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Effect of Partial Replacement of Soybean Meal with Different Levels of Guar Korma Meal on Growth Performance, Carcass Traits and Blood Metabolites of Broiler Chickens

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ABSTRACT

A study was conducted to investigate the effects of Guar Korma Meal (GKM) as a partial replacement for soybean meal (SBM) in broilers diets on growth performance, carcass traits, blood metabolites and economic efficiency. Three hundred; one-day-old Cobb-400 broilers, each with five replicates (n = 15 chicks per replicate), were submitted to one of the four diets contain 0, 25, 50, 75% SBM were replaced with GKM in starter and grower diets, respectively for 42 days in a completely randomized design. Body Weight (BW), Body Weight Gain (BWG) and Feed Intake (FI) were lower (p<0.05) in broilers fed (GKM-50) and (GKM-75) than those fed (GKM-25) and (GKM0), whereas Feed Conversion Ratio (FCR) was better (p<0.05) when broilers fed on (GKM-25). Performance Index (PI) and Performance Index Score (PIS) were superior in the (GKM-25) followed by SBM fed groups when compared to the other groups. Digestibility coefficients of OM, CP, CF and NFE were higher (p<0.05) for broilers fed on (GKM-25) than those fed other diets, however, EE was highest for broilers fed on (GKM-50) and (GKM-75). Carcass traits, cut up parts and yields significantly increased (p<0.05) for chicks fed (GKM0) and (GKM-25), while group fed on (GKM0) recorded the lowest abdominal fat (%) followed by (GKM-25) group. Ascending levels of GKM treatments influenced the carcass meat, which was observed as decrease in CP contents (p<0.05) but increase in moisture, EE and ash contents (p<0.05) in breast and thigh meat compared to (GKM0) group. Broilers fed on (GKM-75) had the highest urea, triglycerides, cholesterol, HDL, LDL and vLDL concentrations than the other treatments. The best value of Economic Efficiency (EE) was recorded by group fed on (GKM-25). High levels of GKM in broilers diets deleteriously affect growth performance, FI, FCR and blood lipids. It was concluded that optimal level of GKM is low level 25% without adverse effects on growth performance, carcass traits, blood lipids or economic efficiency of broilers.

Key words: Guar korma meal, performance, carcass, blood constituents, broilers

INTRODUCTION

No doubt that economy of every country always has one main column which runs the economy of that country. In recent decades poultry industry showed a remarkable product in Egypt. Poultry industry improvement is one of the main objectives of both private and public sectors. In poultry industry, cost of feed is the single largest cost in producing meat and eggs, accounting for nearly

60-70% of the total investment. In fact, today the cost of chick is about 18 Egyptian pounds 12 pounds for feed only while 4 pounds just for soybean meal. So, looking for the alternative of soybean meal considered very necessary. Since the germ fraction of guar meal contains energy, protein, methionine and phosphorus in higher levels than that in soybean meal (SBM), addition of guar meal as a partial replacement (<10%) of SBM in poultry diets may be a useful economic strategy for decreasing feed costs without any negative effects on production (Kamran *et al.*, 2002).

Guar (*Cyamopsis tetragonoloba*) is a drought resistant annual legume grown for its galactomannan polysaccharide gum that in turn has many industrial and food processing applications (Hassan *et al.*, 2008). After the gum is extracted, guar meal is processed by toasting the guar seeds at high temperature to remove the natural trypsin inhibitor, thus enhancing its nutritive value and digestibility. Guar meal is a relatively low-cost high protein meal produced as a by-product of guar gum manufacture. The protein content of guar meal ranges between 36-60% depending on fraction type. Guar meal is a good source of essential amino acids. The amino acid content of the guar meal protein makes guar meal a useful protein supplement for broilers and layers. In addition, about 88% of the nitrogen content is true protein that makes it potentially useful as an ingredient for poultry feed (Verma and McNab, 1984; Lee *et al.*, 2003a, b, 2005). Guar meal contains about 12% gum residue (7% in the germ fraction and 13% in the hulls) (Lee *et al.*, 2005), which increases viscosity in the intestine, resulting in lower digestibility and growth performance (Lee *et al.*, 2009). Guar meal contains other types of anti-nutritional factors: Trypsin inhibitors, saponin, haemagglutinins, hydrocyanic acid and polyphenols (Verma and McNab, 1982; Gutierrez *et al.*, 2007). However, anti-tryptic activity was found to be lower than in heat-treated soybean meal and therefore not the main cause of anti nutritional effects in poultry (Lee *et al.*, 2004). Therefore, the objective of the current study to determine the effect of using different levels of GKM, as a partial replacement for SBM in commercial broiler diets, on performance, digestibility, carcass traits and blood metabolites of Cobb-400 broilers.

