Pakistan Vet. J., 19 (1): 1999

FEEDING DIFFERENT LEVELS OF DRIED POULTRY EXCRETA ON THE GROWTH PERFORMANCE AND BODY COMPOSITION OF *OREOCHROMIS NILOTICUS*

N.A. Al-Asgah and A. Ali
Department of Zoology, College of Science, King Saud University, Riyadh, Kingdom of Saudi Arabia

ABSTRACT

This study evaluated the growth performance and body composition of fish *Oreochromis niloticus* fed different levels (0, 5, 10, 15 and 20%) of dried poultry excreta (DPE) for a period of 60 days. Significant ($P<0.05$) differences were observed in the body weight gain, condition factor, specific growth rate (SGR), feed conversion ratio (FCR), protein efficiency ratio (PER) and net protein retention (NPR) values when the level of DPE in the fish diets was increased over 5%. Increasing the level of DPE in the diets significantly ($P<0.05$) reduced the growth performance of the fish. However, the diets containing 15 or 20% DPE did not show any significant ($P>0.05$) difference between each other. The inclusion of DPE in the diets did not affect ($P>0.05$) the body moisture and crude protein contents of fish. Feeding of DPE however, significantly ($P<0.05$) reduced the total body fat contents of fish as compared to those fed standard basal diet. The increasing level of DPE in the diets however did not produce any significant difference ($P>0.05$) in the body fat content of fish. Similar results were observed for the gross energy content of fish. The body ash content of fish increased significantly ($P<0.05$) with the increasing level of DPE in the diets and it was maximum in fish fed 20% of DPE. The results of the present study suggest that only 5% of DPE can be included in the diets of *Oreochromis niloticus* without any adverse effects on their growth performance. Higher levels of DPE in fish diets may also be used if a little lower fish biomass production is acceptable with higher cost benefit ratios.

INTRODUCTION

Approximately 40-60% of the total cost of production of commercial aquaculture operations may be attributed to feed. The relatively high prices and fluctuating quality of fish meal have limited its use in aquaculture feeds over the past years (McCoy, 1990; Bimbo and Crowther, 1992; Rodriguez-Serna *et al.*, 1996). The search for the use of alternative feed ingredients for fish feeding has, therefore, gained importance throughout the world (Alexis *et al.*, 1985; Anonymous,1996). A number of animal by-product meals, such as blood meal, hydrolysed feather meal or meat and bone meal, have been tried as substitute of fish meal and have shown their relative economical and nutritional significance in fish diets (Hedegus *et al.*, 1990; Steffens, 1994; Rodriguez-Serna *et al.*, 1996). However, a right answer to the proper use of these feedstuffs in the diets of cultured fish is required for the future development of aquaculture industry.

Animal manures have long been used as fertilizers in fish production throughout the world, especially in tropical and subtropical regions (Wohlfarth and Schroeder, 1979; Shevgoor *et al.*, 1994). *Microphagous Tilapia* are known to feed extensively on detritus (Bowen, 1982). Fish ponds are fertilized with animal manure to increase the primary and secondary production. Ponds receiving higher fertilizer inputs had higher nutrient concentration in water, higher primary production and higher fish production than ponds treated with low fertilizer inputs (Diana *et al.*, 1990). The chicken litter has also been used successfully as an organic fertilizer for Tilapia production in many parts of the world (Rappaport and Sarig, 1978; Knud-Hansen *et al.*, 1993). The gross yields of Tilapia have been reported to increase significantly with increased chicken litter applications and produced the estimated profits (Green *et al.*, 1990).

Animal manure, which is used as a fertilizer to increase the natural food production, might also be used as a direct way to feeding fish (Kausar and Ali, 1988). Dried poultry excreta has long been considered as an excellent source of protein and minerals for ruminants (Smith and Wheeler, 1979; Zinn *et al.*, 1996). However, very little information is available on its use as feed ingredient for fish diets (Wohlfarth and Schroeder, 1979). The present study was, therefore, conducted to evaluate the effect of feeding different levels of dried poultry excreta (DPE) on the growth performance and body compostion of fish *Oreochromis niloticus*.

