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Effect of Dietary Inclusion of Graded Levels of Toasted Guar Meal (TGM) at Different Energy Efficiency on Egg Quality and Serum Parameters of White Leghorn Layers

M. Hanumanth Rao[1], S.V. Rama Rao[2] and Srinivas Gurram[*]
Department Poultry Science, College of Veterinary Science,
PV Narasimha Rao Telangana Veterinary University,
College of Veterinary Science,Koutla, Karimnagar-505326, Telangana, India

ABSTRACT

An experiment was undertaken in a completely randomized design to study the effect of supplementation of toasted guar meal (TGM) at graded concentrations on the performance and egg quality parameters of White Leghorn (WL) layers. A total of 224-layer chickens (Babcock, BV 300) were randomly distributed into 56 replicates with 4 birds per each colony cage in well ventilated platform 2 tier cage layer house. Seven experimental diets with graded levels of (0, 6, 12 and 18 %) and two energy efficiency (50 % and 60 % of GE as ME) of TGM were prepared having similar concentrations of protein and ME. Each diet was fed *ad libitum* to 8 replicates from 27 to 42 weeks of age. The results showed that feed intake, feed conversion ratio, egg quality (egg density, yolk index, yolk color, Haugh unit score, shell weight, shell percentage, shell thickness, shell strength) parameters and serum biochemical profile (albumin, protein and cholesterol) were not affected by incorporating TGM up to 18 % (180 g/kg diet) except albumen index which was significantly (P<0.05) higher at 18 % inclusion compared to other groups. From the results of the above study, it was concluded that TGM can be included in WL layer diets up to 18% without affecting egg quality and serum parameters.

Key words: Energy efficiency, Haugh unit, Shell quality, Serum protein, Toasted guar meal

INTRODUCTION

Soya bean 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, is on in search of 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 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, its dietary inclusion increases the intestinal viscosity and hampers the nutrient digestion and absorption and performance in chicken (Lee *et al.* 2003a). Further, Nidhina and Muthukumar (2015) found that, heat treatment significantly (P<0.05) reduced the emulsifying and foaming properties of industrial GM, which may help in better utilization of GM compared to raw meal. Guar gum present in the meal is heat liable, therefore heat treatment (autoclaving) was reported to improve the energy value of GM (Nagpal *et al.* 1971). Rama Rao *et al.* (2015) reported that toasted GM could be safely included in White Leghorn (WL) layer diets up to 15 % without affecting performance. Therefore, the present study was designed to investigate the effect of supplementation of toasted guar meal (TGM) at graded concentrations with two energy efficiencies of TGM on the egg quality and serum parameters of White Leghorn (WL) layers.

MATERIALS AND METHODS

The research work was carried out at Poultry Experimental Station, LFC, College of Veterinary Science, Rajendranagar, Hyderabad and Directorate of

[1] Assistant Professor, Livestock Farm Complex, CVSc, Hyd (hanumanthraom54@gmail.com); [2] Principal Scientist, ICAR-Directorate of Poultry Research, Hyderabad, India; Corresponding author: Email:gurramsrinivas4@gmail.com

Poultry Research, Rajendranagar, Hyderabad. The experiment was conducted on 224 commercial layers (BV 300) of 27 weeks of age having uniform body weight and egg production, which were randomly distributed in to seven experimental groups with eight replicates per group and each replicate contained four birds. Six experimental diets were formulated and ingredient and nutrient composition is shown in the Table 1. The TGM (toasted at 120°C for 35 min) was incorporated in three diets at 6, 12 and 18 % in WL layers considering the ME as 50% of GE. Similarly in another three diets, TGM was incorporated at 6, 12 and 18% considering the ME as 60% of GE and one diet was the reference diet based on Maize-SBM.

