



Effect of Fermented Toasted Guar Meal on Performance of Broilers

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Effect of Dietary Inclusion of Fermented Toasted Guar Meal on Growth Performance and Carcass Characteristics in Broiler Chicken

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ABSTRACT

This experiment was designed to investigate the effect of dietary inclusion of fermented toasted guar meal (FTGM) on performance and carcass characteristics in broiler chicken. Two hundred and fifty, day-old commercial broiler chicks were randomly allotted to 5 dietary treatments with 10 replicates containing 5 birds in each replicate. Dietary treatments consisted of a control diet and 4 test diets where toasted guar meal (TGM) and FTGM were included at 15 and 20 % levels respectively. Dietary inclusion of TGM or FTGM at 15 and 20 %, shown significant ($P < 0.01$) depression on body weight gain (BWG) and feed intake of broilers compared to control group. However, the BWG in FTGM 15 was significantly ($P < 0.01$) higher than TGM 15. No difference in BWG of broilers in 20 % TGM and FTGM groups. The feed intake of broilers in TGM or FTGM groups at same inclusion levels was comparable. Significantly poorer FCR was observed in TGM 15 and 20 groups. However, dietary inclusion of FTGM 15, improved the FCR and was comparable to control and significantly ($P < 0.01$) better than TGM 15 group. Whereas, the FCR in TGM 20 and FTGM 20 groups was comparable. Dietary treatments did not influence the carcass characteristics of broilers. In summary, the fermented toasted guar meal can be included up to 15 % in the diet of broilers without showing any adverse effect on FCR and carcass characteristics.

KEYWORDS: Broiler, Fermented toasted gaur meal, Growth Performance and Carcass Characteristics

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INTRODUCTION

Inadequate availability and escalating prices of quality feed ingredients have made it increasingly difficult to formulate a balanced and least-cost poultry feed. This scenario encourages the exploration of alternative feed resources instead of traditional sources. Guar meal (GM) emerges as a promising option as protein source owing to its widespread availability and favorable nutritional characteristics (Ahmed et al., 2015). Guar meal, a by-product of gum extraction, is composed of both hulls and germ, with the ground seed typically having an approximate ratio of 25% germ to 75% hull (Lee et al., 2005). Guar meal is regarded as a valuable protein source because of its high crude protein content (35–45%) and its well-balanced amino acid profile, particularly its elevated levels of lysine and arginine which make it a promising alternate ingredient to soybean meal for poultry diets (Saeed et al., 2017). However, guar bean contains some anti-

nutritional factors (ANF) like trypsin inhibitor and galactomannan (guar gum) which negatively affect feed conversion ratio and growth performance in broilers (Mohayayee and Karimi, 2012). Effective strategies such as toasting or fermentation can enhance the incorporation of GM into poultry rations. Toasting is a process where guar meal is subjected to a temperature of 100°-140°C for 10 to 40 minutes (Rao et al., 2019a). The process breaks down complex carbohydrates and anti-nutritional factors present in guar meal, making it more digestible and making the meal safer for consumption by birds. Nidhina and Muthukumar (2015) found that heat treatment (toasting) significantly ($P < 0.01$) reduced the emulsifying and foaming properties of industrial GM, which may help in better utilization of GM compared to raw guar meal. The inclusion of toasted guar meal in the diet of broilers improved the growth performance and nutrient digestibility (Ahmed and Abou-Elkhair, 2016).

Fermentation is one of the strategy used nowadays to alleviate the detrimental effects of ANFs in guar meal (Xu et al., 2012). The fermentation process improves the nutritional value of protein sources by increasing the crude protein content while decreasing the crude fiber content (Sugiharto et al., 2016). Previous studies by Sun et al. (2013) and Jazi et al. (2017) reported that fermented cotton seed meal can be included upto 8 and 20 % respectively, in the diet of broiler chicken without any adverse effect on performance and carcass characteristics and it improved gut health in chickens. Dinani et al. (2010) reported that dietary inclusion of 15 % FTGM in broiler quails, significantly ($P < 0.05$) improved the performance when compared to unfermented TGM 15 fed group. The studies on inclusion of different fermented protein sources are available in broilers, however works on inclusion of fermented toasted guar meal at higher levels in broilers are not available. Hence the present study was conducted to evaluate the effect of dietary inclusion of fermented toasted guar meal at 15 and 20 % on performance, carcass characteristics and livability of commercial broiler chicken.

