Full Length Research Paper

Effect of different alkali-treated groundnut (Arachis hypogea) shell meal on blood parameters and meat yield of broiler finisher chickens

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One hundred and eighty 28 day-old Anak 2000 broiler chicks were utilized in an experiment to evaluate the effect of different alkali-treated groundnut shell meal on carcass characteristics and blood parameters of broiler finisher birds. The birds were randomly allocated to five dietary treatments tagged T1, T2, T3, T4 and T5. Diet T1 is served as the control (non groundnut shell), diet T2 contained potash treated groundnut shell meal (PTGS), T3 contained alum treated groundnut shell (ATGS), T4 contained salt treated groundnut shell meal (STGS) while diet T5 contained untreated groundnut shell meal (UTGS) and replicated 4 times. All the diets were compounded to be isonitrogenous (about 20%) and isocaloric (2700kcal/kg ME). At the end of the feeding trial during the finishing phase, blood samples were collected from 4 birds per treatment using 5mls sterile disposable needles under the wings of the birds and emptied into sample bottles containing Ethylene diamine tetra acetic Acid (EDTA) as anticoagulant to prevent clotting of the blood. Red blood cells, white blood cells, hemoglobin, packed cell volume, and leukocyte differential were analyzed while MCH, MCHC and MCV were calculated. Blood samples were also being collected in separate sample bottles without anti-coagulant to allow for clotting for some serum biochemical constituents. The result obtained show that there was no significant variation in the values obtained for all the carcass parameters evaluated; length of the small intestines (64.25 vs. 69.75 vs. 64.00 vs. 78.25 and 86.50cm) and large intestine (11.25 vs. 11.25 vs. 11.25 vs. 10.90 vs. 11.25 and 13.00cm) for UTGS tended to be longer (P>0.05) compared to the other diets. Similarly, the glucose levels (6.45 vs. 5.35 vs. 6.65 vs. 5.25 and 5.40mmoll⁻¹) were not influenced by the dietary treatments but appeared to vary numerically across the treatments. From the findings of this research, farmers can use PTGS, STGS or UTGS untreated groundnut shell in the diets of broilers for production without producing any adverse effects on the heath status of the birds.

Keywords: Groundnut shell meal, broiler chickens, blood parameters, meat yield, alkali

INTRODUCTION

Groundnut (Arachis hypogea) shell is a by product of groundnut processing industry. In Nigeria, and many other neighbouring countries, in addition to industrial extraction of oil, groundnut is consumed directly as nut fresh, dry or cooked. It is also grown as cash crop for exporting.

Groundnut shell is a waste produced when the nut is being processed for consumption by breaking the shell open manually or mechanically. In Lafia, the capital of Nasarawa State of Nigeria, the shell is abundantly available from October to May.

The shell, though sometimes heaped and burnt, do usually just left lying around in unsightly, rotting, smelly heaps, thus constitute an environmental pollution problem. For now, groundnut shell could be very cheap because, being a waste, the only costs would be those of gathering, processing and transporting to points of use.

Exploiting cheap feed resources for animal production
would lower the market price, and, therefore, increase the intake of animal protein by the general populace in under developed countries, such as Nigeria. This would, in turn, ameliorate the havoc caused by malnutrition and under-nutrition in such societies, the brunt of which is borne by women and children.

Groundnut shell is an emerging feedstuff for rabbit. Oke et al. (1986) found out that 15% groundnut shell in diets of rabbits produced weight gain equal to rabbits fed the control diet. Omole and Onwudike (1983) found that rabbits fed 30% groundnut shell in diet without palm oil, gained weight similar to those fed on control diet. With addition of palm oil, Omole and Onwudike (1983) found that feed intake was not affected up to 50% groundnut shell in the diet. Tham et al. (1987) found that when rabbits were fed groundnut shell up to 40% in the diet, methionine decreases fibre level.