MATERIALS AND METHODS

Oreochromis niloticus with an average weight of 7.79±0.19 g were collected from the fish hatchery of King Abdul Aziz City for Science and Technology (KACST) Deerab, Riyadh, Saudi Arabia. To determine their initial body composition, 30 randomly selected fish were killed and, after recording their body weight and length, were stored at -30°C for the proximate analysis at a later stage. One hundred and fifty fish were then randomly divided into 5 different groups with 3 replicates containing 10 fish in each replicate. The fish were kept in glass tanks (100 x 42.5 x 50.0 cm) containing dechlorinated and well aerated tap water and fitted with waste filtration facility. The temperature of water was maintained at 28±1°C. Compressed air was used to maintain the oxygen supply. Regular monitoring of water quality was carried out for temperature, pH, dissolved oxygen, ammonia, nitrite and nitrate levels. These parameters were kept within the tolerance limits for *Oreochromis niloticus*.

A standard basal diet was prepared (Table 1). The poultry excreta used in this study was obtained from the caged laying hens. The feathers and other foreign materials were removed from the excreta. It was first dried in the sun and then dried in the oven at 70°C to a constant weight. It was then grounded to a fine mesh before mixing it with other ingredients for the preparation of experimental diets. Five experimental diets were prepared in which the dried poultry excreta (DPE) was incorporated into the basal diet at 0, 5, 10, 15 and 20% levels (Table 2). The diets were prepared through the extrusion process using a 2 mm die, similar to the method as already described by Al-Asgah and Ali (1994). The proximate chemical composition of the experimental diets and the dried poultry excreta is given in Table 3. The diets were dried at 60°C and then stored at -18°C throughout the experimental period. Each diet was randomly allotted to 3 replicates in different groups in a completely randomized design. The diets were offered twice daily at about 3% of body weight. The feed offered was adjusted every fortnightly in relation to the body weight of fish. The daily feed intake and fortnightly weight gains were recorded. The experiment lasted for 60 days. At the ene of the experimental eriod, all the fish were killed and their body weight and length were recorded. To determine their carcass composition, the fish were cut into pieces and minced through a meat mincer. The homogenized samples were frozen at -30°C for further analysis. The proximate chemical composition was determined according to the methods of Association of Official Analytical Chemists (Anonymous, 1984). The gross energy content of fish was calculated from the fat and protein contents using the equivalents of 39.54 $MJ.Kg^{-1}$ crude fat and 23.64 $MJ.Kg^{-1}$ crude protein (Kleiber, 1961).

Feed conversion ratio (FCR), specific growth rate (SGR), protein efficiency ratio (PER) and net protein retention (NPR) values were calculated as follows:

Feed conversion ratio= Kg feed consumed per Kg weight gain.

Specific growth rate (as percentage of body weight gain per day) =100 [final wt. (g) - initial weight (g)]/time (days).

Protein efficiency ratio= live weight gain (g)/ protein consumed (g).

Net protein retention= [increase in carcass protein/protein fed] x 100.

The condition factor (K) was calculated according to the equation K = [W(g)/L(cm3)] x 100, where W is the wet weight of fish in grams and L is the length in centimeters. The data so collected were subjected to statistical analysis using the analysis of variance technique and the means were compared by Fisher's LSD test according to Snedecor and Cochran (1989).

Table 1: Composition of the standard basal diet

Ingredients	Amount (%)
Fish meal	41.00
Soybean meal	15.00
Corn	25.00
Wheat bran	10.00
Corn oil	5.00
Gelatin	1.00
Mineral mixture[1]	2.00
Vitamin mixture[1]	1.00
Total	100.00

