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# Effect of commercial guar meal (CGM) on the performance and nutrient utilization in broilers

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## ABSTRACT

A biological trial was undertaken to study the effect of inclusion of graded levels of commercial guar meal (CGM) in diet on the performance and nutrient digestibility in commercial broiler chickens. A total of 350 one-day-old broiler male chicks (*Cobb 400*) were reared on wire floor electrically heated battery brooders. The chicks were randomly divided into 7 groups. Each treatment had 10 replicates of 5 chicks each. All the groups received *iso-nitrogenous* and *iso-caloric* diets. First group was fed maize-SBM; 2nd, 3rd and 4th groups were fed control diet during pre-starter phase (1–14 days), later (starter and finisher phase) CGM was incorporated at 6, 12 and 18% respectively, replacing SBM. In rest 3 groups (5th, 6th and 7th), CGM was incorporated at 6% during pre-starter phase followed by (starter and finisher phase) incorporation of CGM at 6, 12 and 18% respectively. The results showed that body weight gain (BWG) was significantly better at 6% CGM inclusion and depressed at 12 and 18% CGM. There was no significant effect of non-inclusion of CGM in juvenile phase on BWG; though feed intake did not differ significantly by CGM inclusion but FCR was significantly higher at all inclusion levels of CGM (6, 12 and 18%). The slaughter parameters, nutrient digestibility, serum parameters did not differ significantly. It can be concluded that CGM could be incorporated up to 6% (60 g/kg diet) in broiler diets without affecting growth performance, nutrient utilization and slaughter variables.

**Key words**: Body weight, Broiler, Commercial guar meal, Feed conversion ratio, Nutrient utilization

Soybean meal (SBM) is conventionally used as a source of protein in poultry diet. However, the shortage and escalating cost of this prime protein source makes poultry farming uneconomical in many developing countries. Continuous efforts are, therefore, made to search viable alternate protein feed ingredients for SBM. Guar (*Cyamopsis tetragonoloba*) is a drought tolerant legume primarily cultivated for culinary preparations. To produce gum (galactomannan), guar seeds are split, which yields protein rich germ fraction and low protein husk fraction as by-products. Guar meal (GM) is a combination of these two fractions, which contains similar amount of CP and is less expensive than SBM (Rama Rao *et al.* 2014). The bitter taste and presence of anti-nutritional factors (trypsin inhibitors) limit the use of GM in poultry feeds. Guar gum is a highly viscous galactomannan polysaccharide and its dietary inclusion increases the intestinal viscosity which hampers the nutrient digestion and absorption, and performance in chicken (Lee *et al.* 2003a). Therefore, the present study was designed to investigate the effect of inclusion of graded levels of commercial guar meal (CGM) on the performance and nutrient utilization in broilers and find out the possibility of utilizing the commercial GM as a source of protein in poultry rations.

## MATERIALS AND METHODS

The research work was carried out at Poultry Experimental Station, LFC, College of Veterinary Science, Rajendranagar, Hyderabad and Directorate of Poultry Research, Rajendranagar, Hyderabad. Samples of CGM, maize (M) and soybean meal (SBM) were analyzed for proximate composition as per AOAC (2005), calcium as per Talapatra *et al.* (1940) and phosphorus as per AOAC (2005). Feed ingredients were analyzed for amino acids (Llames and Fontaine 1994) and ME values (Potter *et al.* 1962). Dietary treatments consisted of three graded (6%, 12% and 18%) levels of CGM and one SBM based control diet. The birds were fed with diets containing 3,000, 3,100 and 3,150 kcal ME and 22.50, 20.50 and 19% crude protein, respectively during pre-starter (1–14 d), starter (15–28 d)

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and finisher (29–42 d) phases. A total of 350 one-day-old broiler male chicks (*Cobb 400*) were reared on wire floor electrically heated battery brooders up to 42 days of age. The chicks were randomly divided into 7 groups. Each group had 10 replicates of 5 chicks each. Details of treatments and experimental diets are given in Table 1.

