

Economic Impacts of Soybean Substitution by Guarkorma in Tilapia Ration

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Abstract: This study was carried-out to study the growth performance, feed utilization and economic efficiency of Nile tilapia fingerlings fed on different levels of guar korma meal replacement in tilapia ration instead of soybean meal. Fish of 10 g initial body weight were classified into 4 groups (25 fingerlings/group) with 3 replicates for each. Group 1 was control group and fed on commercial diet (0% guar korma diet), group 2 fed on treated diet supplemented with 25% guar korma meal instead of soybean meal, group 3 fed on 50% guar korma diet and group 4 fed on 100% guar korma diet. All groups fed twice daily on the rate of about 5% from the total weight for 10 weeks. Performance were evaluated in terms of body weight, body weight gain, specific growth rate, condition factor, total feed intake and feed conversion ratio, returns and costs due to different levels of guar korma substitution instead of soybean. The results showed significant reduction ($p < 0.01$) in all performance parameters as the level of guar korma increase in the three treated groups compared with control group. Significant difference in feed intake and Feed Conversion Ratio (FCR) was detected among treatment groups where feed intake decrease and (FCR) increase as the level of guar korma increase. Also, there was significant difference in economic efficiency parameters where 25% guar korma group is higher in net returns than other 50 and 100% guar korma treated group whereas, 0% guar korma (control group) is the highest compared with other groups. Further studies could use guar korma as a replacement with enzymes to improve its performance and feed utilization.

Key words: Nile tilapia, guar korma, growth performance, economic efficiency, performance, highest compared

INTRODUCTION

Fish is an important source of animal protein for human consumption. In Egypt there is an increasing demand of food, especially for protein sources, so, the fish cultures are intensified for facing this demand. Fish become the hope all-over the world for solving protein shortage problem. Fish culture development requires more knowledge about nutrition that increase yields with minimum costs (El-Sayed, 2007; Mani *et al.*, 2013).

Oreochromis niloticus in Egypt is the most popular and economically important tilapia fish and is widely cultured around the world with 12.2% annual growth rate. It represents the third largest productive group of farmed finfish species (El-Sayed, 2007).

Many researchers try to find substitutes of lower prices that can replace the main resources in formulation of fish ration where the most important cost item in fish production is feed cost (Smith *et al.*, 2003; Yilmaz, 2012).

Guar meal is a relatively low-cost and high protein meal produced as a by-product of guar gum manufacture that considered a good source of essential amino acids. The protein content of guar meal ranges between 36-60% depending on fraction type (Verma and McNab, 1984; Lee *et al.*, 2003).

Guar korma meal (*Cyamopsis tetragonoloba*) is obtained after processing of guar seeds and a relatively inexpensive high protein meal for animals, cattle and poultry. Guar korma meal is used in rations to enhance the milk giving capacity in dairy animals. Guar korma meal price per protein % is lower than soybean and can be used to substitute any protein sources. Improvement of fish production industry in Egypt is one of the main objectives of private and public sectors in recent decades. Feed cost is the largest cost in fish production and accounting nearly about 60-70% of the total investment in fish industry. So, the alternatives of soybean meal SBM in fish diets considered too necessary. A partial replacement of SBM by guar meal in fish diets for decreasing feed

costs may be a useful economic strategy without any negative effects on production (Kamran *et al.*, 2002; Abdel-Wahab *et al.*, 2016).

Use of low levels of guar meal resulted in higher carcass weight in broiler diets than that fed with higher levels of this meal. Also, It is observed that the amount of feed intake significantly decreased ($p < 0.05$) when GKM level increased (Lee *et al.*, 2005; Hafsa *et al.*, 2015).

However, body weight and feed efficiency are reduced in case of high concentrations of guar meal in chicken's diets as, the residual guar gum present in guar meal results in the increased intestinal viscosity that is responsible for reduced performance measures (Lee *et al.*, 2003).

The feed conversion ratio was better ($p < 0.05$) and improved digestibility percentages for most nutrients and feed utilization in (GKM-25) group followed by (GKM0) group than that of the (GKM-50) and (GKM-75) groups (Hafsa *et al.*, 2015).

MATERIALS AND METHODS

This study was conducted at Department of Animal Husbandry and Animal Wealth Development at Faculty of Veterinary Medicine, Sadat City University, to study the effect of guar korma meal replacement instead of soybean meal in Nile tilapia diet on feed utilization, economic and productive performance parameters (Table 1).