1. AL-Asgah and Ali (1994)

RESULTS

The data on the growth performance of *Oreochromis niloticus* fed different levels of dried poultry excreta (DPE) is presented in Table 4. All the fish grew normal and no fish mortality was observed in any group throughout the experimental period. Significant differences were observed in the body weight gain of fish fed different levels of DPE. The substitution of DPE in the standard basal diet at 5% did not affect ($P > 0.05$) the body weight gain of fish. Increasing the level of DPE in the diet above 5% significantly ($P < 0.05$) reduced the body weight gain in fish. However, no significant ($P < 0.05$) differences were observed between the diets containing 15 or 20% levels of DPE. The body weight gain of fish decreased linearly with the increasing level of DPE in the diets (Fig. 1). Similar results were observed for the specific growth rate and body condition factor of fish. The feed intake in fish was only significantly affected when the level of DPE in the diet was increased above 10%. The inclusion of DPE at 5% level in the diet did not affect ($P < 0.05$) the FCR values. The FCR values however, increased significantly with the increasing level of DPE in the diet, indicating poor utilization of feeds. The differences in the FCR values of diets containing 15 or 20% of DPE were however non significant ($P < 0.05$). Similar results were observed for the PER and NPR values.

The data on the body composition of fish fed different levels of DPE is presented in Table 5. The inclusion of DPE in the diet did not ($P > 0.05$) affect the body moisture and crude protein contents of fish. Feeding of DPE however significantly ($P < 0.05$) reduced the total body fat content of fish as compared to those fed standard basal diet. The increasing level of DPE in the diet (5.20%) however, did not produce any significant ($P > 0.05$) effect on the body fat content of fish. Similar results were observed for the gross energy content of fish. The body ash content of fish increased with the increasing level of DPE in the diet and it was maximum in fish fed 20% of DPE. The diets containing 5, 10 or 15% DPE however, did not show any significant ($P > 0.05$) difference in the body ash contents of fish.

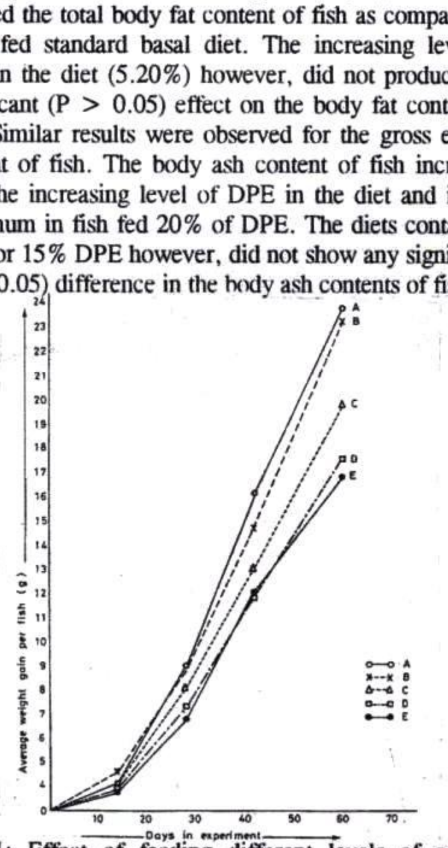

Fig. 1: Effect of feeding different levels of poultry droppings on the growth performance of *Oreochromis niloticus*.

DISCUSSION

The potential of recycling of animal wastes into fish production was first demonstrated by Chinese (Guo and Bradshaw, 1993). The use of livestock wastes has become a norm in the production of cheaper herbivorous fish (Shevgoor *et al.*, 1994). Recently, the poultry manure has also been used widely in both fresh and brackish water aquaculture (Green *et al.*, 1990; Knud-Hansen *et al.*, 1993). According to an FAO (1995) report, the fish raised in semi-intensive systems provides the major portion of farmed, global production. These systems are usually based on ponds fertilized with animal manure and fed with low cost supplementary feeds.

