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EFFECT OF REPLACING FISH MEAL WITH FISH PROCESSING BY-PRODUCTS ON THE GROWTH PERFORMANCE AND NUTRIENTS UTILIZATION OF NILE TILAPIA (*OREOCHROMIS NILOTICUS*) FRY.

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SUMMARY

The aim of this study was to investigate the effect of replacing fish meal protein with dried fish processing byproducts (DFP) on growth performance and nutrients utilization of Nile tilapia (*Oreochromis niloticus*) fry reared in concrete ponds. The experimental diets were formulated to be iso-nitrogenous (33%CP) and iso-caloric (4821 Kcal GE /kg). Four experimental diets were formulated. The control group fed a diet containing only fish meal as a source of animal protein while the second, third and fourth groups were fed on the diets where (DFP) replaced fish meal protein at 25, 50 and 100% levels, respectively. The obtained results showed that the best FCR, PER, PPV and EU were recorded by group fed diet (T_3) followed in a significant ($P<0.05$) decreasing order by both (T_2), (T_4) and (T_1), respectively. Furthermore, there were significant effects on protein, fat and ash contents of fish whole body on dry matter basis with incorporation of DFP instead of FM, the costs to produce one kilogram fish gain is reduced by 10.97; 27.73 and 45.63% for treatment T_2; T_3 and T_4, respectively compared to the control group.

Keywords: *fish meal, fish processing by-products, Nile tilapia, growth performance, feed cost.*

INTRODUCTION

The increasing number of population in Egypt is facing an increasing consumption of major food commodities including animal proteins which significantly exceed domestic supply resulting in a sharp decline in self sufficiency level. This necessitates the importation of large quantities of food including animal protein products. The relative high price of animal protein created a great world demand towards fishes, which provides protein of high digestibility and nutritive value closely resembling that of animal protein on basis of their essential amino acids contents. Therefore, Egypt needs to increase the fish production to cover the consumer needs and increase the offer to stabilize the price in suitable form for the consumer.

On the other hand, fish feeding plays an important role in fish farming especially when this practiced in intensive production systems. Diets containing high levels of proteins are necessary for the economical growth of fish in intensive rearing conditions. Ratios of protein levels in fish feeds generally vary from 25 to 60% and are supplied from a variety of protein sources of both vegetable and animal origin (Gümüş and Ikiz, 2009).

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

Fish meal (FM) is considered the major animal protein ingredient in aquaculture diets for most cultivable fish species because of its nutritional quality (Hardy and Tacon, 2002). However, FM is one of the most expensive macro-ingredients in an aqua- culture diet because it is used in high proportions. Moreover, its availability is limited by various factors such as climatic phenomena, the increasing demand for FM use in animal feed, especially in aquaculture diets, and the overexploitation and decline of fish stocks that are used to produce FM. Restricted FM supplies can no longer meet the needs of the expanding fish feed industry as a result of aquaculture development (Dong *et al.* 1993). Therefore, there is an urgent need to search for non-traditional feedstuffs or by-products which could be used as cheap sources of protein to replace fish meal in formulating fish diets. Many studies have been made to use alternative protein sources such as plant proteins (Sitjà- Bobadilla *et al.* 2005; Tantikitti *et al.* 2005; Cheng *et al.* 2003), and rendered animal proteins (Millamena, 2004; Yoshitomi *et al.* 2006; Cavalheiro *et al.* 2007), poultry by-products (Yang *et al.* 2006), turkey meal (Muzinic *et al.* 2006) and krill (Olsen *et al.* 2006).

The aim of this study was to investigate the effect of replacing fish meal protein with fish processing byproducts (FPP) as non-traditional protein source on growth performance and nutrients utilization of Nile tilapia (*Oreochromis niloticus*) fry reared in concrete ponds.

MATERIALS AND METHODS

The present study was conducted at Water Resources Research Station belonging to the National Institute of Oceanography and Fisheries at Baltim region, Kafr El-Sheikh Governorate, Egypt. The period of experiment was extended to 22 weeks.