Groundnut shell accounts for between 10-13% of the whole weight of groundnut (Kakala, 1981). Maust et al. (1972) showed that groundnut shell when fed to starter and finisher broilers at levels of between 0-30% replacements of maize increases feed intake, reduces body weight gain, and reduces nutrient utilization. Perhaps, feeding groundnut shell to cockerel holds the greatest potential. Studies conducted by Maust et al. (1972) have so far shown satisfactory performance in finisher cockerel with up to 45% inclusion of groundnut shell as a replacement for maize in their rations. Maust et al. (1972) showed that groundnut shell can affect mineral balance, resulting in parakeratosis in pigs which can be prevented by including zinc salts in the diet. Growing pigs fed on a diet containing 40% groundnut shell have been observed to perform satisfactorily (Kakala, 1981). Indeed, pigs fed on such rations produced leaner carcasses and showed an economy of feed conversion. Wyllie and Lekule (1980) found no significant difference in average daily weight gain, feed conversion efficiency or carcass characteristics when groundnut shell replaced 0-54% of maize in diets of growing – finishing pigs. The inclusion of groundnut shell at 30% in the ration was observed to depress the growth of young pigs. However, overall growth and feed efficiency from 18 - 80kg were not influenced by the level of groundnut shell (Kakala, 1981). Since preliminary investigations of the proximate attributes of groundnut shell were promising, this study was undertaken to evaluate its feed value, using broiler chickens.

MATERIALS AND METHODS

Study area

The experiment was carried out at the Teaching and Research Farm of the Faculty of Agriculture, Nasarawa State University, Keffi, Shibu – Lafia Campus. It is located in the guinea savanna zone of North Central Nigeria. It is found on latitude 08° 35’ N and longitude 08° 33’ E. The mean monthly maximum and minimum temperatures are 35. 06 and 20.16°C respectively while the mean monthly relative humidity is 74 %. The rainfall is about 1168. 90mm (NIMET, 2008).

Processing of test ingredients

The groundnut shell (GS) was processed in the following ways:

- Fifty kilogram of GS was soaked in 750litres of water with 3kg potash for three days, sieved, sundried, ground and supplemented in the diet tagged PTGS (Potash Treated Groundnut Shell Meal).
- Fifty kilogram of GS was soaked in 750litres of water with 3kg alum for three days, sieved, sundried, ground and supplemented in the diet tagged ATGS (Alum Treated Groundnut Shell Meal).
- Fifty kilogram of GS was soaked in 750litres of water with 3kg salt for three days, sieved, sundried, ground and supplemented in the diet tagged STGS (Salt Treated Groundnut Shell Meal).

Preparation of experimental diets

The treated GS (PTGSM, ATGSM and STGSM) and untreated GS (UTGSM) were included at 20% in treatments T2, T3, T4 and T5, respectively while T1 (NGS) served as the control. The diets were compounded to be isocaloric (2790Kcal/kg ME), isonitrogenous (20%CP) and crude fibre of about 5%. The diets were adequately furnished with vitamins and minerals and other ingredients were included to meet the nutrient requirements of the class of birds. The proximate and energy composition of the experimental diets are presented in tables 2.

Experimental birds and management

A total of 180 28 day-old Anak 2000 broiler chicks were utilized for the experiment. The birds were randomly allocated to the five dietary treatments at 36 birds per treatment and replicated four times. All experimental birds were given weighed amount of feed and water was provided ad libitum; standard management practices were adopted as outlined by Oluyemi and Robert (2002).

Data Collection

Blood parameters

At the end of the feeding trial during the finishing phase, blood samples were collected from 4 birds per treatment
Table 1. Proximate composition of test ingredients