The results of the present study indicated that the incorporation of DPE in the standard basal diet only at 5% level did not affect the specific growth rate and body condition factors of fish. The growth performance of fish decreased linearly with the increasing level of DPE in the diets. However, no fish mortality was observed in any group throughout the experimental period. It may be concluded from these results that incorporation of DPE up to 20% level in the diet of fish did not show any deleterious toxic effects. No evidence of animal health problems or effects on the safety of animal products have been reported over the past years as a result of feeding DPE to ruminants (Muller, 1980). Gupta *et al.* (1997) reported that the major sources of toxicity in the aqueous leachate of poultry litter appeared to be ammonia and other anionic organic compounds and was not due to the presence of heavy metals or oxidants. It has been suggested that the control use of poultry wastes in fish ponds may reduce the likelihood of pollution to other water bodies as well as the possibility of poisoning of fish (Little, 1995). Waste-fed aquaculture is therefore most likely to alleviate pollution from livestock production than to cause it.

The most common problem associated with the use of alternative feed ingredients in fish diets is the acceptability of the diets related to the palatability (Rodriguez-Serna *et al.*, 1996). In the present study, the feed intake in fish was only significantly affected when the level of DPE in the diet increased over 10%. No significant differences were observed in the feed intake of fish between the diets containing 15 or 20% level of DPE, indicating an adaptive response of fish to the new taste of diets. The FCR values indicated the poor utilization of feeds with the increasing level of DPE in the diet. The poor FCR, PER and NPR values with the increasing levels of DPE in the diet could be related to

Table 2: Composition of the experimental diets (g)

Ingredients/Diets	A	B	C	D	E
Standard basal diet	1000	950	900	850	800
Dried poultry excreta (DPE)	000	50	100	150	200
Total	1000	1000	1000	1000	1000

Table 3: Data on the proximate chemical composition of fish diets and dried poultry excreta (DPE) (on % dry matter basis)

Parameters	Diets					
	A	B	C	D	E	DPE
Dry matter (%)	92.71	93.81	93.62	93.01	93.49	94.22
Crude protein	36.38	35.23	35.02	34.42	34.10	23.24
Crude fibre	3.42	3.78	3.89	4.16	4.59	12.17
Total fat	10.32	9.61	9.77	9.45	9.40	4.32
Ash	12.12	12.95	13.01	13.05	13.47	17.59
Nitrogen free extract (NFE)	37.76	38.43	38.31	38.92	38.44	42.68
Gross energy ($MJ.Kg^{-1}$)	19.15	18.70	18.69	18.53	18.36	14.51

Table 4: Effect of feeding different levels of dried poultry excreta on the growth performance of *Oreochromis niloticus*

Parameters	Diets					
	A	B	C	D	E	SE*
Initial weight ($g.fish^{-1}$)	7.75	7.88	7.77	7.71	7.86	0.19^{NS}
Final weight ($g.fish^{-1}$)	31.54^a	31.16^a	29.70^b	25.31^c	24.76^c	0.87
Total weight gain ($g.fish^{-1}$)	23.79^a	23.28^a	21.93^b	17.60^c	16.90^c	0.79
Specific growth rate (SGR)	2.34^a	2.29^a	2.20^b	1.98^c	1.91^c	0.08
Condition factor (k)	3.02^a	3.06^a	2.89^b	2.90^b	2.92^b	0.23
Total feed consumed ($g.fish^{-1}$)	27.82^a	27.66^a	27.64^a	25.87^b	25.10^b	1.48
Feed conversion ratio (FCR)	1.17^c	1.19^c	1.26^b	1.47^c	1.49^c	0.08
Protein efficiency ratio (PER)	2.35^a	2.39^a	2.27^b	1.98^c	1.97^c	0.10
Net protein retention (NPR)	31.23^a	31.30^a	29.53^b	26.16^c	25.85^c	1.11

* = Pooled standard error

NS = Non-significant

a, b, c, d = Different alphabets in the same row means significant at 5% levels of probability.

Table 5: Data on the body composition of *Oreochromis niloticus* fed different levels of dried poultry excreta (on % wet basis)[1]

Parameters	Diets					
	A	B	C	D	E	S.E.[2]
Moisture (%)	77.09	77.28	77.37	77.02	76.76	0.57^{NS}
Crude protein	13.73	13.61	13.56	13.81	13.74	0.16^{NS}
Total fat	4.34a	3.96b	3.87c	3.77b	3.79b	0.19
Ash	4.32c	4.49b	4.51b	4.59b	4.82a	0.21
Gross energy ($MJ.Kg^{-1}$)	4.95a	4.79b	4.68b	4.74b	4.72b	0.10

1. = Composition of fish slaughtered at the begining of the experiment (moisture, 76.25%; crude protein 13.62%; fat, 4.55%; ash, 4.13% and gross energy, 4.86 $MJ.Kg^{-1}$).

