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# Effect of different levels of roasted guar (*Cyamopsis tetragonoloba* L.) korma with or without ß-mannanase supplementation on performance and carcass traits of broilers

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## ABSTRACT

An experiment was conducted to evaluate the effect of different levels of roasted guar korma with or without mannanase supplementation on performance and carcass traits of broilers. Nine hundred and sixty day old commercial broiler chicks (Vencobb-400 strain) were divided into sixteen treatment groups of 60 each for six weeks. The diet without roasted guar korma served as control. The rest of the diets were formulated by incorporating 10%, 12.5%, 15%, 17.5 % and 20% levels of roasted guar korma, partially replacing soybean meal with and without enzyme (β-mannanase) at two levels (500 g/t and 750 g/t). Body weight gain at the starter phase was found to be non significant however at the finisher phase the differences were significant ($P<0.05$) for T2 (563.35 g) and T5 (533.55 g) than the rest of the groups including control. Differences of feed consumption were significant ($P<0.01$) at the end of starter as well as finisher phases whereas FCR differences were found to be non-significant. Dry matter digestibility was observed significantly better in T5 group. Significantly ($P<0.01$) better nitrogen retention was observed in T5 and T6 groups than the groups having higher levels of roasted guar korma. Eviscerated weight differed significantly ($P<0.01$) whereas non-significant differences were observed for giblet per cent, abdominal fat per cent, edible meat per cent and dressing per cent. It was concluded that 12.5 per cent of roasted guar korma with supplementation of β mannanase @ 500g/t can be safely added in the broiler diet without any adverse effect on performance, nutrient digestibility as well as carcass trait.

**Key words:** β-mannanase, Broiler, Carcass trait, Nutrient digestibility, Performance, Roasted guar korma.

## INTRODUCTION

Ever increasing price of soybean meal (SBM) induces the need to explore alternate, cost effective as well as nutritionally sound protein source which should not adversely affect the performance of birds. Guar meal (GM) is sold at cheaper price as compared to soybean meal. It is a by-product of guar seed which is obtained after the mechanical separation of endosperm from the hulls and germ of the ground seeds. Guar meal (GM) contains 40-50% protein (Conner *et al*., 2001), EE 3.8-4.6 %, CF 8.9- 10.3 %, ME 2200-2250 kcal/kg, lysine 2.55 %, Methionine 0.6% and 0.49 % tryptophan. The presence of guar gum residue in the guar meal and its attributed negative effect on broiler performance is documented by Vohra and Kratzer (1964), Nagpal *et al*.(1971) and Verma and Mc Nab (1982).

Roasted guar korma (RGK) is relatively high in protein with low gum produced by-product of guar gum industry and available commercially. The seed coat is removed first and then the dehulled seed is processed for production of guar korma. Guar korma is cheaper and good source of essential amino acids (Tyagi *et al*., 2011). Feeding of GM has been examined with varying results indicating level of inclusion of raw guar meal in layer and broiler diets.

Supplementation of feed grade enzyme in the poultry diet containing GM is a promising way to counteract GG toxicity in poultry (Tyagi *et al.*, 2015). The negative effects of galacto-mannan content of GM can be ameliorated by supplementing -mannanase which hydrolyses the galactomannan complex of guar meal. As a result the guar gum induced viscosity in digesta is reduced, which increases the digestibility of starch (Zangiabadi and Torki, 2010; Almirall *et al*.,1995) and other macronutrients and improves the metabolizable energy of guar meal. Thus, supplementation of -mannanase helps in achieving superior feed conversion and better growth performance at reduced cost of feed (Imran *et al.*, 2014).

The aim of the study was to evaluate effect of diet containing different levels of roasted guar korma with different levels of supplementation of ß-mannanase enzyme on performance, digestibility and carcass traits of broilers.

