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EFFECTS OF PARTIAL REPLACEMENT OF DIETARY SOYBEAN MEAL BY AUTOCLAVED GUAR MEAL WITH OR WITHOUT SUPPLEMENTATION OF B - MANNANASE ON GROWTH PERFORMANCE OF NILE TILAPIA (*Oreochromis Niloticus*)

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ABSTRACT

A growth trial was conducted to evaluate the effects of replacing 5 or 15% of soybean meal with raw Guar meal, autoclaved Guar meal or autoclaved Guar meal supplemented the diet with β-mannanase (0.04%) on both growth performance and histological status of Nile tilapia fingerlings. Seven iso-nitrogenous (~32% crude protein) and iso-energetic (~3450 Kcal estimated digestible energy) were formulated. Each diet was randomly allocated to duplicate groups of fish in fiberglass tanks and each tank was stocked with 25 fingerlings (initial average body weight 1.98 ± 0.47g). Fish were hand fed the experimental diets four times per day for 60 days. For histopathological examination samples of small intestine were taken from fish in different groups. There was significant reduction in growth performance when fish fed diets containing raw Guar meal comparing to those fed the control diet (free of Guar meal). Irrespective of treatment, there were no significant differences in term of growth performance between groups of fish fed diets containing Guar meal with either 5% or 15% inclusion level except in term of weight gain.

Irrespective of inclusion levels, better performance of fish were observed when fish fed on control diet (diet 1) or diets supplemented with β-mannanase and contained autoclaved Guar meal followed by those fed autoclaved Guar meal without enzyme supplementation, while the worst performance was observed by groups of fish fed diets containing raw Guar meal.

Histopathological study showed that feeding fish diet contained 15% raw Guar meal caused necrosis of the lining mucosa of the small intestine accompanied with infiltration of the inflammatory cells, this status was improved when fish fed diets contained autoclaved Guar meal and more improvement (increase in the number of goblet cells) in intestinal status was observed in group of fish fed diet supplemented with 0.04% β-mannanase and contained 15% autoclaved Guar meal.

Through an economic standing point although, the relative economical efficiency for using Guar meal supplemented with enzyme is compatible with control diet containing soy bean meal, yet in term of net revenue (LE) it is clear that the diet free of Guar meal is still better to be used than any of the diets containing Guar meal.

However, at the same time and through the results of this study, supplementing tilapia diets contained autoclaved Guar meal up to 15% with β-mannanase may be considered as a reliable dietary protein source.

Keywords: Soybean meal, Guar meal, autoclaved, β-mannanase, Nile Tilapia

INTRODUCTION

Aquaculture is the fastest growing animal production sector in the world since 1984. Today, according to the newly released data, world

aquaculture production of food fish reached 62.7 million tones in 2011 contributes by about 40.1% of this production (FAO, 2013).To sustain the high rates of increase of aquaculture production, there should be a matching increase in the levels of production of fish feed.

Feed cost is the largest production cost for commercial aquaculture; it reaches at least 50% of production costs (Hossain *et al.,* 2001).The most expensive ingredients in fish diets are those used as a protein source. As a result, there is a continuous research for alternative protein sources for aqua feed. This was strongly recommended by the Second International Symposium on Sustainable Aquaculture (1997) in Oslo, Norway (Anonymus, 1998) **.**

Guar meal, a by-product that results from the extraction of Guar gum from Guar beans. Its protein content with excellent amino acid profile varies between 35-45% depending on the ratio between germ and hull (Nagpal *et al.,* 1971).

Due to this high protein content, using Guar meal as a partial replace soybean meal in farm animal diets might be a useful strategy for decreasing feed costs.

However, previous studies reported that negative effects of adding Guar meal on body weight and feed conversion ratio may be attributed to the presence of anti-nutritional compounds in Guar meal such as trypsin inhibitor, excusive Guar gum, saponin or some other unknown toxic substances. The presence of about 14-18% residual gum (Anderson and Warnick, 1964 and Nagpal *et al.,* 1971) in Guar meal was proved to be the main source of growth depression in poultry (Hassan *et al.,* 2013).

Guar gum contain 78% non starch polysaccharide, 90% of this non starch polysaccharide (NSP) is *Beta* galactomannan (AGRIaccess, 2001).Due to that, about 60% of Guar meal total sugar and 40% of its protein are bound (AGRIaccess, 2001).

In addition, the residual gum, due to its sticky nature, increases intestinal viscosity and decreases nutrient absorption from the small intestine (Salih *et al.,* 1991 and Lee *et al.,* 2003). According to Al- Hafedh and Siddiqui (1998) Guar seed could replace up to 50% fish meal protein without any adverse effects on growth and feed conversion in Nile tilapia *(Oreochromis niloticus)*.

