



Effect of Dietary Inclusion of Heat-Processed Guar (*Cyamopsis tetragonoloba*) and Enzyme Supplementation on Broiler Performance

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Abstract

The experiment was carried out to study the effect of dietary inclusion of Heat-Processed Guar on broiler performance. The guar seeds were heat processed (boiling) in water for 20 minutes and then dried using solar radiation after water drainage, ground and subjected to chemical analyses. A (2 × 4) factorial arrangement was used in a completely randomized design (CRD) to study the effect of four different levels of Heat-Processed Guar (0, 5, 10, and 15 %) and two levels of enzyme supplementation (0 and 500 mg/kg) on broiler performance. The control diet contained 0% of Heat-Processed guar and 0% Enzyme. A total of 280 broilers were employed to 8 treatments and each treatment was replicated five times with 7 birds each (35 birds/treatment). Feed consumption (FC), weight gain (WG), and feed conversion ratio (FCR) were recorded. Results showed that Heat-Processed Guar reduced phytate and tannin content by 13 and 3%, respectively. Birds fed on diets containing 5 or 15% of Heat-Processed guar consumed less feed when compared with those fed with diets without guar ($p \leq 0.01$). Weight gain and FCR were impaired when dietary inclusion of Heat-Processed guar increased ($p \leq 0.01$). Enzyme supplementation improved the weight gain and FCR ($p \leq 0.01$). However, the supplementation of enzyme had no significant effect ($p \geq 0.05$) on feed consumption. In conclusion, diets containing 5% of Heat-Processed guar and supplemented with enzyme recorded good performance results when compared with control diet.

Key word, Guar seeds, weight gain, feed conversion ratio and enzyme supplementation

List of abbreviations

CRD: completely randomized design

FC: Feed consumption

WG: weight gain

FCR: feed conversion ratio

GM: Guar meal

Introduction

Using non-conventional source feed in poultry diets to supplement or replace some of the expensive common feed ingredients is strategy used by poultry nutritionists all over the world to reduce production cost. Guar meal (GM), a feed ingredient, could be used in poultry diets to alleviate this problem. Guar (*Cyamopsis tetragonoloba*) is a drought-tolerant summer annual legume native to India and Pakistan (**Patel and Mc Ginnis, 1985**). Guar bean consist of three fraction namely endosperm rich in guar gum. (GG), germ rich in crude protein and hull or husk rich in crude fiber. guar meal (GM) is a by-product of the isolation of guar gum from guar bean (GB). GM consists of a mixture of germ and hull fractions (**Lee et al., 2003**). Guar meals can also be used as a binding agent in feed formulation. It is characterized as free flowing, has light greenish color and coarse texture, 100% non-transgenic and contains a minimum of 45% oil and albuminoid. More importantly, guar meal is free from aflatoxins (**lee et al., 2009**). Guar meal is comparable to soya bean meal in terms of nutritional content. For instance, the minimum crude protein percentage of guar meal is rated at 50% compared to 48% of soya bean meal (**Heo et al.,2009**). Guar meal is rarely used as a feed ingredient in poultry diets because of several anti-nutritional factors such as saponin and trypsin inhibitors. These findings were contradicted by **Lee et al (2004)**, who noted that Guar meal contained lower levels of trypsin inhibitors. The data concerning the inclusion of guar meal in poultry diets is contradicted because some authors revealed that the effect of trypsin inhibitor is not significant, but some of them were not (**Anderson and Warnick, 1964; Couch et al., 1967; Thakur and Pradhan, 1975**). To get the beneficial properties of guar meal, so many protocols such as heat treatments and enzyme supplementation could be used to reduce the negative impact of containing ant-nutritional factors. **Patel and McGinnis (1985)**, reported that the performance of broilers was better when guar meal included in the diet up to 10% than that of those fed on 15%. However, they reported that when guar meal autoclaved or supplemented with hemicellulose, the performance was improved. **Verma and McNab (1982)** reported that dietary inclusion of guar meal in higher levels had negative impact on broiler chicken's performance specially when fed to young chicks, but when those levels supplemented with hemicellulose, beta mnnanse and/or treated with toasting and steam pelleting, the feed utilization was improved. So, the current study is designed to investigate this issue.

Material and Methods

Housing and management of the birds

A total of 280 one-day-old unsexed chicks (Ross 308) were purchased from commercial poultry hatchery. At the commencement of the experiment, chicks were weighed and distributed to 40 pens (7 birds each). The average weights of chicks in all pens were approximately the same. A total of 40 pens were divided inside the close system house. The dimensions of each pen were 1.5 m length, 1m width, and 0.75 m height. The pens were separated using steal net partitions. All pens were providing with one feeder and line of water (6 nipples per pen) to allow ad libitum consumption of feed and water. All pens floor was covered with clean wheat-straw as bedding. The lighting was kept constant throughout the experimental period using incandescent bulb lamp of 40 watts for each pen. Automatic controlled brooders were used during the first two weeks to aid heat for the chicks.