MATERIALS AND METHODS

The present research trial was approved by the Institutional Animal Ethics Committee of the College of Veterinary Science, P.V. Narsimha Rao Telangana Veterinary University, Telangana, India vide 02/27/ CVSc, Hyd.

Preparation of FTGM

The toasted guar meal used for the study was procured from M/s Mahesh Agro Food Industries (MAFI), Barmer, Rajasthan, India. The cultures of *Lactobacillus fermentum* (MTCC 1745), *Lactobacillus rhamnosus* (MTCC 12920), *Bacillus subtilis* (MTCC 441), *Bacillus clausii* (MTCC 7914) and *Bacillus licheniformis* (MTCC 3244) were used for the preparation of FTGM. For the fermentation process, each kilogram of TGM was

mixed with one litre of water containing 10^8 CFU/ml of above organisms. After proper mixing, the material was packed in fermentation bags and incubated for 84 hours. After incubation period, the FTGM was checked for the pH (desirable pH value is below 4.5). If the pH falls below 4.5, it indicates successful fermentation, the FTGM was kept for sun drying for 2-3 days and stored until it mixed in the experimental diets.

Experimental Design and Diets

To conduct the proposed study, two hundred and fifty, (250) day-old commercial broiler chicks were randomly allotted to 5 dietary treatments with 10 replicates containing 5 birds in each replicate. Dietary treatments include T1- Control, T2- Toasted guar meal 15 % (TGM 15), T3- Toasted guar meal 20 % (TGM 20), T4- Fermented toasted guar meal 15 % (FTGM 15) and T5- Fermented toasted guar meal 20 % (FTGM 20). Broiler pre-starter (1-14 days), starter (15-28 days) and finisher (29-42 days) diets were formulated to contain 22 %, 20 % and 19 % crude protein and metabolizable energy was 2950, 3050 and 3150 kcal/kg respectively as per Vencobb recommendations (Table 1). During the experimental period, feed and water were given *ad-libitum* to broilers. The birds were vaccinated for as per standard protocols. At the end of the trial (42d of age), 10 birds per treatment (1 bird per replicate) were slaughtered to study the carcass characteristics. The bird weighing to the mean body weight of the respective treatment was selected, fasted overnight and slaughtered by cervical dislocation to study the relative weights of organs like liver, heart, gizzard and percentage of dressing yield, breast yield and abdominal fat. The data was analyzed using the General Linear Model procedure of Statistical Package for Social Sciences (SPSS) 20th version and comparison of means was done using Duncan's multiple range test (Duncan, 1955) and significance was considered at $P < 0.05$.