## MATERIALS AND METHODS

Nine hundred sixty healthy day-old, commercial broiler chicks (Ven-Cobb 400 strain) were weighed and randomly distributed into sixteen treatment groups *viz.*T0, T1 to T15 having three replicates ($R_1$, $R_2$ and $R_3$) of 20

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chicks in each, on equal body weight basis. The sixteen experimental diets were formulated using BIS (2007) standard, based on corn-soybean meal. The pre-starter diets (23% CP, ME 3000Kcal/kg) was common for all the groups up to one week of age. Starter (22% CP, ME 3100 kcal/kg) and finisher (20% CP, ME 3200 Kcal/kg) diets were offered during 2 to 3 and 4 to 6 weeks of age, respectively. The standard broiler diet without roasted guar korma served as control diet. Rest of the diets were formulated by incorporating 10%, 12.5%, 15%, 17.5 % and 20% levels of roasted guar korma, partially replacing soybean meal without and with enzyme (β-mannanase) at two levels (500 g/t and 750 g/t). The sixteen diets formulated were; control (T0), 10 % RGK without enzyme (T1), 10 % RGK with -mannanase @ 500g/t (T2), 10 % RGK with β-mannanase @ 750g/t (T3), 12.5 % RGK without enzyme (T4), 12.5 % RGK with-mannanase @ 500g/t (T5), 12.5 % RGK with β-mannanase @ 750g/t (T6), 15 % RGK without enzyme (T7), 15 % RGK with β-mannanase @ 500g/t (T8), 15 % RGK with β-mannanase @ 750g/t (T9), 17.5 % RGK without enzyme (T10), 17.5 % RGK with β-mannanase @ 500g/t (T11), 17.5 % RGK with β-mannanase @ 750g/t (T12), 20 % RGK without enzyme (T13), 20 % RGK with β-mannanase @ 500g/t (T14), 20 % RGK with-mannanase @ 750g/t (T15). The enzyme β-mannanase with 20,000 IU activity was used in present study. The diets were iso-caloric and iso-nitrogenous. The deficient energy was adjusted by using sweet oil. The feed and water was provided *ad-lib* to all the treatment groups throughout the experimental period. The live body weights of all chicks were recorded accurately at weekly intervals in the morning hours. Average weekly body weight and weight gain were calculated for replicate under treatment groups. Daily feed consumption was calculated from the amount of feed consumed by each group in a day. The weekly feed conversion ratio was estimated by dividing corresponding the feed consumption or total amount of feed consumed by the body weight gain.

At the end of experiment, two birds from each replicate weighing nearer to the mean body weight of respective treatment were randomly selected, weighed, starved and slaughtered. The different carcass traits such as eviscerated weight, edible meat per cent, giblet yield (liver, heart and gizzard) were recorded. A metabolic trial of five days duration was undertaken to determine the retention efficiency of dry matter (DM) and crude protein. Two birds from each replicate of treatment group, representing the average body weight of the group were randomly selected and housed in metabolic cage with provision of separate feeders and drinkers. During the metabolic period, weighed quantity of feed was offered and total excreta voided during 24 hrs was collected daily during evening hours at same time on each day. The representative sample of collected excreta was pooled for consecutive five days and simultaneously dried in hot air oven at temperature of 80 ± 2°C till constant weight achieved and weighed to record the faecal output on dry matter basis. Simultaneously, feed residue of each bird was collected and weighed at end of each day in order to determine the average feed intake per day. Representative samples of feed offered, residues left and excreta voided were analyzed for DM and nitrogen (AOAC, 2012).

Data were analysed by one way ANOVA (GLM procedure) using SPSS version 24.0 and means were compared for significance with Duncan multiple range tests and considered as significant when P–value was less than 0.05. Results were expressed as means with SE.