Experimental design and diets

Guar seeds were purchased from Singa Town-Blue Nile State in the central of Sudan. The guar seeds were heat processed (boiling) in water for 20 minutes and then dried using solar radiation after water drainage, ground and subjected to chemical analyses to be included in the experimental rations. Samples of raw and heat processed (boiling) guar seeds were subjected to proximate analysis according to (AOAC, 2005) (Table 1). The experimental rations were formulated iso-energetic iso-nitrogenous to meet the requirements of broiler starter and finisher periods according to (NRC, 1994). Water and feed were offered ad libitum.

Table (1) approximate analysis of guar seeds before and after boiling

| approximate analysis of guar seeds before boiling | | approximate analysis of proceed guar seeds | |
|---|----------|--|---------|
| Compounds | Percent% | DM | 95 |
| DM | 97.5 | EE | 8.1 |
| EE | 8.5 | CP | 26.9 |
| CP | 28.9 | CF | 12.06 |
| CF | 8.5 | Ash | 7 |
| Ash | 6.6 | NFE | 40.6 |
| NFE | 39.3 | ME (Kcal/kg) | 2897.01 |

¹ME calculated according to equation of *Lodhi et al. (1970)*

Table (2) Analysis of anti-nutritional factor

| | Before the boiling mg/100g | After boiling mg/100g |
|-------------|----------------------------|-----------------------|
| Tannin | 0.0493 | 0.0478 |
| Polyphnol | 3.6297 | 2.5777 |
| Phytic acid | 1.7586 | 1.5288 |

Table (3) composition of experimental diet ingredient %as fed (Starter broiler)

| ingredients | <u>Experimental diets</u> | | | |
|---------------------|---------------------------|-------|-----|------|
| | 0% | 5% | 10% | 15% |
| Sorghum | 56 | 54 | 54 | 54.1 |
| Ground nut | 20 | 19 | 17 | 14.9 |
| Wheat bran | 13.78 | 11.78 | 8.7 | 5.6 |
| Heat-Processed Guar | 0 | 5 | 10 | 15 |
| Super concentrate | 5 | 5 | 5 | 5 |
| Di- calcium | 1.02 | 1.02 | 1.1 | 1.3 |
| L- stone | 0.3 | 0.3 | 0.3 | 0.3 |
| Salt | 0.3 | 0.3 | 0.3 | 0.3 |
| Lysine | 0.5 | 0.5 | 0.5 | 0.3 |

| | | | | |
|-------------------|---------|---------|---------|---------|
| Methionine | 0 | 0 | 0 | 0 |
| V. oil | 2.6 | 2.6 | 2.6 | 2.7 |
| Premix | 0.5 | 0.5 | 0.5 | 0.5 |
| Calculated | | | | |
| ME (calorie /kg) | 3215.33 | 3205.11 | 3202.73 | 3209.13 |
| Protein % | 23.10 | 23.29 | 23.09 | 22.85 |
| Analysis | | | | |
| ME (calorie /kg) | 3230.48 | 3269.34 | 3270.88 | 3200.13 |
| Protein % | 23.4 | 23.2 | 23.2 | 23.25 |

Table (4) composition of experimental diets ingredient %as fed (finisher broiler)

| Ingredient | <u>Experimental diets</u> | | | |
|---------------------|----------------------------------|---------|---------|---------|
| | 0% | 5% | 10% | 15% |
| Sorghum | 56.5 | 54 | 54 | 54 |
| Ground nut meal | 12 | 9.7 | 8 | 7 |
| Wheat bran | 21.28 | 21.28 | 17.9 | 13.8 |
| Heat-Processed Guar | 0 | 5 | 10 | 15 |
| Supper concentrate | 5 | 5 | 5 | 5 |
| Di- calcium | 1.02 | 1.02 | 1.1 | 1.3 |
| L- stone | 0.3 | 0.3 | 0.3 | 0.3 |
| Salt | 0.3 | 0.3 | 0.3 | 0.3 |
| Lysine | 0.5 | 0.5 | 0.5 | 0.3 |
| Methionine | 0 | 0 | 0 | 0 |
| V.oil | 2.6 | 2.4 | 2.4 | 2.5 |
| Premix | 0.5 | 0.5 | 0.5 | 0.5 |
| Calculated | | | | |
| ME (kcal/kg) | 3229.57 | 3205.58 | 3200.84 | 3203.25 |
| Protein % | 20.39 | 20.18 | 20.08 | 20.22 |
| Analysis | | | | |
| ME (kcal /kg) | 3260.27 | 3271.19 | 3275.61 | 3155.49 |
| Protein % | 20.85 | 20.67 | 20.61 | 20.37 |

Growth performance

The body weight (BW), weight gain and feed consumption (FC) were recorded on weekly basis and used to calculate feed conversion ratio (FCR).

