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PRODUCTION OF A LOW COST FISH DIET BY USING POULTRY BY-PRODUCTS RESIDUES

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ABSTRACT

This study aimed to produce a low cost fish diet through using levels of poultry by-products meal in diets of Nile tilapia *(Oreochromis niloticus)*. The experiments were carried out through 90 days and included five treatments of 0, 25, 50, 75 and 100% poultry by-products. The highest weight gain WG (59.84 g) was recorded for fish fed on the control diet followed by those fed on the diet 25% (53.37 g), 50% (52.98 g), 75% (48.46g) and 100% (46.22 g) replacement, respectively. The differences in weight gain among the different fry groups were significant (P<0.05) and the same trend was observed for specific growth rate SGR. The average feed intake, feed conversion ratio and protein efficiency ratio of Nile tilapia were significantly (P<0.05) affected by the incorporation of poultry by-products meal as a substitute of fish meal. The results of this study showed that moisture in whole fish body ranged between 77.40 and 80.55% with insignificant differences. Crude protein ranged between 61.70 and 64.44%, ether extract ranged between 15.50 to 17.73% and ash from 17.84 to 22.43% with significant differences for ether extract and protein content of whole fish bodies. Feed cost decreased as inclusion levels of poultry by-products meal increased. Costs were (6020, 5330, 4640 and 3950 LE/Mg) at fish fed on diets contain (25, 50, 75 and 100% of poultry by-products meal respectively) compared with those fed on the control diet (6660 LE/Mg). In conclusion, replacing up to 50% of fish meal by poultry by-products meal did not affect growth performance and feed utilization for tilapia. The higher replacing levels (75 or 100%) significantly adverse growth and feed utilization parameters.

Key words: Fish diet, poultry by-products meal, fishmeal replacement, Nile tilapia.

INTRODUCTION

Egypt is facing a critical situation in that its consumption of major food commodities including animal proteins, 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 fish, which provides protein of high digestibility and nutritive value closely resembling that of animal protein on basis of their essential amino acids. Moreover, the relative cheaper price of fish and the rapid growth in domestic demand for fish and seafood products should prompt all to improve this sector in all directions. Animal protein is the most valuable component of diet. Fish, as a source of protein for human consumption, is essential to help considerably in correcting the state of malnutrition in such circumstance, as in Egypt, which is topographically situated alongside great areas of fresh and marine waters including canals and inland lakes.

Fish meal is the major protein source in fish diet because it builds the natural proteins of fish. It is not only expensive but also was difficult to be in steady current competition between fish and poultry in one side and mankind in other

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side. For these reasons, nutritionists try to replace part of fish meal as animal protein by another unconventional protein sources. (Shiau *et al.*, 1990) reported that nutrition plays an important role in intensive fish production, depending upon the type of feed availability and its cost. To minimize the cost of feed for tilapia and other cultured fish species, emphasis is bending laid on research into use of agro-industrial by-product to replace expensive protein sources as well as to reduce hazard of pollution resulting from these waste products. However, use of poultry by-products meal (PBM) in fish diets sometimes results in reduced growth in fish, especially when replaced more than 50% of FM (Fish meal) in diets (Steffenes, 1994). (Acea *et al.,* 2002) indicated that using 20% poultry by-products in diet improved performance, however increased ether extract content and decreased crude protein levels in carcass and dry matter, crude protein and energy digestibility coefficients of the diets. The reduced performance for fish was because of amino acid imbalances, as well as a lack of n-3 highly unsaturated fatty acids in the diets containing PBM (Yiğit *et al.*, 2006). Poultry by-product meal is one of the most important sources of animal protein used to feed domestic animals, along with meat and bone meal, blood meal, feather meal and fish meal (Meeker and Hamilton, 2006). Total or partial replacement of fish meal with less expensive animal protein, such as poultry by-product meal may help to reduce feed costs, although these sources may be lower in digestibility, palatability and essential amino acids (Hu *et al.*, 2008). According to (El-Sayed *et al.*, 2012), fish meal protein in Nile tilapia diets could be substituted with poultry by-product meal protein up to 50% without adverse effect on growth performance and nutrient digestibility.

The objectives of the present investigation are to produce a low cost fish diet through increasing levels of poultry by-products meal in diets of Nile tilapia (*Oreochromis niloticus*), Select preferable of poultry by-product meal, optimize some parameters affecting feeding of Nile tilapia and evaluate the performance from the economic point of view.