Guar korma: The guar korma were obtained from Faculty of Agriculture, Minia University and was added to the basal diet at different levels as soybean replacement.

Fish: The fish used in the study is Nile tilapia which is well known and widely cultured in Egypt for its biological and economic importance. The fingerlings were obtained from fish farm of nearly about 10 g weight for each.

Acclimatization: Tilapia fingerlings were stocked in clean concrete pond of (3×1×1 m) dimension. The pond divided into 4 equal parts (groups) by net partitions, each net partition (nearly 30 fingerling/partition) and supplied with underground water. Fish adapted for a period of two weeks and were daily fed on the basal diet at a rate of 3% of their BWt to be adapted gradually to pelleted feed and

Table 1: Guar korma meal and soybean meal analysis (%)

Items	Guar korma meal	Soybean meal
DM	92.5	91
Crude protein	54.73	49
Ether extract	2.95	3
Crud fiber	7.16	7
Ash	4.82	7
NFE	30.34	34

environmental condition. The number of fingerlings per group was 25 and the average initial BWt was 10 g at the end of adaptation period. According to methods applied by Shewita (2004) and EL-Sayed (2007).

Environmental conditions: During the experiment about 12 h. of natural light was available (Meske and Vogt, 2014). The pond was cleaned periodically by removing the wastes in the bottom to avoid algal growth. Water samples were taken every week and the following parameters were measured:

pH value: The water pH value was recorded by using electric digital pH meter Orion research model 201.

Temperature: Temperature of water was recorded in degree centigrade using a mercury thermometer.

Experimental design: The effect of guar korma substitution instead of soybean in Tilapia diet and its effect on the growth performance and economic efficiency of *Oreochromis niloticus* were determined by classifying fish into 4 groups (25 fingerlings/group) with 3 replicates for each, first was control group and fed on commercial diet supplemented with soybean and three other groups fed on treated diets supplemented with different levels of Guar korma meal that substituted the soybean meal as showed in Table 2 and 3. Fish fed twice daily on the rate of about 5% from the total weight.

Table 2: Classification of the different experimental groups

Group	Description
G1	25 Tilapia fingerlings fed the diet contain only soybean meal for 10 weeks (control group)
G2	25 Tilapia fingerlings received diet containing 25% guar korma substitution for 10 weeks
G3	25 Tilapia fingerlings received diet containing 50% guar korma substitution for 10 weeks
G4	25 Tilapia fingerlings received diet containing 100% guar korma substitution for 10 weeks

Water quality

Temperature	25-34±2°C
pH value	8.1

Table 3: Composition of the different group's diet (commercial and experimental)

Items	Diet			
	G1 (0%)	G2 (25%)	G3 (50%)	G4 (100%)
Fish meal	10	10	10	10
Soybean meal	37	27.5	18.5	0
Guar korma	0	9.5	18.5	37
Corn meal	25	26	29	33
Wheat bran	18	17	14	10
Lin oil	4	4	4	4
Vit. mix	2	2	2	2
Min. mix	1	1	1	1
CMC	3	3	3	3
Total	100	100	100	100

Measurements

Growth performance parameters

Body weight (Bwt): Fish were biweekly weighed as fingerlings lifted from water, allowed to drain for 30 sec and directly, transferred into container containing enough water to eliminate environmental stress. Fish weight individually, recorded and then returned to the original water environment.

Body Weight gain (Bwt gain): Body weight gain was calculated as the difference between two successive weights (grams).

Specific Growth Rate (SGR): It was calculated according to Jauncy and Ross (1982) as follows:

$$SGR = \frac{\text{Log}_e W_2 - \text{Log}_e W_1}{T_2 - T_1} \times 100$$

Where:

W₁ = Weight of fish (g) at time T₁ (days)

W₂ = Weight of fish (g) at time T₂ (days)

This gives the average percentage increase in body weight per day over a given period of time.

Body length: The whole body length (cm) measured from the anterior part of fish to the end of its tail.