Slaughter performance

At the end of experimental period two birds from each pen were selected according to their closed to the average weight of the birds in the particular pen. The birds were exposed to feed withdrawal for 6 hours, stunning using electrical voltage and slaughter processing. One carcass from each pen was longitudinally divided into right and left side in symmetrical manner by mid-sawing along the ventral column. The left side was used to determine the weights of the commercial cuts (thigh, drumstick and breast).

Statistical analysis

Experimental data presented as mean \pm standard errors of the mean. Statistical analyses were carried out by using SPSS 21.0 program package (SPSS, 2010). The significance of the differences among means has been determined by Duncan's multiple range tests (Petrie and Watson, 1999).

Results and Discussion

Growth performance

Table (5) showed the impact dietary inclusion of Heat-Processed guar and enzyme supplementation on broiler performance during the starter period (0-21 day). Feed consumption, weight gains and (FCR) were not affected by incorporation of Heat-Processed guar and supplementation of enzyme. While dietary inclusion of Heat-Processed guar without enzyme was highly significantly ($p < 0.01$) affected in Weight gain and (FCR). enzyme supplementation free was not affected in (F.C), (WG) and (F.C.R). The interaction between Heat-Processed guar and enzyme supplementation was highly significantly affected in (WG) and (F.C.R). The (F.C) was not influenced by all treatments during the starter period. The finding agreed with (Maisonnier *et. al.* 2003) how report that feed consumption during the starter phase showed no significant difference among different treatments. growth performance and feed intake are shown did not differed between treatments. (Daskran *et., al.* 2004) how report that the Guar gum reduce weight gain and increase feed gain ratio in starter period.



Table (5) Effect of dietary inclusion of Heat-Processed guar and enzyme supplementation on Broiler performance during starter period (0-21 day)

| Treatment | Items | | |
|---------------------------|------------------|---------------------|-------------------|
| | Feed consumption | Weight gain | F. C. R |
| Guar 0% enzyme | 401.24 | 211.94 | 1.75 |
| Guar 0% no enzyme | 399.54 | 252.06 | 1.67 |
| Guar 5% enzyme | 426.66 | 204.62 | 1.9 |
| Guar 5% no enzyme | 373.23 | 171.52 | 2.04 |
| Guar 10% enzyme | 402.22 | 145.85 | 2.71 |
| Guar 10% no enzyme | 387.13 | 137.8 | 2.78 |
| Guar 15% enzyme | 395.77 | 125.74 | 3.23 |
| Guar 15% no enzyme | 390.20 | 137 | 2.86 |
| SEM | 20.74 | 5.28 | 0.115 |
| Guar effect | | | |
| 0% | 400.39 | 232.0 ^a | 1.71 ^a |
| 5% | 399.94 | 188.07 ^b | 1.97 ^b |
| 10% | 394.67 | 141.82 ^c | 2.75 ^c |
| 15% | 392.98 | 131.24 ^d | 3.04 ^d |
| SME | 14.67 | 3.73 | 0.018 |
| Sig | NS | ** | ** |
| Enzyme effect | | | |
| Supplemented | 406.47 | 171.97 | 2.39 |
| Enzyme free | 387.52 | 174.59 | 2.34 |
| SME | 10.37 | 2.64 | 0.057 |
| Sig | NS | NS | NS |
| Guar × Enzyme Interaction | NS | ** | ** |

^{a b} Means values within a column with no common superscript differ significant

* : Significant with ($p < 0.05$)

** : Significant with ($p < 0.01$)

NS: No significant

Table (6) showed the impact of dietary incorporation of Heat-Processed guar and enzyme supplementation on broiler performance during finisher period (21-42 day). The results indicated that Heat-Processed guar and enzyme supplementation was not affected in (FC), (WG) and (F.C.R). processed guar treatments significantly in (F.C) and highly significantly affected ($p < 0.01$) in (W.G) and (F.C.R) Supplemented Enzyme free highly significantly affected ($p < 0.01$) in (W.G) and (F.C.R) but not affected in (F.C). The processed guar and enzyme interaction highly significantly ($p < 0.01$) in (F.C) and

(F.C.R) while (W.G) was not affected. This results were contradicted with findings of (Lee *et al.*,2004) how reported feed consumption was not affected by addition of guar meal when compared with control diet. (Conner 2002) how report that in the finisher period the data observed significant different ($p<0.01$) in body weight gain between guar and enzyme added. However, the interaction between guar and enzyme is no significant different, the grower and finisher diets should not lead to depressed growth in the late stage of period.