MATERIALS AND METHODS

The present study was carried out through successful season of 2015 at the fish Production and aquaculture system department of Central Laboratory for Aquaculture Research (CLAR), Abbassa, Abou- Hammad, Sharkia, Egypt to produce a low cost fish diets by using poultry slaughterhouses residues and investigate the effect of incorporation of increasing levels of poultry by-products meal in the diets of Nile tilapia (*Oreochromis niloticus*).

Materials

Raw material

Two different kinds of poultry abattoir residues were used (legs and intestines). Intestines and legs can be separated for inedible rendering or processing. The products resulting from slaughtering of bird are carcasses and by-products. The quantity of bird by-products often exceeds 60%. This percentage called "dressing percentage" (carcasses weight/live weight).

Poultry by-product meal

Poultry by-product meal is one of the most important sources of animal protein used to feed domestic animals, along with meat and bone meal, blood meal, feather meal and fish meal. It is made by combining the by-products coming from poultry slaughterhouses or poultry processing plants. poultry by-product meal as the ground, rendered, clean parts of the carcass of slaughtered poultry such as necks, heads, legs, undeveloped eggs, gizzards and intestines (provided their content is removed), exclusive of feathers. Rendering was a heating process for meat industry waste products through which fats were separated from water and protein residues for the production of edible lards and dried protein residues. Commonly it includes the production of a range of products of meat, meat-cum-bone, bone meal and fat from animal tissues. Rendering processes raised temperature and pressure through cooking or steam application.

The experimental fish

The experimental fish were obtained from experimental farm, Central Laboratory for Aquaculture Research (CLAR). After acclimatization, fish were randomly distributed into the experimental fiberglass representing the five treatments at stocking. Body weight (BW) and body length (BL) for each fiberglass were recorded. The fiberglasses were cleaned and water was replaced every four days, dissolved oxygen was maintained by continuous aeration and water temperature was at 25 to 28°C. Fifteen rectangular fiberglass were filled by 120 liters fresh water (3 replicates for each treatment) and each aquarium was stocked with 15 fish with an initial weights ranged from 13.47 to 15.01g.

The experimental diets

The main ingredients of feeds for farmed fish species are fish meal and fish oil, at levels of about 25 percent and 30 percent, respectively. The nutrient balance of feed influences feed utilization and growth of fish. It was very essential to save the nutritional requirements particularly for protein, lipid and energy for optimum growth of a fish species as well as in formulating a balanced diet. Dietary protein and energy levels are known to affect the growth and body composition of fish species. Observed that improper protein, energy and other nutrient levels in feed increased fish production cost especially the recurrent expenditure and deteriorate water quality. While insufficient energy in diets caused protein waste due to the increase proportion of dietary protein used for energy and the produced ammonia can pollute the water and make it unfit for fish culture. However, that excessive energy in diets could lead to increased body lipid deposition and growth reduction because of lack of necessary nutrient for growth. From the economic stand point, feed cost appears to be one of the major constraints against the expansion of aquaculture.

Methods

Preliminary experiments

Processing poultry slaughterhouses residues (intestines, legs and fat) required several steps for production poultry by-product meal. Poultry slaughterhouses residues were primarily collected in containers and washed prior for processing in batch drier. Afterwards the mechanical way used for cooking and processing offal under steam heat and pressure, this was resulted in meals of higher quality. The poultry offal was cooked, sterilized and dried down to 8% moisture. Fat was extracted for percentage of 10-12% fat content poultry by-product meal.

The poultry slaughterhouses residues were loaded into a batch drier under steam heat, pressure and transformed into safety product and digestible protein.

Poultry by-product meal (PBM) consists of clean parts of slaughtered poultry such as intestines, legs and fat, PBM was included guarantees for minimum crude protein, minimum crude fiber, minimum phosphorus, and minimum calcium. The quality of PBM, including critical amino acids, essential fatty acids, vitamins, and minerals along with its palatability, had led to its demand for use in aquaculture.

Diet preparation and feeding regimes

Fish meal and oil are gradually being replaced by animal proteins in feed that is used in fish farms. Animal proteins can be less costly and they are free of potential contaminants like dioxin, PCB or mercury. However, fishmeal is an important ingredient in fish feed and can only to a limited extent be replaced by animal proteins without reducing feed efficiency and growth.