Preparation of dried fish processing by-products:

Fish processing byproducts were brought from Al-Oboor market. They composed of fish preparing wastes (head, fins, skin and viscera) and by-product from fish fillet, fish body without flesh, and also trash fish or small fish not fit for human consumption. Fish processing byproducts were washed and immersed in boiled water for 10-15 min to kill any microbes that could be existed then the excess water was eliminated. They were grinded, dried in oven at 65 °C for 17 hours and followed by drying at 105 °C for 24 hour. Then they were grinded again and stored in plastic bags at 4 °C to avoid rancidity until using in formulating experimental diets. Proximate chemical analysis of dried fish processing byproducts (DFP) compared with fish meal are presented in Table (1).

Table (1): Proximate chemical analysis (DM%) of dried fish processing byproducts (DFP) compared with fish meal.

Item	DFP	Fish meal
Moisture	6.40	8.00
Crude protein	44.50	72.00
Crude fat	22.10	8.40
Ash	26.31	10.70
The rest	0.69	0.90
GE Kcal/Kg*	4603	4862

* *Gross energy was calculated from their chemical composition using the factors 5.65, 9.45, 4.0 and 4.0 (Kcal /Kg DM) for crude protein, ether extract, crud fiber and nitrogen free extract, respectively (Jobling, 1983).*

Diets formulation:

The experimental diets were formulated to be iso-nitrogenous (33.09±0.02 %CP) and iso-caloric (4821±7.0 Kcal GE/ kg). The experiment included four treatments; the first was the control diet in which fish meal was the only animal protein source, while the second, third and fourth treatments were fed on the diets where (DFP) replaced fish meal protein at 25, 50 and 100% levels, respectively. The formulation and composition of the experimental diets are shown in Table (2).

Experimental fish:

Apparently healthy mono sex Nile tilapia (*Oreochromis niloticus)* fry were purchased from a commercial private fish hatchery located at Kafr El-Sheikh Governorate. Fish were acclimated to the experimental conditions for 7 days before starting the experiment in four fiberglass tanks (1 m^3) with small aeration pump. After acclimatization the fish were randomly distributed into four experimental dietary groups. The initial weight of the experimental fish was 0.31 g.

Experimental ponds and stoking rate:

Twelve rectangular cement ponds were used in the experiment with dimensions 2.5 × 2.25 and 1.1 meter depth for each. Three replicates for each dietary treatment.

The experimental ponds before being stocked with fish were drained completely; bottoms were exposed to sun radiation for one week and treated with potassium permanganate. Then the ponds were filled with fresh water to 70 cm height from underground well by electrical pump. The water volume in each pond was about 4 m^3 (2.5 × 2.25 and 0.7 m water depth) stocked by 20 fry/ m^3 presently 80 mono sex of Nile tilapia (*Oreochromis niloticus*) fry.

Table (2): Formulation and proximate composition (DM%) of the experimental diets fed to Nile tilapia (*Orechromis niloticus*) fry.

Item	The experimental diets			
	T1 Control	T2 DFP 25%	T3 DFP 50%	T4 DFP 100%
Fish meal (72%)	25	18.8	12.5	—
Yellow corn	30	26.1	22	16.2
Soybean meal(44 %)	25	26	27	29
Rice bran	12	11	10.7	7
Vegetable oil	6	6	5.6	5.3
DFW	—	10.1	20.2	40.5
Vit. & Min. premix *	2	2	2	2
Total	100	100	100	100
Chemical composition (%)				
Moisture	8.38	8.14	7.94	7.51
Crude protein	33.09	33.10	33.11	33.06
Ether extract	9.40	10.98	12.15	15.10
Ash	6.03	7.92	9.88	13.51
Crude fiber	4.02	3.86	3.77	3.30
NFE[1]	39.08	36.00	33.15	27.52
GE Kcal/Kg **	4817	4828	4813	4828

* *Contains per kg: vitamin A, 4.8 m. I.U; vit D3 , 0.8 m.I.U; vit E, 4.0 g; vit. K, 0.8 g; vit B1, 0.49, vit. B2, 1.6 g; vit. B6, 0.6 g; vit. B12, 4 mg; Pantothenic acid 4 g; Nicotinc acid 8 g; Folic acid, 400 mg; Biotin, 20 mg; Choline chloride, 200 mg; Copper, 4.0 g ; Iodine, 0.4g ; Iron, 12 mg ; Manganese, 22 g; Zinc 22 g and Selenium 0.04 g.*

** *Gross energy was calculated from their chemical composition using the factors 5.65, 9.45, 4.0 and 4.0 (Kcal /Kg DM) for crude protein, ether extract, crud fiber and nitrogen free extract, respectively (Jobling, 1983).*

Calculated by difference.