Weekly individual body weight and feed consumption of each group were recorded. After 42 days of experimental feeding, a metabolism trial of 3 days was conducted with 1 bird from each replicate to determine the retention efficiency of DM, CP and energy. After the experimental period (42 d), 1 bird from each replicate of all the groups were sacrified for recording carcass parameters such as ready-to-cook weight, breast muscle weight, giblet (liver, heart and gizzard) and abdominal fat. Blood samples were collected on 41st day of age for estimation of serum parameters. Serum albumin, protein and cholesterol were determined by using the ErbaChem-5plus V2 clinical chemistry semi-autoanalyzer with commercially available diagnostic kit (M/S Excel Diagnostics Pvt. Ltd., Hyderabad, India). The statistical analysis was done by using SPSS version 15.0.

Table 2. Analyzed nutrient composition (%) of maize and SBM

| Nutrient composition | Maize | SBM |
|---|---|---|
| *Proximate composition (%)** | | |
| Moisture | 10.32 | 9.67 |
| Crude protein | 7.96 | 46.55 |
| Ether extract | 4.17 | 1.61 |
| Crude fiber | 2.95 | 5.13 |
| Total ash | 1.19 | 6.65 |
| Nitrogen free extract | 73.41 | 30.39 |
| *Amino acids (%)** | | |
| Lysine | 0.24 | 2.76 |
| Methionine | 0.16 | 0.58 |
| M+C | 0.34 | 1.23 |
| Arginine | 0.38 | 3.43 |
| Threonine | 0.29 | 1.75 |
| Isoleucine | 0.27 | 2.05 |
| Leucine | 0.95 | 3.62 |
| Valine | 0.39 | 2.17 |
| *Mineral composition (%)* | | |
| Calcium | 0.02 | 0.3 |
| Total phosphorus | 0.28 | 0.61 |
| Metabolisable energy (Kcal/g) | 3.374 | 2.247 |

*On dry matter basis.

Table 1. Treatments and experimental diets

| Treatment | Inclusion level of CGM | |
|---|---|---|
| | 1–14 days | 15–42 days |
| $T_1$ (Maize-SBM Control) | 0% | 0% |
| $T_2$ (CGM) | 0% | 6% |
| $T_3$ (CGM) | 0% | 12% |
| $T_4$ (CGM) | 0% | 18% |
| $T_5$ (CGM) | 6% | 6% |
| $T_6$ (CGM) | 6% | 12% |
| $T_7$ (CGM) | 6% | 18% |

## RESULTS AND DISCUSSION

*Proximate composition of maize and SBM: In vitro* analysis of proximate composition showed that moisture per cent was 10.32 and 9.67 in maize and SBM respectively. Dry matter (DM) content was 89.68 and 90.33% respectively. CP content of maize and SBM were 7.96 and 46.55% on dry matter basis respectively. The extracted crude fat content was 4.1 and 1.61% in maize and SBM respectively. The analyzed values of CF were 2.95 and 5.13% in maize and SBM respectively. The estimated inorganic matter (total ash) content of maize and SBM was 1.19 and 6.65%, respectively. The calculated NFE of maize and SBM was 73.41 and 30.39%, respectively (Table 2).

*Performance parameters:* The interaction between age of CGM inclusion and the level of CGM did not influence (P>0.05) the body weight gain (BWG) during different phases and cumulative growth in commercial broilers (Table 3). The data on phase of CGM inclusion indicated that the BWG was significantly (P>0.05) reduced in groups fed CGM from 1 to 42 days of age during pre-starter phase. However, such reduction in BWG was not observed when CGM was included from 15 days onwards. BWG during starter, finisher and cumulative over all period (1–42 d) was not affected (P>0.05) by the time of CGM inclusion in diet. In the present study, growth depression was observed at higher levels (12,18%) of CGM inclusion during pre-