Effect of Fermented Toasted Guar Meal on Performance of Broilers

Table 1. Ingredient (kg/ton) and nutrient composition (%) of broiler diets

Ingredient	Pre-starter			Starter			Finisher		
	Control	TGM	TGM	Control	TGM	TGM	Control	TGM	TGM
		15 /FTGM	20/ FTGM		15 /FTGM	20/ FTGM		15 /FTGM	20/ FTGM
Maize	562.08	570.59	573.53	621.22	629.73	632.65	633.59	642.19	645.13
Oil- veg	26.68	24.26	23.48	29.68	27.26	26.48	43.00	40.61	39.83
Soybean meal	359.64	201.39	148.40	304.74	146.49	93.54	283.05	124.56	71.56
Salt	3.18	3.25	3.28	3.19	3.27	3.29	2.95	3.02	3.05
Sodium Bicarbonate	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Dicalcium Phosphate	26.61	26.94	27.06	16.48	16.82	16.93	14.95	15.29	15.41
Limestone Powder	8.85	7.83	7.49	12.07	11.05	10.71	11.32	10.31	9.97
DL-Methionine	3.44	3.44	3.44	3.28	3.28	3.28	2.88	2.88	2.89
L - Lysine HCL	2.46	4.70	5.46	2.9	5.14	5.89	2.31	4.56	5.31
L - Threonine	1.27	1.77	1.94	0.95	1.46	1.63	0.45	0.96	1.13
L - Tryptophan	0	0	0.11	0	0	0.09	0	0.11	0.22
Choline chloride 75%	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Toxin Binder	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Trace Mineral Mix ¹	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Coccidiostat ²	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Vitamin Premix ³	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Potassium Chloride	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
TGM/ FTGM	0	150	200	0	150	200	0	150	200
Nutrient composition (calculated)									
M.E (kcal/kg)	2950	2950	2950	3050	3050	3050	3150	3150	3150
Protein %	22	22	22	20	20	20	19	19	19
Dig Lysine %	1.26	1.26	1.26	1.16	1.16	1.16	1.06	1.06	1.06
DigMet. %	0.645	0.644	0.644	0.607	0.606	0.605	0.557	0.556	0.556
Dig Met+ Cyst %	0.94	0.94	0.94	0.88	0.88	0.88	0.82	0.82	0.82
Calcium %	0.94	0.94	0.94	0.8	0.8	0.8	0.74	0.74	0.74
Available P %	0.58	0.58	0.58	0.4	0.4	0.4	0.37	0.37	0.37
Sodium %	0.18	0.18	0.18	0.18	0.18	0.18	0.17	0.17	0.17
Dig Tryptophan %	0.24	0.21	0.21	0.21	0.18	0.18	0.20	0.18	0.18
Dig Threonine %	0.88	0.88	0.88	0.78	0.78	0.78	0.7	0.7	0.7

¹Trace mineral mix provided per kg diet: Manganese, 120 mg; Zinc, 80 mg; Iron 25 mg; Copper, 10 mg; Iodine, 1 mg and Selenium, 0.1 mg. ²Coccidiostat: 1% Maduramicin ammonium at 10g/kg.

³Vitamin premix provided per kg diet: Vitamin A, 20000 IU; Vitamin K, 2 mg; Vitamin E, 10 mg; Riboflavin, 25 mg; Vitamin B₁, 1 mg; Vitamin B₆, 2mg; Vitamin B₁₂, 40 mcg and Niacin 15 mg.

*TGM- Toasted guar meal

**FTGM- Fermented toasted guar meal

RESULTS AND DISCUSSION

Growth performance

Body weight gain (BWG)

The results showed that body weight gain of broilers was significantly ($P < 0.01$) higher in control group when compared to other treatment groups (Table 2). Dietary inclusion of TGM at 15%, significantly ($P < 0.01$) depressed the BWG of broilers. Whereas at 20% TGM inclusion, BWG was further significantly depressed. The BWG of broilers in FTGM 15 group was significantly ($P < 0.01$) higher than TGM 15 group, but was lower than control group. However, the BWG of broilers in TGM 20 and FTGM 20 groups was comparable with no significant difference among them.

The depression on BWG of broilers with dietary inclusion of TGM at 15 and 20 % in present study was in accordance with the reports of Dinani et al. (2010) who reported dietary inclusion of 15% of TGM in broiler quails, significantly reduced body weight when compared to the control group. Similarly, Reddy et al. (2017) and Rao et al. (2018) found significant ($P < 0.01$) depression on BWG of broilers with dietary inclusion of TGM at higher levels (15, 18 and 20%) when compared to control diet fed birds. The poor growth by birds which are fed on 15 and 20% TGM diet might be due to higher intake of guar gum (galactomannan), which increases the digesta viscosity, suppresses nutrient digestibility and finally causes growth depression in broilers (Rao et al., 2017). Branched-chain amino acids like valine, leucine and isoleucine would likely be limiting with increased inclusion levels of TGM, especially in 15 and 20 % which might be also responsible for growth reduction (Reddy et al., 2017).

Dietary inclusion of 15% FTGM in broilers, significantly ($P < 0.01$) improved the BWG when compared to the unfermented TGM 15 % group. The present findings are in accordance with Dinani et al. (2010) who reported a significant improvement in the BWG of broiler quails that are fed with a diet containing 15% FTGM when compared to the TGM 15% based diet fed group. Similarly, Park and Kim (2019) reported that dietary inclusion of 10% guar meal fermented with *Bacillus subtilis* in broilers, significantly ($P < 0.01$) improved the BWG when compared to birds that are fed on unfermented guar meal. The improved BWG in fermented TGM based diet fed birds might be due to the positive effects of

fermentation. The fermentation process enhances the nutritional value of TGM through the degradation of fibers, breakdown of protein (more amino acids available) and non-starch polysaccharides (NSP) leading to a reduction in anti-nutrients and thus increasing the nutrient availability and improved absorption resulting in improved growth performance (Jazi et al., 2019).