## RESULTS AND DISCUSSION

**Body weight:** No significant differences were observed in terms of body weight gain (BWG) at the end of starter phase (Table1) but treatment group T5 (422.34 g) fed 12.5 % RGK with supplementation of β-mannanase@500 g/t exhibited better performance than control, T0 (378.68 g) as well as other treatment groups. However, at the end of finisher phase, treatment group T2 (563.35 g) fed 10% RGK with supplementation of β-mannanase @ 500 g/t as well as T5 (533.55 g) group performed significantly ($P<0.05$) better than rest of the treatment groups including control; indicating better performance of inclusion of low levels of RGK with low level of β-mannanase (Table1). However, at the end of experiment treatment, group T2 (2287.25g) and T5 (2284.07 g) showed better performance than other treatment groups indicating inclusion of RGK at 10 and 12.5 % level with supplementation of β -mannanase @ 500 g/t performed better than inclusion of RGK at 15, 17.5 and 20 % with different levels of supplementation of-mannanase. Results showed that to achieve better performance lower inclusion level of RGK is possible with supplementation of β-mannanase at 500 g/t. Results of BWG are in line with the findings of Rama Rao *et al.* (2014) who observed higher growth of Vanraja chicken fed 15% GM in the diet. Verma and McNab (1982) reported that BWG decreased as dietary GM content increased. Similarly, Kamran *et al.* (2002) reported significant reduction in BWG of broilers fed GM based diet. Gheisari *et al.* (2011) observed depressed body weight gain in chicks fed starter, grower and finisher diets containing 12, 25 and 18% guar meal, respectively. However, Bramha and Siddiqui (1978) and Nagra *et al.* (1985) observed BWG was found to be unaffected when roasted guar meal was incorporated up to 21% of diet. The present finding showed that soyabean meal can be replaced upto 12.5% RGK with supplementation of β -mannanase @ 500g/t without any adverse effect on growth rate of broilers. This may be due to effective roasting method applied which could have either reduced or eliminated the anti-tryptic activity of GM. The deterioration of performances criteria by inclusion of high levels of RGK in the diet implies that birds could have encountered difficulties in digestion and absorption of same dietary nutrients, as documented by Rainbird *et al* (1984) who reported that gum residues increased the viscosity, which might have decreased nutrient digestion and absorption in the gastrointestinal tract of broilers.

**Feed Intake:** Generally inclusion of GM in broilers diets may result in lower fed intake by the birds in dose dependent manner (Kamran *et al*., 2002). At the end of starter phase (Table1) the feed consumption differed significantly (P<0.05). Significantly lowest (523.5 g) feed consumption was observed in (T3) group, while T11(593.3 g) and T14 (576.7 g) recorded significantly higher feed consumption than rest of the treatment groups; indicating increased feed consumption with increased level of RGK in the diet. However, at the end of finisher phase highly significant (P<0.01) differences were recorded; control group, T0 (622.4 g) exhibited lowest feed consumption whereas T2 (1072.0 g) and T5 (980.3 g) group recorded significantly higher feed consumption (Table 2). Results of the present study in respect of feed consumption indicated that treatment groups that exhibited better performance in terms of body weight gain consumed more feed than other groups. These results are in close agreement with the reports; Kamran *et al.* (2002);