Table 3. Effect of inclusion of graded levels of CGM during different phases on cumulative BWG (g) of broiler male chicken (1–6 wks)

| Treatment | Phase (days) | CGM % | Phase | | | |
|---|---|---|---|---|---|---|
| | | | Pre Starter | Starter | Finisher | Cumulative |
| $T_1$ | 1–42 | 0 | 290.5 | 775.5 | 924.2 | 1,990 |
| $T_2$ | 1–42 | 6 | 271.7 | 704.2 | 859.8 | 1,835 |
| $T_3$ | 1–42 | 12 | 255.6 | 644.2 | 891.3 | 1,791 |
| $T_4$ | 1–42 | 18 | 257.7 | 615.1 | 821.7 | 1,694 |
| $T_5$ | 15–42 | 6 | 284.7 | 690.8 | 948.9 | 1,924 |
| $T_6$ | 15–42 | 12 | 270.5 | 682.0 | 884.4 | 1,837 |
| $T_7$ | 15–42 | 18 | 283.4 | 625.3 | 791.8 | 1,701 |
| | $N^*$ | | 10 | 10 | 10 | 10 |
| *Phase days* | | | | | | |
| | Control | | $290.5^a$ | 775.5 | 924.2 | 1,990 |
| | 1–42 days | | $261.6^b$ | 654.5 | 857.6 | 1,774 |
| | 15–42 days | | $279.6^a$ | 666.0 | 875.0 | 1,821 |
| *CGM (%)* | | | | | | |
| | 0 | | $290.5^a$ | $775.5^a$ | 924.2 | $1,990^a$ |
| | 6 | | $278.2^{ab}$ | $697.5^b$ | 904.4 | $1,880^{ab}$ |
| | 12 | | $263.1^c$ | $663.1^c$ | 887.9 | $1,814^{bc}$ |
| | 18 | | $270.6^{bc}$ | $620.2^d$ | 806.8 | $1,697^c$ |
| | SEM | | 2.254 | 5.716 | 20.193 | 22.497 |
| *P value* | | | | | | |
| | Phase | | 0.000 | 0.354 | 0.691 | 0.337 |
| | Level | | 0.047 | 0.000 | 0.156 | 0.011 |
| | Phase × Level | | 0.521 | 0.247 | 0.501 | 0.787 |

Values bearing different superscripts in a column differ significantly (P<0.05).

Table 4. Effect of inclusion of graded levels of CGM during different phases on feed intake (g/bird) of broiler male chicken (1–6 wks)

| Treatment | Phase (days) | CGM % | Pre-Starter | Starter | Finisher | Cumulative |
|---|---|---|---|---|---|---|
| $T_1$ | 1–42 | 0 | 353.8 | 1,190 | 1,806 | 3,350 |
| $T_2$ | 1–42 | 6 | 320.7 | 1,074 | 1,696 | 3,091 |
| $T_3$ | 1–42 | 12 | 312.4 | 1,023 | 1,826 | 3,162 |
| $T_4$ | 1–42 | 18 | 310.2 | 957 | 1,669 | 2,937 |
| $T_5$ | 15–42 | 6 | 348.0 | 1,101 | 1,928 | 3,377 |
| $T_6$ | 15–42 | 12 | 330.2 | 1,080 | 1,767 | 3,177 |
| $T_7$ | 15–42 | 18 | 351.6 | 1,018 | 1,670 | 3,039 |
| | N* | | 10 | 10 | 10 | 10 |
| *Phase days* | | | | | | |
| | Control | | 353.8$^a$ | 1,190$^a$ | 1,806 | 3,350 |
| | 1–42 | | 314.5$^b$ | 1,018$^b$ | 1,730 | 3,063 |
| | 15–42 | | 343.3$^a$ | 1,066$^b$ | 1,788 | 3,198 |
| *CGM (%)* | | | | | | |
| | 0 | | 353.8 | 1,190$^a$ | 1,806 | 3,350 |
| | 6 | | 334.4 | 1,087$^b$ | 1,812 | 3,234 |
| | 12 | | 321.3 | 1,052$^b$ | 1,797 | 3,170 |
| | 18 | | 330.9 | 988$^c$ | 1,669 | 2,988 |
| | SEM | | 2.937 | 9.580 | 43.457 | 47.255 |
| *P value* | | | | | | |
| | Phase | | 0.000 | 0.023 | 0.540 | 0.192 |
| | Level | | 0.224 | 0.001 | 0.401 | 0.134 |
| | Phase × Level | | 0.319 | 0.767 | 0.413 | 0.546 |

Values bearing different superscripts in a column differ significantly (P<0.05).