Five diets were prepared by thoroughly mixing the ingredients which composed of fish meal, soybean meal, poultry by-products, yellow corn, vegetable oil, gluten and rice bran with different percentages (Table 1). In preparing the diets, dry ingredients were first ground to a small particle size. Ingredients were mixed and then water was added to obtain a 30% moisture level. Diets were passed through a mincer machine with diameter of 2 mm and were sun dried for 3 days. The experimental diets were formulated to replace 0, 25, 50, 75 or 100% of fish meal by poultry by-products meal based on protein content. All diets were formulated to be isonitrogenous (30% protein) and isocaloric (about 3200 kcal ME/kg diet).

Table 1. Composition and chemical analysis of the experimental diets

Feed ingredients (%)	Experimental diets				
	Diet1	Diet2	Diet3	Diet4	Diet5
Fish meal (72%)	20	15	10	5	0
Poultry by-products	0	10	15	20	25
Yellow corn	22	17	17	17	17
Soybean meal (44%)	30	30	30	30	30
Gluten	10	10	10	10	10
Rice bran	12	12	12	12	12
Vegetable oil	3	3	3	3	3
Vit. and Min. mixture	3	3	3	3	3
Sum	100	100	100	100	100
Chemical composition					
Crude protein (CP)	30.2	30.19	30.13	29.8	29.73
Ether extract (EE)	8.09	8.19	8.10	8.20	8.17
Crude fiber (CF)	9.33	10.22	10.10	10.24	9.82
Ash	8.77	9.68	8.73	8.73	9.31

[1] Vitamin and mineral mixture/kg premix : Vitamin D_3, 0.8 million IU; A, 4.8 million IU; E, 4 g; K, 0.8 g; B1, 0.4 g; Riboflavin, 1.6 g; B6, 0.6 g, B12, 4 mg; Pantothenic acid, 4 g; Nicotinic acid, 8 g; Folic acid, 0.4 g Biotin,20 mg , Mn, 22 g; Zn, 22 g; Fe, 12 g; Cu, 4 g; I, 0.4 g, Selenium, 0.4 g and Co, 4.8 mg.

Tilapia fish fed the pelleted diets (2 mm in diameter) at a daily rate of 5% during the experimental period of total biomass 6 days/ week (twice daily at 9.00 am and 3.00 pm) and the amount of feed was bi-weekly adjusted according to the changes in body weight throughout the experimental period (84 days). About 10% of water volume in each fiberglass was daily replaced by aerated fresh water after cleaning and removing the accumulated excreta. Water temperature and dissolved oxygen were measured daily at 2.00 pm while total ammonia was weekly measured. Water quality parameters measured were found to be within acceptable limits for fish growth and health.

Aquaculturists typically report growth using absolute (g/d), relative (% increase in body weight), and specific growth rates (%d). Less frequently, von bertalanffy growth functions (VBGF) were used. Each of these rates was a numerical representation of growth which assumes a specific relationship between size and time (linear, exponential, or asymptotic). Aquaculturists typically determine size at time throughout their experiments. Unfortunately, the intermediate data points were ignored when computing growth rates and the appropriateness of the method for calculating growth for a particular data set was not tested. This paper reviewed the basis and computation of each of the growth rates in an effort to encourage aquaculturists to use the appropriate growth rates.

Growth performance and feed utilization parameters were measured as follows

Evaluation of the growth performance and feed utilization in the diets of Nile tilapia *(Oreochromis niloticus)* was based on the following indicators:

Weight gain

Weight gain was an increase in body weight. This can involve an increase in muscle mass, fat deposits, excess fluids such as water or other factors.

$$WG = W_f - W_i$$

Where:

WG = Weight gain, g.

W_f= Final weight, g.

W_i= Initial weight, g.

Specific growth rate

Specific growth rate (SGR) was measured to quantify the speed of fish growth. It is measured as the mass increase per aboveground biomass per day. It was considered to be the most widely used way of estimating fish growth. A term used in aquaculture to estimate the production of fish after a certain period, SGR was calculated using the following equation:

$$SGR = \frac{\ln W_f - \ln W_i}{t} x 100$$

Where:

$\ln W_f$ = the natural logarithm of the final weight.

$\ln W_i$ = the natural logarithm of the initial weight.

t = production period in days.

Feed conversion ratio

Feed conversion ratio (FCR), or feed conversion efficiency (FCE), was expressed as the mass of the food eaten divided by the output, all over a specified period. "Efficiency" was expressed as the ratio of useful output to input, as the ratio of feed mass input to body mass output. It was calculated using feed dry mass, or was calculated as wet mass basis.

$$FCR = \frac{FI}{WG}$$

Where:

FI = Feed ingested, g.