**Table 1:** Performance of experimental birds, on various traits, at the end of starter phase.

| Treatment | Traits | | | |
|---|---|---|---|---|
| | Weekly body weight (g) | Weekly body weight (g) gain | Weekly feed consumption | Weekly FCR |
| $T_0$ :Corn Soya based standard broiler diet | 727.88$^{NS}$±8.99 | 378.68$^{NS}$± 9.69 | 525.2$^{a}$±2.03 | 1.38$^{NS}$ ±0.03 |
| $T_1$: 10% RGK without β-Mannanase enzyme | 757.86$^{NS}$ ±18.93 | 394.32$^{NS}$±15.32 | 528.1$^{ab}$±1.51 | 1.34$^{NS}$ ±0.05 |
| $T_2$ : 10% RGK + β-Mannanase enzyme @500 g/t | 764.06$^{NS}$ ±28.91 | 396.62$^{NS}$ ±30.07 | 569.7$^{bcd}$±27.0 | 1.44$^{NS}$ ±0.05 |
| $T_3$ : 10% RGK +β-Mannanase enzyme @750 g/t | 748.9$^{NS}$ ±15.77 | 385.56$^{NS}$ ±12.02 | 523.5$^{a}$±2.97 | 1.36$^{NS}$ ±0.04 |
| $T_4$ : 12.5% RGK without β-Mannanase enzyme | 776.18$^{NS}$ ±12.28 | 402.39$^{NS}$±7.30 | 529.9$^{ab}$±0.29 | 1.31$^{NS}$ ±0.02 |
| $T_5$ : 12.5% RGK + β-Mannanase enzyme @500 g/t | 815.18$^{NS}$ ±39.4 | 422.34$^{NS}$±29.25 | 551.0$^{abc}$±1.73 | 1.31$^{NS}$ ±0.09 |
| $T_6$ : 12.5% RGK + β-Mannanase enzyme @750 g/t | 785.77$^{NS}$ ±40.94 | 417.88$^{NS}$ ±38.95 | 524.6$^{a}$±2.05 | 1.27$^{NS}$ ±0.02 |
| $T_7$ : 15% RGK without β-Mannanase enzyme | 769.13$^{NS}$ ±15.09 | 397.73$^{NS}$3±8.01 | 545.7$^{abc}$±3.76 | 1.37$^{NS}$ ±0.03 |
| $T_8$ : 15% RGK + β-Mannanase enzyme @500 g/t | 786.78$^{NS}$ ±25.81 | 395.86$^{NS}$±15.65 | 533.0$^{ab}$±6.02 | 1.34$^{NS}$ ±0.03 |
| $T_9$ : 15% RGK + β-Mannanase enzyme @750 g/t | 754.83$^{NS}$ ±15.22 | 382.35$^{NS}$ ±17.40 | 530.8$^{ab}$±0.63 | 1.39$^{NS}$ ±0.05 |
| $T_{10}$ : 17.5% RGK without β-Mannanase enzyme | 741.12$^{NS}$ ±17.44 | 372.91$^{NS}$ ±14.11 | 541.8$^{abc}$±9.74 | 1.45$^{NS}$ ±0.02 |
| $T_{11}$ : 17.5% RGK + β-Mannanase enzyme @500 g/t | 793.08$^{NS}$ ±11.48 | 416.78$^{NS}$ ±21.86 | 593.3$^{d}$±25.87 | 1.42$^{NS}$ ±0.01 |
| $T_{12}$ : 17.5% RGK + β-Mannanase enzyme @750 g/t | 765.5$^{NS}$ ±22.94 | 387.11$^{NS}$ ±19.06 | 559.3$^{abcd}$±26.39 | 1.44$^{NS}$ ±0.09 |
| $T_{13}$ : 20% RGK without β-Mannanase enzyme | 724.25$^{NS}$ ±11.92 | 370.27$^{NS}$±6.65 | 541.5$^{abc}$±7.59 | 1.46$^{NS}$ ±0.04 |
| $T_{14}$ : 20% RGK β-Mannanase enzyme @500 g/t | 782.56$^{NS}$±8.1 | 403.65$^{NS}$ ±12.94 | 576.7$^{cd}$±12.78 | 1.42$^{NS}$ ±0.01 |
| $T_{15}$ : 20% RGK + β-Mannanase enzyme @750 g/t | 760.63$^{NS}$±6.2 | 391.36$^{NS}$ ±6.49 | 559.7$^{abcd}$±15.07 | 1.43$^{NS}$ ±0.05 |
| **Pooled Mean** | **765.85±5.55** | **394.74±4.46** | **545.84±3.98** | **1.38±0.01** |

Column bearing common superscripts does not differ significantly (P<0.05).

