Utilization of Poultry Viscera Meal (PVM) Protein in Nile Tilapia (*Oreochromis niloticus*) and African Catfish (*Clarias gariepinus*) Diets

Srour, T. M.
Department of Animal and Fish Production, Faculty of Agriculture (Saba basha), Alexandria University.

ABSTRACT

The present study aimed to utilize poultry viscera meal (PVM) as protein source for Nile tilapia (*Oreochromis niloticus*) and African catfish (*Clarias gariepinus*). Poultry viscera meal was incorporated into isonitrogenous (30 % protein) diets to replace 0, 25, 50, 75 and 100 % of fish meal (FM) protein in the control diet. The experimental diets were fed to duplicate groups of tilapia (1.43 g) and catfish (46.5 g) twice a day for 14 weeks in two separate experiments 1 and 2, respectively. Data on growth performance, feed utilization and body composition along with a simple economic evaluation. The study demonstrated that PVM as untraditional protein source could replace 25 and up to 50 % of FM protein in Nile tilapia and African catfish diets without any adverse effects on its growth performance and feed utilization. However, the economic evaluation showed that as the level of PVM increased as the cost/Kg gain decreased up to 100 %respectively.

INTRODUCTION

The development of commercial aquafeeds or complete formulated diets for cultured fish species has usually been based upon the use of fish meal (FM) as the main source of dietary protein. The nutritional characteristics of FM protein approximating almost exactly to the nutritional requirements of cultured finfish (Tacon, 1993). Fish meal is still the preferred protein source for use within compound aquafeeds for its high nutritional quality and biological value for fish. Fish meal is also a good source of essential amino acids, essential fatty acids, digestible energy, macro and trace minerals, vitamins, and generally act as a feeding stimulant for most finfish species. However, the uncertain supply and the higher cost of FM in the Egyptian markets led the nutritionist to search for alternative protein sources or FM replacers to be used as dietary replacement of FM within compound aquafeeds for cultured fish. A wide variety of FM replacers were tested by different authors such as soybean meal (Tacon, 1995), cottonseed meal (Webster, et al., 1992 and El-Sayed, 1994), sunflower seed meal, sesame seeds meal, palm kernel (Jackson, et al., 1982), aquatic plants (Wee, 1991) legumes and cereal by-products (Pouomogne, 1995) and poultry by-products (Fowler, 1991),

Poultry by-product meal has been studied as a partial FM replacement in the diets of channel catfish (Brown *et al.*, 1985), rainbow trout (Alexis *et al.*, 1985 and Steffens, 1994), Chinook salmon fry (Fowler, 1991), European eels (Gallagher and Degani, 1988), seabream (El-Sayed, 1990) and tilapia (Tacon *et al.*, 1983 and Davies *et al.*, 1989). Meanwhile, tilapia and catfish are an important cultured species in the tropics (Balarin and Hatton, 1979, and Dunham *et al.*, 1983) and little is known about the utilization of different levels of PBM in fish diets in Egypt. Therefore, the present study aims evaluate the utilization of poultry viscera meal (PVM) protein as partial and total replacements for dietary FM protein on growth performance, nutrient utilization and body composition of Nile tilapia (*Oreochromis niloticus*) and African catfish (*Clarias gariepinus*) in two separated experiments. Also a simple economical evaluation was conducted.

MATERIALS AND METHODS

The experimental work of the present study was carried out in the Fish Nutrition Laboratory, Faculty of Agriculture (Saba basha), Alexandria University to determine the influence of using poultry viscera meal (PVM) protein as partial and total replacements of fish meal (FM) protein in diets of Nile tilapia (*Oreochromis niloticus*) and African catfish (*Clarias gariepinus*).