The layers were fed respective diets for four laying periods, of 28 days each. Eggs produced by each replicate were collected on the daily basis and all eggs laid during last three consecutive days of every period were collected to assess the egg quality parameters. Internal egg quality parameters were evaluated by utilizing 2 eggs from each replicate during the end of each period. In total, 16 eggs per treatment were utilized for measurement of egg quality traits (*viz.*, shell weight (g), shell thickness (mm), Haugh unit score, egg

Table 1. Ingredient and nutrient composition (%) of layer experiment diets

Ingredients	**Control**	**TGM 50% ME**			**TGM 60% ME**		
		6%	**12%**	**18%**	**6%**	**12%**	**18%**
Maize	61.99	61.37	60.72	60.06	59.61	57.21	54.79
Soya DOC 45%	24.41	18.17	11.81	5.37	17.76	10.99	4.15
Guar meal	0.00	6.00	12.00	18.00	6.00	12.00	18.00
De-oiled rice bran	1.08	1.96	2.90	3.94	4.10	7.22	10.40
Salt	0.380	0.38	0.38	0.38	0.38	0.38	0.38
Di-calcium phosphate	1.38	1.41	1.44	1.48	1.40	1.42	1.44
Stone grit	10.25	10.22	10.19	10.16	10.24	10.22	10.20
DL- methionine	0.13	0.13	0.13	0.13	0.13	0.13	0.13
L- lysine HCL	0.00	0.00	0.03	0.10	0.00	0.04	0.12
L-threonine	0.00	0.0214	0.044	0.0678	0.022	0.046	0.072
Choline chloride 50%	0.05	0.05	0.05	0.05	0.05	0.05	0.05
AB_2D_3K[2]	0.02	0.02	0.02	0.02	0.02	0.02	0.02
B- complex[3]	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Toxin binder	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Trace mineral pre mix[1]	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Nutrient composition*							
ME (kcal/kg)	2650	2631	2612	2593	2602	2554	2506
Protein (%)	16.50	16.50	16.50	16.50	16.50	16.50	16.5
Calcium (%)	3.700	3.700	3.700	3.700	3.700	3.700	3.700
Available phosphorus (%)	0.330	0.330	0.330	0.330	0.330	0.330	0.330
Lysine (%)	0.874	0.825	0.800	0.800	0.820	0.800	0.800
Methionine (%)	0.400	0.400	0.400	0.400	0.400	0.400	0.400
Sodium (%)	0.163	0.162	0.161	0.160	0.161	0.160	0.159

Trace mineral mix[1] provided per kg diet: manganese, 120mg; Zinc, 80mg; Iron, 25mg; Copper,10mg; Iodine, 1mg and Selenium, 0.1mg.Vitamin premix[2] provided per kg diet: Vitamin A, 20000IU; Vitamin D_3, 3000IU; Vitamin E, 10mg; Vitamin K, 2mg;[3] Riboflavin, 25mg; Vitamin B_1, 1mg; Vitamin B_6, 2mg; Vitamin B_{12}, 40mcg and Niacin, 15mg.

density, shell strength, shell percentage, albumen index and yolk index) were measured during the four laying periods. Serum albumin, protein and cholesterol were determined by using the Erba Chem-5 Plus V2 Clinical Chemistry Semi Auto Analyzer with commercially available diagnostic kit (M/S Excel Diagnostics Pvt. Ltd., Hyderabad, India) methods.

The data was analyzed by using general linear mode procedure of statistical analysis by applying factorial method of ANOVA using SPSS 15th version. Difference was compared with Duncan's multiple range test at P<0.05.

RESULTS AND DISCUSSION

Feed intake/hen/day (FI) was significantly (P<0.05) lower in birds fed 50% energy efficiency of TGM from 27-42 wks of age. Inclusion of graded level of TGM did not significantly influence the FI. However FI was lower in birds fed TGM at 6 % level of inclusion. The interaction between varying energy efficiencies of TGM and graded (6, 12 and 18 %) inclusion levels of TGM did not influence (P>0.05) the FI. Numerically lower FI was observed in birds fed TGM at 6 % and 50 % energy efficiency (Table 2). The results are in agreement with the findings of Rama Rao *et al.* (2015) who reported that FI was not affected by the level of GM in the diet. Ehsani and Torki (2010) also reported no significant effect on FI by dietary GM supplementation. In general, progressive increase in feed intake with reduction in dietary ME level is expected (Rama Rao *et al.* 2014). The lack of significant response in these parameters due to variation in dietary energy concentration could be due to either age of the bird,

Table 2. Effect of inclusion of graded levels and varying metabolisable energy of TGM on albumin and yolk parameters of commercial layers from 27th- 42nd weeks of age