Table 5. Effect of inclusion of graded levels of CGM during different phases on the cumulative feed conversion ratio of broiler male chicken (1–6 wks)

| Treatment | Phase (days) | CGM % | Pre-Starter | Starter | Finisher | Cumulative |
|---|---|---|---|---|---|---|
| $T_1$ | 1–42 | 0 | 1.219 | 1.537$^c$ | 1.954$^c$ | 1.684$^b$ |
| $T_2$ | 1–42 | 6 | 1.182 | 1.524$^c$ | 1.970$^{bc}$ | 1.681$^b$ |
| $T_3$ | 1–42 | 12 | 1.223 | 1.589$^{ab}$ | 2.047$^{ab}$ | 1.763$^a$ |
| $T_4$ | 1–42 | 18 | 1.204 | 1.555$^{bc}$ | 2.024$^{bc}$ | 1.726$^{ab}$ |
| $T_5$ | 15–42 | 6 | 1.222 | 1.594$^{ab}$ | 2.029$^{bc}$ | 1.752$^a$ |
| $T_6$ | 15–42 | 12 | 1.221 | 1.584$^{ab}$ | 2.000$^{bc}$ | 1.729$^{ab}$ |
| $T_7$ | 15–42 | 18 | 1.241 | 1.627$^a$ | 2.107$^a$ | 1.784$^a$ |
| | N* | | 10 | 10 | 10 | 10 |
| *Phase days* | | | | | | |
| | Control | SBM | 1.219 | 1.537$^b$ | 1.954 | 1.684$^b$ |
| | 1–42 | CGM | 1.203 | 1.556$^b$ | 2.014 | 1.723$^{ab}$ |
| | 15–42 | CGM | 1.228 | 1.602$^a$ | 2.045 | 1.755$^a$ |
| *CGM (%)* | | | | | | |
| | 0 | SBM | 1.219 | 1.537$^b$ | 1.954$^c$ | 1.684 |
| | 6 | CGM | 1.202 | 1.559$^{ab}$ | 1.999$^{bc}$ | 1.716 |
| | 12 | CGM | 1.222 | 1.586$^a$ | 2.024$^{ab}$ | 1.746 |
| | 18 | CGM | 1.223 | 1.591$^a$ | 2.065$^a$ | 1.755 |
| | SEM | | 0.005 | 0.005 | 0.010 | 0.007 |
| *P value* | | | | | | |
| | Phase | | 0.036 | 0.000 | 0.138 | 0.052 |
| | Level | | 0.274 | 0.058 | 0.044 | 0.123 |
| | Phase × Level | | 0.268 | 0.011 | 0.033 | 0.017 |

Values bearing different superscripts in a column differ significantly (P<0.05).

starter and starter phases but not in finisher phase indicating that birds are more sensitive to CGM (dietary changes) during early age but tolerant during later part of growth. The findings were in accordance with Verma and McNab (1982) who reported that young broilers are sensitive to the inclusion of guar meal in diet. Conner (2002) determined that peak inhibition of growth occurred at 21 days with guar meal feeding. Gheisari *et al*. (2011) also reported reduced body weight in broilers fed diet containing 12, 15 and 18% GM in starter, grower and finisher phases. Lee *et al*. (2005) reported that growth depressing effects of GM are more pronounced in young compared to old birds. Similar results were also reported by Rama Rao *et al*. (2014). Birds fed 12 and 18% CGM showed significantly (P<0.05) lower body weight gain compared to control and 6% CGM. The deterioration of performance criteria by inclusion of high levels of guar meal in the diets implies that chicks had probably encountered difficulties in digestion and absorption of some dietary nutrients. Rainbird *et al*. (1984) also reported that gum residues increase intestinal viscosity, which decreases nutrient digestion and absorption in the gastrointestinal tract in broilers.

In the present study, reduced feed intake due to inclusion of CGM might be responsible for depressed performance of broilers fed higher levels (12 and 18%) of CGM (Table 4). The results were in agreement with Verma and Mc Nab (1982) who reported that feed intake was reduced to 80–91% of the control group. Deterioration effects of using guar meal on performance can be attributed to its viscosity causing properties, and increase in viscosity reduces feed intake. Similar results were reported by Lee *et al*. (2005) and Kamran *et al*. (2002). This might be related to presence of guar gum residues which are known to reduce gastric emptying and poor palatability of GM may be attributed to presence of saponins in GM as they are bitter in taste.