MATERIALS AND METHODS

The experimental work was carried out in New Borg El Arab station, Animal Production Research Institute, Agricultural Research Centre and Livestock Research Department, Arid Lands Cultivation Research Institute, City of Scientific Research and Technological Applications, New Borg El-Arab Alexandria, Egypt from January to March 2014. A total of 300 unsexed one-day old Cobb-400 (45.5 ± 0.46) chicks were randomly distributed into four dietary treatments replicated five times in such a way that each had 15 birds. Treatments included 0, 25, 50, 75% SBM were replaced with GKM in starter (1-21 days) and grower (22-42 days) diets fed to chicks for 42 days. Composition of experimental diets is shown in Table 1. Experimental diets were formulated according to NRC guideline NRC (1994) and the proximate analyses of the starter and grower diets were calculated as shown in Table 2. Total chick's weight of each pen was established to be equal and feeder was separately allocated at each pen. Feed and water were provided *ad-libitum*. All birds were kept under the same managerial, hygienic and environmental conditions. The chicks were vaccinated against the common broiler diseases according to the conventional program used for broilers. Live body weight and feed consumption were recorded weekly interval throughout the experimental period. Daily weight gain, feed conversion ratio and economic efficiency were calculated. Economic Efficiency (EE) and Relative Economic Efficiency (REE) were calculated according to input-output analysis data. Besides Performance Index (PI) was calculated according to North (1981) and Performance Index Score (PIS) was calculated using the following formula:

Table 1: Chemical composition of soybean meal and guar korma meal

Item	Soybean meal	Guar korma meal
Dry matter	88.59	89.49
Organic matter	94.11	92.07
Crude protein	43.87	50.09
Crude fiber	6.11	7.66
Ether extract	2.64	7.04
N free extract	41.49	29.09
Ash	5.89	7.88
Metabolic energy (kcal kg ⁻¹)	3055.00	3191.00
Total energy (kcal kg ⁻¹)	3980.00	4050.00
Amino acid		
L-lysine	2.37	2.88
L-methionine	1.25	0.75
Arginine	2.64	3.50
Cystine	1.06	0.76
Isoleucine	2.22	2.24
Valine	2.47	2.31
Tryptophan	1.42	0.65

Table 2: Composition and chemical analysis of the experimental diets

Feed ingredient (%)	Starter (0-21) day				Grower (22-42) day			
	GKM0	G KM-25	GKM-50	GKM-75	GKM0	GKM-25	GKM-50	GKM-75
Corn yellow	58.50	59.50	60.50	61.00	65.50	66.50	67.00	67.50
Soybean meal (44%)	27.00	20.25	13.50	6.75	25.00	18.75	12.50	6.26
Guar korma meal	0.00	6.75	13.50	20.25	0.00	6.25	12.50	18.75
Corn gluten meal (60%)	10.00	9.00	8.00	7.50	5.00	4.00	3.50	3.00
Limestone	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35
Dicalcium phosphate	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20
Salt (NaCl)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Vit-mineral*	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
DL-methionine	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
L-lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Cocciostate	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Total feed	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total price feed/100 kg	350.00	322.00	312.00	304.00	325.00	310.00	301.00	288.00
Calculated chemical composition (%)								
Crude protein	23.00	23.00	23.00	23.00	19.50	19.50	19.50	19.50
ME kcal/kg diet	3100.00	3100.00	3100.00	3100.00	3200.00	3200.00	3200.00	3200.00
Calcium	1.26	1.29	1.33	1.34	1.22	1.23	1.27	1.30
Phosphorus available	0.84	0.87	0.88	0.84	0.81	0.83	0.84	0.83
Lysine	1.19	1.25	1.27	1.30	1.14	1.18	1.22	1.26
Methionine	0.66	0.61	0.58	0.56	0.62	0.58	0.56	0.53
Methionine+cystine	0.92	0.91	0.89	0.88	0.89	0.86	0.86	0.82

*Provided the following per kilogram of diet: Vit. A: 1200 IU, Vit. D: 3000 IU, Vit. E: 100 IU, Vit. C: 3 mg, Vit. K: 4 mg, Vit. B1: 3 mg, Vit B2: 3 mg, Vit B6: 5 mg, Vit B12: 0.03 mg, Bantothinic acid: 15 mg, Folic acid: 2 mg, Biotin: 0.20 mg, Cobalt: 0.05 mg, Copper: 10 mg, Iodin: 50 mg, Manganese: 90 mg, Selenium: 0.20 mg and Zinc: 70 mg, ME: Metabolic energy

$$PIS = \left(\frac{\text{Livability} \times \text{average final live body weight}}{\text{Age of experimental birds} \times \text{FCR}} \right) \times 100$$

Digestibility trial was undertaken at the end week of the experimental period (6 week of age), 10 chicks were randomly selected from each group; birds were housed individually in metabolism cages. The experimental diets were offered daily and fresh water was provided all the time. Feed consumption was accurately determined. Feces were collected for 5 days as a collection period, then the feces was dried at 60°C for 24 h. All collected feces for each bird were mixed, then representative feces samples were ground for chemical analysis. Chemical analysis of different diets and feces was determined according to AOAC (2005).

On day 42, two chicks were randomly selected from each pen, fasted for 16 h before slaughtering, weighed and manually slaughtered. Carcass weight (Dressing, breast, thigh, abdominal fat, liver, heart, empty gizzard and other total edible parts) were calculated as percentage of live body weight. Chemical analysis of meat was done according to AOAC (2005) and the values were expressed on DM basis.

Blood samples were collected from sacrificed birds in clean sterile tubes and then were immediately centrifuged at 3000 rpm for 15 min and stored at -20°C until use. Total Protein (TP), albumin (ALB), globulin (GLB) (TP-ALB), urea, cholesterol, HDL, LDL, vLDL and triglyceride concentrations were determined by spectrophotometer (Spectronic 21 DUSA) using commercial diagnostic kits (Combination, Pasteur Lap.).