Feed intake (FI)

Results of the present study indicated that FI of broilers was significantly ($P < 0.01$) higher in the control group when compared to other treatment groups (Table 2). The inclusion of TGM and FTGM at higher levels (15 and 20 %) significantly ($P < 0.01$) depressed the feed intake. With dietary inclusion of 20 % TGM or FTGM, the feed intake of broilers was further depressed. There was no significant difference between the TGM and FTGM groups at their respective inclusion levels in terms of feed intake.

The present findings are in accordance with the reports of Rao et al. (2018) who found that feed intake of broilers which are fed on diet containing 15 and 20 % TGM was significantly ($P < 0.01$) depressed. Similarly, Rao et al. (2019b) with dietary inclusion of 10 % of TGM and Jazi et al. (2017) with 10 and 20 % of cotton seed meal in broilers observed significant ($P < 0.05$) depression on feed intake. Reduced feed intake of broilers with increased levels of TGM in this study might be due to higher levels of anti-nutritional factors like residual gum, fiber and saponins (Reddy et al., 2017).

Feed conversion ratio (FCR)

The FCR was significantly ($P < 0.01$) poorer with inclusion of TGM at 15 and 20 % in the diet of broilers. The significantly ($P < 0.01$) better FCR was recorded in the FTGM 15 group of birds which is on par with control group and significantly ($P < 0.01$) better than other treatments (TGM 15, TGM 20 and FTGM 20). There was no significant difference between the TGM 15, TGM 20 and FTGM 20 groups in terms of FCR (Table 2).

The present findings of poorer FCR in broilers with dietary inclusion of TGM at higher levels were in accordance with reports of Reddy et al. (2017) who reported TGM inclusion at 15 and 18 % in the diet of broilers, had significant ($P < 0.05$) depression on FCR. Similarly, Rao et al. (2018) found that FCR was significantly ($P < 0.05$) poorer as the level of TGM

(5, 10, 15 and 20 %) increased in the diet of broiler chicken. Similar findings of poorer FCR with higher inclusion level of guar meal in the diet were reported by Gharaei et al. (2012), Nassrallah (2016), Pashamwar et al. (2018) in broilers and Rao et al. (2014) in Vanaraja chicken and Dinani et al. (2010) in broiler quails.

Poorer FCR with higher levels of TGM inclusion in diet might be due to increased intestinal viscosity and the presence of anti-nutritional factors, which hinder nutrient absorption and digestion. This results in reduced growth performance and feed efficiency in the birds.

Similar to the findings of improved FCR in broilers which are fed on FTGM 15 based diet in present study, Dinani et al. (2010) reported that incorporation of 15 % of FTGM in broiler quail diets, significantly

($P < 0.01$) improved the FCR as similar to the control group. Park and Kim (2019) observed an improvement in FCR of broilers with dietary inclusion of FTGM at 10 % when compared to unfermented TGM based diet fed birds. Similar findings of improved FCR with different fermented feeds were reported by Chiang et al. (2010) with fermented rapeseed meal, Nie et al. (2015) and Jazi et al. (2017) with fermented cotton seed meal, Elbaz (2021) with fermented canola meal and Supriya et al. (2023) with fermented soybean inclusion in the diet of broilers.

Improved FCR with dietary inclusion of fermented toasted guar meal might be due to the improved nutritive value of TGM after fermentation by breakdown of anti-nutritional factors, increased nutrient availability and increased activity of digestive enzymes that lead to enhanced feed efficiency (Feng et al., 2007).