WG= Weight gain, g.

Protein efficiency ratio

Protein efficiency ratio (PER) was based on the weight gain in gram of a test subject divided by its intake of a particular food protein in gram during the test period. The protein efficiency ratio had been a widely used method for evaluating the quality of protein in food.

$$\text{Protein efficiency ratio (PER)} = \frac{WG}{PI}$$

Where:

WG= Weight gain, g.

PI= Protein ingested, g.

Condition factor

Standard weight in fish was the typical or expected weight at a given total length for a specific species of fish. Most standard weight equations were for freshwater fish species. As fish grow in length, they increase in weight. The relationship between weight and length was not linear. Standard weight was used as a basis for comparison to assess the health of an individual or group of fish. Generally, fish that were heavier than the standard weight for their length were considered healthier, having more energy reserves for normal activities, growth and reproduction. Fulton's condition factor, K, was another measure of an individual fish's health that was used standard weight. It was assumed that the standard weight of a fish was proportional to the cube of its length as follows:

$$K = \frac{W}{L^3} x100$$

Where:

K = Fulton's condition factor, g/cm^3

W = Weight of fish, g.

L^3 = Cube of total length of fish, cm.

Chemical Analyses

At the end of each experiment, three fish were randomly sampled from each aquarium and subjected to the chemical analyses of whole fish body. Moisture, dry matter (DM), ether extract (EE), crude protein (CP), crude fiber (CF) and ash content of diets and fish were determined according to AOAC (1990).

Statistical Analyses

Statistical analyses of the obtained data for the two experiments were analyzed according to SAS (1996). Differences between means were tested for significance according to Duncan's multiple rang test as described by Duncan (1955). The following model was used to analyze the obtained data:

$$Y_{ij} = \mu + \alpha_i + e_{ij}$$

Where:

Y_{ij} = the observation on the ijth fish eaten the ith diet.

μ = overall mean.

α_i= the effect of i^{th} diet.

e_{ij} = random error assumed to be independently and randomly distributed (0, δ^2 e).

In most animal diets, protein was the most expensive portion and was usually the first nutrient that was computed in diet formulation. The energy level of the diet was then adjusted to the desired level by addition of high energy supplements) which were less expensive than protein supplements. The price of the feedstuffs was used in diet formulations must be considered to formulate a cost-efficient diet. Feedstuffs can be compared with another one on the basis cost per unit of protein, energy, or amino acid.

RESULTS AND DISCUSSION

The obtained results will be discussed under the following items:

Effect of Replacing Levels of Fish Meal with Poultry By-Products Meal in the Diets

Final body weight and final body length

Representative values of final body weight and final body length versus replacing levels of fish meal ranged from 0 to 100% are illustrated in Fig. 1. Obtained results show that replacing of 25% or 50% of fish meal relied on poultry by-products meal in the diets, reduced the final body weight to 53.37 and 52.98g but these values were insignificant compared to fish fed the basal diet, the highest average final body weight (59.84 g) was recorded for control group which fed the basal diet (control). The higher replacing levels of fish meal through by-products (75 or 100%) in the diets significantly (P<0.05), caused a decrease in the BW of Nile tilapia fish to 48.46 and 46.22g, respectively, indicating the possibility of replacing 50% of fish meal in the basal diets of Nile tilapia fish through poultry by-products meal. It is also noticed that the increase of replacement levels from 25 to 100% was followed with a reduction in final body length from 15.12 to 14.49 cm, the differences between fish groups were significant. The highest average body length (16.78 cm) was recorded for fish in control group followed in a descending order by those fed the control diet.

Daily weight gain and specific growth rate

From Fig. 2 which show the effect of the obeviously replacing levels of fish meal on both of daily weight gain and specific growth rate. It is cleared that, the levels of 25% and 50% had insignificant effect on the daily weight gain compared to control one. Obtained results show that replacing of 25% or 50% of fish meal relied on poultry by-products meal in the diets, reduced the daily weight gain to 0.58g and 0.57g but these values did not much different compared to fish fed the basal diet, the highest average daily weight gain (0.63 g) was recorded for control group which fed the basal diet (control) while the higher replacing levels of fish meal through by-products (75 or 100%) in the diets significantly (P<0.05), decreased the daily weight gain of Nile tilapia fish to 0.53 and 0.51g, respectively, indicating the possibility of replacing 50% of fish meal in the basal diets of Nile tilapia fish through poultry by-products meal. On the other side, increase of replacement levels in the diets by the values of 25, 50, 75 and 100% decrease specific growth rate (SGR) to 2.50, 2.51, 2.43 and 2.37, respectively, the differences between fish groups did not significant. The highest specific growth rate (2.62) was recorded for fish control group followed in a descending order by those fed the control diet.