Data were statistically analyzed using the general linear model of SAS (2001) as a completely randomized design. Differences among treatment means were estimated by Duncan's multiple range test (Duncan, 1955). Statement of statistical significance was based on ($p < 0.05$).

RESULTS AND DISCUSSION

Growth performance: Performance evaluation of the birds fed varied levels of GKM substitute instead of SBM at different ages are presented in Table 3 indicated that LBW of (GKM-25) fed groups was inferior to (GKM-50 and GKM-75) fed ones when measured at week 3 and 6 of age, but insignificant differences were observed between (GKM0) and (GKM-25) at week 3 of age. It is noting that when SBM was partially replaced with GKM at 50 and 75% levels, LBW significantly decreased at week 3 and 6 of age. Similar trend of BWG of chicks fed graded levels of GKM had highly significant ($p < 0.05$) differences in the entire experimental periods. As GKM level increased 50 and 75% substituted instead of SBM, BWG significantly decreased at 1-3, 3-6 and 1-6 weeks. While BWG of broilers in (GKM-25) group was better than those in (GKM0) group by 2.8, 3.08 and 2.97% at 1-3, 3-6 and 1-6 weeks, respectively. Feed intake in (GKM0) and (GKM-25) groups were increased ($p < 0.05$) than those in (GKM-50) and (GKM-75) groups in starter, grower and the entire experimental period. It is observed that when GKM level increased, the amounts of feed intake

Table 3: Performance of broiler chicks fed different levels of guar korma meal

Items	Guar korma meal supplement				SEM	Significance
	GKM0	GKM-25	GKM-50	GKM-75		
BW (g)						
IBW	46.00	44.50	46.50	45.00	0.55	NS
At 3 weeks	844.00 ^a	865.50 ^a	688.00 ^b	624.00 ^c	24.76	**
At 6 weeks	2055.00 ^b	2115.00 ^a	1675.00 ^c	1570.50 ^d	35.98	**
BWG (g)						
1-3 weeks	798.00 ^a	821.00 ^a	641.50 ^b	600.00 ^b	46.57	*
3-6 weeks	1211.00 ^a	1249.50 ^a	987.00 ^b	925.25 ^b	37.99	*
1-6 weeks	2009.00 ^a	2070.50 ^a	1628.50 ^b	1525.25 ^c	44.15	**
FI (g)						
1-3 weeks	965.50 ^a	947.25 ^a	897.00 ^b	875.00 ^b	12.86	*
3-6 weeks	2265.00 ^a	2170.00 ^b	1887.00 ^c	1810.00 ^d	22.95	**
1-6 weeks	3230.50 ^a	3117.25 ^b	2784.00 ^c	2685.00 ^d	17.46	**
FCR (g feed/g gain)						
1-3 weeks	1.21 ^c	1.15 ^d	1.40 ^b	1.46 ^a	0.03	**
3-6 weeks	1.87 ^c	1.74 ^d	1.91 ^b	1.96 ^a	0.02	**
1-6 weeks	1.61 ^b	1.51 ^c	1.71 ^a	1.76 ^a	0.05	**
PI (%)	124.78 ^b	137.42 ^a	95.23 ^c	86.66 ^c	9.06	**
PIS (%)	288.71 ^b	323.49 ^a	205.24 ^c	178.47 ^c	24.66	**

^{a, b, c and d}: Means in the same row with different superscript are significantly different ($p < 0.05$), BW: Body weight, BWG: Body weight gain, FI: Feed intake, FCR: Feed conversion ratio, IBW: Infant body weight

significantly decreased ($p < 0.05$). Feed conversion ratio was clearly better ($p < 0.05$) in (GKM-25) group followed by (GKM0) group than that of the (GKM-50 and GKM-75) groups both in the growth period and in the entire experimental periods ($p < 0.05$).

