±0.29	4.60^{a} ±0.17	4.45^{ab} ±0.08	3.81^{b} ±0.45
FCR[1]	2.01^{b} ±0.27	2.07^{ab} ±0.39	2.27^{ab} ±0.21	3.12^{a} ±0.68
PER[2]	1.653^{a} ±0.19	1.622^{a} ±0.30	1.470^{a} ±0.11	1.02^{b} ±0.23
PPV[3] (%)	21.81^{a} ±3.08	21.74^{a} ±2.90	17.60^{ab} ±2.89	12.0^{b} ±1.20
EU[4] (%)	14.43^{a} ±1.58	14.12^{a} ±1.71	11.51^{ab} ±1.57	7.65^{b} ±0.71
Survival rate (%)	100^{a} ±1.02	95.56^{a} ±2.22	97.78^{a} ±2.22	97.78^{a} ±2.22

a, b means in the same row with different superscripts are significant ($P \leq 0.05$) different.
SGR = Specific growth rate. FCR[1] = Feed conversion ratio. PER[2] = Protein efficiency ratio. PPV[3] = Protein productive values. EU[4] = Energy utilization.

From practical view point, results indicated that the expensive fish meal and soybean in tilapia diets could be replaced by cheaper shrimp waste meal up to 20% of feed protein being (13.06%) without harmful effects on final weights and weight gain. The findings of Al-Azab (2005) may support the present results concerning the possibility of replacing fish meal by cheaper shrimp waste meal up to 50% (being 13.50%) in tilapia diets without adverse effects on final weights and weight gain.

Also, Soliman (2000a) reported that increasing the replacement level of fish meal by mantis shrimp waste meal reduced the fish growth which was more pronounced at high replacement levels. The same trend was observed by Nwanna and Daramola (2001) who reported that using the shrimp waste meal at 0, 15, 30, 45 and 60% in Nile tilapia diets (30% dietary crude protein) decreased final body weight and total gain that was pronounced at high replacement levels.

Specific growth rate (SGR, %/d) values were 1.50, 1.46, 1.35 and 0.92% for T_1, T_2, T_3, and T_4 groups, respectively. Results revealed that the control group showed significantly ($P < 0.05$) better SGR compared with T_4 group, which had the lowest SGR records. Results of survival rate (Table 3) showed that treatments applied had no effect on mortalities and these results are in agreement with the findings of Soliman (2000a) and Nawanna and Daramola (2001).

Results of nutrients utilization in terms of feed conversion ratio (FCR), protein efficiency ratio (PER) and protein productive value (PPV) are illustrated in Table (3). Values of FCR of T_1, T_2, T_3 and T_4 were 2.01, 2.07, 2.27 and 3.12 kg feed for each kg weight gain, respectively. Results indicated that the best ($P \leq 0.05$) FCR values were obtained by T_1, T_2 and T_3 and the worst FCR ($P \leq 0.05$) value was records by T_4 group. The same trend was observed with PER where T_1, T_2 and T_3 showed better ($P \leq 0.05$) PER records compared to T_4 (Table 3). These results may indicate that fish meal could be replaced by shrimp waste meal up to 20% of feed protein in growing tilapia diets without any adverse effects on feed utilization parameters (FCR or PER). These results are in the same direction with the findings of Soliman (2000 a,b), Nwanna and Daramola (2001) and Al-Azab (2005).

As presented in Table 3, values of PPV% and EU% for T_1, T_2, T_3 and T_4 decreased gradually with significant ($P \leq 0.05$) differences among treatments. The control group recorded the highest PPV% and EU% values while T_4 recorded the lowest ones. These results due to the low digestibility of shrimp waste meal at level of 30%. Also, Soliman (2000a) reported that replacement of feed protein with mantis shrimp waste meal at levels of 25, 50, 75 or 100% steadily decreased the apparent protein digestibility of Nile tilapia.

3- Whole body composition:

Whole body composition including crude protein (CP), ether extract (EE), ash and gross energy (GE kcal/kg) which calculated on dry matter basis are presented in Table (4). The DM contents of whole bodies of tilapia were 22.96, 23.64, 23.06 and 24.67% for T_1, T_2, T_3 and T_4 groups, respectively. Results revealed that T_4 had insignificantly ($P \leq 0.05$) higher dry matter contents compared to the others treatment groups.

The highest value of CP content was observed ($P \leq 0.05$) in T_1 (57.50%) and T_2 followed by T_2 (55.97) and T_3 (52.94) group with significant difference whereas, the lowest ($P \leq 0.05$) value was observed in T_4 group. These results are in the same direction with the findings of Al-Azab (2005) who found that carcass CP content of tilapia fish decreased significantly ($P \leq 0.05$) as the levels of shrimp waste meal increased.