Feeding rate:

The experimental diets were fed in pellets form during the whole experimental period. During the feeding practice, the fish were fed the experimental diets at rates of 30, 10, 6 and 4% of their body weight for fish weights (0 - 1g), (1 - 5g), (5 - 20g) and (20g until end of experiment), respectively. The daily feed amount was distributed daily by hand in four equal portions at 9, 11, 13 and 15 hrs according to Kubaryk (1980).

Water quality:

During the experiment period; water was changed and renewed at a rate 20% of the water column daily to obtain a good water quality while the ponds were drained every two week for cleaning.

Water quality parameters were measured every week including water temperature (24 to 30.9 °C), dissolved oxygen (DO) concentration (6.3 and 9 mg / l), water transparency (37 to 52 cm), pH (7.3 to 7.9), ammonia (NH_3) (0.022 to 0.033 mg /l) and total dissolved salts (T.D.S) (8610 and 9580 mg / l) . All tested water quality parameters were within the optimal levels required for growth and development of Nile tilapia. Analytical methods were done according to American Public Health Association (APHA, 1992). The pH and water temperature values were determined by digital temperature and pH meter. Dissolved oxygen was monitored by using Oxymeter, Jan way model 9071.

Analytical methods:

Initial body composition of fish was analyzed from samples of 50 fish which were frozen (at -20°C) prior to the study. At the end of the study, random fish samples from each pond were netted, their total weights (g) were recorded and frozen for final chemical analysis.

The chemical analysis of the feed ingredients, the tested dried fish processing byproducts, the experimental diets and fish carcass were done to estimate moisture, crude protein (CP%), ether extract (EE%), crude fiber (CF%) and ash contents according to the methods of AOAC, (2000), while nitrogen free extract (NFE%) was calculated by difference. Gross energy (Kcal/ Kg) contents of all the samples were calculated according to Jobling, (1983).

Economical evaluation:

The Economic evaluation for the experiment was done to determine the cost of feed required to produce one Kg of fish weight gain. The cost of the experimental diets has been done in L.E. for market prices at the period of implemented experiment.

Statistical analysis:

Collected data were subjected to statistical analysis as one-way analysis of variance (ANOVA) using the general liner model procedure of SPSS, (1998). Duncan's Multiple Range Test (Duncan, 1955) was done to separate means when the dietary treatment effect was significance.

RESULTS AND DISCUSSION

One important challenge concerning aquaculture in near future is to establish and maintain sustainable and profitable production. As the demand for fish meal for aquaculture increases while their availability decreases, the feed cost is expected to rise. A dependable supply of cost effective alternative sources of protein must be provided for fish farming. In general, replacing FM protein with DFP in Nile tilapia groups fed diets up to 50% (T_3) improved all growth performance traits (Table 3) compared with the control group.

Table (3): Growth performance and feed utilization of the experimental diets fed to Nile tilapia (*Orechromis niloticus*) fry.