These results are similar to the findings of Gutierrez *et al.* (2007) which reported that addition of 5% guar by product to hen diets did not have adverse effects on the growth performance. Also, Tyagi *et al.* (2011) and Mishra *et al.* (2013) found that no adverse effects of guar korma on broiler performance even at levels as high as 10%. Although Kamran *et al.* (2002) and Larhang and Torki (2011) showed that there were negative effects of guar meal on broiler performance. The lower LBW in (GKM-50) and (GKM-75) groups at week 3 of age was due to the fact that growth depressing effect of guar meal is more pronounced in young chicks than in older birds (Verma and McNab, 1982; Lee *et al.*, 2003b). It has been reported earlier that high galactomannan content of guar meal increases digesta viscosity and suppresses nutrient digestibility to cause growth depression in broilers (Almirall *et al.*, 1995). However, LBW of broilers fed on diet containing 25% GKM was better than those fed on basal diet by 2.5 and 2.84% respectively, at week 3 and 6 of age. The comparable results between the (GKM-0) and (GKM-25) groups reflect the ability of these chicks to adequately handle and tolerate anti-nutritional factors at this level. The increase in viscosity reduces the gastric-emptying time that can cause reduced FI that is the main cause of weight loss (Frias and Sgarbieri, 1998). Furthermore, the increased viscosity decreases the absorption of nutrients that may be another factor in weight loss (Lee *et al.*, 2009). In conflict with Mohayayee and Karimi (2012) found that the low and high guar meal diet ($\pm$ enzyme) diets reduced BWG compared to the control by 7 and 13%, respectively. Lee *et al.* (2003a) indicated that the use of high levels of guar meal (germ or hull) in feeding broilers deleteriously affected feed intake. Hassan (2013) and Mishra *et al.* (2013) found that GKM fed groups consumed significantly higher amount of feed and also detected that guar korma depressed the digestibility of starch and deprived the birds of the available energy as a compensatory mechanism. Chicks fed 25% GKM had the best FCR values during the periods 1-3, 3-6 and 1-6 weeks of age by about 1.15, 1.74 and 1.51 compared with control group which recorded 1.21, 1.87 and 1.61, respectively, at the same periods. However, chicks fed on (GKM-50) and (GKM-75) groups had worst values of FCR compared to the control group. This poor in FCR in chicks that received high percent of GKM tend to that galactomannan content of GKM might have increased intestinal viscosity leading to impaired metabolism of major metabolites like starch, protein and glucose. These results are in agreement with the findings of Brahma and Siddiqui (1978) who reported that increase level of guar meal led to increase FCR. Leeds *et al.* (1980) reported that guar gum decreased glucose metabolism and retarded insulin secretion rate in swine. May be control of insulin secretion impaired the intestinal uptake and utilization of glucose and amino acids and results in poor feed efficiency as reported earlier by Jackson *et al.* (1999). Also, Larhang and Torki (2011) found that diet inclusion of 8% guar meal significantly increased FCR compared to the birds fed control diet. Hassan (2013) found that FCR was poor and significantly higher for chicks fed 5.0% GM than all the other treatments from 1-7 days of age.

It was reported that guar meal contains about 5.0% crude guar saponin (Hassan *et al.*, 2007, 2010) which have anti-nutritional properties (Shimoyamada *et al.*, 1990). High level of GKM 50 and 75% which replaced instead of SBM in the diet had high concentration of saponins which depress digestion and the feed intake. This may explain the poor chicks' performance in (GKM-50) and (GKM-75) fed groups. Saponins can be reduce intestinal motility (Klita *et al.*, 1996), inhibit gastric emptying (Yoshikawa *et al.*, 2001) and decrease growth rate (Makkar and Becker, 1996). They also

lower digestion rate (Killeen *et al.*, 1998), depress mucosal enzyme activity in the lower intestine (Olli *et al.*, 1994) and inhibit the absorption of vitamins A and E in chicks (Jenkins and Atwal, 1994). While Lee *et al.* (2005) reported that guar meal could be safely fed to broilers at 2.5% of the diet without adversely affecting performance. However Mishra *et al.* (2013) stated that partial replacement of SBM with guar korma may not yield any substantial benefits in terms of performance. Keeping parity with the performance data, the PI and PIS was positively affected by low level of guar korma in diet, in other studies have been reported that the PIS was negatively affected by supplementation of guar korma in diet (Mishra *et al.*, 2013).

Economic Efficiency: The final body weight, length of the growing period and feeding cost are generally among the most important factors involved in achievement of maximum efficiency values of meat production. The EE of the different formulated diets as affected by different treatments is shown in Table 4. It should be pointed that the EE values were calculated according to the prevailing market selling price of 1 kg LBW, which was 12.5 L.E. Results indicated that recommended levels of GKM improved slightly the EE and reduced the cost of kilogram BW as compared to control group. Data showed that adding 25% GKM to broilers diets gave the best economic efficiency (0.76) followed by control group (0.59), when compared to the other treatment 50 and 75% GKM (0.52 and 0.49), respectively. The results indicated that replacement 25% GKM as a partial replacement for SBM improved the relative economic efficiency of diets by 28.81% compared to control diet. However, the other treatments containing 50 and 75% GKM decreased the relative economic efficiency when compared to control group by 11.86 and 16.96%, respectively. The results of this study are in agreement with those of Mishra *et al.* (2013) who found that economic efficiency values were increased when SBM was partially replaced with guar korma by about 20 g kg⁻¹ in pre-starter, 50 g kg⁻¹ in starter and finisher in the diets.

Nutrients digestibility: Data of digestion coefficients are presented in Table 5. Broilers in (GKM-25) group recorded the highest CP digestibility (p<0.05), but (GKM-0) and (GKM-25) groups recorded the lowest EE digestibility compared to the other groups. Apparent OM, CF and NFE digestibility showed no significant difference between (GKM-0) and (GKM-25) groups, while OM, CF and NFE in (GKM-0) and (GKM-25) groups surpassed those in (GKM-50) and (GKM-75) groups. The improvement of digestibility percentages for most nutrients associated with the increasing of

Table 4: Economic analysis of broiler fed diets containing different levels of guar korma meal