The same trend was observed with EE, whereas, the highest significant value ($P \leq 0.05$) was observed with T_1 (20.54%) compared with T_4 (14.94%). These results are in agreement with the findings of El-Sayed (1998), Soliman (2000a) and Al-Azab (2005).

With increasing the dietary level of shrimp waste meal, whole body's ash contents of tilapia significantly ($P \leq 0.05$) increased, since, the lowest value (19.90%) was obtained with the control group and the highest value was observed with T_4 (28.57%). These may be due to the high ash contents of the shrimp waste meal used herin (26.35%) as illustrated in Table (1). These results are in agreement with the findings of Soliman (2000 a,b) and Al-Azab (2005), they reported that incorporation of shrimp waste meal in Nile tilapia diets increased ash contents in whole fish bodies.

supplied with tap water which was previously aerated, the whole water content of each aquarium was completely replaced by another fresh water daily. Fry were weighed in bulk at the start of the experiment. Water temperature range was 23 - 27°C during the experimental period. Fish were fed by hand three times daily at 8, 12 and 16 at a fixed daily rate of 3% body weight during the experimental period (64 days).

Table (2): Formulation and proximate analysis of the experimental diets.

Item	Experimental diets			
	T_1 (control)	T_2 (10% SM)	T_3 (20% SM)	T_4 (30% SM)
Feeding ingredients:				
Yellow corn	35.0	33.47	31.94	30.41
Soybean meal	31.0	28.0	25.0	22.0
Fish meal	20.0	18.0	16.0	13.0
Wheat bran	5.0	5.0	5.0	5.0
Shrimp waste meal (SM)	-	6.53	13.06	19.59
Corn oil	7.0	7.0	7.0	8.0
Vit. & Minerals[1]	2.0	2.0	2.0	2.0
Total	100	100	100	100
Proximate analysis (%):				
DM*	94.58	95.30	93.72	94.24
CP*	32.48	32.32	32.21	31.77
EE*	7.20	7.54	7.53	8.87
CF*	3.40	4.46	7.0	8.25
Ash	10.73	11.29	12.02	14.57
NFE[2]	46.19	44.39	41.24	36.54
Gross Energy (Kcal/Kg)[3]	4499.12	4492.61	4461.05	4424.82
C/P ratio (Kcal /mg)	138.52	139.00	138.50	139.28
Cost L.E/ton	3737	3599	3460	3292

1-Each 1Kg contains vitamin: B_1, 1.4g; B_2, 0.8g; B_6, 3.8g, B_{12}, 4.2g; Pantothonic acid, 7g Nicotinic acid, 400mg, Folic acid, 25g; biotin, 150g, Choline chloride, 5g ; A, 5000 000, I. U; D_3, 1000 000, I. U;4g; K,0.5g; Copper, 0.5g; Iodine, 10g; Manganese, 20g and Zinc, 0.07g.
2- Calculated by differences.
3- Based upon the factors 5.65, 9.45, 4.0 and 4.0 Kcal/Kg of proteins, ether extract, crude fiber and nitrogen free extract Jobling (1983).
***DM= Dry matter; CP= Crude protein; EE= Ether extract; CF=Crude fiber; C /P ratio = carbohydrates and protein ratio.**

Fish were bulk weighed, counted and the quantity of feed was adjusted accordingly at biweekly intervals. After the final weighing, ten fish were randomly removed from each aquarium for body composition analysis.

Growth measured by the percentage of body weight and body weight gain and feed conversion ratio were calculated according by Chou and Shiau (1996).

The parameters were calculated as follows:

Weight Gain (WG, g) = final weight (g) - initial weight (g)

Weight Gain (WG, %) = [final weight (g) - initial weight (g)]/initial weight (g) x100

Average daily gain = {final weight (g) - initial weight (g)}/experimental period

Specific growth rate (SGR) = 100 x [(ln final fish weight) - (ln initial fish weight)] / experimental period.
FCR = feed intake (g)/weight gain (g)
Protein efficiency ratio (PER) = weight gain (g)/protein intake (g)
Protein retained (g) = final body protein – initial body protein
Productive protein value (PPV %) = {Protein retained (g)/protein intake (g)} x 100

The economical efficiency of treatments was calculated by the cost of feed/Kg of fish weight gains.