The interaction between age of CGM inclusion and the level of CGM significantly (P>0.05) depressed the FCR in the starter and finisher phases, but was not influenced during pre starter phase; while the cumulative FCR showed a poor trend with increasing level of CGM. Significantly better FCR was observed in the SBM control group and poor FCR in 18% CGM diet, except in 6% CGM group (1–42 d) which was similar to SBM control group (Table 5). Similarly, Rama Rao *et al.* (2014) reported increased FCR as the dietary inclusion of GM increased from 7.5 to 15% at 21 days of age; while Gheisari *et al.* (2011) also reported increased FCR in broilers fed diet containing 12, 15 and 18% GM of starter, grower and finisher phases respectively. These results agree with findings of Muhammad Kamran *et al*. (2002) and Lee *et al*. (2005), who indicated that as the GM level increased cumulative feed: gain ratio significantly increased.

*Slaughter variables:* Supplementation of CGM at 6, 12 and 18% excluding CGM in juvenile phase or including in

Table 6. Effect of inclusion of graded levels of CGM during different phases on the slaughter characteristics (%) of broiler male chicken at 42nd day

| Treatment | Phase (days) | CGM % | Dressing percent | Breast | Giblet | Abd fat | Heart | Liver | Gizzard |
|---|---|---|---|---|---|---|---|---|---|
| $T_1$ | 1–42 | 0 | 73.30 | 18.19 | 4.489 | 1.747 | 0.624 | 2.121 | 1.744 |
| $T_2$ | 1–42 | 6 | 72.94 | 17.83 | 4.489 | 1.710 | 0.562 | 2.097 | 1.829 |
| $T_3$ | 1–42 | 12 | 74.11 | 18.92 | 4.260 | 1.761 | 0.499 | 1.926 | 1.835 |
| $T_4$ | 1–42 | 18 | 72.79 | 15.61 | 3.981 | 2.044 | 0.524 | 1.732 | 1.725 |
| $T_5$ | 15–42 | 6 | 73.84 | 17.87 | 4.798 | 1.954 | 0.707 | 2.044 | 2.047 |
| $T_6$ | 15–42 | 12 | 73.76 | 17.83 | 4.804 | 2.220 | 0.617 | 2.294 | 1.893 |
| $T_7$ | 15–42 | 18 | 72.97 | 17.84 | 4.777 | 1.572 | 0.565 | 1.905 | 2.307 |
| N* | 10 | 10 | 10 | 10 | 10 | 10 | 10 | | |
| *Phase days* | | | | | | | | | |
| Control | SBM | 73.30 | 18.19 | 4.489 | 1.747 | 0.624 | 2.121 | $1.744^{b}$ | |
| 1–42 days | CGM | 73.31 | 17.55 | 4.256 | 1.828 | 0.529 | 1.928 | $1.800^{ab}$ | |
| 15–42 days | CGM | 73.52 | 17.85 | 4.793 | 1.916 | 0.629 | 2.081 | $2.082^{a}$ | |
| *CGM (%)* | | | | | | | | | |
| 0 | SBM | 73.30 | 18.19 | 4.489 | 1.747 | 0.624 | 2.121 | 1.744 | |
| 6 | CGM | 73.39 | 17.85 | 4.643 | 1.832 | 0.635 | 2.071 | 1.938 | |
| 12 | CGM | 73.94 | 18.38 | 4.532 | 1.990 | 0.558 | 2.110 | 1.864 | |
| 18 | CGM | 72.89 | 16.81 | 4.410 | 1.790 | 0.546 | 1.825 | 2.039 | |
| SEM | 0.399 | 0.432 | 0.092 | 0.088 | 0.051 | 0.057 | 0.009 | | |
| *P value* | | | | | | | | | |
| Phase | 0.780 | 0.679 | 0.009 | 0.689 | 0.054 | 0.148 | 0.025 | | |
| Level | 0.615 | 0.355 | 0.566 | 0.700 | 0.306 | 0.081 | 0.607 | | |
| Phase × Level | 0.834 | 0.352 | 0.617 | 0.134 | 0.698 | 0.294 | 0.221 | | |

Values bearing different superscripts in a column differ significantly (P<0.05).