Feed conversion ratio and protein efficiency ratio

Representative values of feed conversion ratio and protein efficiency ratio versus replacing levels of fish meal are given in Fig.3. Obtained results show that feed conversion ratio values were found to be 3.19 for fish groups fed the experimental diets of 0, 25, 50% replacement, and 3.24 and 3.31 for fish groups fed the experimental diets 75 and 100% replacement, the differences were insignificant (P>0.05).

Results of protein efficiency ratio of tilapia fed the experimental diets show that the average protein efficiency ratio for fish groups fed the experimental diets ranged between 1.33 and 1.39. The lowest value (1.33) was observed for fish group fed the diet of 100% replacement of fish meal with poultry by-products meal compared to the others.

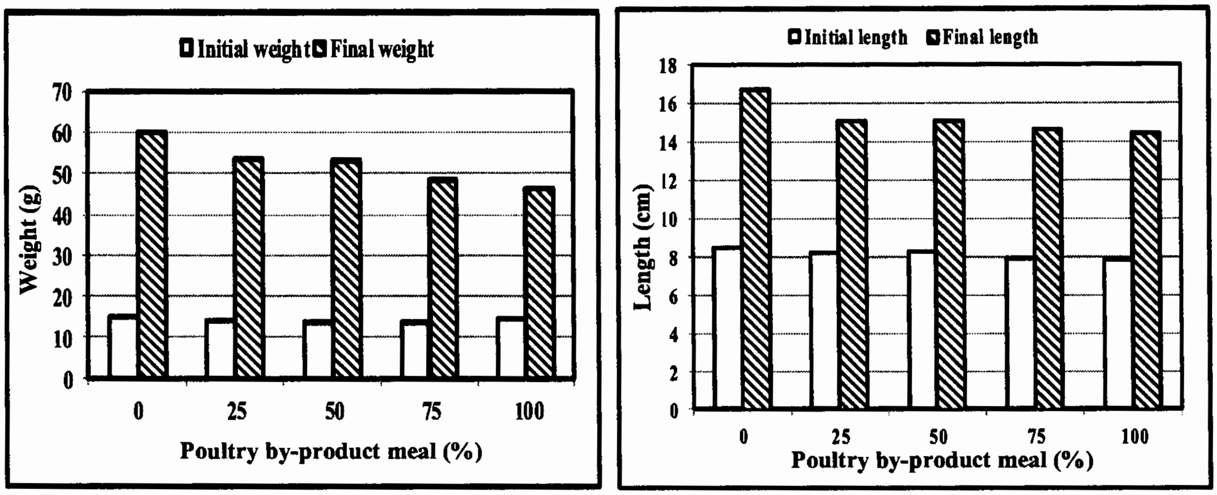

Fig.1. Effect of replacing levels of fish meal with poultry by-products meal in the diets on final body weight and final body length

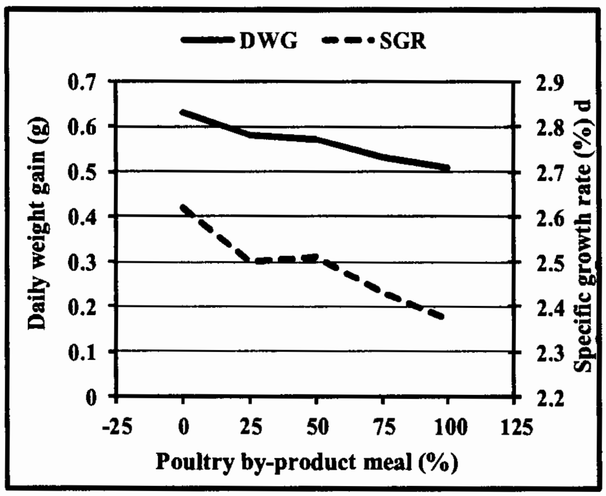

Fig. 2. Effect of replacing levels of fish meal in the diets on daily weight gain (DWG) and specific growth rate (SGR)