3- Chemical and statistical analyses:

Shrimp waste meal (SM), experimental diets and sub-samples of whole body fish were analyzed according to the producers of A.O.A.C (1990). Gross energy of the tested diets and the fish carcass were calculated using the factors 5.65, 9.45, 4 and 4 kcal /g for protein, ether extract, crude fiber and carbohydrates, respectively (Jobling, 1983).

Data obtained were statistically analyzed using the SAS (1999) program and the significant differences among means were evaluated by Duncan's multiple rang test (Duncan, 1955).

RESULTS AND DISCUSSION

1- Chemical composition of shrimp meal:

Results in Table (1) indicated that shrimp waste meal contains high amounts of CP (49.00%), ash (26.35%) and CF (10.48%) but, it had low contents of EE (3.32%) and GE (3935.00 Kcal/g). The crude protein percentage of shrimp waste meal is an indicator for its potential value as a source of animal protein. However, the high content of CF (10.48%) of shrimp waste meal may be the main factor that limits its usage as a feed ingredient for fish.

Shrimp waste meal of different species was analyzed by many authors (El-Sayed, 1998; Soliman, 2000a and Al-Azab, 2005) who stated that its content of CP ranged from 41.22 to 51.66%, EE ranged from 4.26 to 5.53%, CF ranged from 10.80 to 12.48% and ash ranged from 26.60 to 28.80%. The results of shrimp waste meal composition are in agreement with the findings of those previous authors.

Increasing SM% in the diets led to increase CF and ash contents particularly in the 4th diet T_4 as shown from Table 2.

2- Fish growth performance and feed utilization

Fish performance as well as feed protein and energy utilization of Nile tilapia fingerlings fed different levels of shrimp waste meal are presented in Table (3).

Results showed that, the initial weights ranged from 1.41 to 1.44 g with insignificant differences ($P > 0.05$) among the experimental groups. Final body weights of T_1, T_2, T_3 and T_4 were 3.75, 3.63, 3.38 and 2.66 g, respectively. Fish fed the control group had significantly higher ($P \leq 0.05$) values of final weight and weight gain compared with T_4 (followed by T_2 and T_3). Average of total weight gain during the whole experimental period was 2.33, 2.22, 1.96 and 1.22 g for the control, T_2, T_3, and T_4, respectively.

Table (4): Whole body composition (on DM basis) of tilapia fed different levels of shrimp waste meal (Mean ± SE).

Item	Initial body composition	Experimental diets			
		T_1 (control)	T_2 (10% SM)	T_3 (20% SM)	T_4 (30% SM)
DM (%)	20.87^{b} ±1.45	22.96^{ab} ±1.85	23.64^{a} ±1.46	23.06^{ab} ±1.49	24.67^{a} ±1.30
CP (%)	55.06^{bc} ±0.89	57.50^{a} ±0.88	55.97^{ab} ±0.33	52.94^{c} ±0.52	50.73^{d} ±0.58
EE (%)	22.66^{a} ±1.06	20.54^{ab} ±2.03	18.86^{abc} ±0.88	17.04^{bc} ±1.13	14.94^{c} ±0.91
Ash (%)	18.51^{c} ±0.34	19.90^{c} ±2.31	21.81^{bc} ±0.88	24.78^{ab} ±1.53	28.57^{a} ±0.67
GE kcal/Kg	5402.9^{a} ±53.91	5272.3^{a} ±216.89	5079.0^{ab} ±77.08	4807.4^{bc} ±130.22	4508.4^{c} ±78.19

a, b, c; means within the same row with different superscript are significantly ($P \leq 0.05$) different.

Table (4): Whole body composition (on DM basis) of tilapia fed different levels of shrimp waste meal (Mean ± SE).

Item	Initial body composition	Experimental diets			
		T_1 (control)	T_2 (10% SM)	T_3 (20% SM)	T_4 (30% SM)
DM (%)	20.87^{b} ±1.45	22.96^{ab} ±1.85	23.64^{a} ±1.46	23.06^{ab} ±1.49	24.67^{a} ±1.30
CP (%)	55.06^{bc} ±0.89	57.50^{a} ±0.88	55.97^{ab} ±0.33	52.94^{c} ±0.52	50.73^{d} ±0.58
EE (%)	22.66^{a} ±1.06	20.54^{ab} ±2.03	18.86^{abc} ±0.88	17.04^{bc} ±1.13	14.94^{c} ±0.91
Ash (%)	18.51^{c} ±0.34	19.90^{c} ±2.31	21.81^{bc} ±0.88	24.78^{ab} ±1.53	28.57^{a} ±0.67
GE kcal/Kg	5402.9^{a} ±53.91	5272.3^{a} ±216.89	5079.0^{ab} ±77.08	4807.4^{bc} ±130.22	4508.4^{c} ±78.19

a, b, c; means within the same row with different superscript are significantly ($P \leq 0.05$) different.