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>UTGS</th>
<th>PTGS</th>
<th>ATGS</th>
<th>STGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM</td>
<td>96.11</td>
<td>85.59</td>
<td>84.36</td>
<td>86.47</td>
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<td>CP</td>
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<tr>
<td>CF</td>
<td>37.82</td>
<td>10.26</td>
<td>10.19</td>
<td>10.84</td>
</tr>
<tr>
<td>Ash</td>
<td>4.30</td>
<td>4.12</td>
<td>4.04</td>
<td>4.30</td>
</tr>
<tr>
<td>NFE</td>
<td>56.04</td>
<td>51.34</td>
<td>51.25</td>
<td>51.29</td>
</tr>
<tr>
<td>NDF</td>
<td>43.67</td>
<td>41.16</td>
<td>40.01</td>
<td>42.19</td>
</tr>
<tr>
<td>ADF</td>
<td>37.09</td>
<td>36.80</td>
<td>36.16</td>
<td>37.12</td>
</tr>
<tr>
<td>ADL</td>
<td>13.27</td>
<td>11.28</td>
<td>11.25</td>
<td>11.38</td>
</tr>
<tr>
<td>Hemicellulose</td>
<td>27.21</td>
<td>24.12</td>
<td>25.63</td>
<td>25.14</td>
</tr>
<tr>
<td>Cellulose</td>
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<td>14.67</td>
<td>15.34</td>
<td>14.59</td>
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<tr>
<td>Calcium</td>
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</tr>
<tr>
<td>Phosphorus</td>
<td>1.37</td>
<td>1.01</td>
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<td>1.07</td>
</tr>
<tr>
<td>Energy (Kcalkg⁻¹ ME)</td>
<td>2210.76</td>
<td>2210.34</td>
<td>2210.11</td>
<td>2209.26</td>
</tr>
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</table>


Table 2. Proximate and energy composition of experimental diets for finisher broiler birds (g100g⁻¹)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>T1 NGS</th>
<th>T2 PTGS</th>
<th>T3 ATGS</th>
<th>T4 STGS</th>
<th>T5 UTGS</th>
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<td>CP</td>
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<tr>
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<td>6.53</td>
<td>6.54</td>
<td>6.22</td>
<td>6.62</td>
</tr>
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<tr>
<td>Ash</td>
<td>4.89</td>
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<td>4.52</td>
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<td>4.33</td>
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<td>36.61</td>
<td>38.34</td>
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</tr>
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<td>Hemicellulose</td>
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<td>20.25</td>
<td>23.85</td>
<td>21.45</td>
<td>20.28</td>
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<tr>
<td>Cellulose</td>
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<td>12.76</td>
<td>14.24</td>
<td>13.45</td>
<td>15.12</td>
</tr>
<tr>
<td>Calcium</td>
<td>1.04</td>
<td>1.01</td>
<td>1.01</td>
<td>1.01</td>
<td>1.01</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>0.85</td>
<td>0.75</td>
<td>0.75</td>
<td>0.75</td>
<td>0.75</td>
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<tr>
<td>Energy (Kcalkg⁻¹ ME)</td>
<td>2791.64</td>
<td>2797.54</td>
<td>2799.58</td>
<td>2790.19</td>
<td>2780.24</td>
</tr>
</tbody>
</table>


using 5mls sterile disposable needles under the wings of the birds and emptied into sample bottles containing Ethylene diamine tetra acetic Acid (EDTA) as anticoagulant to prevent clothing of the blood. Red blood cells (RBC) White Blood cells (WBC) hemoglobin (Hb), packed cell volume (PCV) and leukocyte differential were analyzed according to Schalm et al. (1975). The PCV was analyzed using microhaematocrit method; haemoglobin concentration was also determined by Schalm et al. (1975). Erythrocyte indices of Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC) were determined using the formula of Schalm et al. (1975):

\[
\text{MCV} = \frac{\text{PCV} \times 10}{\text{RBC}} \text{ fentolitre (fl)}
\]

\[
\text{MCH} = \frac{\text{Hb} \times 10}{\text{RBC}} \text{ pictogram (pg)}
\]

\[
\text{MCHC} = \frac{\text{Hb} \times 100}{\text{PCV}} \text{ gram per deciliter (gm dl⁻¹)}
\]

Blood samples were also being collected in separate sample bottles without anti-coagulant to allow for clotting for serum biochemical analysis. Serum protein, urea, uric acid, albumen and cholesterol were analyzed using sigma kits. Glucose was analyzed according to Feteris...
(1965) and cholesterol according to Roschlan et al. (1974).

Carcass characteristics

At 8 weeks of age, carcass data were collected from four randomly selected birds per treatment group. The birds were fasted for 12h (but had access to water only) and individually weighed using a 5-kg scale with a precision of 0.005. The birds were starved to determine the actual live weight of the birds and reduce gut content thus, reducing the risk of contamination of the carcass during dressing without affecting meat quality. They were then slaughtered by severing the carotid arteries and jugular veins and blood drained under gravity; the carcasses were then divided into the following parts as described by Kleczek et al. (2007).