Treatment	Energy efficiency of TGM	Inclusion level of TGM (%)	Feed intake (g/b/day)	Feed conversion ratio	Haugh unit score	Albumen index	Yolk index	Yolk colour
1	0%	0	107.3	118.1	67.97	5.092	33.46	4.406
2	50%	6	103.8	115.4	70.25	5.453	34.05	4.564
3	50%	12	105.2	116.7	71.19	5.427	33.85	4.506
4	50%	18	102.6	116.9	70.91	5.800	35.72	4.500
5	60%	6	104.7	120.4	67.74	5.270	34.63	4.656
6	60%	12	106.1	123.1	67.50	5.370	33.87	4.463
7	60%	18	108.1	117.5	70.37	5.976	34.00	4.630
Energy efficiency of TGM								
0	0%		107.3[a]	118.1	67.97[b]	5.092	33.46	4.406
1	50%		103.9[b]	116.3	70.78[a]	5.560	34.54	4.523
2	60%		106.3[a]	120.3	68.54[ab]	5.539	34.17	4.583
TGM (%)								
0	0		107.3	118.1	67.97	5.092[b]	33.46	4.406
1	6		104.3	117.9	69.00	5.362[b]	34.34	4.610
2	12		105.6	119.9	69.34	5.399[b]	33.86	4.484
3	18		105.3	117.2	70.64	5.888[a]	34.86	4.565
SEM			0.625	0.908	0.427	0.078	0.253	0.026
P-Value								
ME			0.075	0.046	0.019	0.901	0.499	0.289
TGM			0.683	0.516	0.318	0.024	0.339	0.185
ME*TGM			0.284	0.464	0.378	0.679	0.212	0.413

Values bearing different superscripts within the column are significantly (P<0.05) different

body weight or static gut capacity. Alteration in feed intake with dietary ME concentration is largely noticed in broiler or layer chicks. The GI tract volume or capacity is in dynamic mode, in growing birds, while in mature birds (lying phase), the intestinal capacity is fixed and flexibility in gut volume is very limited. Therefore, dietary variation and nutrient concentration influenced the feed intake in growing birds but not in mature laying hens.

Feeding graded levels of TGM (6, 12 and 18 %) had no effect (P>0.05) on the FCR from 27 to 42 wks of age and numerically lower FCR was noticed in 50 % energy efficiency of TGM. whereas the interaction between varying energy efficiencies of TGM and graded (6, 12 and 18 %) inclusion levels of TGM did not influence (P>0.05) the FCR (Table 2). Rama Rao *et al.* (2015) reported no significant difference in feed efficiency by inclusion of TGM up to 10 % in layer diets but FCR was poor at 15 % inclusion. Abdul Mohsen (2014) reported that inclusion of GM up to 10 % in laying hens did not show significant (P>0.05) effect on FCR.

There was no significant effect of varying energy efficiency of TGM on the albumen index, inclusion of TGM at 18 % showed significantly (P<0.05) higher albumen index from 27-42 weeks of age; however, there was no interaction effect between energy efficiency of TGM and TGM inclusion level (Table 2). The Haugh unit score was not significantly affected by inclusion of graded levels of TGM and

Table 3. Effect of inclusion of graded levels and varying metabolisable energy of TGM on shell quality of commercial layers from 27th- 42nd weeks of age

Treatment	Energy efficiency of TGM	Inclusion level of TGM (%)	Egg density	Shell weight (%)	Shell strength (N)	Shell weight (g)	Shell thickness (mm)
1	0%	0	1.072	8.914	21.86	5.093	0.366[b]
2	50%	6	1.067	9.173	25.15	5.021	0.370[ab]
3	50%	12	1.067	8.999	23.55	5.122	0.376[ab]
4	50%	18	1.069	9.301	25.28	5.053	0.373[ab]
5	60%	6	1.068	9.160	24.62	5.075	0.381[a]
6	60%	12	1.067	9.029	25.73	5.061	0.373[ab]
7	60%	18	1.068	9.120	27.02	5.124	0.376[ab]
Energy efficiency of TGM							
0	0%		1.072	8.914	21.86	5.093	0.366
1	50%		1.068	9.158	24.66	5.065	0.373
2	60%		1.068	9.103	25.79	5.087	0.377
TGM (%)							
0	0		1.072	8.914	21.86	5.093	0.366
1	6		1.067	9.166	24.88	5.048	0.376
2	12		1.067	9.014	24.64	5.091	0.374
3	18		1.068	9.211	26.15	5.089	0.374
SEM			0.001	0.056	0.501	0.027	0.001
P-Value							
ME			0.985	0.653	0.301	0.718	0.174
TGM			0.929	0.384	0.478	0.796	0.911
ME*TGM			0.908	0.753	0.551	0.614	0.090