Patel and McGinnis (1985) stated that, using from 10 to 15% autoclaved Guar meal in broiler diets has increased growth and feed efficiency compared with birds fed raw Guar meal. Also, they stated that dry heating at 150˚C for 6hr. or water treatment of Guar meal was not effective in stimulating growth and feed efficiency.

Supplementing diets containing Guar meal for mono gastric animals with enzymes especially mannanase reduced digesta viscosity (Zangiabadi and Torki 2010 and Ehsani and Torki, 2010). In the same trend, McNaughton *et al.* (1998) and Daskiran *et al.* (2004) stated that supplementing broiler diets containing Guar meal with mannanase helped in improving feed conversion and the growth performance for birds compared with those fed raw Guar meal.

The aim of the study was to evaluate the effects of partially replacement of soybean meal with raw Guar meal, autoclaved Guar meal and autoclaved Guar meal + supplementing the diet with β-mannanase on both productive performance and histological status of Nile tilapia fingerlings.

MATERIALS AND METHODS

Experimental system and fingerlings:

Nile tilapia fingerling *(Oreochromis niloticus)*, mono sex were brought to Fish Experimental Unit of the Regional Lab for Food and Feed, Agriculture Research Center, Ministry of Agriculture, Giza, Egypt from a fresh water commercial farm in Domiat governorate.

The fish were reared in a static water system composed of 14 fiberglass tanks (of 85 L water). The tanks were individually aerated from a main compressor and had individual input and output for dechlorinate tap water. Water temperature was about 24±1ºC. All the experimental treatments were conducted under an artificial photo period equal to natural light/darkness period (12h light: 12hdarkness).

Diet formulation:

Guar meal

Guar meal sample of Indian origin was used in this study. The Guar meal was analyzed for Moisture, Crude Protein (CP), Ether Extract (EE), Crude Fibers (CF), ash, Calcium, Phosphorus, Lysine, Methionine and Cystine using standard official methods (AOAC, 2005). A comparison between the determined chemical compositions of Guar meal with that of soybean is shown in Table 1.

Guar meal used in this study was divided into two portions. The first portion was used in raw status representing raw Guar meal. The second portion was autoclaved at 102˚C for 15 min. according to what have been recommended by Patel and McGinnis (1985)**.** After autoclaving the meal was dried.

Seven experimental diets were formulated to contain ~32% crude protein and ~3450 kcal estimated digestible energy according to NRC (1993) (Table 1). The control diet was formulated to contain fish meal and soybean meal as the primary protein sources (diet1). Two experimental diets were formulated to replace 5 and 15% of the soybean meal with raw Guar meal (diets 2 and 3). Another two diets were formulated using autoclaved Guar meal with the previous replacement ratio (diets 4 and 5). The last two diets were formulated as diets 4 and 5 but supplemented with 0.04 % β-mannanase (Hemicell-HT) (according to the manufacturer recommended dose) (diets 6 and 7).

The proximate analysis, calculated digestible energy, lysine, methionine and cystine of the experimental diets are shown in (Table 2).

Experimental procedure:

Three hundred and fifty Nile tilapia fingerlings *(Oreochromis niloticus)* mono sex of mean initial body weight (1.98 ± 0.47g) were randomly distributed on 14 open system 85 liter tanks, where each tank contained 25

fingerlings. Each two tanks (duplicate) represented an experimental treatment. The first 15 days of the experiment were considered as habituation period and thereafter the growth trials were carried out for 60 days. Diets were randomly assigned to the experimental units. Fish were hand fed the experimental diets at three% rate of body weight for six days weekly, four times per day (Jauncey and Ross, 1982 and Coche, 1982). Fish were weighed every two weeks.

Growth parameters and nutrient utilization:

Growth and nutrient utilization parameters were monitored and analyzed in terms of feed intake which is equal to amount of feed presented for each tank at rate of 3% of body weight across the whole experimental period, final body weight (FBW), weight gain (WG), f ***Histological examination of intestine:***

Samples were taken from the small intestine of fish in different groups and fixed in 10% formalin saline for twenty four hours. Washing was done in tap water then serial dilutions of alcohol (methyl , ethyl and absolute ethyl)were used for dehydration . Specimens

Table (1): Nutrient compositions of corn (estimated) and low tannin sorghum (determined).