Table 2. Effect of dietary inclusion of TGM and FTGM on growth performance of commercial broiler chicken

Diets	BWG	FI	FCR
T1 Control	2297.77 ^a	3500.17 ^a	1.524 ^a
T2 TGM 15	2119.25 ^c	3361.03 ^b	1.586 ^b
T3 TGM 20	2025.73 ^d	3260.16 ^{bc}	1.610 ^b
T4 FTGM 15	2209.07 ^b	3341.5 ^b	1.515 ^a
T5 FTGM 20	2015.15 ^d	3204.59 ^c	1.590 ^b
P- Value	0.001	0.001	0.001
N	10	10	10
SEM	9.28	13.31	0.006

Values bearing different superscripts within a column are significantly ($P < 0.01$) different

P-value: Probability value, SEM: Standard Error Mean,

Each pen is a replicate of 5 chicks, N: Number of replicates,

TGM- Toasted guar meal, FTGM- Fermented toasted guar meal

Carcass Characteristics

The incorporation of either TGM or FTGM at 15 and 20 % level in broiler diets did not affect the dressing percentage, breast yield, giblet yield and abdominal fat yield (Table 3).

The present findings were supported by Reddy et al. (2017) who found non- significant effect on carcass yield with dietary inclusion of TGM at graded

levels (0, 6, 9, 12, 15 and 18 % of diet) in broilers. Rao et al. (2018) with inclusion of TGM at 5, 10, 15 and 20 % of diet in broilers found non-significant effect on carcass yield and abdominal fat yield. Similarly, Rao et al. (2019a) with dietary inclusion of 6, 12 and 18 % of commercial guar meal and Rao et al. (2019b) with TGM 10 % inclusion in diet of broilers found non-significant effect on slaughter variables (ready to cook yield, abdominal fat and giblet yield).

Table 3. Effect of dietary inclusion of TGM and FTGM on carcass characteristics of commercial broiler chicken

Diets	Dressing percentage %	Breast yield %	Abdominal fat %	Giblet %
T1 Control	69.07	22.57	1.10	4.13
T2 TGM 15	69.18	21.97	0.98	4.32
T3 TGM 20	68.25	21.26	1.16	4.61
T4 FTGM 15	69.52	22.77	0.95	4.24
T5 FTGM 20	68.57	21.81	1.19	4.47
N	10	10	10	10
P- Value	0.300	0.324	0.512	0.078
SEM	0.19	0.14	0.05	0.06

P-value: Probability value, SEM: Standard Error Mean, Each pen is a replicate of 5 chicks, N: Number of replicates, TGM- Toasted guar meal and FTGM- Fermented toasted guar meal

Livability and Mortality

The mortality and livability of broilers in different dietary treatments groups was presented in Table 4. Mortality during the experimental period ranged from 4 to 6 % and livability ranged from 94 to 96 % in different dietary treatment groups. It was observed

that mortality and livability was not influenced by the dietary inclusion of TGM or FTGM diets. The mortality of birds during pre-starter and finisher phases may be due to unabsorbed yolk conditions and heat stress, respectively. Mortality recorded was within the acceptable range and no specific disease outbreak was observed during the experiment.

Table 4. Effect of dietary inclusion of TGM and FTGM on cumulative mortality (phase wise) in broiler chicken

Treatments	No. of birds housed	No. of birds died	Percent cumulative mortality			Overall period (0-6 weeks)	Livability (%)
			Pre starter phase (0-2 weeks)	Starter phase (3-4 weeks)	Finisher phase (5-6 weeks)		
T1 Control	50	2	-	2.00	2.00	4.00	96
T2 TGM 15	50	2	2.00	-	2.00	4.00	96
T3 TGM 20	50	3	2.00	2.00	2.00	6.00	94
T4 FTGM 15	50	2	-	2.00	2.00	4.00	96
T5 FTGM 20	50	3	-	4.00	2.00	6.00	94

In agreement with these results, Mishra et al. (2013) stated that dietary inclusion of roasted guar korma in broilers did not affect mortality. Sun et al. (2013) reported that dietary inclusion of fermented cottonseed meal up to 12 % in the diet did not show any effect on mortality of broilers. Li et al. (2022) found no significant effect on the mortality of broilers that are fed on fermented feed based diet up to 25 % inclusion level.

CONCLUSION

Based on the overall results, it is concluded that fermented toasted guar meal can be included up to 15 % of the diet without any adverse effect on FCR and carcass characteristics in broiler chicken.

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