Economic efficiency	Treatments			
	GKM0	GKM-25	GKM-50	GKM-75
Average total weight gain/chick (kg)	2.055	2.115	1.675	1.5705
Total revenue/chick (LE) ⁽¹⁾	25.69	26.44	20.94	19.63
Total feed intake/rabbit (kg)	3.231	3.117	2.784	2.685
Price of feeding/kg (LE)	3.38	3.16	3.07	2.96
Total cost of feed/chick (LE)	10.92	9.85	8.55	7.95
Total cost of/chick (LE)	4.10	4.10	4.10	4.10
Total cost of medication/chick (LE)	1.10	1.10	1.10	1.10
Total cost/chick (LE)	16.12	15.05	13.75	13.15
Net revenue/chick (LE) ⁽²⁾	9.57	11.39	7.19	6.48
Economic efficiency (EE) ⁽³⁾	0.59	0.76	0.52	0.49
Relative economic efficiency (REE)	100.00	128.81	88.14	83.05

(1): Price of one kg/live body weight on selling was 12.5 LE, (2): Net revenue: Price of sell chick (LE): Total cost (LE) (3), Economic efficiency: Net revenue/Total cost (LE)

BW and BWG results (Table 3) and the improvement of feed utilization which improves the FCR (Table 3) for the broilers fed on (GKM-25). It has been reported earlier that the high galactomannan content of guar meal increases digesta viscosity and suppresses nutrient digestibility to cause growth depression in broiler chicken (Almirall *et al.*, 1995). Owusu-Asiedu *et al.* (2006) reported that 7% of guar gum reduced CP digestibility ($p < 0.05$) in grower pigs.

Saponins have long been known to inhibit the absorption and utilization of minerals by animals. Saponins decrease protein quality by reducing digestibility and palatability (Ogunbode *et al.*, 2014). Saponins were recognized as antinutrient constituents, due to their adverse effects such as growth impairment and reduce their food intake due to the bitterness and throat-irritating activity of saponins. In addition, saponins were found to reduce the bioavailability of nutrients and decrease enzyme activity and it affects protein digestibility by inhibiting various digestive enzymes such as trypsin and chymotrypsin (Liener, 1974). Protease or trypsin inhibitors of guar korma meal have been reported to hinder the activity of the proteolytic enzymes trypsin and chymotrypsin in monogastric animals which in turn lowers protein digestibility (Liener and Kakade, 1980).

Carcass traits: Carcass traits of birds for different groups are shown in Table 6. Generally, group fed on (GKM0) showed significantly ($p < 0.05$) the highest dressing, breast and thigh percentages followed by (GKM-25) while (GKM-75) had the lowest percentages. Dressing, breast and thigh

Table 5: Nutrients digestibility coefficient (%) of diets with different levels of guar korma meal

Items	Guar korma meal supplement				SEM	Significance
	GKM0	GKM-25	GKM-50	GKM-75		
OM	77.39 ^a	77.05 ^a	70.32 ^b	68.22 ^c	0.28	**
CP	77.85 ^b	80.56 ^a	72.86 ^c	70.44 ^d	0.33	**
EE	75.37 ^b	75.97 ^b	77.58 ^a	77.86 ^a	0.47	*
CF	40.11 ^a	38.76 ^a	34.63 ^b	30.66 ^c	0.62	**
NFE	76.77 ^a	75.36 ^a	67.57 ^b	61.42 ^c	0.84	**

a, b, c and d. Means in the same row with different superscript are significantly different ($p < 0.05$), OM: Organic matter, CP: Crude protein, EE: Ether extract, CF: Crude fiber, NFE: Nitrogen free extract

Table 6: Carcass traits and chemical composition of meat of chicks fed different levels of guar korma meal

	Guar korma meal supplement					
Items	GKM0	GKM-25	GKM-50	GKM-75	SEM	Significance
Carcass characteristics and body organs (%)						
Dressing	66.65 ^a	65.95 ^a	62.35 ^b	61.75 ^b	0.52	*
Breast	36.54 ^a	36.22 ^a	31.60 ^b	29.55 ^c	0.14	**
Thigh	27.35 ^a	26.89 ^{ab}	26.44 ^b	25.78 ^c	0.54	**
Liver	2.65 ^c	2.85 ^b	3.15 ^a	3.22 ^a	0.08	**
Heart	0.62	0.66	0.67	0.64	0.05	NS
Gizzard	2.06 ^a	1.97 ^b	1.88 ^c	1.84 ^d	0.02	**
Abdominal fat	1.97 ^c	2.22 ^b	2.32 ^a	2.39 ^a	0.08	**
Chemical composition of meat on DM basis (%)						
Breast						
Moisture	67.54 ^b	67.77 ^b	68.83 ^a	68.96 ^a	0.23	*
Protein	23.22 ^a	23.57 ^a	21.98 ^b	21.74 ^b	0.21	*
Ether extract	1.76 ^b	1.83 ^b	1.98 ^a	2.08 ^a	0.10	*
Ash	1.62 ^b	1.71 ^b	1.87 ^a	1.98 ^a	0.13	*
Thigh						
Moisture	73.63 ^b	73.12 ^b	74.53 ^a	74.88 ^a	0.58	*
Protein	20.11 ^a	20.47 ^b	19.78 ^c	18.66 ^c	0.27	**
Ether extract	2.26 ^b	2.56 ^b	2.88 ^a	2.98 ^a	0.14	*
Ash	2.12 ^b	2.41 ^b	2.64 ^a	2.75 ^a	0.11	*

a, b, c and d. Means in the same row with different superscript are significantly different ($p < 0.05$), NS: Non significant