Item	Guar meal	Soybean meal
Moisture%	11.30	11.30
CP%	48.20	47.45
Fat%	3.38	1.80
Fiber%	6.73	5.41
Ash%	5.40	6.30
NFE[1] %	22.39	27.74
GE[2] (kcal/Kg)	4305	4243
Ca%	0.22	0.44
Total P%	0.70	0.73
Amino acids:		
Lys%	1.32	3.73
Meth%	0.22	0.73
Cys%	0.36	0.75

[1] NFE = 100 – (% moisture + % protein + %EE + %ash + % Fibre).

[2] GE Gross energy content was calculated using the values 5.65, 4.2 and 9.45 Kcal/ gm for protein, carbohydrate and lipid, respectively according to Hepher *et al.* (1983).

were cleared in xylene and embedded in paraffin at 56 degree in hot air oven for twenty four eed conversion ratio (FCR), specific growth rate (SGR) and protein efficiency ratio (PER). hours . Paraffin bees wax tissue blocks were prepared for sectioning at 4 microns thickness. The obtained tissue sections were collected on glass slides, deparaffinized and stained by hematoxylin and eosin stain for routine examination. (Bancroft and Stevens,1996).

Table (2):The formulation and chemical composition of the experimental diets (%).

Items	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6	Diet 7
Fish meal 60% (FM)	12.00	12.00	12.00	12.00	12.00	12.00	12.00
Guar meal	…….	5.00	15.00	5.00	15.00	5.00	15.00
Soybean meal 48%	43.00	38.00	28.00	38.00	28.00	38.00	28.00
Ground yellow corn	18.40	18.40	18.40	18.40	18.40	18.40	18.40
Wheat bran	8.50	8.50	8.50	8.50	8.50	8.50	8.50
Corn starch	9.00	9.00	9.00	9.00	9.00	8.96	8.96
Ground mung bean seeds	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Monocalcium phosphate	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Enzyme	…….	…….	…….	…….	…….	0.04	0.04
Vit. & min. mix	1.60	1.60	1.60	1.60	1.60	1.60	1.60
Total	100	100	100	100	100	100	100
Determined chemical composition, calculated digestible energy and protein energy ratio							
Dry matter (%)	92.40	92.20	92.10	92.10	92.60	92.00	92.48
Crude protein (%)	32.50	32.40	32.80	32.50	32.35	32.30	32.20
Ether extract (%)	1.58	2.05	2.32	2.13	2.28	2.39	2.84
Crude fiber (%)	3.08	3.41	3.90	3.31	3.22	3.06	3.09
Ash (%)	8.02	8.72	8.30	8.96	8.08	8.31	8.00
NFE (%)[1]	47.22	45.62	44.78	45.20	46.67	45.94	46.35
Digestible energy (kcal/kg)[2]	3494	3467	3476	3462	3528	3506	3558
Total phos. (%)	1.36	1.39	1.37	1.39	1.37	1.39	1.37
Calcium (%)	1.35	1.33	1.35	1.33	1.35	1.33	1.35
Lysine	2.09	1.76	1.75	1.76	1.75	1.76	1.75
Methionine	0.60	0.57	0.52	0.57	0.52	0.57	0.52
Cystine	0.69	0.65	0.57	0.65	0.57	0.65	0.57
Protein energy ratio (mg/kcal)[3]	93.02	93.45	94.36	93.90	91.70	92.13	90.50

[1] NFE = 100 – (% moisture + % protein + %EE + %ash + % fiber).

[2] Digestible energy was calculated using the values 4.5, 4 and 9 kcal /g for protein, carbohydrate and lipid, respectively according to Wang *et al.* (1985).

[3] Protein energy ratio (P/E ratio) = crude protein x 10000 / digestible energy, according to Hepher *et al.*(1983).

Economical evaluation

The use of raw Guar meal, autoclaved Guar meal and autoclaved Guar meal supplemented with β- mannanase in Tilapia diets have been economically evaluated to measure the impact of such practice on the performance efficiency.

The following equations were used to calculate net revenue, economical efficiency and relative economical efficiency of various experimental diets.

Net revenue = Total income (L.E.) – Total feed cost (L.E.)

Total income (L.E.) = Total final fish weight Kg * price of one Kg of fish (L.E.)

Total feed cost = Total amount of feed consumed Kg * price of one Kg diet (L.E.).

Economic efficiency = Net revenue (L.E.) / Total feed cost

Relative economical efficiency = calculated as a percentage from the economical efficiency of the control diet.

Statistical analysis:

The data obtained were subjected to a two way analysis of variance using the linear model (GLM) of SAS (SAS Institute, 1991). Means were compared using Duncan's new multiple range test (Duncan, 1955).