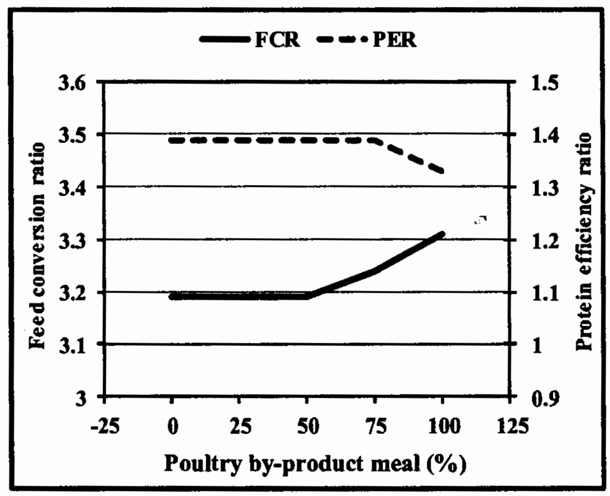

Fig. 3. Effect of replacing levels of fish meal in the diets on feed conversion ratio (FCR) and protein efficiency ratio (PER)

Condition factor

Values of condition factor versus replacing levels of fish meal are given in Fig.4. It is shown that the highest average condition factor (1.71) was recorded for fish control group and 25% replacement followed in descending order by those fed the diet of 50 and 100% replacement (1.69), and the lowest value (1.67) was observed for fish group fed the diet 75% replacement of fish meal was replaced by poultry by-products meal.

The present study clearly demonstrated that 50% of fish meal could be replaced by poultry by-products in practical diets for Nile tilapia. This is in agreement with the results of Viola and Zohar (1984), who reported that up to 50% of FM could be replaced by poultry by-products in the diets of tilapia hybrids. In addition, (Steffenes, 1994) reported that using of PBM in fish diets sometimes results in reduced growth in fish, especially when replaced more than 50% of FM in diets.

On the other hand, many authors reported that PBM can totally replace FM in practical diets for Nile tilapia. El-Sayed (1998) revealed

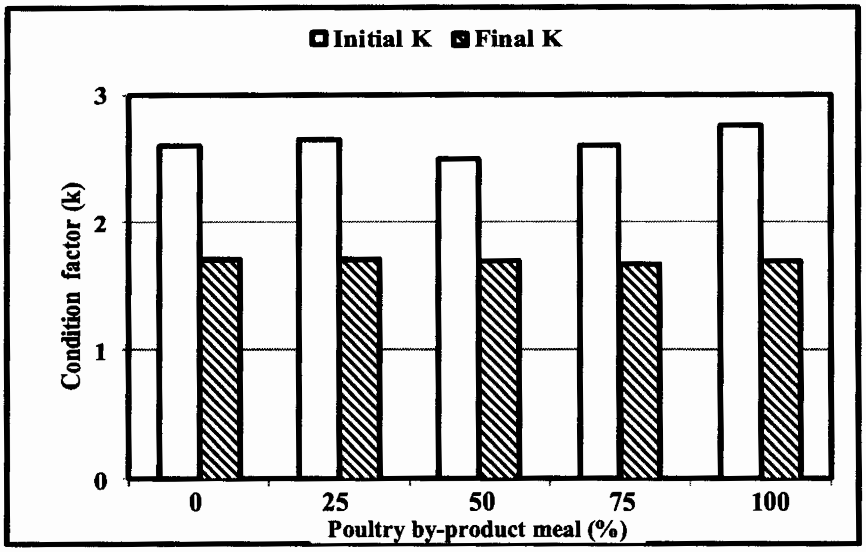

Fig. 4. Effect of replacing levels of fish meal in the diets on condition factor

that PBM can totally replace FM in practical Nile tilapia diets under the experimental conditions employed. In addition, these protein sources are locally available at much lower prices than imported fish meal. This is in agreement with the results of Abdelghany *et al.* (2005) who studied the effect of replacing FM with PBM in diets for Nile tilapia. The differences among these results may have been related to protein source, quality and processing, fish species and size, experimental period and culture systems.

Proximate Analysis of Whole Fish

The average proximate analysis of tilapia as affected by replacing levels of FM by PBM in the diets outlined in Fig. 5. As described, moisture ranged between 77.40 and 80.55%; crude protein 61.70 and 64.44%; ether extract ranged between 15.50 and 17.73 and ash from 17.84 and 22.43% and the differences among the different experimental fish groups were significant.