- **Head**: the head was obtained by cutting off between the occipital condyl and the atlas
- **Neck**: this was obtained by cutting along the line joining the cephalic borders of the coracoids
- **Wing**: the wing was obtained by cutting through the shoulder joint
- **Thigh**: this was obtained by cutting through the hip joint (from the pubic process, through the groin towards the back, and the along the backbone, starting from the anterior border of the pelvis)
- **Breast**: it was obtained by a double cut through the cartilaginous junctures of the ribs, from the anterior border of the backbone towards the coracoids
- **Back**: this is referred to as the dorsal-lumbar quarter (the remaining part of the carcass)

The relative fasted body weight (% of final live body weight) was obtained. The weight of the thigh, breast, and back were taken as the carcass weight, was later expressed as percentage of the final live body weight. Similarly, the relative weights of the cut parts (head, neck, wing, thigh, breast, and back) and the visceral organs (liver, heart, and small and large intestines) were determined using the formula (Mohammed et al., 2008; Grosso et al., 2009):

\[
\text{Relative weight (cut part or organ)} = \frac{\text{Fresh weight of cut part or organ}}{\text{Final live body weight of bird}} \times 100
\]

STATISTICAL ANALYSIS

Data obtained were subjected to One Way Analysis of Variance (ANOVA). The separation of means was effected using least significant difference method and tested at probability level of 5% as described by Steel and Torrie (1980). Each bird was randomly assigned to a test diet in a Completely Randomized Design (CRD). The following statistical model was used:

\[
Y_{ij} = \mu + T_i + \mu_i + \epsilon_{ij}
\]

Where \(Y_{ij}\): Individual observation

\(\mu\): Population Mean

\(T_i\): Treatment Error

\(\mu_i\): Random error

RESULTS AND DISCUSSION

Proximate composition of treated and untreated groundnut shell

The proximate composition of the various alkali-treated and untreated groundnut shell meal (table 1) indicates that dry matter was highest in the UTGS (96.11%) compared to the others, PTGS (85.59%), ATGS (84.36%) and STGS (86.47%). The crude protein level was also highest in the UTGS (13.88%). Similarly, the crude fibre was highest in the UTGS (37.82%) as compared to the PTGS (10.26%), ATGS (10.19%) and STGS (10.84%). The ether extract were within the normal range for fibrous materials (McDonald et al., 1995) which is about 1.25 – 2.00%. The values recorded in the present study were lower than those reported by Aduku (2004) for crude protein, energy and NFE for maize but higher than the value of crude fibre. Similarly, the hemicellulose and cellulose were within the normal range for fibre, the marginal variations recorded were probably due to the different processing methods; calcium and phosphorus were calculated according to Pauzenga (1985).

Carcass quality

The result of the effect of alkali-treated groundnut shell meal on carcass characteristics of broiler finisher birds is presented in table 3. The result showed that both the cut parts (back, drumsticks, thigh, neck, wings, legs and head) did not vary significantly (\(P>0.05\)) across the dietary treatments. Similarly, the fasted weights, dressed weights and dressing percentages did not shows any variation (\(P>0.05\)) due to the dietary treatment. Similarly, length of the small intestines (64.25 vs. 69.75 vs. 64.00 vs. 78.25 and 86.50cm) and large intestine (11.25 vs. 11.25 vs. 10.90 vs. 11.25 and 13.00cm) for UTGS tended to be longer (\(P>0.05\)) compared to TGS and the control diets. Similar findings (Isikevenu et al., 2010) support the result of the present study where the authors evaluated the effects of replacing groundnut cake with urea-treated and fermented brewer’s dried grains fed broiler finishers and observed that all the carcass parameters evaluated were not significantly affected by the treatment. The values recorded in this study were close to 1990 – 1710 g/bird and 1640 – 2060 g/bird for dressed weight and fasted weight respectively. Since the carcass measurements were similar for all treatment groups, it can be inferred that alkali-treated GS are similar nutritionally, and capable of tissue synthesis in broilers under the same environment.