RESULTS

The proximate analysis (Table 1) of both of Guar meal and soya bean meal indicated that both of them have nearly the same chemical composition. This gave a preminarly indication that it could be possible to use Guar meal to replace soya bean in tilapia diets.

Initial body weights of fish used in present study (Table 3) were slightly different among the different treatments. However, those differences were not significant ($P>0.05$).

Replacing dietary soybean by either 5% or 15% raw Guar meal (diets 2 or 3) significantly reduced ($P<0.05$) growth performance of fish comparing to those fed the diet that contain no Guar meal (diet1). Growth of fish fed on either diet contained 5% raw Guar meal (diet 2) or diet contained 15% raw Guar meal (diet 3) was significantly difference ($P<0.05$) only in term of weight gain while there was no difference ($P>0.05$) in the other parameters .

Fish fed on diets contained 5% autoclaved Guar (diet 4) or 15% autoclaved Guar meal (diet 5) had better growth rate than those fed diets contained 15% raw Guar meal. However, this improvement in fish growth did not bring the growth of fish to a growth level similar to that of fish fed on a diet contained no Guar meal (diet 1). Fish fed on diets supplemented by 0.04 % β-mannanase and contained either 5% autoclaved Guar meal (diet 6) or 15% autoclaved Guar meal (diet 7) had growth performance with no significant difference ($P>0.05$) from those fed the control diet (diet1).

No significant differences ($P>0.05$) for feed conversion ratio and protein efficiency ratio were observed between fish fed the control diet (diet1) and fish fed a diet contained 5% raw Guar meal (diet 2) . However, FCR significantly increased ($P<0.05$) and PER significantly decreased when fish fed a diet contained 15% raw Guar meal. Replacing SBM by 5% autoclaved Guar meal (diets 4) and 5% or 15% autoclaved Guar meal supplemented with β-mannanase (diets 6 or 7) resulted in significantly better FCR and PER values compared to those of diets 2, 3 and 5.

Irrespective of inclusion levels, better performance of fish were observed when fish fed on control diet (diet 1) or diets supplemented with β-mannanase and contained autoclaved Guar meal followed by those fed

autoclaved Guar meal without enzyme supplementation while the worst was for those fed raw Guar meal.

The result obtained from the histopathological study showed that using 5% raw Guar meal (Fig. 2) caused normal appearance of intestinal histopathology while using 15% of raw Guar meal (Fig. 3) caused necrosis of the lining mucosa accompanied with infiltration of inflammatory cells.

The use of 5% autoclaved Guar meal (Fig. 4) caused appearance of goblet cells. Using 15% autoclaved Guar meal fig. 5 prevented necrotic effect on the mucosa in spite of the presence of inflammatory cells. On the other hand diets contained autoclaved Guar meal together with β-mannanase (Fig. 6 and 7) showed the greatest beneficial effect on the intestinal structure as diffuse goblet cells were noticed at 5% autoclaved Guar meal with β-mannanase while increased number of goblet cells in the presence of inflammatory cells infiltration were noticed at 15% autoclaved Guar meal with β-mannanase.

Table (3): Effect of partial replacement for SBM with raw, autoclaved Guar meal and autoclaved Guar meal with the diet supplemented with β-mannanase on tilapia growth performance[1].

Experimental treatments	% replacement of SBM	IBW[2]	FBW[3]	FI[4]	WG%[5]	FCR[6]	PER[7]	SGR[8]
Control	-----	2.45 ±0.25	8.00^{a} ±0.5	10.62^{a} ± 0.5	5.55^{a} ±0.22	1.92^{bc} ±0.03	1.63^{ab} ±0.04	1.18^{a} ±0.03
Raw Guar meal	5	1.86 ±0.21	5.13^{bc} ±0.29	6.80^{b} ±0.30	3.27^{b} ±0.16	2.08^{ab} ±0.11	1.50^{bc} ±0.08	1.02^{cd} ±0.06
	15	1.50 ±0.20	3.79^{c} ±0.25	5.14^{b} ±0.35	2.29^{c} ±0.103	2.25^{a} ±0.09	1.36^{c} ±0.05	0.93^{d} ±0.06
Autoclaved Guar meal	5	1.92 ±0.40	5.83^{b} ±0.36	7.49^{ab} ±0.40	3.91^{b} ± 0.176	1.91^{bc} ±0.04	1.62^{ab} ±0.03	1.12^{abc} ±0.01
	15	2.26 ±0.06	6.46^{ab} ±0.08	8.45^{ab} ±0.03	4.20^{ab} ±0.189	2.02^{bc} ±0.07	1.53^{ab} ±0.06	1.05^{bc} ±0.04
Autoclaved Guar meal + β-mannanase	5	2.18 ± 0.25	6.89^{ab} ±0.45	8.70^{ab} ±0.45	4.71^{ab} ±0.235	1.85^{bc} ± 0.0	1.68^{a} ±0.0	1.15^{ab} ±0.0
	15	2.12 ± 0.27	6.84^{ab} ±0.45	8.59^{ab} ±0.45	4.72^{ab} ±0.24	1.82^{c} ±0.02	1.70^{a} ±0.05	1.17^{a} ±0.01