**Table 2:** Performance of experimental birds, on various traits, at the end of finisher phase.

| Treatment | Traits | | | |
|---|---|---|---|---|
| | Weekly body weight( g) | Weekly body weight (g) gain | Weekly feed consumption | Weekly FCR |
| $T_0$ :Corn Soya based standard broiler diet | 2125.63$^{NS}$ ±20.26 | 309.61$^{a}$±57.84 | 622.4$^{a}$±155.99 | 1.94$^{NS}$±0.17 |
| $T_1$: 10% RGK without β-Mannanase enzyme | 2238.93$^{NS}$ ±21.45 | 446.85$^{abcde}$±31.41 | 819.9$^{abc}$±62.73 | 1.83$^{NS}$±0.10 |
| $T_2$ : 10% RGK + β-Mannanase enzyme @500 g/t | 2287.25$^{NS}$ ±32.95 | 563.35$^{e}$±4.48 | 1072.0$^{d}$±9.85 | 1.92$^{NS}$±0.03 |
| $T_3$ : 10% RGK + β-Mannanase enzyme @750 g/t | 2118.39$^{NS}$ ±38.85 | 378.53$^{abc}$±7.44 | 705.4$^{ab}$±31.31 | 1.86$^{NS}$±0.04 |
| $T_4$ : 12.5% RGK without β-Mannanase enzyme | 2229.55$^{NS}$ ±30.88 | 518.11$^{cde}$±26.50 | 958.3$^{cd}$±8.45 | 1.85$^{NS}$±0.08 |
| $T_5$ : 12.5% RGK + β-Mannanase enzyme @500 g/t | 2284.07$^{NS}$ ±53.25 | 533.55$^{de}$±84.28 | 980.3$^{cd}$±125.78 | 1.85$^{NS}$±0.07 |
| $T_6$ : 12.5% RGK + β-Mannanase enzyme @750 g/t | 2158.02$^{NS}$ ±31.35 | 432.2$^{abcde}$±17.51 | 815.4$^{abc}$±42.89 | 1.88$^{NS}$±0.08 |
| $T_7$ : 15% RGK without β-Mannanase enzyme | 2209.42$^{NS}$ ±42.33 | 470.8$^{bcde}$±.4389 | 889.0$^{bcd}$±41.53 | 1.90$^{NS}$±0.10 |
| $T_8$ : 15% RGK + β-Mannanase enzyme @500 g/t | 2242.97$^{NS}$ ±21.66 | 477.68$^{bcde}$ ±39.57 | 890.3$^{bcd}$±46.6 | 1.87$^{NS}$±0.06 |
| $T_9$ : 15% RGK + β-Mannanase enzyme @750 g/t | 2217.81$^{NS}$ ±58.74 | 410.84$^{abcd}$±48.60 | 765.6$^{abc}$±31.62 | 1.89$^{NS}$±0.13 |
| $T_{10}$ : 17.5% RGK without β-Mannanase enzyme | 2174.82$^{NS}$ ±34.34 | 440.45$^{abcde}$±20.05 | 882.8$^{bcd}$±57.92 | 2.00$^{NS}$±0.08 |
| $T_{11}$ : 17.5% RGK + β-Mannanase enzyme @500 g/t | 2214.32$^{NS}$ ±4.3 | 447.3$^{abcde}$±22.19 | 873.0$^{bcd}$±46.08 | 1.95$^{NS}$±0.00 |
| $T_{12}$ : 17.5% RGK + β-Mannanase enzyme @750 g/t | 2206.37$^{NS}$ ±44.89 | 413.5$^{abcd}$±25.25 | 808.3$^{abc}$±46.01 | 1.95$^{NS}$±0.05 |
| $T_{13}$ : 20% RGK without β-Mannanase enzyme | 2194.47$^{NS}$ ±53.54 | 402.18$^{abcd}$±57.80 | 804.7$^{abc}$±64.98 | 2.03$^{NS}$±0.12 |
| $T_{14}$ : 20% RGK β-Mannanase enzyme @500 g/t | 2193.3$^{NS}$ ±50.28 | 362.56$^{ab}$±78.65 | 700.0$^{ab}$±107.94 | 1.98$^{NS}$±0.14 |
| $T_{15}$ : 20% RGK + β-Mannanase enzyme @750 g/t | 2214.49$^{NS}$ ±32.61 | 381.71$^{abc}$±35.86 | 758.9$^{abc}$±3.57 | 2.02$^{NS}$±0.18 |
| **Pooled Mean** | **2206.86±10.37** | **436.83±12.97** | **834.13±21.45** | **1.92±0.02** |

Column bearing common superscripts does not differ significantly (P<0.05).

Dinani *et al.* (2010); Hassan (2013) and Salma *et al.* (2015) who reported lower feed consumption in broilers fed more than 5 % GM. Gheisari *et al.* (2011) indicated reduced feed consumption in broilers with increased dietary inclusion of GM. On the contrary, Bramha and Siddiqui (1978);Vidya Sagar *et al.*(1978); Nagra *et al.*(1985); and Tyagi *et al.* (2011) observed that inclusion of heat processed GM in broiler diets had no effect on feed consumption.

