Vet.Med.J.,Giza. Vol.42,No.1.(1994):201-206

CORN GLUTEN IN TILAPIA FINGERLINGS DIETS

BY

R. EL. BANNA, MAHA M. HADY, T. M. SHAHAT* and H. M. TELEB
Nutrition and Clinical Nutrition .Dept. Fac. Vet. Med., Cairo University.
* National Institut of Oceanography and Fisheries, Cairo, Egypt.

Received : 10/1/1994

SUMMARY

The digestibility of corn gluten meal (CGM) and possibility of its inclusion in tilapia diets were studied in two steps. Firstly, CGM was fed as a sole dietary ingredient to tilapia and showed digestibility coefficient (DC) of 86.32, 82.2 and 74.8 % for CP , EE ang GE, respectively. Secondly, an experimental study was done to investigate the effect of CGM inclusion rate (25, 50 and 100 %) in fish diets replacing either soybean meal (SBM) or fish meal (FM) on tilapia performance. In addition, the DC of such diets was determined. Tilapia fed on diets contained CGM (especially at high inclusion rate) did not perform well as those fed on SBM-FM control diet. Although 25 % replacing level of SBM by CGM surpassed all dietary treatments in CP and EE digestibility. It can be concluded that, CGM can successfully replaces either SBM or FM in fish diets up to 25% of the total protein in case of their shortage.

INTRODUCTION

The primary aim of fish farming is to maximize survival and growth at a minimal cost. Nutritionally adequate and low cost diets have always been one of the most important goals for successful fish culturing in many developing countries. Commercial tilapia diets contain variable but high amounts of protein (25-50 %) most of which is usually supplied by fish and soybean meals. Since good quality fish and soybean meals are becoming increasingly expensive and sometimes difficult to be obtained; a satuation which encouraged many research workers to find other alternative protein sources that can, at least partially, replace both ingredients in fish diets.

Replacement of fish meal by other animal-protein rich sources as milk or whey powder (Meske et al., 1977), feather and meat meal (Tiews et al., 1976), single cell protein (Atack et al., 1979) and poultry by-products (Osman 1988) were experimented.

On the other hand, most of the attempts to replace fish meal by vegetable protein (SBM) had adversly affected both growth rate and feed conversion rate (Nose, 1971); Koops et al., (1976); Atack and Matty (1979); Viola et al., (1980); Pantha (1982) and Hossain and Jauancey (1989).

Corn gluten as a feed by-product was successfully fed for many species; in particular, broilers and layers (Castanon et al., 1990), in turkey hens (Owings et al., 1988), and steers (Titgemeyer et al., 1989). However, Lovell (1977) found that the crude protein digestibility of corn gluten meal was 80 % in catfish when used as a sole dietary ingredient, whereas, it was 89% when used at level of 21.7% of the diet. Moreover, Hepher (1988) cited that net portein utilization and Biological value of corn gluten in fish diet were 35 and 36 to 55% ; repectively.

The digestibility of corn gluten and the possibility of its inclusio in tilapia diets are not recorded in the available literature. Therefore, two studies were conducted; first to determine the digestibility of corn gluten when fed as a sole dietary ingredient to tilapia. The Second to assess the tilapia performance when fed on diets in which soybean or fish meals were replaced with corn gluten at levels of 25, 50 and 100% . Also, the digestibility of such diets was evaluated.

MATERIALS AND METHODS

Preliminary study on corn gluten meal digestibitity in tilapia:

Aimed at the determination of digestibility of corn gluten when used as a sole dietary ingredient, thirty tilapia fingerlings (Orechromis niloticus) with an average weight of 20.0 ± 1.3 g were used. They were randomly stocked in two glass aquarla (120 L) each of 15 at Fish culture Research Station at El-Kanater El-Khairia. During the experimental period, water temperature, pH, and dissolved oxygen were mentained within the optimum recommended values for tilapia; Heher (1988). Tap water treated be antichlor reagent accoeding to Boyd (1979) was used. Fich were starved for 48 hours before the begining of the experiment then fish were acclimatized gradually to corn gluten meal (CGM) for a period of two weeks. Fine ground CGM was fed at a rate of 5% of life body weight (LBW) daily according to El-Banna (1991). Chromic oxide was added at a level of 0.5 % to CGM an indicator. Faecal collection period lasted for ten days during which faecal samples were collected using siphoning technique as described by Abd-El-Ghany(1993). The concentration of chromic oxide was measured in CGM and faecal samples spectophotometrically by the method of Furukawa and Tankahara (1966). The proximate chemical analysis of CGM and faecal samples was done according to AOAC. (1980). Gross energy (GE) of the diet and faecl samples was determined using a bomb claorimeter according to Nijkamp (1971).

Calculation of digestibility coefficient (DC) of different nutrients was done as described by Hepher (1988). GE was calculated as mentioned by Abd-El- Ghany (1993).