Fish and culture facilities

Nile tilapia and African catfish (average initial weight of 1.43 and 46.52 g/fish, respectively) obtained from Maryout Company for Fish Farms and Edko Lake, respectively were used in the present study in two separate experiments (1^{st} for tilapia and 2^{nd} for catfish). Ten glass aquaria (30 x 40 x 100 cm) and ten fiber glass circular tanks (1000 L capacity) were used in the 1^{st} and the 2^{nd} experiments, respectively. Fish were randomly stoked into all treatments at a rate of 10 fish in each aquarium or tank, with two replications per treatment. Fish from each replicate were weighed at the start of each experiment and then every 2 weeks. The feeding rates readjusted as percentage of live body weight. About 20 fish from each species were frozen for initial proximate body chemical analysis. The experimental glass aquaria and fiber glass tanks were cleaned every morning before the first feeding, and about half of the water was replaced by fresh dechlorinated tap water. Water temperature was checked daily, and ranged between 25 – 27° C. Dissolved oxygen was kept close to saturated level.

Experimental diets

The PVM were collected fresh from the local Egyptian markets, cooked and treated under standard steam at pressure with continual agitation (Binkley and Vasak, 1950). The poultry cooked viscera was minced and oven dried at 60 – 80° C for 48 hrs. Finally, the oven dried viscera was ground in a house blender, then mixed with the other ingredients. These steps of PVM preparation were repeated every 3 days to use it fresh. Five isonitrogenous (30 % protein) experimental diets where FM protein was substituted by 0, 25, 50, 75 and 100 % of PVM protein (Table 2). All diets were complete in essential vitamins and trace minerals (NRC, 1993). Diet ingredients were thoroughly mixed in a plastic container. The oil was added, a few drops at a time, during mixing. The PVM was added, then warm water (45° C) was slowly added under continuous mixing until the diets began to clump. The diets were passed through commercial meat grander 3 times, and oven dried at 80° G for 24 hrs in a drying oven. Dried diets were stored in a freezer at -20° C throughout all experimental period. Diets were prepared every 3 days in order to keep the diets fresh throughout the experimental period.

The diets were fed to the experimental fish two times a day (08,00 and 16,00 hr) at a rate of 2.5 and 2 % of live body weight on feed dry weight basis for the 1st and the 2nd experiments, respectively for 14 weeks (6 days a week).

Samples collection and analysis

At the termination of the experiments, fish were weighed and counted per each replicate in both experiments from each treatment for whole-body composition analysis. Fish samples were pulverized, autoclaved and after wards homogenized with ultra-tunax. The homogenized samples were oven dried at 60 – 80° C for 48 hrs. Body composition and chemical analysis of fish and feeds were performed using standard AOAC, (1990) methods. All data were analyzed for statistical significance by using analysis of variance (SPSS/PC program). Least significant difference (LSD) was used to test the difference among treatment means when *F* values from one-way ANOVA were significant.

RESULTS AND DISCUSSION

A comparison between the proximate chemical analysis of FM and PVM is shown in Table 1. The results revealed that dry matter and ash contents of FM were higher than those in PVM, but ether extract and gross energy were lower in FM. On the other hand, crude protein was almost similar (60 and 59.75 %) in both of FM and PVM, respectively. Concerning crude protein and ash, Higgs *et al.* (1979), Westgate (1979), Fowler (1981a, b and 1982) and El-Sayed (1994) obtained the same results. Those tests were conducted with standard PBM that normally contains about 58 –60 % protein and 16 – 22 % ash.

Table 1. Proximate chemical analysis (%) of fish meal (FM) and poultry viscera meal (PVM).

Ingredient	DM (%)	On DM basis (%)				Gross energy Kcal/100g DM
		Crude protein	Ether Extract	Ash	Crude Fiber	
FM	27.28	10.00	15.00	24.00	1.00	481.50
PVM	23.15	59.75	23.80	11.45	-	513.19

DM = Dry matter

The composition and proximate analysis (%) of the experimental diets used in the 1st and the 2nd experiments are shown in Table 2. The experimental diets were almost isonitrogenous and isoenergetic, about 30 % and 445.2 Kcal/100 g, crude protein and gross energy, respectively. The mean values of protein to energy (P:E) ratio was 68.73 mg protein/Kcal gross energy.

Table 2. Formulations and proximate chemical analysis of the experimental diets.