Table (4) illustrated that gross energy (GE) contents in whole tilapia bodies decreased with each increase of dietary shrimp waste meal level.

Mantis shrimp waste meal could replace the fish meal protein safely up to 25% and the higher levels are not recommended, that due to its detrimental effects such as increasing carcass moisture and deceasing carcass lipids and protein (Soliman, 2000a). Also, shrimp waste meal diet had very low levels of essential amino acids especially lysine, methionine and arginine and the shrimp waste meal contain appreciable amounts of non-protein nitrogen (NPN) which produce toxicity and contains indigestible material (chitin) (Soliman, 2000b).

4- Economical study:

Feeding cost in fish aquaculture is above 50% of the total production costs (Collins and Delmendo, 1979). Results of the economical study including feed costs and its ratio to the control group are presented in Table (5).

Table (5): Feed price (L.E.) for one kg weight gain produced by Nile tilapia fed shrimp waste meal.

Treatments	Feed intake (g/fish)	Price (L.E.) of one ton	Total gain (g)	Feed price/ kg gain (L.E.)	Relative to control
T_1 (control)	4.68	3737	2.33	7.51	100
T_2 (10% SM)	4.60	3599	2.22	7.46	99.33
T_3 (20% SM)	4.45	3460	1.96	7.86	104.66
T_4 (30% SM)	3.81	3292	1.22	10.28	136.88

According to market prices during 2007: Price (L.E)/ton of shrimp waste meal = 2000 L.E; Soybean meal = 2200 L.E; Fish meal = 9000 L.E; Yellow corn = 1500 L.E; Wheat bran = 1000 L.E; Corn oil =6000 L.E; Vitamine and mineral mix = 13000 L.E.

Costs of one ton of the experimental diets were 3599, 3460 and 3292 L.E for T_2, T_3 and T_4, respectively whereas; the control group was 3737 L.E. These results means that increasing shrimp waste meal level in tilapia diets decreased the feed cost with adverse effects in weight gain.

So, the present study recommended that substitution of high price proteins in the diet by local shrimp waste meal up to 20% of the dietary protein is logic for growth performance with lower costs of production; whereas, at higher levels of shrimp waste meal may reduce tilapia growth and increase gain costs.

Acknowledgment

This experiment was funded by Faculty of Agriculture, Menofiya University, Egypt. The authors are very grateful to Prof. Deyab El-Saidy, Faculty of Agriculture, Menofiya University, Egypt for providing the facilities to conduct this study.

REFERENCES

Agouz, H.M. and Tonsy, Hayam.D. (2003). Evaluation of whole cray fish meal (*Procambrus clarkii*) as partial or complete replacement of fish meal protein in polyculture commercial diets. Egyptian J. Nutr. and Feeds, 6 (species issue): 315-330.

Al-Azab, A.A. (2005). Effect of partial and complete replacement of fish meal with locally produced shrimp meal on growth performance of Nile tilapia (*Oreochromis niloticus*). Egyptian J. Nutrition and feeds, 8(1): 1145-1156.

AOAC (Association of Official Analytical Chemists) (1990). Official Methods of Analysis (15^{th} Ed.) AOAC Inc. Arlington, Virginia, U.S.A.

Chou, B.S. and Shiau, S.Y. (1996). Optimal lipids level for growth of juvenile hybrid tilapia, (*O.niloticus* & *O.aureaus*). Aquaculture, 143: 185 195.

Collins, R.A. and Delmendo, M.N. (1979). Comparative economics of aquaculture in cages, race ways and enclosures. In: Advance in Aquaculture, protein. 427. England, Fishing News Books.

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

El-Sayed, A.F. (1998). Total replacement of fish meal with animal protein sources in Nile tilapia, *Oreochromis* (L.), Feeds. Aquaculture Research, 29: 275-280.

Jobling, M. (1983). A short review and critique of methodology used in fish growth and nutrition studies. J. Fish Boil, 23: 685.

National Research Council NRC (1983). Nutrient requirement of warm water fish and shellfishes. National Academy of Science, Washington. D.C.

Nwanna, L.C. and Daramola, J.A. (2001). Harnessing of shrimp head waste in Nigeria for low cost production of tilapia. Pakistan J. Nutrition, 2: 339-345.

Refsite, S; Storebakken, T. and Roem, A. J. (1998). Feed consumption and conversion in Atlantic salmon (*Salmo salar*) fed diets with fish meal. Extracted soybean meal or soybean meal with reduced content of oligosaccharaides. Trypsin inhibitors. Lectins and Soya antigens. Aquaculture, 162: 301-312.