Item	The experimental diets			
	T1 Control	T2 DFP 25%	T3 DFP 50%	T4 DFP 100%
IW (g/fish)	0.31	0.31	0.31	0.31
	±0.00	±0.00	±0.00	±0.00
FW(g/fish)	81.39 [c]	81.8 [c]	98.95 [a]	91.51 [b]
	±1.27	±2.1	±1.43	±1.68
WG (g/fish)	81.08 [c]	81.49 [c]	98.64 [a]	91.2 [b]
	±1.27	±2.1	±1.43	±1.68
FI (g/fish)	165.25 [c]	165.24 [c]	185.66 [a]	178.28 [b]
	±2.25	±2.10	±2.53	±3.08
ADG (g/fish/day)	0.53 [c]	0.53 [c]	0.64 [a]	0.59 [b]
	±0.01	±0.01	±0.01	±0.01
SGR (%/day)	3.62 [c]	3.62 [c]	3.74 [a]	3.69 [b]
	±0.01	±0.02	±0.01	±0.01
FCR	2.04 [b]	2.03 [b]	1.88 [a]	1.95 [ab]
	±0.02	±0.06	±0.01	±0.01
PER	1.49 [b]	1.50 [b]	1.61 [a]	1.55 [ab]
	±0.02	±0.04	±0.01	±0.01
PPV (%)	25.06 [c]	26.49 [b]	28.65 [a]	26.47 [b]
	±0.27	±0.73	±0.14	±0.12
EU (%)	16.44 [c]	17.55 [b]	19.36 [a]	17.70 [b]
	±0.18	±0.48	±0.1	±0.08

a, b,..etc.: Means within row with different superscripts are significantly different ($P<0.05$).
WG (g)=FW–IW; ADG (g fish/ day)=(AWG(g)/days); SGR (%/day)= ((LnFW– LnIW)/feeding days)×100; FI (g) = Total dry matter feed intake; FCR = FI / WG; PER = WG / protein intake; PPV (%) = (Retained protein /protein intake) × 100; EU (%) = (Retained energy / energy intake) × 100

Averages of FCR and PER indicated that the fish group fed (T_3) had significantly ($P<0.05$) the best values compared to the control and (T_2), however differences among the

(T_3) and the (T_4) groups were insignificant. The PPV and EU values showed that fish group fed T_3 had the highest ($P<0.05$) values followed in a significant decreasing order by both T_4 and T_2 then the control group, respectively.

The present results are in accordance with the findings of Goddard and Al-Shgaa (2008) who reported that incorporation of fishery by-catch and processing wasted meals in diets of Nile tilapia had no significant effects on apparent protein digestibility measurements and survival, weight gain, specific growth rate (SGR), feed conversion ratio, protein efficiency ratio, phosphorus retention and whole body proximate composition.

In this connection Soltan and Tharwat (2006) replaced fish meal protein with 25, 50, 75 and 100% fermented fish silage in Nile tilapia and catfish diets and found that, dried fermented fish silage can replace 25 and 50 % of fish meal protein in diets of both fish species without any significant loss in growth performance and feed utilization, but higher inclusion level (75 or 100%) significantly reduced growth performance, feed utilization and body composition of tilapia and catfish.

Furthermore, Abdel-Hakim *et al.* (1996) replaced 30, 35 or 40 % of fish meal in diets of catfish with fish silage , sun or oven dried, in the diets contained about 26% crude protein. They reported that the optimum growth performance and nutrients utilization parameters were recorded by fish fed on diet containing 30 % fish silage.

The present results are consistent with that of Cavalheiro *et al.* (2007) who reported that the shrimp head silage could substitute for fish meal in tilapia fish feed without affecting its nutritional quality of the feed and being economical. Also, our results are in partial agreement with the finding of Wassef (2005) who replaced fish meal protein with acid fish silage protein at 25, 30 and 35% levels in diets of Nile tilapia and blue tilapia. She reported that tilapia fish can utilize efficiently acid fish silage protein up to 30 % dietary level to produce growth performance equivalent, or even better, to that of FM diet with no marked alteration in their nutrient composition. In addition, up to 80% of fish meal protein can be replaced by processed meat meal and blood meal coming from terrestrial animals with no adverse effects on growth, survival, and feed conversion ratio of juvenile grouper (Millamena, 2004). Furthermore Phuong and Yu (2003) reported that poultry by products meal can replaced 80% of fish meal in the diets of juvenile black tiger shrimp without harming growth performance and feed utilization.

In addition, results of Soltan and Tharwat (2006) are in partial agreement with the present results. They incorporated fermented fish silage in diets of Nile tilapia and catfish to replace 0, 25, 50, 75 and 100% of fish meal protein. They reported that replacement of fish meal protein with dried fish silage at 25 and 50 % levels had no significant effects on feed utilization parameters, however higher levels of replacement (75 or 100%) significantly depressed feed utilization. Goddard and Al-Shagaa (2008) also reported that fishery by catch and fish processing waste meals had no negative effects on feed conversion ratio, protein efficiency ratio and growth performance parameters and were highly digestible by Nile tilapia fish.