Items	Diets[1]				
	1	2	3	4	5
		Formulation (%)			
Fish meal	24	18	12	6	-
Soybean meal	24	24	24	24	24
Wheat bran	20	20	20	20	20
Yellow corn	27	27	27	27	27
PVM[2]	-	6	12	18	24
Corn oil	3	3	3	3	3
Vit. & Min[3].	2	2	2	2	2
Total	100	100	100	100	100
		Proximate chemical analyses (%)			
Dry matter	92.00	92.00	90.30	89.63	88.75
		On dry matter basis			
Crude protein	31.30	31.00	30.50	30.18	30.00
Ether extract	8.27	8.40	8.37	8.72	8.85
Ash	11.42	10.22	10.16	10.30	10.59
Crude fiber	4.73	4.89	4.83	4.77	4.71
NFE[4]	44.28	45.39	46.14	46.03	45.85
GE (Kcal/100g)[5]	441.39	446.15	445.63	446.68	446.15
P/E ratio[6]	70.91	69.48	68.44	67.57	67.24

Diets 1, 2, 3, 4 and 5 = 0, 25, 50, 75 and 100 % PVM from FM protein, respectively.
[2]PVM = Poultry viscera meal
[3]Meveco premix, Vit. & Min., every 3 Kg contains of Vit. A 12000000 UI, D_3 2500000 UI, E 10 g, K_3 2.5 g, B_1 1.5 g, B_2 5g, B_6 1.5g, B_{12} 10 mg, Biotin 50 mg, Folic acid 1g, Niacin 20g, Pantothanic acid 10g, Mn 60.g, Cu 10 g Zn 55 g, Fe 35 g, I 1 g, Cobalt 250 mg, Se 150 mg and anti oxidation substance 10 g; the carrier substance is Calcium carbonate.
[4]NFE = Nitrogen free extract.
[5]GE = Gross energy, calculated on the basis of 5.65, 4.2 and 9.5 Kcal GE/g protein, NFE and lipid, respectively. [6] P/E ratio = Protein to energy ratio, mg crude protein/Kcal GE..

The effect of dietary treatments on growth performance of Nile tilapia (*O. niloticus*) and African catfish (*C. gariepenus*) are shown in Tables 3 and 4, respectively. The results revealed that final weight (g/fish), weight gain (g/fish), average daily gain (ADG mg/fish/day), specific growth rate (SGR %) of tilapia fed the diet of 25 % of FM are replaced by protein from PVM and catfish fed diet containing 25 and 50 % PVM protein instead of FM protein were not significantly different from those containing FM protein only (control diet). Diets containing 50, 75 and 100% PVM protein, in tilapia, and 75 and 100 % PVM protein, in catfish, resulted in significant ($P < 0.05$) retardation in fish performance. According to Higgs *et al.*, (1979) at least 28 % of PBM protein may be included in the diet of coho salmon. Growth and feed conversion ratios (FCR) of fish were very good. Falaye (1982) and Bishop *et al.* (1995) reported that hydrolyzed feather protein could replace up to 50 % and 66 % of FM protein within diets for *O. niloticus*, fingerlings and fry with no loss in growth performance, respectively. Also, Fowler (1991) suggested that PBM can comprise 20 % of a practical diets for fish by concurrent reduction of the FM content by 50 % without compromising performance for chinook salmon. Moreover, Gallagher and Degani (1988) reported that PBM could be substituted, in part, for FM in diet formulations for European eels (*Anguilla anguilla*). Sayed (2000) reported that no difference was observed between diets containing 25 and 50 % PBM, and performance was better than the control, 75 and 100 % PBM diets of tilapia (*O. niloticus*). In contrast, Tacon *et al.* (1983), Viola and Zohar (1984) and Davies et *a l.* (1989) all reported poor growth in tilapia hybrids, respectively when fed hydrolyzed feather meal. Concerning the difference between the response of Nile tilapia and catfish to PBM utilization, El-Sayed (1994) found that the inclusion of PBM in fish diets depends on fish species and size as well as composition and processing techniques of PBM. Lu and Kevern (1975) found that a diet containing 30 % PBM and 70 % salmon feed lowered the growth rate of Channel catfish, while gold fish grew better on the same diet than the control salmon diet. On the other hand, up to 75 % of FM could be replaced by defatted PBM in coho salmon diets without adverse effects on fish growth (Higgs *et al.*, 1979).