Table (6) Effect of dietary inclusion of Heat-Processed guar and enzyme supplementation on broiler performance during the finisher period (21-42 day)

| Treatment | Items | | |
|--------------------------|----------------------|---------------------|-------------------|
| | Feed consumption | Weight gain | F. C. R |
| Guar 0% enzyme | 880 | 452.5 | 1.95 |
| Guar 0% no enzyme | 884.83 | 420.66 | 2.12 |
| Guar 5% enzyme | 808.33 | 415.55 | 2.23 |
| Guar 5% no enzyme | 882.83 | 390.44 | 2.34 |
| Guar 10% enzyme | 889.22 | 250.27 | 3.76 |
| Guar 10% no enzyme | 864.94 | 237.83 | 3.71 |
| Guar 15% enzyme | 846.51 | 164.77 | 5.30 |
| Guar 15% no enzyme | 859.27 | 150.57 | 5.83 |
| SME | 13.05 | 6.73 | 0.057 |
| Guar effect | | | |
| 0% | 882.41 ^a | 436.58 ^a | 2.03 ^a |
| 5% | 845.58 ^a | 403 ^b | 2.28 ^b |
| 10% | 877.08 ^{bc} | 244.05 ^c | 3.73 ^c |
| 15% | 852.89 ^{ab} | 157.76 ^d | 5.57 ^d |
| SME | 9.23 | 4.76 | 0.041 |
| Sig | * | ** | ** |
| Enzyme effect | | | |
| Supplemented | 856.02 | 320.77 ^a | 3.31 ^a |
| Enzyme free | 872.97 | 299.92 ^b | 3.5 ^b |
| SME | 6.52 | 3.36 | 0.029 |
| Sig | NS | ** | ** |
| Guar× Enzyme Interaction | ** | NS | ** |

^{a b} Means values within a column with no common superscript differ significant

* : Significant with ($p<0.05$)

** : Significant with ($p<0.01$)

NS: No significant

Table (7) showed the influence of dietary inclusion of Heat-Processed guar and enzyme supplementation on broiler performance during over all period (0-42 day). The result indicated that dietary inclusion of Heat-Processed guar and enzyme supplementation were not influence on broiler performance. While dietary inclusion of Heat-Processed guar treatments highly significantly affected ($p< 0.01$) in (F.C), (WG), and (F.C.R). the interaction between dietary inclusion of Heat-Processed guar and enzyme supplementation was highly significantly affected ($p< 0.01$) in (F.C), (W.G) and (F.C.R) during over all period. This results were in line with (Lee *et, al* 2003) how report that the high concentration of guar meal in poultry diets deleteriously affected growth, feed intake, feed conversion ratio.

Table (7) Effect of dietary inclusion of Heat-Processed guar and enzyme supplementation on broiler performance during over all period (0-42 day)

| Treatments | Items | | |
|---------------------------|----------------------|--------------------|------------------|
| | Feed consumption (g) | Weight gain (g) | F.C.R (g) |
| Guar 0% enzyme | 640.62 | 332.2 | 1.85 |
| Guar 0% no enzyme | 642.15 | 336.4 | 1.89 |
| Guar 5% enzyme | 617.5 | 310.1 | 2.06 |
| Guar 5% no enzyme | 628.3 | 280.9 | 2.19 |
| Guar 10% enzyme | 645.72 | 198.1 | 3.3 |
| Guar 10% no enzyme | 626.03 | 187.8 | 3.2 |
| Guar 15% enzyme | 621.14 | 145.1 | 4.26 |
| Guar 15% no enzyme | 624.73 | 143.9 | 4.34 |
| SEM | 4.6 | 2.0 | 0.02 |
| Guar effect | | | |
| 0% | 641.4 ^a | 334.2 ^a | 1.9 ^a |
| 5% | 622.8 ^b | 295.5 ^b | 2.1 ^b |
| 10% | 635.8 ^a | 192.9 ^c | 3.2 ^c |
| 15% | 622.9 ^b | 144.5 ^d | 4.3 ^d |
| SEM | 3.3 | 1.41 | 0.02 |
| Sig | ** | ** | ** |
| Enzyme effect | | | |
| Supplemented | 631.24 | 246.4 ^a | 2.8 ^a |
| Enzyme free | 630.25 | 237.3 ^b | 2.9 ^b |
| SEM | 2.29 | 1.0 | 0.01 |
| Sig | NS | ** | ** |
| Guar × enzyme Interaction | ** | ** | * |