Condition factor (K): The condition factor which relates body length to the body weight of fish and computed according to Gjedrem and Gunnes (1978) as follows:

$$K = \frac{\text{Body weight (g)}}{\text{Total length (cm)}} \times 100$$

Where:

W = Body weight

L = Body length

Feed Conversion Ratio (FCR): It was calculated according to Degani *et al.* (1986). It indicates the weight of feed required for producing a unit weight of fish as following:

$$FCR = \frac{\text{Feed intake (g)}}{\text{Weight gain (g)}}$$

Economic parameters

Costs

Fixed Costs (TFC): It includes the costs of land and equipment depreciation value for each fish. The depreciation rate of building and equipment calculated as building within 25 year and equipment within 5 years according to El-Tahawy (2004) by the following equation:

$$\text{Depreciation rate} = \frac{\text{Value of asset}}{\text{Age of asset (year)}}$$

Variable Costs (TVC): It includes purchased fingerlings costs and the feed costs. It was estimated per EGP during the experiment.

Total Costs (TC):

$$\text{Total Cost (TC)} = \text{TFC} + \text{TVC}$$

Returns

Total Returns (TR):

$$\text{Total return} = \text{Fsale (according to the market price)}$$

Net return:

$$\text{Net return} = \text{Total return} - \text{Total cost}$$

Statistical analysis: Data was analyzed using the computer program SPSS/PC+(2001), to estimate the effect of different treated groups on productive and economic efficiency parameters the statistical method used was one way ANOVA test. Data presented as mean±SE and significance was declared at (p<0.01).

RESULTS AND DISCUSSION

Effect of soybean meal replacement by Guar Korma (GK) on growth performance parameters: The results of growth performance parameters in Table 4 showed that, there is a significant difference (p<0.01) among the different three (GK) treated groups and control group on final body weight (g) of Nile tilapia. The lowest final BWt were 79.64 in group 4 fed 100% guar korma diet and the

Table 4: Effect of Guar Korma (GK) as a replacement on growth performance

Items	Group No.			
	G1 (0%)	G2 (25%)	G3 (50%)	G4 (100%)
Final weight (g)	112.59±0.3 ^a	100.67±0.2 ^b	92.79±0.4 ^c	79.64±0.1 ^e
Final length (cm)	11.91±0.05 ^a	11.86±0.06 ^a	11.83±0.05 ^a	11.26±0.04 ^b
Weight gain (g)	102.58±0.6 ^a	90.67±0.1 ^b	82.79±0.5 ^c	69.63±0.7 ^e
Specific growth rate (%)	0.76±0.02 ^a	0.75±0.03 ^a	0.73±0.01 ^a	0.66±0.02 ^b
Condition factor	1.75±0.01 ^a	1.62±0.03 ^b	1.49±0.03 ^c	1.46±0.02 ^c

^{a-c}Means in the same row with different superscripts are significantly different (p<0.01)

Table 5: Effect of Guar Korma (GK) as a replacement on feed utilization

Parameters	Group No.			
	G1 (0%)	G2 (25%)	G3 (50%)	G4 (100%)
Total feed intake (g)	210.3±0.6 ^a	201.3±0.4 ^b	189.6±0.1 ^c	179.6±0.8 ^a
Feed Conversion Ratio (FCR)	2.05±0.03 ^a	2.22±0.05 ^b	2.29±0.07 ^c	2.45±0.01 ^a

^{a-c}Mean in the same row with different superscripts are significantly different (p<0.01)

Table 6: Effect of soybean meal replacement by Guar Korma (GK) on economic efficiency

Items	Group No.			
	G1 (0%)	G2 (25%)	G3 (50%)	G4 (100%)
Guar korma %/100 (kg)	0	9.5	18.5	37
Soybean meal %/100 (kg)	37	27.5	18.5	0
Cost of guar korma (EGP)	0	71.25	138.75	277.5
Cost of soybean (EGP)	379.25	281.88	189.63	0
Difference in feed cost (EGP)	0	26.12	50.87	101.75
Decrease in feed cost (%)	0%	6.89 %	13.4 %	26.8 %
Total feed intake (kg)/100 fish	21.03	20.13	18.96	17.96
Total cost of consumed feed (EGP)/100 fish	147.21	131.45	118.5	105.07
Weight of fish (kg)/100 fish	11.26	10.07	9.28	7.96
Total petum (EGP)/100 fish	202.68	181.26	167.04	143.28
Net return (EGP)/100 fish	55.47	49.81	48.54	38.21
Difference in net return (EGP)	0	5.66	6.93	17.26
Decrease in net return (%)	0 %	10.2 %	12.49 %	31.1 %

highest final BWt were 112.59 in the group 1 (control group) that fed on the basal diet without any guar korma treatment. Whereas, the BWt for groups 2 and 3 that fed on 25 and 50% guar korma diets were 100.67 and 92.79, respectively.