Table 3. Effect of poultry viscera meal (PVM) protein in the diet as partial and total replacements for fish meal (FM) protein on growth performance of Nile tilapia (*Oreochromis niloticus*).

Diets No.	Diets	Initial weight (g/fish)	Final weight (g/fish)	Gain (g/fish)	ADG[1] (mg/fish/day)	SGR[2] (%/day)
1	0 %PVM	1.43	16.59 [a]	15.16 [a]	154.70 [a]	2.51 [a]
2	25 %PVM	1.43	16.45 [a]	15.02 [a]	153.27 [a]	2.50 [a]
3	50 %PVM	1.43	15.14 [b]	13.71 [b]	139.90 [b]	2.41 [b]
4	75 %PVM	1.43	13.97 [b]	12.54 [b]	127.91 [b]	2.33 [b]
5	100 %PVM	1.43	12.05 [c]	10.63 [c]	108.42 [c]	2.18 [c]
$LSD_{0.05}$		NS	1.198	1.198	12.231	0.096

Means in each column not sharing the same superscript are significantly different (P< 0.05).
[1]ADG = Average daily gain (g/fish/day): gain/experimental period.
[2]SGR = Specific growth rate (%/day): *(ln wt-ln wi/T) x 100*, where *wt* is weight of fish at time *t*, *wi* is weight of fish at time 0, and *T* is the experimental period in days.
NS = Not significant.

Table 4. Effect of poultry viscera meal (PVM) protein in the diet as partial and total replacements for fish meal (FM) protein on growth performance of African catfish (*Clarias gariepinus*).

Diets No.	Diets	Initial weight (g/fish)	Final weight (g/fish)	Gain (g/fish)	ADG[1] (mg/fish/day)	SGR[2] (%/day)
1	0 %PVM	46.75	98.09 ^{a}	51.34 ^{a}	523.88 ^{a}	0.756 ^{a}
2	25 %PVM	46.35	97.15 ^{a}	50.80 ^{a}	518.37 ^{a}	0.755 ^{a}
3	50 %PVM	46.50	96.06 ^{a}	49.56 ^{a}	505.72 ^{a}	0.740 ^{a}
4	75 %PVM	46.60	87.41 ^{b}	40.81 ^{b}	416.38 ^{b}	0.642 ^{b}
5	100 %PVM	46.40	85.17 ^{b}	38.77 ^{b}	395.56 ^{b}	0.620 ^{b}
$LSD_{0.05}$		NS	3.11	3.21	32.84	0.037

Means in each column not sharing the same superscript are significantly different (P< 0.05).
[1]ADG = Average daily gain (g/fish/day): gain/experimental period.
[2]SGR = Specific growth rate (%/day): *(ln wt-ln wi/T) x 100*, where *wt* is weight of fish at time *t*, *wi* is weight of fish at time 0, and *T* is the experimental period in days.
NS = Not significant.

The present results showed that at 100 % substitution level, fish growth was significantly (P < 0.05) reduced compared to the other treatments. These results could be attributed to the imbalance of some amino acids caused by inclusion of high levels of PVM protein instead of FM protein. The amino acid profile of PBM indicated that methionine was the first limiting and phenylalanine as well as lysine the second limiting amino acids when compared to the amino acids requirement for chinook salmon (Tacon and Jackson, 1985 and Hardy, 1991). So, the insufficient supply of essential amino acids under these conditions becomes evident in the lower growth performance in fish fed diets in which high levels of FM protein were replaced by protein from PVM.

The effects of dietary inclusion of PVM on feed and nutrient utilization of Nile tilapia and African catfish are shown in Tables 5 and 6, respectively. Partial replacements (about 25 % in tilapia and up to 50 % in catfish of FM protein by PVM protein) showed no significant differences in feed intake and FCR when compared with the control diet (100 %FM) protein. Values of protein and energy utilization (PER, PPV and EU) were similar in tilapia and catfish, which received the control diet, 25 % and 50 % of the FM protein replaced by PVM protein. At the higher levels of replacement (50, 75 and 100 %), feed intake and FCR of tilapia were significantly different (P < 0.05) from those fed the control diet. Meanwhile, at 75 and 100 % PVM levels, feed intake and FCR of catfish were significantly (P < 0.05) reduced. Protein and energy utilization of Nile tilapia and catfish were reduced significantly (P < 0.05) at 75 and 100 % PVM level. The results of feed intake, FCR, PER and PPV in the present study (Tables 5 and 6) were similar to