percentages were significantly ($p < 0.05$) increased for the broiler fed on (GKM-25) as compared to those fed on (GKM-50 and GKM-75). While, the percentage weight of heart was nearly similar for the different groups. However, GKM led to significant ($p < 0.05$) increase in liver and abdominal fat percentages weight as presented in (GKM-50) and (GKM-75). These results agreed with those obtained by Lee *et al.* (2005) who reported that use of low levels of guar meal germ fraction in broiler's feeding resulted in higher carcass weight and breast weight than broilers fed with higher levels of this meal. However, high level 50 and 75% of GKM cause depressed the dressing relative percentage of chicks. This is contradictory to the findings of Kamran *et al.* (2002) who reported decreased dressing percentage in birds fed with diets containing guar meal. On the other hand, replacing SBM with graded level of GKM 25, 50 and 75% significantly ($p < 0.05$) decreased relative thigh and gizzard weights compared to the control diet. Liver relative weight was significantly increased for those groups fed on (GKM-50 and GKM-75). However, the increase in relative organ weights, such as observed in the liver with inclusion of the GKM, may suggest that a toxic agent contained in guar meal, such as saponins, could be present (Leeson and Summers, 2001). An alternative explanation is that the liver are proportionally larger in the guar meal fed chicks as an artifact of reduced body size resulting from reduced whole body growth rates. In contrast Lee *et al.* (2003b) found that the relative weight of liver was not significantly affected by consumption of the germ fraction at any level when compared with the control. Abdominal fat were significantly affected by experimental treatments that probably it can be due to energy and protein balance deficiency. It was concluded that partial replacement of SBM with guar korma may not yield any substantial benefits in terms of carcass traits (Mishra *et al.*, 2013).

There were significant differences ($p < 0.05$) in the contents of moisture, protein, ether extract and ash among the different groups. Results indicated that replacing SBM by 25% GKM in diet significantly ($p < 0.05$) decreased moisture, ether extract and ash contents in breast and thigh meat compared to those fed on control and 50 and 75% GKM. Ether extract and ash contents of meat was significantly ($p < 0.05$) increased as increasing the levels of GKM in the diet. The highest protein content in breast and thigh meat was recorded for broilers fed on GKM0 and 25% GKM, however groups fed on 50 and 75% GKM had the lowest protein content.

Blood parameters: The concentrations of total protein, albumin and globulin in blood serum decreased significantly ($p < 0.05$), while serum urea concentration increased significantly ($p < 0.05$) with GKM diets for the different groups (Table 7). However, serum triglycerides, cholesterol, HDL, LDL and vLDL concentrations decreased significantly ($p < 0.05$) for group fed on (GKM0) followed by the group fed on (GKM-25), while (GKM-75) had the highest concentrations. Of blood parameters, cholesterol was significantly affected by experimental treatments; these probably were because of the eating of high levels of guar meal. Non starch polysaccharide in guar meal destroys the intestinal micro-flora and this effect on amino acid intestinal-hepatogenic cycle may be caused to increase cholesterol. However, the significant higher value in serum urea as guar korma meal inclusion level increases may be refer to that there is wasting or catabolism of muscle tissue. In other studies have been reported that the high viscosity of guar gum may contribute to some beneficial physiological functions including decreasing plasma cholesterol (Fairchild *et al.*, 1996; Ou *et al.*, 2001). Blood biochemical parameters were not affected by guar meal including three levels of guar korma meal (0.0, 25 and 50.0 g kg⁻¹) except for the serum level of cholesterol was increased (Shahbazi, 2012).

Table 7: Blood serum parameters of chicks fed diets with different levels of guar korma meal

Items	Guar korma meal supplement				SEM	Significant
	GKM0	GKM-25	GKM-50	GKM-75		
TP (g dL ⁻¹)	3.47 ^a	3.11 ^b	2.97 ^b	2.65 ^c	0.17	*
ALB (g dL ⁻¹)	2.16 ^a	1.89 ^b	1.80 ^b	1.67 ^c	0.12	**
GLB (g dL ⁻¹)	1.31 ^a	1.22 ^b	1.17 ^b	1.01 ^c	0.04	**
Urea (mg dL ⁻¹)	15.33 ^c	15.77 ^c	16.71 ^b	18.22 ^a	0.28	**
Cholestrol (mg dL ⁻¹)	139.76 ^d	144.56 ^c	165.74 ^b	170.44 ^a	1.33	**
HDL (mg dL ⁻¹)	93.65 ^c	95.15 ^c	100.42 ^b	126.75 ^a	1.85	**
LDL (mg dL ⁻¹)	43.11 ^d	44.27 ^c	49.61 ^b	53.33 ^a	0.32	**
vLDL (mg dL ⁻¹)	3.75 ^b	3.96 ^b	4.98 ^a	5.05 ^a	0.22	**
Triglyceride (mg dL ⁻¹)	19.26 ^d	20.11 ^c	22.65 ^b	23.98 ^a	0.16	**

a, b, c and d: Means in the same row with different superscript are significantly different (p<0.05)

Blood serum proteins are a significant indicator of the health condition and production features of the organism because of their numerous roles in the physiology. Among numerous factors that influence the concentration of serum proteins, feeding plays an important role in the physiology. However, replacing soybean meal with graded level of guar korma meal 25, 50 and 75% significantly (p<0.05) decreased the blood serum total protein, albumin and globulin with increasing the levels of guar korma meal compared with the control diet, respectively. The described changes are related to the most important physiological role of blood proteins; e.g., as a source of amino acids for synthesis of tissue proteins.

