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Haematological and biochemical parameters of West Africa Dwarf goats fed pleurotus tuber regium biodegraded groundnut shells included diets

Abstract

A total of twenty (20) West African Dwarf (WAD) bucks with an average weight of 6.5 kg were used to study the Haematological and biochemical parameters. The animals were weighed and randomly distributed into five treatment groups of four animals per treatment diets containing varying levels of undegraded ground nut shells (UGNS) and Pleurotus tuber regium biodegraded ground nut shells (PT-GNS) in a Completely Randomized Design for the feeding trial (T1=100% UGN, T2=75% UGN + 25% PT-GNS, T3= 50% UGN + 50% PT-GNS, T4= 25% UGN + 75% PT-GNS and T5= 100% PT-GNS) such that each animal served as a replicate. Feed and water were provided at *lib libitum*. Blood samples were collected from the jugular vein of the 20 WAD goats at the 84th day of the feeding trail. Three milliliter (3ml) of blood collected from each of these goats were stored in plastic sample bottles containing EDTA (ethylene diamine tetra acetic acid) for haematological and serum biochemistry study. The result showed all haematological parameters showed significance ($P<0.05$) difference except mean corpuscular volume. Serum biochemistry also showed significance ($P<0.05$) difference except for calcium and urea. The study concluded that for groundnut shells to make a substantial contribution to ruminant nutrition, it must be treated in some ways to improve its nutritional potentials and make it easier for rumen microbes to attack the fibre.

Keywords: haematological, biochemical, parameters, groundnut shell

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Dauda A,[1] Saingbe PA,[2] Jibrin DN[3]
[1]Department of Animal Production and Health, Federal University Wukari, Nigeria
[2]Department of Animal Nutrition, Federal University of Agriculture Makurdi
[3]Department of Biological sciences Borno State University, Nigeria

Correspondence: Dauda A, Department of animal production and health, Federal university wukari, taraba State, Nigeria, Email ayubadaud87@gmail.com

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Introduction

The shortage of feeds in general and protein in particular attract attention of many researchers to manipulate the unconventional sources of feeds.[1] On the other hand, huge amounts of lignocellulostic wastes and residues, of agricultural, forest, industrial and domestic origin are generated annually. Such materials are comprised for the most part of cellulose, hemicellulose and lignin. Lignin is a main constituent of ADF, and is non-digestible by ruminants and resistant to most of the microbial enzymatic systems as well. The presence of lignin and its hemicellulose binding matrix increases the unavailability of other energy-containing constituents present in the agricultural residues for the ruminants.[2] The primary factors limit utilization of crop residues are low digestibility, low protein content, high crude fiber and low palatability. Their low digestibility generally due to the high fibrous contents consists mainly of 30–40% cellulose; 25–35% hemicelluloses and 10–15% lignin on dry matter (DM) base.[3] One of the strategies to utilize agricultural wastes and by- products is to biodegrade with edible fungi such as *Pleurotus tuber- regium* that will not only improve the quality of fibre but also help in obtaining protein rich substrates. Edible fungi are able to bioconvert a wide variety of lignocellulosic materials due to the secretion of extracellular enzymes.[4] The use of microorganisms to convert carbohydrates, lignocelluloses and other industrial wastes into feedstuffs rich in protein is possible due to the ability of microorganisms to grow very fast on the substrate.[5] In Nigeria, groundnut shells abound, bioconverting them to livestock feeding will reduce the environmental hazard of burning them and also help in providing better quality feedstuff for ruminant animals. Thus, this study was carried out to determine the effect of Haematological and biochemical parameters of West African dwarf goats fed *Pleurotus tuber regium* biodegraded groundnut Shells Included Diets.

Materials and methods

The study was conducted at the Farm Unit of the College of Agriculture, Lafia, Nasarawa State. Lafia is located on Latitude 08^0 North, Longitude 08^0 East and Altitude 164.5m in the guinea savannah vegetation with its sandy loam soil texture.[6] A total of twenty (20) West African Dwarf (WAD) bucks with an average weight of 6.5 kg were sourced within Lafia L.G.A, Nasarawa State. A week to their arrival, the pens were swept, washed and disinfected using a strong disinfectant solution (Morigard). The feeding and drinking trough were all properly washed and sun-dried. The animals were quarantine for fourteen (14) days to further examine them. Two weeks before the commencement of the experiment, the animals were vaccinated against *Pest de Petits* Ruminant using Rinderpest Tissue Culture (RTCV) vaccine, subcutaneously at 1ml/10kg body weight. Also, they were given a complete course of antibiotics (Tridox long acting) to produce a uniform health status among the animals. The animals were also dewormed using ivomectin, through intramuscular at 3ml/10 kg body weight. The animals were weighed and randomly distributed into five treatment groups of four animals per treatment such that each animal served as a replicate. Fourteen days were allowed for adjustment to the feed as well as the environment. The animals were weighed and randomly distributed into five treatment groups of four animals per treatment diets containing varying levels of undegraded groundnut shells (UGNS) and *Pleurotus tuber regium* biodegraded ground nut shells (PT-GNS) in a Completely Randomized Design for the feeding trial (T1=100% UGN, T2=75% UGN + 25% PT-GNS, T3= 50% UGN + 50% PT-GNS, T4= 25% UGN + 75% PT-GNS and T5= 100% PT-GNS) such that each animal served as a replicate. Feed and water were provided at *lib libitum*. Feed and water were provided at *lib libitum.*

Collection of groundnut shells and *Pleurotus tuber-regium* (PTR)

Groundnut shells were obtained from the Eggon Women Groundnut Oil Processing Industry, Nasarawa Eggon L.G.A, Nasarawa State. It was milled to reduce its particle size and create greater surface area for microbial activity. The sample of PTR was obtained from Lafia modern Market, Lafia Nasarawa State.