(1994). Moreover, Higgs *et al.* (1979) found that raising the dietary proportion of PBM for coho salmon up to complete replacement of FM, resulted in poor FCR. Steffens (1994) found that raising the level of PBM in the diet of rainbow trout (*Oncorhynchus mykiss*) resulted in increases in FCR and the consumption of gross energy. Also the author observed a decrease in PER, PPV and EU. Sayed (1998) found that feed intake decreased in tilapia (*O. niloticus*) fed on high levels of PBM (75 and 100 %). Protein efficiency ratio and protein retention in fish fed 25 and 50 % PBM were higher than the control group; values were lowest with 100 % PBM substitution. In contrast, Fowler (1991) found that fish fed diet with 30 % PBM had poorer appetite than those fed the other diets. This may be related to

Table 5. Effect of poultry viscera meal (PVM) protein in the diet as partial and total replacements for fish meal (FM) protein on feed and nutrients utilization of Nile tilapia (*Oreochromis niloticus*).

Diet No.	Diets	Feed intake (g/fish)	FCR[1]	Protein utilization		EU[4] %
				PER[2]	PPV[3] %	
1	0 %PVM	27.98 ^{a}	1.85 ^{a}	1.73 ^{a}	24.55 ^{a}	16.48 ^{a}
2	25 %PVM	27.44 ^{a}	1.83 ^{a}	1.77 ^{a}	24.96 ^{a}	16.40 ^{a}
3	50 %PVM	26.34 ^{b}	1.93 ^{b}	1.71 ^{ab}	23.70 ^{ab}	16.02 ^{ab}
4	75 %PVM	25.22 ^{c}	2.02 ^{b}	1.65 ^{b}	22.01 ^{b}	14.88 ^{b}
5	100 %PVM	23.62 ^{d}	2.23 ^{c}	1.51 ^{c}	18.76 ^{c}	12.85 ^{c}
$LSD_{0.05}$		0.99	0.12	0.08	1.98	1.40

Means in each column not sharing the same superscript are significantly different (P< 0.05).

[1]FCR = Feed conversion ratio: total dry diet fed (g)/total wet weight gain (g).

[2]PER = Protein efficiency ratio: wet weight gain (g)/amount of protein fed (g).

[3]PPV = Protein productive value (%): $(P-P_0)100/P_i$ where P is protein content in fish carcass at the end of the experiment, P_0 is the protein content in fish carcass at start of experiment and P_i is the protein in feed intake.

[4]EU = Energy utilization (%): $(E-E_0)100/E_i$ where E is the energy in fish carcass (Kcal) at the end of the experiment, E_0 is the energy in fish carcass (Kcal) at the start of the experiment , and E_i is the energy in feed intake (Kcal).

several factors. First, the digestible energy value assigned to PBM for these tests may have been too low. Second reduced diet palatability could also be a factor when PBM is fed at high levels and have been the cause of food rejection.

Table 6. Effect of poultry viscera meal (PVM) protein in the diet as partial and total replacements for fish meal (FM) protein on feed and nutrients utilization of African catfish (*Clarias gariepinus*).

Diets No.	Diets	Feed intake (g/fish)	FCR[1]	Protein utilization		EU[4] %
				PER[2]	PPV[3] %	
1	0 %PVM	113.48 ^{a}	2.21 ^{a}	1.445 ^{a}	25.13 ^{a}	18.30 ^{a}
2	25 %PVM	114.49 ^{a}	2.26 ^{a}	1.425 ^{a}	23.65 ^{ab}	17.16 ^{a}
3	50 %PVM	114.73 ^{a}	2.32 ^{a}	1.415 ^{a}	22.12 ^{ab}	16.20 ^{abc}
4	75 %PVM	107.48 ^{b}	2.64 ^{b}	1.260 ^{b}	19.29 ^{bc}	14.37 ^{bc}
5	100 %PVM	108.09 ^{b}	2.79 ^{c}	1.200 ^{b}	16.80 ^{c}	13.29 ^{c}
$LSD_{0.05}$		3.93	0.118	0.065	4.420	3.046