[1] values are the mean of duplicate groups of fish. Mean values in the same column with different superscripts are significantly different (P<0.05).

[2] IBW Initial body weight (g). [3] FBW Final body weight (g). [4] FI Feed intake = (g). [5] WG Weight gain= mean final body weight (g)(W1)- mean initial body weight (g) (W0). [6] FCR Feed conversion ratio (g/g) = feed intake (g) / weight gain (g).

[7] PER Protein efficiency ratio (%) = Weight gain (g) / Protein intake (g). [8] SGR Specific growth rate (%) = 100* [Ln final body weight (W1) – Ln initial body weight (W0)] / number of feeding days.

Table (4) illustrated that the most economical diet was diet1 (control), which gave net revenue 54.5 L.E. followed by diet 7 53.32 L.E. than Diet 6 51.80L.E. The worst net revenue was presented by diet 3 (containing 15% raw Guar meal) 28.74 L.E.

The economical efficiency could be used to compare the differences among the experimental treatments. The priority of the diets goes to the more economical ones.

The results showed that diets containing raw Guar meal diet 2 (5% Guar meal) and diet 3 (15% Guar meal) scored the least feed cost (L.E.) values respectively. While, the highest value (41.50 L.E.) was for the diet free of Guar meal (diet1 control). The best relative economical efficiency (141%) was for the group fed 15% autoclaved Guar meal + enzyme supplementation (diet 7) followed by group fed 15% autoclaved Guar meal diet 5 (135%).

DISUCSSION

Inclusion of raw Guar meal instead of soybean meal, in the present study, deleteriously affects measures of growth and feed efficiency at levels of 5% and 15%. This is supported by the data obtained in (Fig. 3) which demonstrate that using 15% of raw Guar meal caused necrosis of the lining mucosa accompanied with infiltration of inflammatory cells indicating negative effect on the absorption of the nutrients. Mishra *et al.* (2013) concluded that replacing SBM with Guar korma at the rate of 2% in pre-starter and 5% in starter and finisher diets resulted in poor FCR and inferior performance index score. It is reported that the use of Guar meal in poultry, pig and cattle rations is limited because of its adverse effects on growth rate (Thakur and Pradhan, 1975) and feed intake (Verma and Mcnab, 1982). The depression of growth after feeling chicks was dose related. In contrast, effective replacement of fish meal protein by Guar seed protein up to the level of 50% is possible in tilapia practical diets without any adverse effects on growth and feed conversion ratio. The growth inhibition that follows the addition of Guar meal in diets may be attributed to the residual gum content of the meal. The residual gum, due to its sticky nature, increases intestinal viscosity and decreases nutrient absorption from the small intestine (Lee *etal.*, 2003). Increasing viscosity of the intestinal contents alters small intestinal structure and intestinal growth (Lee *et al.,* 2005). Mishra *et al.* (2013) also observed an increase in the length of chicken intestine after they fed a raw Guar meal. They concluded that this change may be due to increasing intestinal viscosity.

The improvement in tilapia growth and feed efficiency measures in the present study (Table 3) after feeding fish on diets contained autoclaved Guar meal may be due to the effect of heat on the removal of anti-nutritional compounds. Patel and Mc Ginnis (1985) also showed that using autoclaved Guar meal in chicks diets improved growth performance. The histopathological data showed that autoclaving of Guar meal caused a marked positive effect on the health of the intestinal villi as using 5%autoclaved Guar meal (Fig. 4) caused appearance of goblet cells which function is to protect the intestinal mucosa by its secretion (mucin).

Meanwhile, using 15% autoclaved Guar meal (Fig.5) prevents necrotic effect on the mucosa in spite of the presence of inflammatory cells indicating the beneficial effect of such treatment. Kleessen *et al.* (2003), reported that non starch polysaccharides interact with protein and glycoprotein's of the epithelial tissue, causing damage to the tissue.