Values bearing different superscripts within the column are significantly (P<0.05) different

varying energy efficiency of TGM during the experiment. Ehsani and Torki (2010) reported that layers fed diet with GM up to 7 % inclusion should affect no Haugh unit score; similarly Gutierrez *et al.* (2007) also observed no significant effect on Haugh unit score by supplementing guar by- products (2 and 5 %) in high production laying hen diets. Shahbazi (2012) reported that GM supplementation up to 7 % in layer diets did not influence the Haugh unit score; similarly Rama Rao *et al.* (2015) observed no significant difference in Haugh unit score in layers fed TGM up to 15 % compared to control group fed SBM diet. Similar results were also reported by Sagar *et al.* (2017).

Inclusion of TGM at graded levels did not influence the yolk index and yolk color, similarly the interaction between energy efficiency of TGM and inclusion levels of TGM was not significant (Table 2). Ehsani and Torki (2010) reported that layers fed with GM up to 7 % inclusion should no affect on yolk index, while Shahbazi (2012) reported that GM supplementation up to 7 % in layer diets did not influence the yolk index.

Inclusion levels of TGM and energy efficiency of TGM did not show any significant (P>0.05) effect on shell weight, shell percentage, shell thickness, shell strength and egg density from 27 to 47 wks of age (Table 3). These results are in agreement with Ehsani and Torki (2010) and Shahbazi (2012) who reported that layers fed with GM up to 7 % inclusion showed no affect on shell quality parameters. Similarly Rama Rao *et al.*

Table 4. Effect of inclusion of graded levels and varying metabolisable energy of TGM on serum parameters of commercial layers from 27th- 42nd weeks of age

Treatment	Energy efficiency of TGM	Inclusion level of TGM (%)	Serum protein (g/dl)	Serum albumin (g/dl)	Serum cholesterol (mg/dl)
1	0%	0	4.875	1.948	155.2
2	50%	6	4.759	1.815	174.8
3	50%	12	4.901	1.983	208.8
4	50%	18	4.369	1.736	192.0
5	60%	6	4.804	1.790	184.6
6	60%	12	4.639	1.655	197.5
7	60%	18	4.191	1.959	139.4
Energy efficiency of TGM					
0	0%		4.875	1.948	155.2
1	50%		4.676	1.845	191.9
2	60%		4.545	1.801	173.8
TGM (%)					
0	0		4.875	1.948	155.2
1	6		4.781	1.803	179.7
2	12		4.770	1.819	203.2
3	18		4.280	1.848	165.7
SEM			0.174	0.056	8.008
P-Value					
ME			0.727	0.722	0.302
TGM			0.466	0.954	0.213
ME x TGM			0.942	0.188	0.334

Values bearing different superscripts within the column are significantly (P<0.05) different

(2015) observed no significant difference in shell quality parameters in layers fed TGM up to 15 %. Similar results were also reported by Sagar *et al.* (2017).

Serum biochemical parameters like serum albumin, serum protein and serum cholesterol were not affected by (P>0.05) supplementation of graded levels of TGM and varying energy efficiency of TGM in commercial layers (Table 4). Shahbazi (2012) reported increased serum cholesterol concentration in layers fed diet containing GM (5 %). However, other studies have reported that the high viscosity of guar gum may contribute to decreasing plasma cholesterol (Favier *et al.* 1998).

CONCLUSION

From the results of the present study, it was concluded that TGM can be safely and economically included in White Leghorn (WL) layer diets up to 18% without affecting Feed intake, FCR, external and internal quality of eggs.

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