The cut-up parts such as back, drumstick, thigh and...
wings weights (expressed as a percentage of fasted live weight) of broilers birds which were not significantly different fell within the range reported by other workers (Leeson and summers, 1980; Broadbent et al., 1981 and Njoku, 1986). The organ weight of liver also expressed as a percentage of live weight was not different among the dietary treatments; this is a confirmation of the fact that the incorporation of ATGSM in place of energy based ingredient (maize) in broiler diets does not cause any toxicity or abnormal metabolic activities in their organs or systems, and therefore, safe for use in broiler production. The values of organs weights obtained in this study are in agreement with those reported by Madhusuhan et al., (1986); Ologhobo (1990); Akpodiete et al., (1997); Fanimo et al. (2005) and Isiokwu et al. (2010) who observed no gross morphological changes nor histopathological manifestation in the organs of birds fed diets compounded from various feed ingredients. The color, small intestines (expressed in cm) were not significantly influenced by the dietary treatments; they tended to be shorter compared to the normal and UTGSM. This observation may be explained by the fact that broilers fed with untreated fibrous diets had their gastrointestinal tracts (GIT) modified to enable them accommodate their more bulky rations thereby resulting in increased length of the GIT and its component section. This observation is supported by the antecedent reports of savory and Gentle (1976a and 1976b); Abdelsamie et al. (1983); Krogdahl (1986); Hetland and Svihus (2001). Hetland et al. (2002) and Hetland et al. (2003) reported increase in length of GIT in broilers and Japanese quails when high fibre diets were fed to them.

Blood parameters

Table 4 summarizes the results of the effect of ATGSM on blood constituents of broiler finisher birds. The result obtained for haematological parameters and serum metabolites showed no significant (P > 0.05) differences and fell within the normal range for chickens as earlier expected.
reported by Mitruka and Rawnsley (1977) but contradicted the report of Ogunwole et al. (1984), that high fibre diets reduce serum glucose concentration. There were no significant (P>0.05) differences in packed cell volume (PCV), haemoglobin concentration (Hb), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) values among broilers fed the dietary treatments. Similarly, there was no variation (P>0.05) observed in red blood cells count (RBC) and white blood cells count (WBC) values among treatments. The PCV values ranged from 14.50 – 19.50% though not different (P>0.05) but were observed to be higher in control and PTGS diets compared to ATGS, STGS and UTGS diets. The Hb values (10.45 vs. 11.10 vs. 9.40 vs. 8.80 and 9.50 gdl$^{-1}$) though not different (P>0.05) but were found to be higher in birds fed the control and PTGS diets. Red blood cells count were similar (P>0.05) among broilers fed the control, treated and untreated diets. Similarly, the values (97.80 vs. 81.65 vs. 82.85 vs. 81.50 and 79.60 x10$^{3}$μl) obtained for white blood cells count showed no significant (P>0.05) variation among the treatment groups; same trend was observed for MCV (117.50 vs. 116.50 vs. 123.50 vs. 114.50 and 113.50 fl), MCH (78.45 vs. 77.20 vs. 78.15 vs. 75.30 and 74.50 gdl$^{-1}$) and MCHC (66.55 vs. 62.90 vs. 63.15 vs. 65.80 and 59.00 gdl$^{-1}$). The total protein (59.00 vs. 64.00 vs. 67.50 vs. 60.50 and 60.00 gdl$^{-1}$) showed no variation (P>0.05) though ATGS and UTGS had higher values compared to the control. Birds fed the normal diet and ATGS had higher values (P>0.05) of glucose than the other diets, similarly creatinine values for normal diet (40.35gdl$^{-1}$) and STGS were higher (P>0.05) than those fed PTGS, ATGS and UTGS diet values recorded for triglyceraldehyde were highest in bros fed the ATGS and STGS diets followed by those fed the normal diet (2.00 gdl$^{-1}$), UTGS and PTGS. The values recorded in this study fell within the normal ranges as reported by Mitruka and Rawnsley (1977) and were close to those earlier reported (Isikewenu and Omeje, 2007 and Adebiyi et al., 2009).

CONCLUSION AND RECOMMENDATION

Based on the conditions of this experiment, supplementing alkali-treated groundnut shell meal in the diets of finisher chickens is recommended especially if potash is chosen for processing. This is because the dietary treatments did not affect negatively the health status and meat quality of the birds.

REFERENCES