Results of carcass traits (Table 4) indicated the incorporation of DFP at levels of 50 and 100 % to replace FM protein improved the dressing and flesh percentages on the costs of head and by-products percentages. Abdel-Hakim *et al.* (1996) incorporated fish waste silage in growing catfish diets using sun and draying methods at 30; 35 and 40% levels in replacement with fish meal protein. They reported that incorporation of fish silage (sun dried) at 30% levels improved the dressing percentage of male catfish while a level of 35% improved the carcass (dressing) percentage in males.

Table (4): Carcass parameters of Nile tilapia (*Oreochromis niloticus*) fed the experimental diets.

Item	The experimental diets			
	T1 Control	T2 DFP 25%	T3 DFP 50%	T4 DFP 100%
Dressing (%)	59.92 ^{b}	60.68 ^{b}	63.39 ^{a}	63.27 ^{a}
	±0.32	±0.27	±0.25	±0.32
Head (%)	19.6 ^{a}	19.76 ^{a}	18.33 ^{b}	17.91 ^{b}
	±0.23	±0.17	±0.17	±0.18
Wastes (%)	48.05 ^{a}	48.67 ^{a}	45.44 ^{b}	45.62 ^{b}
	±0.33	±0.28	±0.23	±0.36
Flesh (%)	51.95 ^{b}	51.33 ^{b}	54.56 ^{a}	54.38 ^{a}
	±0.33	±0.28	±0.23	±0.36

a, b, ..etc.: Means within row with different superscripts are significantly different (P < 0.05).

Table (5): Carcass composition (%) of Nile tilapia (*Orechromis niloticus*) fed the experimental diets.

Item	Nutrients component (%)			
	DM	CP	EE	Ash
T1 (Control)	27.68 ^{a}	60.80 ^{b}	21.11 ^{b}	18.09 ^{a}
	±1.13	±0.47	±0.35	±0.48
T2 (DFW 25%)	28.58 ^{a}	61.91 ^{ab}	22.27 ^{ab}	15.82 ^{b}
	±0.32	±0.43	±0.32	±0.7
T3 (DFW 50 %)	28.55 ^{a}	62.25 ^{ab}	23.47 ^{a}	14.28 ^{bc}
	±0.24	±0.52	±0.5	±0.88
T4 (DFW 100%)	26.91 ^{a}	63.38 ^{a}	23.32 ^{a}	13.30 ^{c}
	±0.09	±0.45	±0.53	±0.35
Initial	20.81	60.19	14.65	25.16
	±.04	±.03	±.05	±.06

a, b,..etc.: Means within column with different superscripts are significantly different (P < 0.05).

Results of Table (5) reveal that the fish group fed DFP (100%) had significantly (P<0.05) CP content compared to the control group, however differences among the other groups in this trait were insignificant. The results show that fish groups (DFP 50 and 100%) had significantly (P<0.05) higher fat content in their DM compared to the control group, however differences in this trait among the control and DFP 25% groups were insignificant. These results may indicate that the increases in protein and fat contents in the DM of fish bodies especially in the group fed diet (T_4) were on the costs of the reduction of ash contents in fish bodies of this group.

The results of the same table show that fish fed T_4 had significantly higher CP and fat contents compared to the control group. These results may indicate that the increases in protein and fat contents in the DM of fish bodies especially in the group fed diet (T_4) were on the costs of the reduction of ash contents in fish bodies of this group. In this connection Ali and Sahu (2002) replaced fish meal with either acid fish silage or fermented fish silage in the diets of juveniles (113.8g) ***macrobrachian rosenbergii*** for 60 days. They reported that incorporation of both fish silage kinds had no effect on carcass composition. Also Abdel-Hakim *et al.* (1996) reported that incorporation of fish silage (sun dried) at 30% level instead of FM protein improved the dressing percentage of male catfish while a level of 35% substitution improved the carcass (flesh) percentage.