Table (4): Economical efficiency of Nile tilapia *(tilapia niloticous)* fed the experimental diets.

Items	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6	Diet 7
Total amount of feed consumed (Kg).	10.62	6.80	5.14	7.49	8.45	8.70	8.59
Price of one Kg diet (L.E.)	3.90	3.50	3.31	3.50	3.31	3.55	3.35
Total feed cost (L.E.)*	41.50	23.80	17.01	26.22	27.97	30.90	28.78
Total fish weight (Kg)	8.00	5.13	3.79	5.83	6.46	6.89	6.84
Price of one kg fish (L.E.)**	12.00	12.00	12.00	12.00	12.00	12.00	12.00
Total income (L.E.)	96.00	61.56	45.48	70.00	77.50	82.70	82.10
Net revenue (L.E.)	54.50	37.76	28.47	43.78	49.53	51.80	53.32
Economical efficiency	131	159	167	167	177	168	185
Relative economical efficiency (%)	100	121	127	127	135	128	141

*** Economic evaluation was calculated depending on the prevailing prices being : price of Diet1,**
Diet2, Diet3, Diet4, Diet5, diet6 and diet 7 was 3900, 3508, 3314, 3508, 3314, 3548 and 3354 L.E. respectively,
**** However Kg of tilapia fish was 12 (LE).**

Fig (1): Small intestine of tilapia fed corn-soybean meal diet showed normal appearance, having no morphological characteristics of certain pathologies H&E X 40

Fig (2): Intestine of tilapia fed the 5% raw Guar meal showing normal mucosal lining epithelium with focal inflammatory cells aggregation H&E X 40

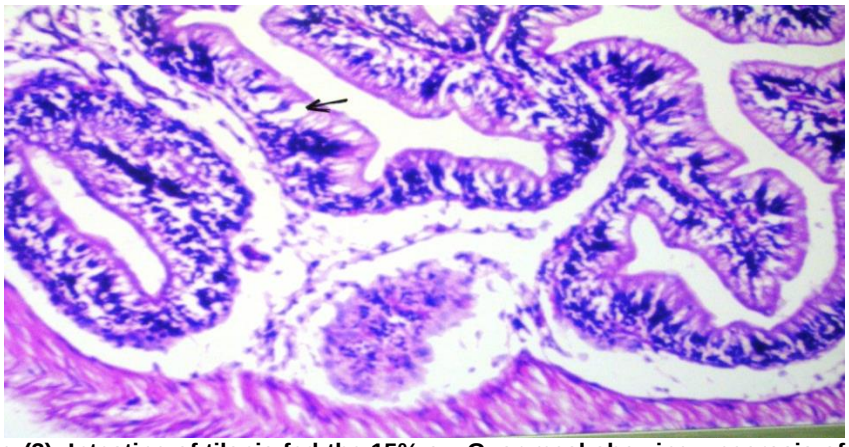

Fig (3): Intestine of tilapia fed the 15% aw Guar meal showing necrosis of the mucosal layer with inflammatory cells infiltration H&E X 40

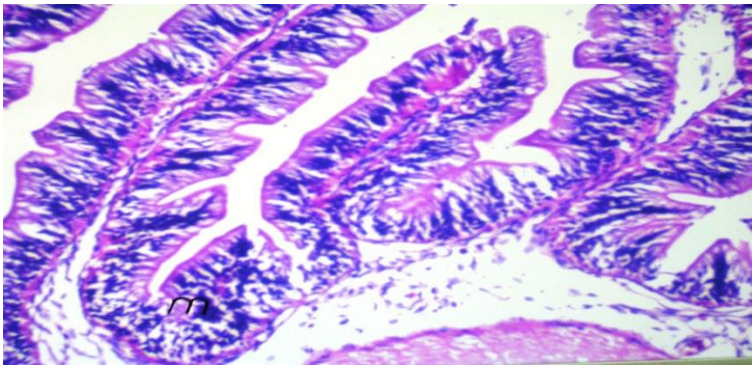

Fig. (4): Intestine of tilapia fed the 5% Autoclaved Guar meal showing goblet cells formation in the mucosal lining epithelium H&E X 40