Experimental study:

An attempt was made to investigate the usefulness of the nutritional information obtained from digestibility study done with diets containing large quantities of CGM in an experimental study. Seven isonitrogenous and equacaloric experimental diets were formulated to fulfill the requirement (El-Banna, 1991). The chemical analysis of diet ingredients (table 1) was the basis used in formulating those diets.

CGM replaced either soybean meal (SBM) or fi meal (FM) at levels of 25, 50 and 100% , wh the control diet contained both SBM and FM(the main protein sources (table 2). Tilap fingerlings with an average 1.6 ± 0.2 g we alloted into 7 equal duplicate geoups each of 1 Faculty of Veterinary Medicine, Cairo Univers Two weeks before starting the 8- wee performance trial; fish were stocked in the sa type of glass aquaria and under similar ecologi conditions as mentioned in the preliminary stu for acclimatization.

Fish were weighed biweekly and the daily fe was adjusted accordingly to a rate of 5% LB daily and the amount of feed was offered tw daily at 9.00 a. m. and 3 p.m. The used parame to evaluate fish performance were body wei gain, feed conversion ration (FCR) and p percentage weight gain claculated from the ini weight.

At the end of 8-weeks experimental period digestibility trial for the previously formula experimental diets was conducted using the sa technique mentioned before, in the Fish Cul Research Station at El-Kanater El-Kha Statistical analysis was done acording to snede and Cochran (1980).

RESULTS AND DISCUSSION

Preliminary study:

The results of digestibility coefficient (DC) CGM as a sole dietary ingredient were 86.2 74.8% for CP, EE and EE, respectively . result of DC of CP obtained through digestibility trial in which CGM was used single dietary ingredient was closely relate that reported by Lovell (1977) in catfish (I Unfourtunately, htere is no available concerning CGM digestibility in tilapia to c such findings. In general, considerable var in nutrient digestibility of various feedstuffs among fish species and under diffe environmental conditions (hovell, 1977).

Table (1): Chemical composition (%) of ingredients used in formulating the experimental diets.

Ingredient Item	Fish emal	Soybean meal	Yellow corn	Corn gluten
Crude protein	71.93	44.15	9.80	46.43
Ether extract	8.41	1.23	3.82	1.34
Crude fiber	0.71	5.80	2.61	2.50
Ash	10.50	6.10	1.31	3.52

Experimental study:

The effect of replacing SBM or FM by CGM on tilapia performance are presented in table (3) .

Fish fed the SBM-FM diet showed the highest final body weight (14.08 g) body gain (12.45 g) and good feed conversio ratio (1.28) during the 8-weeks experimental period . replacing of SBM or FM by CGM had always induced a negative effect on tilapia performance traits specially at higher levels of inclusion (50 and 100 %). The replacement of sbm or FM at levels of 50 and 100 % had induced significantly ($P < 0.05$) lower final body weight compared the SBM-FM control diet. The partial replacement (25%) of either SBM or FM by CGM had the mildest adverse effect on the body weight gain (10.89, 11.05 vs g, respectivley), while feed conversion results were

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

Diet Ingredient	Substitution %						Control SBM-FM diet
	SBM			Fish Meal			
	25	50	100	25	50	100	
Fish meal	30.5	30.0	29.0	23.2	15.5	--	31.0
SBM	30.0	20.0	--	40.0	40.0	41.0	40.0
Yellow corn	25.5	26.0	27.0	20.5	16.8	5.0	25.0
Corn gluten	10.0	20.0	40.0	12.3	23.7	49.0	--
Corn oil	--	--	--	--	--	1.0	--
Mineral premix*	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Vit. premix**	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Total	100	100	100	100	100	100	100
Proximate analysis %							
C. P.	42.07	41.99	41.84	41.83	41.26	41.31	42.15
E. E.	4.17	4.25	4.47	3.52	3.01	2.95	4.03
Calculated analysis							
Methionine	0.95	1.00	1.12	0.87	0.82	0.77	0.89
Lysine	2.58	2.39	1.96	2.47	2.51	1.52	2.79
Tryptophan	0.47	0.43	0.34	0.48	0.44	0.37	0.55
ME (Kcal/Kg)***	3397	3430.9	3472.8	3367.6	3354.6	3400.6	3332.9
Cal/P	80.75	81.71	83.00	81.50	81.30	82.30	79.10

* Each kg of mineral premix contains Ca 125 gm, P 90 gm, Fe 25000 mg, Cu 2000 mg, Mn 60000 mg, I 200 mg, Se 100 mg. Zn 40000 mg and Nacl 250 mg.
** Each kg vitamin premix contains Vit. A 4000,000 I. U. , Vit. D 8000 I. U., Vit. E 1000 mg, vit B1 2000 mg; B2 10000 mg, B6 100mg Vit K 1000 mg, B12 3mg, Vit. C 10mg. Folic acid 500 mg .Pantothenic acid 5000mg and Niacine amide 5000 mg.
*** Calculated as described by El-Banna (1991).