**Feed conversion ratio:** Statistically non-significant differences were observed in all treatment groups including control for starter and finisher phases. At the end of starter period (Table 1) T6 (1.27) group fed 12.5 % RGK with supplementation of ß -mannanase @ 750 g/t recorded lowest and T13 (1.46) fed 20% RGK without any supplementation exhibited highest FCR than rest of the treatment groups including control. Finisher phase (Table 2) showed T1 (1.83) group as having lowest FCR and T13 (2.03) as highest FCR than rest of groups. The result of present study in terms of FCR showed that at lower level of RGK with β -mannanase @ 500 g/t exhibited better performances as compared to higher level of inclusion of RGK as well as supplementation of β -mannanase. Present study revealed that FCR during starter and finisher phases of experiment increased as the dietary RGK inclusion level increased in the diet indicating negative relationship when diets containing higher levels of RGK were fed to experimental birds. High content of galacto-

**Table 3:** Apparent nutrient digestibility, retention as influenced by different treatments in experimental birds at the end of 6th week.

| Treatments | DM digestibility(%) | Nitrogen Retention(%) |
|---|---|---|
| $T_0$ :Corn Soya based standard broiler diet | $71.00^{cde}$±0.28 | $72.05^{e}$±0.60 |
| $T_1$: 10% RGK without β-Mannanase enzyme | $71.16^{de}$±0.68 | $74.33^{f}$±0.41 |
| $T_2$: 10% RGK + β-Mannanase enzyme @500 g/t | $71.44^{de}$±0.70 | $74.06^{f}$±0.21 |
| $T_3$: 10% RGK +β-Mannanase enzyme @750 g/t | $71.2^{de}$ ±0 .46 | $73.64^{f}$±0.04 |
| $T_4$: 12.5% RGK without β-Mannanase enzyme | $70.21^{bcde}$±1.74 | $74.75^{f}$±0.21 |
| $T_5$: 12.5% RGK + β-Mannanase enzyme @500 g/t | $71.6^{e}$±0.01 | $74.57^{f}$±0.34 |
| $T_6$: 12.5% RGK + β-Mannanase enzyme @750 g/t | $70.55^{bcde}$±0.64 | $74.72^{f}$±0.43 |
| $T_7$: 15% RGK without β-Mannanase enzyme | $70.34^{bcde}$±0.42 | $71.57^{de}$±0.31 |
| $T_8$: 15% RGK + β-Mannanase enzyme @500 g/t | $70.50^{bcde}$±0.51 | $70.49^{cd}$±0.79 |
| $T_9$: 15% RGK + β-Mannanase enzyme @750 g/t | $70.53^{bcde}$±0.46 | $70.17^{bcd}$±0.08 |
| $T_{10}$: 17.5% RGK without β-Mannanase enzyme | $68.41^{ab}$±0 26 | $70.75^{cde}$±0.15 |
| $T_{11}$: 17.5% RGK + β-Mannanase enzyme @500 g/t | $69.19^{abcde}$±0.99 | $71.30^{de}$±0.56 |
| $T_{12}$: 17.5% RGK + β-Mannanase enzyme @750 g/t | $69.11^{abcd}$±0.25 | $69.43^{abc}$±0 .19 |
| $T_{13}$: 20% RGK without β-Mannanase enzyme | $67.69^{a}$±0.26 | $69.46^{abc}$±0.93 |
| $T_{14}$: 20% RGK β-Mannanase enzyme @500 g/t | $68.41^{ab}$±1.39 | $68.77^{ab}$±0.74 |
| $T_{15}$: 20% RGK + β-Mannanase enzyme @750 g/t | $68.59^{abc}$±0.45 | $68.57^{a}$±0..26 |
| **Pooled Mean** | **70.01±0.23** | **71.79±0.33** |

Column bearing common superscripts does not differ significantly (P<0.05).