The results of final length cleared that, there is a significant difference (p<0.01) among different groups in its effect on final length (cm). The length ranged from 11.26 in group 4 fed 100% guar korma diet to 11.91 in group 1 fed 0% guar korma diet. While, the final length were 11.86 and 11.83 in groups 2 and 3 fed on 25% and 50 guar korma diet, respectively.

The results of BWt gain (g) indicated that, there is a significant difference (p<0.01) among the different 4 groups in its effect on BWt gain (g). The lower level of BWt gain were 69.63 in group 4 fed 100% guar korma diet and the highest final BWt were 102.58 in the group 1 (control group) that fed on the diet without guar korma treatment. While, the BWt gain for 25 and 50% guar korma treated groups were 90.67 and 82.79, respectively. The specific growth rate results illustrated that, there is a significant difference (p<0.01) among different 4 groups. The lower level of specific growth rate (%/day) were 0.66 in the group 4 fed 100% guar korma and the highest level in group 1 (control) with 0% guar korma in the diet as were 0.76. Meanwhile, the specific growth rate in 25 and 50% guar korma treated groups were 0.75 and 0.73, respectively.

The results of condition factor showed that, there is a significant difference (p<0.01) among the 4 groups in its effect on condition factor. The lowest condition factor were 1.46 in the group fed 100% guar korma and the highest condition factor were 1.75 in control group fed 0% guar korma. While the condition factor in 25 and 50% guar korma treated groups were 1.62 and 1.49, respectively.

These results indicated that growth performance decrease as the level of guar korma increase than the level of soybean meal in diet and the growth parameters improved with increased soybean meal level in the diet. These results agreed with Lee *et al.* (2005) as observed that the growth performance parameters decrease with increased level of guar meal in fish diet.

Effect of soybean meal replacement by Guar Korma (GK)

on feed utilization: The results in Table 5 showed that, there is a significant difference (p<0.01) in feed intake (g) among examined groups. The highest feed intake were 210.3 in 0% guar korma group (group 1) followed by 201.3 and 189.6 in group 2 and 3 fed on 25 and 50% guar korma diet, respectively. While the lowest feed intake were 170.6 in group 4 of 100% guar korma treated group. The results of feed conversion ratio showed a significant difference (p<0.01) among the different groups where the higher feed conversion were 2.45 in the group fed 100% guar korma diet and the lower conversion ratio were 2.05 in 0% guar korma group. Where, the feed conversion ratio in groups of 25 and 50% guar korma diet was 2.22 and 2.29, respectively.

The results of feed utilization showing a decreased level of feed intake and increased ratio of feed conversion with increased guar korma level and parameters improved with increasing level of soybean meal. This result may be owed to that fish eat high amount of feed due to palatable taste of soybean meal. The results may agree with Hafsa *et al.* (2015).

Effect of soybean meal replacement by Guar Korma (GK)

on economic efficiency: The results in Table 6 showed that, there is a significant difference of economic efficiency among different groups (p<0.01). where the

group of 25% guar korma replacement decrease the diet cost comparing to control group by about 26.12 (EGP) and 6.89%. Whereas 50% guar korma replacement group decrease the cost by about 50.87 (EGP) and 13.4% and by about 101.75 (EGP) and 26.8% in group of 100% guar korma diet. While the difference in net return from control group were (5.66 (EGP) and 10.2%) (6.93 (EGP) and 12.49%) and (17.26 (EGP) and 31.1%) for 25, 50 and 100% guar korma replacement groups, respectively.

CONCLUSION

The results of cost and net return due to partial substitution of soybean indicated that as the substitution percent increase the costs of feed and net returns decrease as the lowest costs and return present in group 4 of 100% guar korma. From economic point of view the results indicated that, the substitution of soybean with guar korma at the level of 25% is better than 50 and 100% substitution level where net return is higher in group 2 of 25% guar korma than group 3 and group 4 of 50 and 100% guar korma, respectively. Meanwhile, the control group of 0% guar korma is the highest in net return compared to other treated groups. These results agreed with (Hafsa *et al.*, 2015) where concluded that lower level of soybean substitution with guar korma is better than higher levels as save the cost of the ration with higher returns.

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