^{a b} Means values within a column with no common superscript differ significant

* : Significant with (p<0.05)

** : Significant with (p<0.01)

NS: No significant

Table (8) showed the influence of dietary incorporation of Heat-Processed guar and enzyme supplementation on broiler carcass cuts. The results indicate that dietary incorporation of Heat-Processed guar and enzyme supplementation were not significantly affected on broiler carcass cuts. dietary incorporation of Heat-Processed guar without enzyme highly significantly affected (p<0.01) in relative weight of Dressing percentage, Head %, Leg%, Breast% and Shank%. Highest value of Dressing percentage relative weight was recorded with birds fed diets contain 5% of processed guar and lowest value of relative weight with birds fed diets contain 15% of processed guar. Head % and Leg% relative weight increased when dietary inclusion of processed guar increase. Highest value of Shank% relative weight was recorded with birds fed diets contain 5% of processed guar and lowest value of Shank% relative weight was recorded with birds fed diets contain 10% of processed guar. Current results in line with (NabipourAfrouzi, *et. al* 2016) how report that using of guar meal up to 10 % without Hemicell enzyme in the diet compared to the control were significantly reduced carcass (70.32 vs. 71.50) and breast (32.93 vs. 33.60) Percentages (P<0.05). interaction between Heat-Processed guar and enzyme supplementation was highly significantly affected (p<0.01) in relative weight of Dressing percentage, Head %, Leg% and Breast%.

Table (8) Effect of dietary inclusion of Heat-Processed guar and enzyme supplementation on broiler carcass cuts

| Treatments | Items | | | | | |
|---------------------------|---------------------|-------------------|-------------------|--------------------|---------|-------------------|
| | Dressing percentage | head % | Leg % | Breast % | Thigh % | Shank % |
| Guar 0% enzyme | 70.63 | 2.52 | 1.91 | 12.34 | 5.67 | 5.61 |
| Guar 0% no enzyme | 68.76 | 2.59 | 1.85 | 11.93 | 5.36 | 5.50 |
| Guar 5% enzyme | 70 | 2.77 | 1.85 | 11.11 | 6.04 | 5.93 |
| Guar 5% no enzyme | 69.3 | 2.56 | 2.27 | 11.52 | 5.25 | 6.44 |
| Guar 10% enzyme | 68.43 | 3.41 | 2.12 | 11.65 | 5.58 | 5.53 |
| Guar 10% no enzyme | 67.80 | 3.08 | 2.86 | 9.75 | 5.40 | 5.39 |
| Guar 15% enzyme | 68.40 | 2.69 | 2.81 | 10.79 | 5.27 | 5.08 |
| Guar 15% no enzyme | 67.76 | 3.38 | 2.47 | 11.67 | 6.08 | 6.04 |
| S E M | 0.153 | 0.130 | 0.110 | 0.336 | 0.236 | 0.201 |
| Guar effected | | | | | | |
| Guar 0% | 69.70 ^a | 2.55 ^b | 1.88 ^b | 12.13 ^a | 5.51 | 5.56 ^b |
| Guar 5% | 69.68 ^a | 2.67 ^b | 2.07 ^b | 11.32 ^b | 5.65 | 6.18 ^a |
| Guar 10% | 68.11 ^b | 3.24 ^a | 2.49 ^a | 10.70 ^b | 5.49 | 5.46 ^b |
| Guar 15% | 68.08 ^b | 3.04 ^a | 2.64 ^a | 11.23 ^b | 5.67 | 5.56 ^b |
| S E M | 0.108 | 0.092 | 0.078 | 0.237 | 0.167 | 0.142 |
| Sig | ** | ** | ** | ** | NS | ** |
| Enzyme effected | | | | | | |
| Supplemented | 69.36 ^a | 2.98 | 2.17 ^b | 11.47 | 5.64 | 5.53 ^b |
| Enzyme free | 68.42 ^b | 2.90 | 2.37 ^a | 11.22 | 5.53 | 5.84 ^a |
| S E M | 0.076 | 0.065 | 0.055 | 0.168 | 0.118 | 0.100 |
| Sig | ** | NS | * | NS | NS | * |
| guar × enzyme interaction | ** | ** | ** | ** | * | * |

^{a b} Means values within a column with no common superscript differ significant

* : Significant with (p<0.05)

** : Significant with (p<0.01)

NS: No significant

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