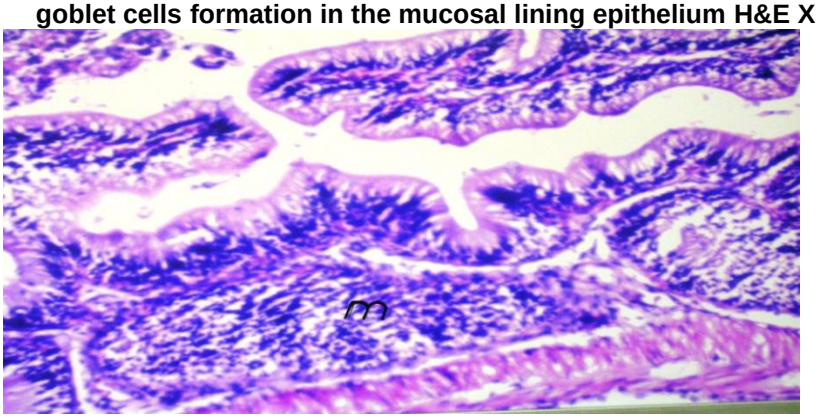

Fig (5): Intestine of tilapia fed the 15% autoclaved Guar meal showing focal inflammatory cells aggregation was noticed in the lamina propria of the mucosal layer. H&E X 40

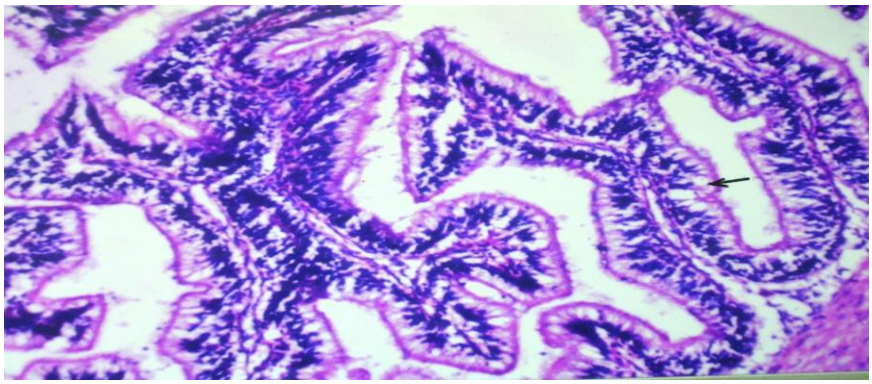

Fig. (6): Intestine of tilapia fed the 5% autoclaved Guar meal + β-mannanase showing the lining mucosal epithelium showed diffuse goblet cells formation H&E X 40

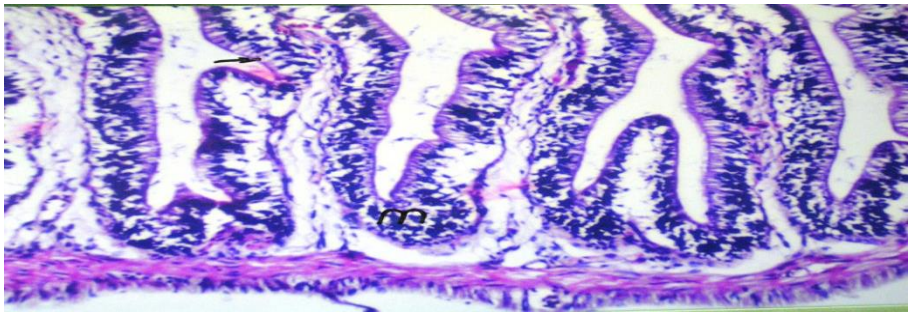

Fig (7) : Intestine of tilapia fed the 15% autoclaved Guar meal + β-mannanase showing diffuse goblet cells formation as well as inflammatory cells infiltration H&E X 40

Supplementing diets contained 5% autoclaved Guar meal diet or 15% autoclaved Guar meal by β-mannanase showed growth and feed efficiency measures comparable to those of the control diets (Table 3). This is could be supported by the histopathological data in (Fig. 6 and 7) which showed the greatest beneficial effect on the intestinal structure as diffuse goblet cells were noticed indicating the best quality of the absorbing mucosa which was clear in the results of performance parameters . Using 15% autoclaved Guar meal together with β – mannanase caused increased number of goblet cells in the presence of inflammatory cells infiltration. Gharaei *et al.* (2012) reported that adding β-mannanase to a diet contained raw Guar gum improve growth and FCR of broilers. Also, Lee *et al.* (2005) observed that adding β-mannanase to broiler diets containing 5% Guar meal significantly improved feed: gain ratio virsus the untreated diets. This may be due to the fact that β-mannanase is capable of hydrolyzing Guar gum, and

thereafter decrease the viscosity of the intestinal digesta and finally make the dietary Guar meal more digestible.