2. = Pooled standard error.

a,b,c,d = Different alphabets in the same row means significant at 5% levels of probability.

lower crude protein and higher crude fibre and ash contents of the diets. Wohlfarth and Schroeder (1979) suggested that the low metabolizable energy and digestible protein levels are the main factors affecting the usefulness of various types of dried poultry wastes when replaced with conventional feed ingredients in fish diets. The nutritional quality of poultry wastes varies depending upon the quality of feed used as well as on the efficiency of the birds (Muller, 1980). Nutrient composition may be a useful guide to value the waste but the availability or the release of nutrients to the food web may be more important. The low energy value of DPE is due largely to the ash content. The DPE used in the present study was obtained from the caged layer batteries. The nutrient composition of the DPE indicated 23.24% crude protein; 12.17% crude fibre and 17.59% ash contents on dry matter basis. The incorporation of DPE in the standard basal diet at 5, 10, 15 and 20% levels reduced the crude protein contents of the experimental diets with a simultaneous increase in the crude fibre and ash contents. The poor growth performance of fish on the experimental diets as compared to that of basal diet might be because of this variability in the composition of diets as affected by the substitution of DPE.

Both the endogenous and exogenous factors operate simultaneously to influence the body composition of fish (Burtle, 1990; Haard, 1992; Shearer, 1994). The results of the present study on the body composition of fish indicated that the inclusion of different levels of DPE in the diet did not affect the body moisture and crude protein contents of fish. The changes in the body fat and ash contents of fish appeared to be associated with the level of incorporation of DPE in the diet. The lower body fat and higher ash contents of fish fed experimental diets containing DPE as compared to those fed basal diet explain the low energy value of DPE due largely to the crude fibre and ash contents.

The results of the present study suggested that only 5% DPE can be included in the diets of *Oreochromis niloticus* without any adverse effects on their growth performance. Higher levels of DPE in fish diets may also be used if a little lower fish biomass production is acceptable with higher cost benefit ratios

REFERENCES

Anonymous, 1996. Final Technical Report IRDC. The development of feeding systems for fish and an integrated duck fish system (December 30, 1991-April 31, 1996). Agricultural and Aquatic Systems Program, School of Environment, Resources and Development, Asian Institute of Technology, p: 41.

Al-Asgah, N.A., and A. Ali, 1994. Effects of feeding various carbohydrate sources on the growth performance and nutrient utilization in *Oreochromis niloticus*. Agribiol. Res., 47: 1-12.

Alexis, M.N., E. Papaparaskeva-Papoutsoglou and V. Teochari, 1985. Formulation of practical diets for rainbow trout (*Salmo gaidneri*) made by partial or complete substitution of fish meal by poultry by-products and certain by-products. Aquaculture, 50: 61-73.

Anonymous, 1984. Official Methods of Analysis of The Association of Official Analytical Chemists. Washington, D.C., U.S.A.

Bimbo, A.P. and J.B. Growther, 1992. Fish meal and oil: current uses. U. Amer. Oil Chemists Soc., 69: 221-227.

Bowen, S.H., 1982. Feeding, digestion and growth-qualitative considerations. In: The Biology and Culture of Tilapias (Ed. Pullin, R.S.V. and R.H. Lowe-McConnell). International Centre for Living Aquatic Resources Management, Makati, philippines, pp: 141-156.

Burtle, G.J., 1990. Body composition of farm-raised catfish can be controlled by attention to nutrition. Feedstuffs, 62(5): 68-70.