Means in each column not sharing the same superscript are significantly different (P< 0.05).
[1]FCR = Feed conversion ratio: total dry diet fed (g)/total wet weight gain (g).
[2]PER = Protein efficiency ratio: wet weight gain (g)/amount of protein fed (g).
[3]PPV = Protein productive value (%): $(P-P_0)100/P_i$ where P is protein content in fish carcass at the end of the experiment, P_0 is the protein content in fish carcass at start of experiment and P_i is the protein in feed intake.
[4]EU = Energy utilization (%): $(E-E_0)100/E_i$ where E is the energy in fish carcass (Kcal) at the end of the experiment, E_0 is the energy in fish carcass (Kcal) at the start of the experiment , and E_i is the energy in feed intake (Kcal).

The results of the proximate chemical analysis of the whole body fish at the end of the experiments are shown in Tables 7 and 8 for tilapia and catfish, respectively. Tilapia, body protein was decreased significantly (P < 0.05) with increasing the proportion of PVM in the diet. Meanwhile, body lipid was increased significantly (P < 0.05) with increasing PVM in the diet. Fish fed the highest level of PVM had a significantly (P < 0.05) higher percentage of body lipid in their bodies than fish fed other diets. In regard to the effect of diet treatments on body composition of catfish, the same trend of tilapia body protein was observed in catfish protein content. Dry matter was significantly (P < 0.05) lower in all PVM treatments than fish fed the control diet containing FM only. Similar results were observed by Fowler (1991) and Steffens (1994) who found a significantly lower protein and high body lipid in rainbow trout fed PBM compared with the control group. In contrast, the results of catfish in the present study showed that dry matter was not affected by the inclusion of PBM in the diets. Moreover, fish body ash was affected by PBM treatments.

Table 7. Effect of poultry viscera meal (PVM) protein in the diet as partial and total replacements for fish meal (FM) protein on body composition (%) of Nile tilapia (*Oreochromis niloticus*).

Diets No.	Diets	Dry matter	Crude protein	Ether extract	Ash	Gross energy (Kcal/100g)
Initial		24.47	52.39	22.67	24.94	511.37
1	0 %PVM	25.04	55.99 ^{a}	22.37 ^{c}	21.65	528.82
2	25 %PVM	24.57	55.12 ^{ab}	22.93 ^{bc}	21.95	529.27
3	50 %PVM	25.45	54.13 ^{ab}	24.04 ^{ab}	21.84	534.19
4	75 %PVM	25.03	53.02 ^{bc}	24.30 ^{ab}	22.69	630.39
5	100 %PVM	24.30	51.63 ^{c}	24.41 ^{a}	23.97	523.58
$LSD_{0.05}$		NS	2.419	1.423	NS	NS

Means in each column not sharing the same superscript are significantly different (P< 0.05).
NS = Not significant.

Table 8. Effect of poultry viscera meal (PVM) protein in the diet as partial and total replacements for fish meal (FM) protein on body composition (%) of African catfish (*Clarias gariepinus*).

Diets No.	Diets	Dry matter	Crude protein	Ether extract	Ash	Gross energy (Kcal/100g)
Initial		23.18	51.98	25.87	22.15	539.45
1	0 %PVM	28.11 ^{a}	52.81 ^{a}	25.91	21.28	544.53
2	25 %PVM	27.24 ^{b}	52.77 ^{a}	26.56	20.68	550.45
3	50 %PVM	26.79 ^{b}	51.90 ^{ab}	26.77	21.34	547.48
4	75 %PVM	27.05 ^{b}	50.21 ^{bc}	26.80	23.00	538.22
5	100 %PVM	26.48 ^{b}	48.96 ^{c}	27.91	23.14	541.74
$LSD_{0.05}$		0.77	2.289	NS	NS	NS

Means in each column not sharing the same superscript are significantly different (P< 0.05).
NS = Not significant.