Robina, L., Lzquierdo, M.S., Moyano, F.J., Socorro, J., Vergara, J.M., Montero, D. and Fernadez-Palacios, H. (1995). Soybean and Lupin seeds meal as protein sources in diets for gilthead sea bream (*Sparus aurata*): Nutritional and histological limplications. Aquaculture, 130: 219-233.

SAS (1999). User's Guide; Statistical, Version 6,4th ed., SAS Institute INC., Cary N.C., USA.

Scharoder, G.L. (1977). Agriculture waste in fish farming. A commercial application of the culture of single cell organisms for protein production. Water Res., 11: 419.

Shiau, S.; Lin, S.; Yu S.; Lin, A. and Kwok, C. (1990). Defatted and full-fat soybean meal in Tilapia (*Oreoochromis niloticus* and *O. aureus*) diets at low protein level. Aquaculture, 8: 40-4-407.

Soliman, A.K. (2000a). Partial and complete replacement of fish meal with mantis shrimp (*Squlla mantis*) waste meal diets of Nile tilapia. Proceeding of The Fifth International Symposium on Tilapia Aquaculture, 1: 203-208, 3-7 September, Riode Janeiro, Brazil.

Soliman, A.K. (2000b). Utilization of carcass fish waste diets of Nile tilapia (*O. niloticus*) Tilapia Aquaculture in the 21st Century proceeding of the Fifth International Symposium on Tilapia Aquaculture, 1: 3-7, September Rio de Janeiro, Brazil.

Steffens, W. (1994). Replacing fish meal with poultry by-product meal in diets for rainbow trout (*Oncorhynchus mykiss*). Aquaculture, 124: 127.

Tacon, A.G.J. and Jackson, A.J. (1985). Utilization of conventional and unconventional protein sources in practical fish feeds In: Nutrition and Feeding in Fish (ed. by C.B. Cowey. A.M. Meckle and J.G. Bell) pp.119-145. Academic Press-London.

الإحلال الجزئى لبروتين العليقة بمسحوق مخلفات الجمبرى فى علائــق البلطــى النيلى

سامى حــسنى محمــود ، هيــام دســوقى تونــسى ، فــايزة عبــد الحــى ســلامة و مصطفى عبد المنعم الجارحى
معهد بحوث الانتاج الحيوانى – قسم بحوث الاستفادة من المخلفات- مركز البحوث الزراعيــة – الدقى – الجيزة – مصر.

تم الإحلال الجزئى لبروتين العليقة بمسحوق مخلفات الجمبرى فى أربعة علائق تجريبية لزريعة البلطى النيلى بنسب صفر، ١٠، ٢٠، ٣٠% . العلائق المختبــرة طبقت فى ١٢ حوضــا (٣ أحواض لكل معاملة) وأبعاد الاحواض (٦٠ – ٤٠ – ٣٠سم)، وزعت الاسماك عشوائيا بمعدل ١٥ سمكة/حوض، بمتوسط وزن إبتدائى ١,٤جرام، واستمرت التجربة ٦٤ يوما.

التحليل الكيماوى لمسحوق مخلفات الجمبرى وجد أنه يحتوى على نــسبة عاليــة مــن البروتين ٤٩% والرماد ٢٦,٣٥% مع انخفاض نسبة الدهن حيث كانت نسبته ٣,٣٢%، محتــوى الألياف الخام ١٠,٤٨ ومحتوى الكربوهيدرات الذائبة ١٠,٨٥%، أوضحت النتائج انخفاض الوزن النهائى لأسماك البلطى مع زيادة نسبة مسحوق مخلفات الجمبرى فى العليقــة إلــى ٣٠% كبــديل لبروتين العليقــة.

وأوضحت النتائج أن:

أعلى زيادة وزنية، ومعدل النمو النسبى ، ومعدل الاستفادة من البروتين، والقيمة الحيوية للبروتين، والاستفادة من الطاقة كانت فى العلائق المحتوية على ١٠%، ٢٠% بالمقارنة بالعليقــة التى تحتوى على ٣٠% من مسحوق مخلفات الجمبرى بدون أى تــأثيرات ســلبية علــى النمــو والاستفادة من الغذاء.

مما سبق يتضح إمكانية استخدام مسحوق مخلفات الجمبرى غذائيا واقتصاديا كمــصدر بروتين حيوانى غير تقليدى فى علائق البلطى النيلى حتى ٢٠% من بروتين العليقة.