**Table 4:** Average carcass yield of experimental birds at the end of 6th weeks.

| Treatment | Eviscerated weight (g) | Dressing % | Edible meat % | Giblet % | Abdominal fat % |
|---|---|---|---|---|---|
| $T_0$ :Corn Soya based standard broiler diet | $1671.00^{ab}$±31.47 | $74.59^{NS}$±0.37 | $70.16^{NS}$±0.30 | $4.42^{NS}$±0.10 | $1.21^{NS}$±0.05 |
| $T_1$: 10% RGK without β-Mannanase enzyme | $1774.00^{abcd}$±40.32 | $75.36^{NS}$±0.44 | $71.08^{NS}$±0.60 | $4.28^{NS}$±0.21 | $1.25^{NS}$±0.65 |
| $T_2$: 10% RGK + β-Mannanase enzyme @500 g/t | $1685.00^{ab}$±24.76 | $75.34^{NS}$±0.50 | $71.00^{NS}$±0.50 | $4.33^{NS}$±0.10 | $1.28^{NS}$±0.03 |
| $T_3$: 10% RGK + β-Mannanase enzyme @750 g/t | $1703.83^{abc}$±59.18 | $75.62^{NS}$±0.50 | $71.25^{NS}$±0.60 | $4.36^{NS}$±0.14 | $1.29^{NS}$±0.07 |
| $T_4$: 12.5% RGK without β-Mannanase enzyme | $1774.66^{abcd}$±56.84 | $74.77^{NS}$±0.47 | $70.48^{NS}$±0.53 | $4.29^{NS}$±0.14 | $1.21^{NS}$±0.05 |
| $T_5$: 12.5% RGK + β-Mannanase enzyme @500 g/t | $1611.16^{a}$±24.41 | $74.51^{NS}$±0.264 | $69.98^{NS}$±0.22 | $4.52^{NS}$±0.09 | $1.27^{NS}$±0.01 |
| $T_6$: 12.5% RGK + β-Mannanase enzyme @750 g/t | $1740.00^{abcd}$±28.18 | $76.23^{NS}$±0.48 | $71.84^{NS}$±0.50 | $4.38^{NS}$±0.15 | $1.23^{NS}$±0.03 |
| $T_7$: 15% RGK without β-Mannanase enzyme | $1755.50^{abcd}$±63.32 | $76.20^{NS}$±1.11 | $71.92^{NS}$±1.07 | $4.28^{NS}$±0.18 | $1.19^{NS}$±0.03 |
| $T_8$: 15% RGK + β-Mannanase enzyme @500 g/t | $1831.00^{bcd}$±89.02 | $76.58^{NS}$±0.47 | $72.42^{NS}$±0.50 | $4.15^{NS}$±0.10 | $1.17^{NS}$±0.05 |
| $T_9$: 15% RGK + β-Mannanase enzyme @750 g/t | $1847.00^{bcd}$±54.11 | $77.10^{NS}$±0.62 | $72.97^{NS}$±0.61 | $4.12^{NS}$±0.07 | $1.15^{NS}$±0.02 |
| $T_{10}$: 17.5% RGK without β-Mannanase enzyme | $1881.66^{cd}$±66.80 | $76.58^{NS}$±0.46 | $72.42^{NS}$±0.50 | $4.15^{NS}$±0.08 | $1.24^{NS}$±0.04 |
| $T_{11}$: 17.5% RGK + β-Mannanase enzyme @500 g/t | $1611.00^{a}$±65.43 | $75.44^{NS}$±0.92 | $70.82^{NS}$±0.96 | $4.61^{NS}$±0.12 | $1.37^{NS}$±0.02 |
| $T_{12}$: 17.5% RGK + β-Mannanase enzyme @750 g/t | $1752.16^{abcd}$±85.36 | $76.69^{NS}$±0.14 | $72.32^{NS}$±0.30 | $4.37^{NS}$±0.19 | $1.26^{NS}$±0.07 |
| $T_{13}$: 20% RGK without β-Mannanase enzyme | $1780.33^{abcd}$±26.12 | $75.46^{NS}$±0.68 | $71.21^{NS}$±0.61 | $4.25^{NS}$±0.08 | $1.25^{NS}$±0.04 |
| $T_{14}$: 20% RGK β-Mannanase enzyme @500 g/t | $1828.50^{bcd}$±71.10 | $75.37^{NS}$±1.09 | $71.35^{NS}$±1.12 | $4.02^{NS}$±0.14 | $1.18^{NS}$±0.05 |
| $T_{15}$: 20% RGK + β-Mannanase enzyme @750 g/t | $1914.83^{d}$±49.72 | $75.75^{NS}$±0.78 | $71.83^{NS}$±0.85 | $3.91^{NS}$±0.11 | $1.15^{NS}$±0.03 |
| **Pooled Mean** | **1760.10±15.61** | **75.72±0.16** | **71.44±0.17** | **4.28±0.03** | **1.23±0.01** |