Furthermore, Abdel-Warith and Al-Azab (2007) replaced fish meal protein with poultry by-products meal (PBM) at 20, 40, 60, 80 and 100% levels in Nile tilapia diets. They reported that increasing the PBM level from 60 to 80 or 100% to replace fish meal resulted in significant increase in whole body lipid contents and at replacement levels higher than 60% it increased significantly ash contents.

According to Soltan and Tharwat (2006) who cited that endogenous factors (size, sex and stage of life cycle) and exogenous factors (diet composition, feeding, frequency, temperature etc...) affect the body composition of fish. It should be noted that within endogenous factors, the composition of the feed is only factor, which could have influenced the chemical composition of fish, as other endogenous factors were maintained uniform during the study. The results indicated that, compared to control fish group, all replacing levels of FM by fermented fish by-products silage (FFS) significantly ($P<0.001$) decreased protein and EE contents whereas fish group fed the control diet gained the highest protein and EE contents.

On contrast with our results, Soltan *et al.* (2008) found that all replacing levels of fish meal (25, 50, 75 and 100%) by fermented fish by-products silage (FFS) significantly decreased protein and ether extract contents where fish group fed the control diet gained the highest protein and ether extract contents. In addition, Wassef *et al.* (2003) found that, replacing of FM by FFS up to 75% did not significantly affected protein content in tilapia bodies.

Decreasing feed cost and costs of production of one Kg gain in weight are obtained as incorporation level of DFP in Nile tilapia diets increased (Table 6). The present results are in accordance with the findings of Abdel-Hakim *et al.* (1996) who reported that incorporation of fish silage instead of fish meal in catfish diets reduced costs required for each kg gain in weight and the reduction was more pronounced at higher dried fish silage levels (40%) compared to the lower levels 30 or 35%.

Table (6): Feed cost (L.E) for one Kg weight gain produced by fish fed the experimental diets.

Item	The experimental diets			
	T1 Control	T2 DFP 25%	T3 DFP 50%	T4 DFP 100%
Feed intake (g/fish)	165.25	165.24	185.66	178.28
Cost (L.E) of one Kg of feed	2.966	2.6541	2.3209	1.6811
Total weight gain (g/fish)	81.08	81.49	98.64	91.20
Feed cost/Kg gain (L.E)	6.045	5.382	4.369	3.287
Percentage decrease in feed cost to produce one Kg fish gain	100	89.03	72.27	54.37

The cost of producing one Kg gain= amount of feed used to produce 1 Kg fish gain × cost of one Kg feed.

Furthermore, Soltan *et al.* (2008) obtained decreasing feed costs gradually compared to the fish meal control group the costs of one Kg gain in weight were increased with increasing the level of substitution.

CONCLUSION

Based on results obtained from the present study it could be recommended the use of dried fish waste DFP in growing Nile tilapia diets to reduce the price of dietary protein and the price of one Kg gain in weight of Nile tilapia fish without any adverse effects on growth performance feed utilization parameters.

REFERENCES

Abd El- Hakim, N.F.; M.A. El-Garhy; S.H. Sayed and F.A. Salama (2009). Replacement of fish meal with a mixture of protein sources in juvenile monosex Nile tilapia (*Oreochromis niloticus*) diets. Egypt J. Aquat. Biol. & Fish. vol. 13. No. 4:179-193 (2009).

Abd El- Hakim, N.F.; A.A. Al-Azab, and Kh.F. El-Kholy (2003). Effect of feeding some full fat oil seeds on performance of tilapia hybrid (*Oreochromis niloticus* × *O. aureus*) reared in tanks. Egyptian J. Nutrition and Feeds, 6 (Special Issue): 389-403.

Abd El- Hakim, N.F.; E.A. Hellali; T.M. Shahat; F.A. El-Nemaki; and S.A. Salah El-Din (1996). Effect of diets containing different levels of fish silage on the growth

Abdel-Warith, A.A. and A. A. Al-Azab, (2007). Partial and total substitution of fish meal by poultry by-product meal in diets for monosex nile tilapia (*Oreochromis niloticus*). Annals of Agric. Sc. Moshtohor, Vol. 45(4): 1381-1393.