Table 7. Effect of inclusion of graded levels of CGM during different phases on the nutrient utilization of broilers male chicken at 42nd day

| Treatment | Phase (days) | CGM % | Nutrient utilization (%) | | |
|---|---|---|---|---|---|
| | | | Energy | Protein | Dry matter |
| $T_1$ | 1–42 | 0 | 68.94 | 61.54 | $75.78^{bc}$ |
| $T_2$ | 1–42 | 6 | 61.28 | 53.28 | $77.51^{a}$ |
| $T_3$ | 1–42 | 12 | 55.90 | 51.68 | $75.90^{b}$ |
| $T_4$ | 1–42 | 18 | 54.80 | 54.50 | $74.09^{d}$ |
| $T_5$ | 15–42 | 6 | 56.32 | 52.48 | $74.54^{cd}$ |
| $T_6$ | 15–42 | 12 | 58.54 | 51.50 | $75.52^{bc}$ |
| $T_7$ | 15–42 | 18 | 50.18 | 49.18 | $75.57^{bc}$ |
| | N* | | 10 | 10 | 10 |
| *Phase days* | | | | | |
| | Control | | 68.94 | 61.54 | 75.78 |
| | 1–42 CGM | | 57.33 | 53.15 | 75.83 |
| | 15–42 CGM | | 55.01 | 51.05 | 75.21 |
| *CGM (%)* | | | | | |
| | 0 | | 68.94 | 61.54 | $75.78^{ab}$ |
| | 6 | | 58.80 | 52.88 | $76.02^{a}$ |
| | 12 | | 57.22 | 51.59 | $75.71^{ab}$ |
| | 18 | | 52.49 | 51.84 | $74.83^{b}$ |
| | SEM | | 1.512 | 0.825 | 0.157 |
| *P value* | | | | | |
| | Phase | | 0.485 | 0.248 | 0.077 |
| | Level | | 0.276 | 0.823 | 0.022 |
| | Phase × Level | | 0.569 | 0.448 | 0.000 |

Values bearing different superscripts in a column differ significantly (P<0.05).

juvenile phase did not significantly influence the slaughter parameters like dressing percentage, breast yield, giblet weight, abdominal fat and weight of heart, liver. However, gizzard weight was significantly (P<0.05) higher when CGM was administered in phase feeding compared to control phase (Table 6). The results of the present study were in agreement with the results of Rama Rao *et al*. (2014), who reported that slaughter variables were not influenced by the dietary inclusion of guar meal up to 20% in Vanaraja chicken. Similarly, Brahma *et al*. (1982) and Gheisari *et al*. (2011) reported no changes in slaughter parameters when 10% raw or up to 16% toasted GM was incorporated in chicken diet.

*Nutrient utilization:* There was no significant difference (P>0.05) in protein and energy utilization between different phases feeding of CGM. The protein and energy utilization was not influenced by inclusion of different levels of CGM (Table 7). The interaction between phase feeding of CGM and different levels of inclusion did not influence (P>0.05) protein and energy utilization in broilers. Gheisari *et al.* (2011) reported that including guar meal in diets did not affect the protein digestion in broilers. Tyagi *et al.* (2011) reported that birds fed on different levels of roasted guar meal (0, 5, 7.5 and 10%) showed nonsignificant protein and energy efficiency during all growth phases. However, the findings were contrary to that of Prasad *et al.* (1981) who reported reduced energy utilization in chicken fed toasted guar meal.

There was no significant (P>0.05) difference in dry matter utilisation in different phase feeding of CGM. However, DM

Table 8. Effect of inclusion of graded levels of CGM during different phases on the serum biochemical variables in broiler male chicken