Although, the relative economical efficiency of using Guar meal supplemented with enzyme is quit comparable with control diet containing soy bean meal, yet from the net revenue (LE) point of view the diet free of Guar meal is still better to be used then that containing Guar meal. Thus, it could be concluded that using soy bean meal in Nile tilapia diets are still better than using Guar meal.

These results indicated that supplementing tilapia diets contained autoclaved Guar meal up to 15% with β-mannanase may be considered as a reliable dietary protein source. Further researches are needed using longer experimental period.

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تأثير الإحلال الجزئي في عليقة كسب فول الصويا بكسب الجوارالمعامل بالبخار سواء كان مدعماً أو غير مدعم بإنزيم البيتا منانيزعلي أداء النمو في أسماك البلطي النيلي

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المركز الإقليمي للأغذيه والأعلاف-مركز البحوث الزراعية-جيزه-مصر

تم إجراء تجربة نمو لتقييم تأثيرإحلال جزئي لكسب فول الصويا بكسب الجوار ، كسب الجوار المعامل بالبخار و كسب الجوار المعامل بالبخار المدعم بأنزيم البيتا منانيز (٠,٠٤%) على كل من أداء النمو و الحاله الهستولوجيه لإصبعيات البلطي النيلي. تم تركيب سبع علائق متزنه في محتواها من البروتين (٣٢%) و محتواها من الطاقه (٣٤٥٠ كيلو كالوري على اساس الطاقه المهضومه المفترضه) . تم توزيع العلائق عشوائياً بحيث كانت كل عليقه تقدم لمجموعتين من الأسماك المتواجده في أحواض من الألياف الزجاجيه بحيث إحتوى كل حوض على عدد ٢٥ إصباعيه (متوسط وزن البدايه ١,٩٨ ± ٠,٤٧ جم). وقد قدمت العلائق التجريبيه يدوياً أربع مرات خلال اليوم لفترة ٦٠ يوماً. بالنسبه لعينات الإختبار الهستوباثولوجي للأمعاء الدقيقه فقد تم الحصول عليها من الأسماك للمجموعات المختلفه. أوضحت النتائج حدوث إنخفاضاً معنوياً لأداء النمو عندما تغذت الأسماك على علائق إحتوت على كسب الجوار الخام وذلك مقارنة بتلك التي تغذت على العليقه القياسيه (خاليه من كسب الجوار). وبغض النظر عن المعامله لم يكن هناك فارق معنوي في أداء النمو بين مجموعات الأسماك التي تغذت على علائق إحتوت على كسب الجوار بنسبة إضافه ٥% او ١٥% الا في حالة الوزن المكتسب (العلائق التي إحتوت على كسب الجوار الخام ٥% وتلك المحتويه على كسب الجوار الخام ١٥%).

بغض النظر عن نسبة الإحلال ، لوحظ تحسن في أداء الأسماك عندما تغذت على العليقة القياسيه (العليقه ١) أو على العليقه المحتويه على كسب الجوار المعامل بالبخار والمدعمه بأنزيم البيتا منانيز تبعها في ذلك العليقه المحتويه على كسب الجوار المعامل بالبخار بدون تدعيم إنزيمي، بينما أقل أداء نتج عن مجموعة الأسماك التي تغذت على علائق إحتوت على كسب الجوار الخام.أظهرت الدراسه الهستوباثولوجيه أن تغذية الأسماك على علائق إحتوت على ١٥% كسب جوار خام نتج عنها النخر في الغشاء المخاطي المبطن للأمعاء الدقيقه مصحوبه بتضخم في الخلايا. تلك الحاله تحسنت عندما تغذت الأسماك على علائق إحتوت على كسب الجوار المعامل بالبخار، وقد لوحظ مزيد من التحسن (مقاس عن طريق زياده في عدد خلايا الجوبلت) في حالة الأمعاء بالنسبه للأسماك التي تغذت على عليقه مدعمه ب ٠,٠٤% بيتا منانيز و إحتوت على ١٥% كسب جوار المعامل بالبخار. من خلال وجهة النظر الإقتصاديه فبرغم أن الكفاءه الإقتصاديه النسبيه لإستخدام كسب الجوار المدعم بالإنزيم منافسه لتلك المحتويه على كسب فول الصويا، الا أنه من حيث صافي الإيرادات فمن الواضح أن العليقه الخاليه من كسب الجوار لا تزال أفضل للإستخدام عن تلك المحتويه على كسب الجوار.

الأ انه وفي نفس الوقت ومن خلال النتائج نجد أن تدعيم علائق اسماك البلطي المحتويه على ١٥% كسب جوار معقم بإنزيم البيتا منانيز يمكن إعتباره مصدر بروتين غذائي.