CONCLUSION

The addition of guar korma meal as a partial replacement for soybean meal as a protein source in poultry diets may be useful economic strategy for decreasing feed costs. The results of this study suggest that guar meal can be fed to chicks at levels up to 25% replacement of the soybean meal without negative effects on growth performance, economic efficiency, carcass traits and blood parameters.

REFERENCES

- AOAC., 2005. Official Methods of Analysis. 18th Edn., Association of Official Analytical Chemists, Washington, DC., USA.
- Almirall, M., M. Francesch, A.M. Perez-Vendrell, J. Brufau and E. Esteve-Garcia, 1995. The difference in intestinal viscosity produced by barley and β -glucanase alter digesta enzyme activities and ileal nutrient digestibilities more in broiler chicks than in cocks. J. Nutr., 125: 947-955.
- Brahma, T.C. and S.M. Siddiqui, 1978. A preliminary study on the utilization of toasted guar meal in broiler rations. Ind. Poult. Gazette, 62: 133-138.
- Duncan, D.B., 1955. Multiple range and multiple F tests. Biometrics, 11: 1-42.
- Fairchild, R.M., P.R. Ellis, A.J. Byrne, S.D. Luzio and M.A. Mir, 1996. A new breakfast cereal containing guar gum reduces postprandial plasma glucose and insulin concentrations in normal-weight human subjects. Br. J. Nutr., 76: 63-73.
- Frias, A.C. and V.C. Sgarbieri, 1998. Guar gum effects on food intake, blood serum lipids and glucose levels of Wistar rats. Plant Foods Hum. Nutr., 153: 15-28.
- Gutierrez, O., C. Zhang, A.L. Cartwright, J.B. Carey and C.A. Bailey, 2007. Use of guar by-products in high-production laying hen diets. Poult. Sci., 86: 1115-1120.

- Hassan, S.M., O. Gutierrez, A.U. Haq, J.A. Byrd, C.A. Bailey and A.L. Cartwright, 2007. Saponin-rich extracts from quillaja, yucca, soybean and guar differ in antimicrobial and hemolytic activities. *Poult. Sci.*, 86: 121-121.
- Hassan, S.M., A.K. El-Gayar, D.J. Cadwell, C.A. Bailey and A.L. Cartwright, 2008. Guar meal ameliorates *Eimeria tenella* infection in broiler chicks. *Vet. Parasitol.*, 157: 133-138.
- Hassan, S.M., A.U. Haq, J.A. Byrd, M.A. Berhow, A.L. Cartwright and C.A. Bailey, 2010. Haemolytic and antimicrobial activities of saponin-rich extracts from guar meal. *Food Chem.*, 119: 600-605.
- Hassan, S.M., 2013. Effects of Guar meal, Guar gum and saponin rich Guar meal extract on productive performance of starter broiler chicks. *Afr. J. Agric. Res.*, 8: 2464-2469.
- Jackson, M.E., D.W. Fodge and H.Y. Hsiao, 1999. Effects of β -mannanase in corn-soybean meal diets on laying hen performance. *Poult. Sci.*, 78: 1737-1741.
- Jenkins, K.J. and A.S. Atwal, 1994. Effects of dietary saponins on fecal bile acids and neutral sterols and availability of vitamins A and E in the chick. *J. Nutr. Biochem.*, 5: 134-138.
- Kamran, M., T.N. Pasha, A. Mahmud and Z. Ali, 2002. Effect of commercial enzyme (Natugrain) supplementation on the nutritive value and inclusion rate of guar meal in broiler rations. *Int. J. Poult. Sci.*, 1: 167-173.
- Killeen, G.F., C.A. Madigan, C.R. Connolly, G.A. Walsh and C. Clark *et al.*, 1998. Antimicrobial saponins of *Yucca Schidigera* and the implications of their *in vitro* properties for their *in vivo* impact. *J. Agric. Food Chem.*, 46: 3178-3186.
- Klita, P.T., G.W. Mathison, T.W. Fenton and R.T. Hardin, 1996. Effects of alfalfa root saponins on digestive function in sheep. *J. Anim. Sci.*, 74: 1144-1156.
- Larhang, R.A. and M. Torki, 2011. Evaluating performance of broilers fed guar meal-included diet supplemented by enzyme. *Researches of the First International Conference, Babylon and Razi Universities, Babylon, Iraq*, pp: 243-247.
- Lee, J.T., C.A. Bailey and A.L. Cartwright, 2003a. β -mannanase ameliorates viscosity-associated depression of growth in broiler chickens fed guar germ and hull fractions. *Poult. Sci.*, 82: 1925-1931.
- Lee, J.T., C.A. Bailey and A.L. Cartwright, 2003b. Guar meal germ and hull fractions differently affect growth performance and intestinal viscosity of broiler chickens. *Poult. Sci.*, 82: 1589-1595.
- Lee, J.T., S. Connor-Appleton, A.U. Haq, C.A. Bailey and C.L. Cartwright, 2004. Quantitative measurement of negligible trypsin inhibitor activity and nutrient analysis of guar meal fractions. *J. Agric. Food Chem.*, 52: 6492-6495.
- Lee, J.T., S. Connor-Appleton, A. Cartwright and C.A. Bailey, 2005. Effects of guar meal by-product with and without β -mannanase hemicell on broiler performance. *Poult. Sci.*, 84: 1261-1267.
- Lee, J.T., C.A. Bailey and A.L. Cartwright, 2009. *In vitro* viscosity as a function of guar meal and β -mannanase content of feeds. *Int. J. Poult. Sci.*, 8: 715-719.
- Leeds, A.R., S.S. Kang, A.G. Low and I.E. Sambrook, 1980. The pig as a model for studies on the mode of action of guar gum in normal and diabetic man. *Proc. Nutr. Soc.*, 39: A44-A44.
- Leeson, S. and J.D. Summers, 2001. Naturally Occurring Toxins Relevant to Poultry Nutrition. In: Scott's Nutrition of the Chicken, Leeson, S. and J.D. Summers (Eds.). 4th Edn., University Books, Guelph, Canada, ISBN-13: 9780969560043.
- Liener, I.E., 1974. Phytohemagglutinins: Their nutritional significance. *J. Agric. Food Chem.*, 22: 17-22.