Ali, S. and N.P. Sahu (2002). Response of *Macrobrachium rosenbergii* (de Man) Juveniles to Fish Silages as Substitutes for Fish Meal in Dry Diets. Asian Fisheries Society, Manila, Philippines. Asian Fisheries Science, 15 (2002): 61-71.

Association of Official Analytical Chemists (AOAC) (2000). Official Methods of Analysis. 17 ed. Association of Official Analytical Chemists Washington, DC, USA.

Cheng, Z.J.; R.W. Hardy and J.L. Usry (2003). Effects of lysine supplementation in plant protein-based diets on the performance of rainbow trout (*Oncorhynchus mykiss*) and apparent digestibility coefficients of nutrients. Aquaculture: 215, 255-265.

Cavalheiro, J.M.O.; E. Oliveira de Souza and P.S. Bora (2007). Utilization of shrimp industry waste in the formulation of tilapia (*Oreochromis niloticus* Linnaeus) feed. Bioresource Technology: 98, 602-606.

Dong, F. M.; N. F. Hardy; F. T. Barrows; B. A. Rasco; W. T. Fairgrieve and I. P. Foster (1993). Chemical composition and protein digestibility of poultry byproduct meals for salmonid diets. Aquaculture: 116: 149-158.

Duncan, D. (1955). Multiple range and Multiple (F) tests. Biometrics, 11: 1-2.

Goddard, S; G. Al-Shagaa and A. Ali (2008). Fisheries by-catch and processing waste meals as ingredients in diets for Nile tilapia, *Oreochromis niloticus*. Aquaculture Research: 2008, 39(5): 518-525

Gümüş, E. and R. Ikiz (2009). Effect of dietary levels of lipid and carbohydrate on growth performance, chemical contents and digestibility in rainbow trout, *Oncorhynchus mykiss* walbaum, 1792. Pakistan Vet. J. 29(2): 59-63.

Hardy, R.W. and A.G.J. Tacon (2002). Fish meal: Historical uses, production trends and future outlook for sustainable supplies. Responsible Marine Culture: 311-325.

Jobling, M. (1983). A short review and critique of methodology used in fish growth and nutrition studies. J. fish biology, 23: 685-703.

Khattab, Y.A. (1996). Studies on fish growth. Ph. D. Thesis, Fac. of Agriculture, Zagazig Univ.

Kubaryk, J. M. (1980). Effect of diet, feeding schedule and sex on food consumption, growth and retention of protein and energy by tilapia. Ph.D. Dissertation. Auburn University, Auburn, Alabama .

Millamena, O.M. (2004). Replacement of fish meal by animal by-product meals in a practical diet for grow-out culture of grouper *Epinephelus coioides*. Aquaculture: 204, 75-84.

Muzinic, L.A.; L.S. Thompson; S. Metts; S. Dasgupta and C.D. Webster (2006). Use of turkey meal as partial and complete replacement of fish meal in practical diets for sunshine bass (*Morone chryops* × *M. saxatilis*) grown in tanks. Aquaculture Nutrition, 12: 71-81.

Olsen, R.E.; J. Suontama; E. Jangmyhr; H. Mundheim; E. Ringo; W. Melle; M. K. Malde and G. I. Hemre (2006). The replacement of fish meal with Antarctic krill, *Euphausia superba* in diets for Atlantic salmon, *Salmo salar*. Aquaculture Nutrition,12: 280-290.

Phuong, N.T. and Y. Yu (2003). Replacement of fish meal with MBM and PBM on growth performance of juvenile Black Tiger Shrimp (P. monodon) (2003, Vietnam –2). World Renderers Organization, Research and Presentations, Aquaculture. (http://www.worldrenderers.org).

Sitjà-Bobadilla, A.; S. Peña-Llopis; P. Gómez-Requeni; F. Médale; S. Kaushik and J. Pérez-Sánchez (2005). Effect of fish meal replacement by plant protein sources on non-specific defense mechanisms and oxidative stress in gilthead sea bream (*Sparus aurata*). Aquaculture: 249, 387-400.