closely related as compared with SBM-FM diet (1.25, 1.27 vs 1.28, respectivley). The percentage increase of weight gain suportedthe previous results of wwight gain and fish fed SBM-FM diet showed the highest increase followed by the fish fed on the diets where CGM replaces 25 % of either SBM or FM. The higher inclusion rates of CGM (50 and 100%) reduce the percentage weight gain dramatically.

all dietary treatments in CP digestiblity. Th was insignificant difference observed in CP and GE digestibility when CGM had replaced at levels of 25, 50 mand 100% compared SBM-FM diet.

The obtained data suggested that there is no cl link between the nutrient digestibility and tilapia performance, many factors may

Table (3): Effect of replacing Soybean meal and fish meal by corn gluten meal on tilapia productive performance.

Parameters	Substitution %						Control SBM-FM diet
	SBM			FM			
	25	50	100	25	50	100	
Av. initial weight (g)	1.67^{a} ± 0.32	1.77^{a} ± 0.28	1.65^{a} ± 0.31	1.61^{a} ± 0.26	1.59^{a} ± 0.21	1.69^{a} ± 0.33	1.65^{a} ± 0.11
Av. final weight (g)	12.51^{b} ± 1.74	11.15^{c} ± 1.28	9.88^{d} ± 1.22	12.66^{b} ± 1.33	10.57^{c} ± 0.97	10.39^{c} ± 0.93	14.08^{a} ± 0.32
Total weight gain (g)	10.84	9.38	8.23	11.05	8.98	8.70	12.43
Total feed consump. g	13.50	13.79	12.66	14.06	13.76	12.06	15.97
Av. daily gain (g)	0.194	0.168	0.147	0.197	0.160	0.155	0.229
F. C. R.	1.25	1.47	1.55	1.27	1.53	1.39	1.28
Weight gain (%) *	649.1	529.9	498.8	686.3	564.8	514.8	753.3

* a,b,c, & d Means ± SD in rows with different superscripts are significantly differed (P< 0.05). of the initial weight.

Results of digestibility of different experimental diets are presented in table (4), the digestibility coefficient (DC) of C.P. and EE was 78.92 and 64.92 and 64.6 in fish fed the SBM-FM diet which was lower than that of fish fed CGM as a sole dietary ingredient. The replacement of SBM at levels of 50 and 100% by CGM showed slight improvement in DC of both CP and EE compared with sBM-FM diet, while the GE showed values especially at complete replacement. Meanwhile, 25% replacing level of SBM by CGM surpassed

contributed for such results:

1- The digestibility of feed when used as a s dietary ingredient is usually differ than digestibility when fed in a complete diet. 2- results of nutrient digestibility in fish are usu contradectory due to the difference in meth used for collection of feed samples (d vsstomach content) as well as faecal collec methods (siphoning, stripping and intest content) Hanly (1991) .3-there is a possibility

fish feeding on selected component of the diet as tilapia repeatedly pick and expel feed from their mouth before swallowing (Bowen, 1978 and Popma, 1982) unlike carnivorous fish that swallow their food as a whole. Therefore the digestibility trial alone is not a good parameter to assisst in evaluating newly introduced feedstuff in fish nutrition, long term feeding trials using graded level of the new feedstuff under investigation are required to obtai a full nutritional informations on its value.

Table (4) The digestibility coefficient (%) of crude protein, Ether extract and gross energy of the experimental diets.

Experimental diet	CO	EE	GE
SBM - FM diet	78.92^{b} ± 6.2	64.4 ± 5.9	54.7^{a} ± 4.8
SBM-substitution %			
25	85.12^{a} ± 7.2	68.2 ± 6.1	52.3^{ab} ± 5.2
50	82.12^{b} ±8.1	66.3 ±5.1	50.4^{bc} ± 4.1
100	28.67^{b} ±8.9	66.4 ±5.4	48.2^{cd} ± 4.6
FM-substitution %			
25	79.07^{b} ±5.6	65.6 ±6.9	51.8^{ab} ± 5.4
50	78.39^{b} ±7.7	64.1 ±6.0	48.6^{cd} ± 5.0
100	77.55^{b} ±6.8	64.0 ±7.1	46.6^{d} ± 4.8

a,b,c, & d Means (n=20) ± SD of the same column with different superscripts are significatntly deffered ($P < 0.05$).

From the present investigation it can be concluded that tilapia fed on diets contained CGM did not perform well as those fed on the SBM-FM diet (control), although, SBM substituation by CGM showed improvement in both CP and EE digestibility . So CGM can successfully replace either SBM or FM up to 25% of their total protein in case of the shortage as monitored by performance data.