- Liener, I.E. and M.L. Kakade, 1980. Protease Inhibitors. In: Toxic Constituents of Plant Food Stuffs, Liener, I.E. (Ed.). 2nd Edn., Academic Press, New York, USA., ISBN-13: 9780124499607, pp: 7-71.
- Makkar, H.P.S. and K. Becker, 1996. Effect of Quillaja Saponins on *in vitro* Rumen Fermentation. In: Saponins Used in Food and Agriculture, Waller, G.R. and K. Yamasaki (Eds.). Plenum Press, New York, USA., ISBN-13: 978-1-4613-0413-5, pp: 387-394.
- Mishra, A., S.K. Sarkar, S. Ray and S. Halder, 2013. Effects of partial replacement of soybean meal with roasted guar korma and supplementation of mannanase on performance and carcass traits of commercial broiler chickens. Vet. World, 6: 693-697.
- Mohayayee, M. and K. Karimi, 2012. The effect of guar meal (germ fraction) and β -mannanase enzyme on growth performance and plasma lipids in broiler chickens. Afr. J. Biotechnol., 11: 8767-8773.
- NRC., 1994. Nutrient Requirements of Poultry. 9th Rev. Edn., National Academy Press, Washington, DC., USA., ISBN-13: 978-0309048927, Pages: 176.
- North, D.C., 1981. Structure and Change in Economic History. Norton and Co., New York, USA., ISBN-13: 9780393952414, Pages: 228.
- Ogunbode, A.A., S.D. Ogungbenro, M.O. Raji and M.O. Oyeboji, 2014. Performance and nutrient digestibility of broiler fed graded levels of raw pride of barbados seed meal. Int. J. Agric. Biosci., 3: 123-126.
- Olli, J.J., K. Hjelmeland and A. Krogdahl, 1994. Soybean trypsin inhibitors in diets for Atlantic salmon (*Salmo salar*, L): Effects on nutrient digestibilities and trypsin in pyloric caeca homogenate and intestinal content. Comp. Biochem. Physiol. Part A: Physiol., 109: 923-928.
- Ou, S., K. Kwok, Y. Li and L. Fu, 2001. *In vitro* study of possible role of dietary fiber in lowering postprandial serum glucose. J. Agric. Food Chem., 49: 1026-1029.
- Owusu-Asiedu, A., J.F. Patience, B. Laarveld, A.G. van Kessel, P.H. Simmins and R.T. Zijlstra, 2006. Effects of guar gum and cellulose on digesta passage rate, ileal microbial populations, energy and protein digestibility and performance of grower pigs. J. Anim. Sci., 84: 843-852.
- SAS., 2001. SAS/STAT User's Guide. Version 6, 5th Edn., SAS Institute Inc., Cary, NC.
- Shahbazi, H.R., 2012. Dietary inclusion of guar meal supplemented by B-mannanase II) evaluation egg quality characteristics and blood parameters of laying hens. Global Vet., 9: 67-72.
- Shimoyamada, M., S. Kudo, K. Okubo, F. Yamauchi and K. Harada, 1990. Distributions of saponin constituents in some varieties of soybean plant. Agric. Biol. Chem., 54: 77-81.
- Tyagi, P.K., A.B. Mandal and P.K. Tyagi, 2011. Utilization of roasted guar (*Cyamopsis tetragonoloba*) korma in the diet of broiler chickens. Indian J. Poult. Sci., 46: 326-329.
- Verma, S.V.S. and J.M. McNab, 1982. Guar meal in diets for broiler chickens. Br. Poult. Sci., 23: 95-105.
- Verma, S.V.S. and J.M. McNab, 1984. Chemical, biochemical and microbiological examination of guar meal. Ind. J. Poult. Sci., 19: 165-170.
- Yoshikawa, M., T. Murakami, A. Kishi, T. Kageura and H. Matsuda, 2001. Medicinal flowers. III. Marigold. (1): Hypoglycemic, gastric emptying inhibitory and gastroprotective principles and new oleanane-type triterpene oligoglycosides, calendasaponins A, B, C and D, from Egyptian *Calendula officinalis*. Chem. Pharm. Bull., 49: 863-870.