Results in Table 9 summarized the cost of feed required for fish production in experiments 1 and 2 with the assumption that feeding cost for fish production is about 50 % of total production cost (Collins and Delmendo, 1979). The economic evaluation showed that, increasing the inclusion rates of PVM protein instead of FM protein resulted in decreasing the cost of feeds required to produced one Kg gain in both of Nile tilapia and catfish. Meanwhile, Abd El-Maksoud (2000) demonstrated that the diet contained poultry offal, up to 50 % of FM protein could be used to reduce the feeding cost and increase the profit of Nile tilapia.

Table 9. Cost (L.E) of feed required for production of one Kg gain of Nile tilapia and catfish fed the experimental diets.

Diets		Amount of feed /one Kg gain (Kg)		Cost of one kg fish gain (LE)		Change in feed cost/one kg fish gain (%)	
		Tilapia	Catfish	Tilapia	Catfish	Tilapia	Catfish
1	0 %PVM	1.85	2.21	4.61	5.53	-	-
2	25 %PVM	1.83	2.26	4.02	4.96	12.80	10.24
3	50 %PVM	1.93	2.32	3.46	4.17	25.01	24.58
4	75 %PVM	2.02	2.64	3.02	3.96	34.49	28.49
5	100 %PVM	2.23	2.79	2.67	3.35	42.08	39.44

PVM = Poultry viscera meal. Diet 1 used as a base for calculation. The price of diets was calculated according to the ingredients price in the local markets in August 2003.

The present results of growth performance and feed utilization recommended the use of PVM protein instead of FM protein up to 25 and 50 % in diets of tilapia and catfish, respectively. However, the economical evaluation results showed that the cost of one Kg fish gain is in favour of increasing PVM level in the diet up to the higher level, i.e. 100 % replacement.

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الملخص العربى

الاستفادة من بروتين أحشاء الدواجن في علائق أسماك البلطى النيلى والقرموط الأفريقى.

طارق محمد أحمد سرور

قسم الانتاج الحيوانى والسمكى – كلية الزراعة – سابا باشا – جامعة الاسكندرية

يهـدف الـبحث للاسـتفادة من أحشاء الدواجن كمصدر للبروتين فى علائق البلطى النيلى والقرموط الافريقى حيث تم استخدام هذه المخلفات فى تكوين علائق متزنة فى البروتين (٣٠ % بروتين) لتحل محل ٠ و ٢٥ و٥٠ و٧٥ و١٠٠ % من مسحوق السمك. وقد وزعت أسماك البلطى (١,٤٣ جم/سمكة) فى أحواض زجاجية بينما وزعـت القراميط (٤٦,٥ جم/سمكة) فى تانكات من الالياف الزجاجية. و تم تغذية كل من البلطى النيلى والقرموط الافـريقى بهـذه العلائـق فى تجربتين منفصلتين بواقع خمس علائق لكل تجربة ومكررتين لكل معاملة لمدة ١٤ أسبوع (مدة البحث). وغليه تم دراسة اثر هذا الإحلال على كفاءة النمو و الاستفادة من الغذاء و العناصر الغذائية ثـم تقييـم النـتائج المتحصل عليها تقييما اقتصاديا. و قد أظهرت النتائج أن افضل معدل إحلال لمسحوق أحشاء الدواجـن محل مسحوق السمك فى علائق البلطى هو ٢٥ % حيث أعطى هذا المستوى من الإحلال افضل نمو و استفادة من الغذاء والبروتين والطاقة. بينما كان افضل معدل إحلال لمسحوق أحشاء الدواجن محل مسحوق السمك فى علائـق القـراميط هـو ٢٥ و ٥٠ % حيـث أعطيا هذان المستويان من الإحلال اكفأ نمو واستفادة من الغذاء والبروتين والطاقة. ومن هنا توصى هذه الدراسة بإمكانية الاستفادة من أحشاء الدواجن كبديل لمسحوق السمك بنسبة ٢٥% فى علائـق البـلطى و ٢٥ أو ٥٠ % فى علائق القراميط. ومن الناحية الاقتصادية فان هذه الأحشاء عمليا يمكن أن تحل محل مسحوق السمك بنسبة ١٠٠ %.