REFERENCES

Abdel-Ghany, A. F. (1993) Apparent digestibility of protein and gross energy of several diets fed to Nile Tilapia (Oreochromis niloticus L.) and their essential amio acids composition 4th Symp Anim Poult and Fish Nutrition, El-Fayoum

A. O. A. C. (1980) Association of official analytical chemists Official methods of analysis 13th Ed Washington DC

Atack, T. and Matty, A. J. (1979) The evaluation of some singlecell proteins in the diet of tainbow trout II The determination of net protein utilization, biological value and true digestibility. In K Tiews and Halver (Editors) world Symposium on Finfish nutrition and Food Technology I Hamburg, 1987 Heeneman, Barlin, PP 263-273

Atack, T., Jauncey, K. and Matty, A. J (1979) The utilization of some single cell proteins by fingerling mirror carp Aquaculture, 18: 337-348

Bowen, S. H. (1978): Chromic oxide in assimilation studies a caution Trans Am. Fish Soc., 107: 755-756

Boyd, C. E. (1979) Water quality in warm water fish pons Auburn Univ. Agric. Exp. Station Aburum, Alabama

Castanon, F.; Han, Y. and Parsons, CH (1990) Protein quality and metabolizable energy of corn gluten feed Poultry Sci., 69 (7): 1165-1173

El-Banna, R. A. (1991): Studies on some nutrient requirements for tilapia and its effect on performence Ph. D. Thesis, Fac. Vet. Med. Cairo University

Furnkawa, A. and Tsukahara, H. (1966) On the acid digestion, method for determination of chromic oxide as an index substance in the study of digestibility in fish feed. Bull. Jpn. Soc. Sci. Fish., 32: 502-506

Hanley, F. (1987): The digestibility of foodstudffs on the effects of feeding selectivity on digestibility determinations in tilapia Oreochromis niloticus (1) Aquaculture. 66: 163-179

Hepher, B. (1988): Nutrition of pond fishes. Cambridg Univ. Press. 1st Edition

Hossain, M. A. and Jauncey, K. (1989) Nutritional evaluation of some Bangaladesh oil seed meals as partial substitutes for fish meal in the diet of common carp (Cyprinus carpio). Aquaculture and Fisheries Management, 20: 255-268.

Koops, H. Tiewe, K., Beck, H. and Gropp, J. (1976) The utilization of soybean protein by rainbow trout (Salmo gairdneri R). Arch. Fischerwiss., 26 (23)L 131-191

Lovell (1977) Digestibility of nutrients in feedstuffs for catfish. Regional Research Project 5-83 " Catfish production" Auburn Agricultural Experimentla Station Auburn Univ., Albama

Meske, C. Ney, K. H. and Pruss H. D. (1977) Fischmehlfries fischfutter unf Malkenbasis Fischr Tierphsiol, Tierernadr., Beiheft, 8: 56-70

Nijkamp, H. J. (1971) Some remarks and recommendatio concerning bomb calorimetery. 2. Tierphys. Tierr Futtermittle, 27, 115-18

Nose, T. (1971) Determination of nutritive value of food proteins in fish III. Nutritive value of Casein, white fish

meal and soybean meal in rainbow trout fingerlings. Bull. Fresh Water fish. Res. Lab., tokyo Univ., 21: 85-98.

Osman, M. M. M. (1988): The effect of nutrition on tilapia nilotica production. Ph. D. Thesis., Pac. Vet. Med., Cario Univ.

Owings, W. J., Sell, J.L., Ferket, P. and Hasiak Rj. (1988): Growth performance and carcass composition of turkey hens fed corn gluten feed. Poult. Sci., 67 (4): 585-589.

Pantha, M. B. (1982): The use of soybean in practical feeds for tilapia (Oreachromis niloticus L.,) Dissertation M. Sc. Univ. Stirling, Scotland.

Popma, T. J. (1982): Digestibility of selected feddstuffs and naturally ocuring algae by tilapia. Ph. D. Dissertation, Auburn Univ., Auburn, Al., 78 pp.

Snedecor, G. W. and cochran, W. G. (1980): Statis methods. Iowa state Univ. Press, Ames, Iowa, U. S. A

Tiews, K.; Gropp, J. and Koope, S. 1976): On development of optimal raimbow trout pellet feeds. A Fischwiss; 27, Suppl; 1:1.

Titgemeyer, E. C., Merchen, N. R. and Berger, L. L. (19 Evaluation of sobean meal, corn gluten meal, blood m and fish emal as sources of nitrogen and amino ac disappearing from the small intestine of steers. J. An Sci., 67 (1) : 262-175.

Viola, S., Mokady, S. and Ariell, Y. (1983): Effect soybean processing methods on the growth of c (Cypinus carpio).Aquaculture, 32: 27-38.