Economic Evaluation of Nile Tilapia as Affected by Replacing Levels of FM by PBM in the Diets

The cost of feed required to produce a unit of fish biomass was estimated using economic evaluation. The estimation was based on the local retail sale market price of all the dietary ingredients at the time of the study. These prices (in LE /kg) were as follows: herring fish meal, 17; soybean meal, 4.2; corn meal, 2.20; vegetable oil, 10.2; poultry by products meal, 3.2; vitamin premix and mineral mixture 9.7; gluten 6.9; rice bran 1.9.

Economic analysis show that feed cost and feed cost/kg gain were high in the control group than poultry by-products meal replaced diets (Fig. 6). Feed cost decreased as inclusion levels of poultry by-products meal increased. Costs were (6020, 5330, 4640 and 3950 LE/Mg) at fish fed diets contain (25, 50, 75 and 100% of poultry by-products meal, respectively) compared with those fed the control diet (6660 LE/Mg). Feed cost to produce one kilogram fish gain was (19.20, 17.00, 15.03 and 13.07 LE) at fish fed diets contain (25, 50, 75 and 100% of poultry by-products meal, respectively) compared with those fed the control diet (21.25 LE) and reduction in feed cost to produce one kg fish gain compared with control diet showed (9.65, 20, 29.27 and 38.49%) for the mentioned replace levels.

Conclusion

The obtained results reveal that fish fed on diet containing 0, 25 and 50% poultry by-products meal showed the highest average body weight (59.84, 53.37 and 52.98g), respectively weight gain (0.63, 0.58 and 0.57g) for the same previous diets, specific growth rate (SGR) (2.62, 2.50 and 2.51) for the same previous diets. Feed

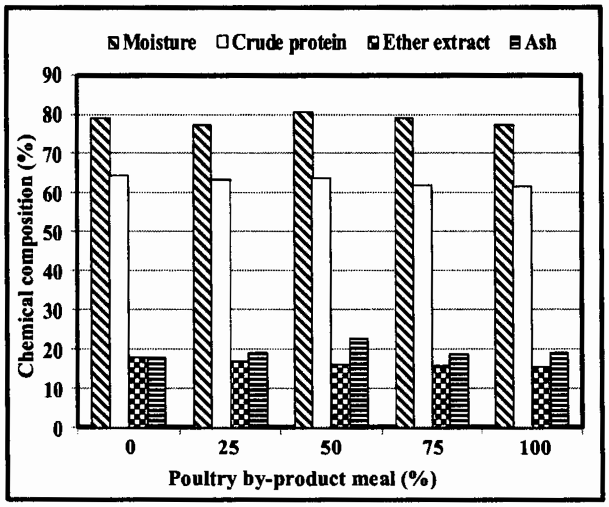

Fig. 5. Changes in proximate chemical composition (%) on DM basis in fish body of Nile tilapia as affected with poultry by-products meal

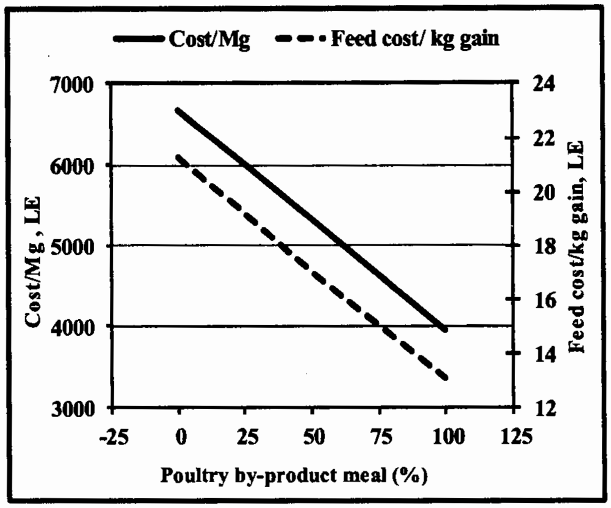

Fig. 6. Effect of replacing levels of fish meal in the diets on Economic evaluation

conversion ratio (FCR) recorded 3.19 and protein efficiency ratio (FER) recorded 1.39 for the previous diets. Results also showed that feed cost decreased as inclusion levels of poultry by-products meal increased. Costs were (6020, 5330, 4640 and 3950 LE/Mg) at fish fed diets contain (25, 50, 75 and 100% of poultry by-products meal, respectively) compared with those fed the control diet (6660 LE).