Diana, J.S., C.K. Lin and P.J. Schneeberger, 1990. Relationship among nutrient inputs, water nutrient concentrations, primary production and yield of *Oreochromis niloticus* in ponds. Aquaculture, 92: 323-341.

FAO, 1995. Inland Water Resources and Aquaculture Services, Fisheries Resources Division. Review of the state of world fisheries resources; aquaculture, FAO Fisheries Circular No. 886. FAO, Rome, p: 127.

Green, B.W., D.R. Teichert-Coddington, and R.P. Phelps, 1990. Response of Tilapia yield and economics to varying rates of organic fertilization and season in two Central Americal countries. Aquaculture, 90: 279-290.

Guo, J.Y. and A.D. Bradshaw, 1993. The flow of nutrients and energy through a Chinese farming system. J. Appl. Ecology, 30: 86-94.

Gupta, G., J. Borowiec and J. Okoh, 1997. Toxicity identification of poultry litter aqueous leachate. Poult. Sci., 76: 1364-1367.

Haard, N.F. 1992. Control of chemical composition and food quality attributes of cultured fish. Food Res. Int., 25: 289-307.

Hedegus M., J. Bokori, E. Andrasofzkari and L. Kovari, 1990. Optimizing protein quality of mixtures of blood meal, feather meal and bone meal. Acta Veterinaria Hungarica, 28: 143-152.

Kausar, R. and A. Ali, 1988. Fish production through recycling of animal wastes. Progressive Farming, 8: 36-42.

Kleiber, M., 1961. The Fire of Life. An Introduction to Animal Energetics. John Wiley, New York, USA.

Knud-Hansen, C.F., T.R. Batterson and C.D. McNabb, 1993. The role of chicken manure in the production of Nile Tilapia (*Oreochromis niloticus*). Aquaculture and Fisheries Management, 24: 483-193.

Little, D.C., 1995. The development of small scale poultry fish integration in Northeast Thailand: Potential and Constrainst, In: Proceedings of a Seminar "The Management of Integrated Freshwater Agro-piscicultural Ecosystems in Tropical Areas" (Symoens, J.J. and J.C. Micha, Ed.), Brussels, May 16-19, 1994.

McCoy, H.D.II, 1990. Fishmeal-The critical ingredient in aquacultur feeds. Aquaculture Magazine, 16(2): 43-50.

Muller, Z.O., 1990. Feed from Animal Wastes: State of Knowledge. FAO Animal Production and Health Paper, FAO, Rome, pp:190.

Rappaport, U. and S. Sarig, 1978. The results of manuring on intensiv growth fish farming at the Ginosar station ponds in 1977. Bamidgeh, 30: 27-36.

Rodriguez-Serna, M., M.A. Olvera-Novoa and C. Carmona-Osalde, 1996. Nutrional value of animal by-products meal in practical diets for Nile Tilapia *Oreochromis niloticus* (L.) Fry. Aquaculture Research, 27: 67-73.

Shearer, K.D. 1994. Factors affecting the proximate composition of cultured fish with emphasis on salmonids. Aquaculture, 119: 63-88.

Shevgoor, L.C., F. Knud-Hansen, P. Edwards, 1994. An assessment of the role of buffalo manure for pond culture of Tilapia. III, limiting factors. Aquaculture, 126: 107-118.

Smith, L.W and W.E. Wheeler, 1979. Nutritional and economic value of animal excreta. J. Anim. Sci., 48: 144.

Snedecor, G.W. and W.G. Cochran, 1989. Statistical Methods. 8th Edition. The Iowa State University Press, Ames, Iowa, USA.

Steffens, W., 1994. Replacing fish meal with poultry by-product meal in diets for rainbow trout, *Oncorhyncus mykiss*. Aquaculture, 124: 27-34.

Wohlfarth, G.W and G.L. Schroeder, 1979. Use of manure in fish farming-a review. Agricultural Wastes, 1: 279-299.

Zinn, R.A., R. Barajas, M. Montano and Y. Shen, 1996. Protein and energy value of dehydrated poultry excreta in diets for feedlot cattle. J. Anim. Sci., 74: 2331-2335.