| Treatment | Phase (days) | CGM % | Protein (g/dl) | Albumin (g/dl) | Cholesterol (mg/dl) |
|---|---|---|---|---|---|
| $T_1$ | 1–42 | 0 | 5.296 | 1.547 | 117.0 |
| $T_2$ | 1–42 | 6 | 3.783 | 1.431 | 89.1 |
| $T_3$ | 1–42 | 12 | 3.597 | 1.247 | 94.9 |
| $T_4$ | 1–42 | 18 | 2.474 | 1.673 | 119.9 |
| $T_5$ | 15–42 | 6 | 3.709 | 1.330 | 112.1 |
| $T_6$ | 15–42 | 12 | 3.826 | 1.337 | 108.9 |
| $T_7$ | 15–42 | 18 | 2.779 | 1.590 | 116.0 |
| | N* | | 10 | 10 | 10 |
| *Phase days* | | | | | |
| | Control | | 5.296 | 1.547 | 117.0 |
| | 1–42 | | 3.285 | 1.451 | 101.3 |
| | 15–42 | | 3.438 | 1.419 | 112.3 |
| *CGM (%)* | | | | | |
| | 0% | | 5.296[a] | 1.547 | 117.0 |
| | 6 | | 3.746[b] | 1.381 | 100.6 |
| | 12 | | 3.711[b] | 1.292 | 101.9 |
| | 18 | | 2.626[c] | 1.631 | 118.0 |
| | SEM | | 0.072 | 0.075 | 4.651 |
| *P value* | | | | | |
| | Phase | | 0.335 | 0.847 | 0.278 |
| | Level | | 0.000 | 0.218 | 0.300 |
| | Phase × Level | | 0.584 | 0.868 | 0.546 |

Values bearing different superscripts in a column differ significantly (P<0.05).

Table 9. Effect of inclusion of graded levels of CGM during different phases on the cost economics in broiler male chicken

| Treatment | Phase (days) | CGM % | Feed cost/kg live weight (₹) |
|---|---|---|---|
| $T_1$ | 1–42 | 0 | 52.94 |
| $T_2$ | 1–42 | 6 | 58.48 |
| $T_3$ | 1–42 | 12 | 57.90 |
| $T_4$ | 1–42 | 18 | 63.70 |
| $T_5$ | 15–42 | 6 | 56.81 |
| $T_6$ | 15–42 | 12 | 58.70 |
| $T_7$ | 15–42 | 18 | 65.64 |
| | N* | | 10 |
| *Phase days* | | | |
| | Control | SBM | |
| | 1–42 | CGM | 60.03 |
| | 15–42 | CGM | 60.38 |
| *CGM (%)* | | | |
| | 0 | SBM | 52.94[c] |
| | 6 | CGM | 57.64[b] |
| | 12 | CGM | 58.30[b] |
| | 18 | CGM | 64.67[a] |
| | SEM | | 0.653 |
| *P value* | | | |
| | Phase | | 0.803 |
| | Level | | 0.000 |
| | Phase × Level | | 0.567 |

Values bearing different superscripts in a column differ significantly (P<0.05).

utilisation was better in 6 and 12% CGM inclusion level and was comparable with that of control diet. But DM utilization at 18% inclusion level was significantly (P>0.05) lower. The interaction between phase feeding and level of CGM inclusion showed significantly (P<0.05) higher utilisation in 6%, during 1–42 day phase feeding of CGM. Similarly, Dinani *et al*. (2010) reported that 15% GM inclusion had comparatively low utilization of DM as compared to other dietary treatments (7.5% TGM).

*Serum parameters:* There was no significant difference (P>0.05) in serum parameters (serum protein, albumin and cholesterol) between different phase feeding of CGM (Table 8). The serum parameters were not influenced by inclusion of different levels of CGM. The interaction between phase feeding of CGM and different levels of inclusion did not influence (P>0.05) serum parameters in broilers. Gheisari *et al.* (2011) reported no significant difference in serum total cholesterol, HDL and total protein concentration in broilers fed incremental levels of guar meal.

*Cost economics:* Supplementation of CGM at 6, 12 and 18% showed a significantly (P<0.05) higher cost of broiler production compared to the control diet, neither interactions, nor the effect of phase feeding influenced the feed cost per kilogram body weight (Table 9). Similarly, Bhutia (2006) also reported no effect on cost per kg live weight or per kg of meat production in broiler quail fed diets containing 5, 7.5 and 10% GM with enzyme supplementation. Similar results were also reported by Dinani *et al.* (2010).

It can be concluded that commercial guar meal (CGM) can be included up to 6% in commercial broiler rations of maize-SBM based diet, without affecting the BWG, FI, FCR, nutrient utilization and carcass traits.

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