To achieve the aim of this study which is represented in reducing the cost of producing fish diet, the experimental results recommended the following:

Fish meal can be partially replaced by PBM at a rate of 50% and consequently provide substantial feed cost savings with no loss in growth performance.

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إنتـــاج علـف للأســـماك قليــل التكلفـــة باســتخدام مخلفـــات مجـــازر الـدواجن

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الهدف الرئيسي لهذا البحث هو إنتاج علف قليل التكلفة لتغذية الأسماك عن طريق استخدام مسحوق مخلفات المجازر كنسبة من مسحوق السمك في علائق البلطي النيلي، تم تنفيذ التجارب الأساسية بالمعمل المركزي لبحوث الثروة السمكية - العباسة - أبوحماد - محافظة الشرقية، وفى هذه الدراسة قسمت اصبعيات اسماك البلطى النيلى (١٣,٤٧- ١٥,٠١جم وزن ابتدائى) إلى ٥ مجموعات لكل مجموعه ثلاث أحواض، سعة الواحد منها ١٢٠ لتر وبه ١٥ سمكة، تغذت الأسماك على علائق ٣٠% بروتين متماثلة في التركيب تحتوى علي تركيزات مختلفة من مسحوق مخلفات المجازر (صفر ، ٢٥، ٥٠، ٧٥، ١٠٠%) من مسحوق السمك لمدة ١٢ أسبوع، وقد أظهرت النتائج المتحصل عليها ما يلي: لم يتأثر معدل النمو النسبي في الأسماك المغذاة على علائق تحتوي على صفر ، ٢٥، ٥٠% من مسحوق مخلفات مجازر الدواجن تأثيراً معنوياً، حيث كان معدل النمو النسبى (٢,٦٢، ٢,٥٠، ٢,٥١) على الترتيب، بينما قل معدل النمو النسبي إلى (٢,٤٣، ٢,٣٧) فى الأسماك المغذاة على علائق تحتوي على ٧٥، ١٠٠% من مسحوق مخلفات مجازر الدواجن على الترتيب، الأسماك المغذاة على علائق تحتوي على صفر ، ٢٥، ٥٠% من مسحوق مخلفات مجازر الدواجن أعطت أفضل معدل تحويل غذائي (٣,١٩)، بينما كان معدل التحويل الغذائى (٣,٢٤، ٣,٣١) للأسماك المغذاة على علائق تحتوي على ٧٥، ١٠٠% من مسحوق مخلفات مجازر الدواجن على الترتيب، لم يتأثر معامل الحالة معنوياً في المعاملات المختلفة حيث كانت أعلى قيم لمعامل الحالة فى الأسماك المغذاة على علائق تحتوي على صفر ، ٢٥% من مسحوق مخلفات مجازر الدواجن (١,٧١) وأقل قيم فى الأسماك المغذاة على علائق تحتوي على ٥٠، ١٠٠% من مسحوق مخلفات مجازر الدواجن (١,٦٩)، وجد من التحليل الكيماوي أن نسبة البروتين ونسبة الدهن ونسبة الرماد لم تتأثر معنوياً في الأسماك المغذاة على علائق تحتوي على ٢٥، ٥٠% من مسحوق مخلفات مجازر الدواجن بالمقارنة بالأسماك التي تم تغذيتها على عليقة خالية من مسحوق مخلفات مجازر الدواجن، أظهر التقييم الاقتصادي أنه بزيادة نسبة مسحوق مخلفات مجازر الدواجن كبديل لمسحوق السمك قلت التكلفة الاقتصادية، حيث قلت تكلفة الطن من ٦٦٦٠ جنيه للعلائق الخالية من مسحوق مخلفات مجازر الدواجن إلى (٦٠٢٠، ٥٣٣٠ جنيه) للعلائق المحتوية على (٢٥، ٥٠%) من مسحوق مخلفات مجازر الدواجن على الترتيب دون أي تأثير سلبي على الوزن المكتسب، ومن ثم توصى الدراسة باستخدام مخلفات مجازر الدواجن بنسبة تصل إلى ٥٠% من مسحوق السمك فى علائق أسماك البلطي النيلي للحصول على أقل تكاليف بدون أي تأثير سلبي على الوزن المكتسب ومعدل التحويل الغذائي الذي بلغ ٣,١٩.

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