Soltan, M.A. ; M.A. Hanafy and M.I.A. Wafa (2008). An Evaluation of Fermented Silage Made from Fish By-Products as a Feed Ingredient for African Catfish (*Clarias gariepinus*). Global Veterinarian; 2 (2): 80-86, 2008.

Soltan, M.A. and A.A. Tharwat (2006). Use of fish silage for partial or complete replacement of fish meal in diets of Nile tilapia (*Oreochromis niloticus*) and African catfish (*Ciarias gariepinus*). Egyptian Journal of Nutrition and Feeds. 2006; 9(2): 299-314

SPSS (1998). Statistical Program for Windows XP, Ver.14, Copyright © ,SPSS Inc.

Tantikitti, C.; W. Sangpong and S. Chiavareesajja (2005). Effects of defatted soybean protein levels on growth performance and nitrogen and phosphorus excretion in Asian seabass (*Lates calcarifer*). Aquaculture: 248, 41-50.

Wassef, E.A. (2005). Alternative protein sources for fish feeds in Egypt. Cahiers Options Méditerranéennes, Volume 63, 127-141.

Wassef, E.A.; M.A. Sweillam and R.F. Attalah (2003). The use of fermented fish silage as a replacement for fish meal in practical diets for Nile tilapia *Oreochromis niloticus*. Egyptian Journal Nutrition and Feeds. 6 (Special issue): 357-370.

Yang, Y.; S. Xie; Y. Cui; X. Zhu; W. Lei and Y. Yang (2006). Partial and total replacement of fish meal with poultry by-product meal in diets for gibel carp, *Carassius auratus gibelio* Bloch. Aquaculture Research, 37: 40-48.

Yoshitomi, B.; M. Aoki; S. Oshima and K. Hata (2006). Evaluation of krill (*Euphausia superba*) meal as a partial replacement for fish meal in rainbow trout (*Oncorhynchus mykiss*) diets. Aquaculture: 261, 440-446.

تاثير إستبدال مسحوق الأسماك بمخلفات الأسماك على الأداء الإنتاجى والإستفادة من المركبات الغذائية لاصبعيات البلطى النيلى

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تهدف هذه الدراسة إلى دراسة تأثير استبدال بروتين مسحوق السمك بمخلفات الأسماك المجففة على أداء النمو والاستفادة من العناصر الغذائية فى أسماك البلطي النيلي المرباه فى أحواض أسمنتية.
تم تكوين أربعة علائق تجريبية متشابهه فى نسبة البروتين (٣٣ ٪) و متشابهه فى الطاقة (٤٨٢١ كيلوكالورى/ كجم). غذيت المجموعة المقارنة على عليقة يحتوي على مسحوق الأسماك فقط كمصدر للبروتين الحيواني في حين أن المجموعة الثانية ، الثالثة والرابعة تم إحلال٢٥ و ٥٠ و ١٠٠٪ من بروتين مسحوق الأسماك بالعليقة المقارنة بمخلفات تصنيع الأسماك المجففة على التوالي. أظهرت النتائج التي تم الحصول عليها أن أفضل معامل تحويل غذائى ، نسبة كفاءة البروتين ، القيمة الإنتاجية للبروتين والاستفادة من الطاقة سجلتها مجموعة الأسماك التى غذيت على العليقة الثالثة (٥٠٪ مخلفات تصنيع الأسماك المجففة) يتبعها معنويا بترتيب تنازلي مجموعتي الأسماك التى غذيت على (٢٥ و ١٠٠٪ مخلفات تصنيع الأسماك المجففة) ثم المجموعة المعازنة على التوالى.

علاوة على ذلك ، كانت هناك تأثيرات معنوية على محتوى جسم الأسماك من البروتين والدهون والرماد على أساس المادة الجافة عند إحلال مخلفات تصنيع الأسماك المجففة محل مسحوق الأسماك. إنخفضت تكاليف إنتاج واحد كيلوجرام من الأسمك بنسبة ١٠,٩٧ ؛ ٢٧,٧٣ ؛ ٤٥,٦٣٪ فى المجموعة الثانية ، الثالثة والرابعة على التوالي مقارنة مع مجموعة المقارنة.