Columns bearing common superscripts does not differ significantly (P<0.05).

mannan gum in RGK might have increased the viscosity suppressing the growth resulting in reduced feed efficiency. Higher FCR was observed in broilers when dietary content of GM increased (Mohayaye and Karimi, 2012; Mishra *et al*., 2013 and Ahmed and Abou-Elkhair, 2016). Similar results were reported by Tyagi *et al*. (2011) and Ramteke *et al.* (2014) who noted that incorporation of RGK upto 10 and 12 % level, respectively in the broiler diet did not significantly alter the FCR. Bramha and Siddiqui (1978) and Nagra *et al.* (1985) reported no detrimental effect of roasted guar meal upto 24 and 16% dietary level, respectively on growth rate and FCR in broilers. Similarly, Rama Rao *et al.* (2014) and Salma *et al.* (2015) opined that GM can be incorporated upto 15 and 25% levels respectively without affecting the performance of the birds upto 6 weeks of age. On the contrary, Kamran *et al.* (2002) and Dinani *et al.* (2010) reported negative effects on FCR, fed more than 5% level of GM included diets. Vidya Sagar *et al*. (1978) reported that roasted guar meal can be included upto 10% without affecting BWG, Feed consumption and FCR.

**Nutrient utilization:** Significantly better dry matter digestibility was observed in treatment groups fed lower levels of RGK with β -mannanase and control group as compared to higher levels of RGK fed groups, indicating that dry matter digestibility decreased as the inclusion level of RGK increased (Table 3). Similar trend was observed for nitrogen retention. Significantly better retention was observed in group T5 and T6 with different level of -mannanase supplementation i.e, 500g/t and 750 g/t as compared to other treatment groups as well as control. Results of nutrient utilization (DM and CP) revealed that dry matter and crude protein utilization was influenced by inclusion of different levels of RGK as well as supplementation of different levels of β -mannanase. Overall, higher the incorporation level of RGK lower was the utilization of dry matter as well as crude protein. Similar results were obtained by Salma *et al.* (2015) who reported that broiler fed diet having guar korma meal at 6.25% recorded higher CP digestibility (80.56%) as compared to other treatment groups containing 12.5 and 18.75 % guar korma meal. Contrarily, Brahma and Siddiqui (1978) revealed that no significant difference in protein efficiency in broiler fed toasted guar meal upto 21% in the diet. Poor utilization of dry matter and crude protein was also documented by Dinani *et al.* (2010) and Narsala *et al.*(2015). Poor utilization of dry matter and crude protein at higher level of RGK might be due to negative effect of residual gum which may affect nutrient absorption.

**Carcass traits:** Slaughter parameters *viz*., eviscerated weight and edible meat exhibited highly significant (P<0.01) variation among treatments and control (Table 4). Significantly highest eviscerated weight and edible meat percentage was observed in T15 group as 1914.83 g and 71.83 % respectively, fed 20% RGK with supplementation of β -mannanase @ 750 g/t. However, other parameters *viz*., giblet weight, giblet %, edible meat % and dressing% showed non-significant differences indicating that inclusion of RGK at different levels with supplementation of ß -mannanase did not influence the slaughter parameters. The result of study are in agreement with the results of Rama Rao *et al*.(2014), who reported that slaughter variables were not influenced by dietary inclusion of GM upto 20% in Vanraja chicken. Similarly, Bramha *et al*. (1982) and Gheisari *et al.* (2011) reported that no change in slaughter parameter when 10 % or upto 16 % toasted guar meal was incorporated in chicken diet. Mohayayee and Karimi (2012) concluded that diet containing GM upto 12% had no significant effect on relative weight of carcass and giblet weight. On the contrary, Kamran *et al*.(2002) reported decreased carcass yield in broilers fed on 5% GM based diet. Salma *et al*.(2015) observed that broilers receiving low GM diet yielded significantly higher carcass than birds fed diet containing higher content of GM.

## CONCLUSION

It is concluded that inclusion of 12.5 % of RGK with supplementation of mannanase@ 500g/t in the diet of broiler improved the performance and digestibility of nutrients without any adverse effect on carcass trait.

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