Treatment of groundnut shells with *Pleurotus tuber-regium*

Tubers of PTR were weighed, washed and soaked in water for one hour after which they were removed and put in white transparent buckets and covered for two days to enable spore formation of the tubers. After two days, the tubers were removed and dissected to smaller bits carrying the spores. The composted shells were loaded on three tier wooden tray of dimension 1.5m x 1.2m x 0.75m (height, breadth and width) constructed using 2x2 wood and wire mesh base. The base of the wooden tray was covered with white transparent polyethene sheet disinfected using methylated spirit soaked cotton wool. Spores of PTR were then inoculated into the composted groundnut shells at the rate of 1.0 kg spores to 5.0 kg groundnut shells. The ends of the polyethene sheets was brought together and sealed to create an air tight environment. This was allowed for 30 days to allow the mass of the composted shells to be completely colonized by mycelium of the fungus showing whitish growths. After 30 days the colonized mass of composted shells was taken out from the inoculation room and sundried to terminate growth of the fungus. The material was sundried to a constant weight and then put in sacks for use. (Figure 1)

Figure 1 Groundnut shell.

Haematological and Serum biochemical parameters of WAD Goats fed diets containing *Pleurotus tuber – regium* biodegraded and untreated groundnut shell

Blood samples were collected from the jugular vein of the 20 WAD goats at the 84th day of the feeding trail. Three milliliter (3ml) of blood collected from each of these goats were stored in plastic sample bottles containing EDTA (ethylene diamine tetra acetic acid) for haematological studies, while another 7ml were deposited into anticoagulant free plastic tube and allowed to clot at room temperature within three hours of collection. The serum samples were stored at a temperature of -20ºC prior to biochemical studies.

Blood analysis

The haematological analysis were carried out according to procedures by Jain[7] to determine: Packed cell volume (PCV), Haemoglobin concentration (Hb), Erythrocytes (RBC), Leucocytes counts (WBC);Mean corpuscular volume (MCV), Mean corpuscular haemoglobin (MCH), and Mean corpuscularhaemoglobin concentration (MCHC), were determined according to method described by Schalm. Biochemical parameters were determined by the method described by Khon & Allen.[8] The parameters were Serum Sodium (mol/L), Potassium(mol/L), Chloride (mol/L), Calcium (mol/L), Phosphorus (mol/L), Urea (mol/L), Cholesterol (mol/L), Glucose (mol/L), Total protein (g/L), Albumin (g/L) and Globulin (g/L).

Statistical analysis

Data obtained from the study were subjected to one way analysis of variance (ANOVA) using the Minitab.[9] Statistical Software and were significance differences occurred, means were separated using the Duncan's Multiple Range Test (DMRT).

Results and discussion

The haematological parameters of WAD bucks fed treatment diets are presented in Table 1. The result showed Significant ($P<0.05$) difference for pack cell volume (PCV), haemoglobin concentration (Hb), white blood cell (WBC), red blood cell (RBC) and mean corpuscular haemoglobin (MCH) of the bucks. The PCV values of 29.00, 29.50, 26.50, 27.50 and 30.50 % were obtained for bucks in T1, T2, T3, T4 and T5 respectively. All PCV values reported in this work fell within the ranged reported by Njidda[10] for WAD goats of semi-arid environment fed on natural rangeland of Northern Nigeria. The significant variations in PCV values in this study may be in response to the crude protein (CP) content which also varied among treatment diets. Arigbede,[11] attributed non-significant PCV values to marginal differences in CP content of diets while Babayemi[12] attributed significant difference in PCV values to variation in CP levels of the diets. In this study, the dietary CP level varied from 14.16 % (T1) to 17.58 % (T5) and is believed to be responsible for significant variation in PCV values. Hb concentration was 9.00, 11.46, 11.65, 9.05 and 10.35 g/dl in the same order aforementioned. The Hb result of this study agrees with works of Grunwaldt[13] & Belewu,[14] but disagree with that of Daramola[15] for healthy WAD goats. This Hb result is attributed to the protein content of the dietary treatments. According to Babayemi,[12] low Hb values connote nutritional anaemia. In this study, the nutrient status of the dietary treatments were high, thus eliminating possibility of nutritional anaemia, and giving credence to the significantly different Hb values for the different dietary treatments. WBC was 6.00, 6.30, 5.50, 5.75 and 4.10 x 10^3/µl for T1, T2, T3, T4 and T5 respectively. The WBC result obtained in this study 4.10 – 6.30 (x10^3/ µl) agrees with the report of Elitok[16] 4.27 – 7.09 (x10^3/ µl) for Saanen goat, but contradicts that of Oduguwa[17] & Daramola[15] who reported higher values of 9.27 – 11.22 (x10^3/ µl) when evaluating the haematological and biochemical parameters of WAD goats. The significance of WBC in this study indicates the ability of the dietary treatments to confer similar body immunity against diseases.[15] Similarity in WBC may imply conferment with similar immunity since WBC is known to fight disease. While RBC obtained was 9.74, 7.25, 6.84, 6.62 and 8.48 x 10^6/µl for T1, T2, T3, T4 and T5 in that order. The red blood cell (RBC) result 6.62 – 9.74 (x10^6/ µl) agrees with 6.13 – 8.76 (x10^6/ µl) by Ashiru on Yankasa rams fed sugarcane waste, but disagrees with Belewu,[14] who reported 11.31 – 14.72 (x10^6/ µl) for healthy Red Sokoto goats. The significant difference observed in this study may be in response to the crude protein levels of the dietary treatments.[15] The mean corpuscular haemoglobin (MCH) gave 39.25, 47.15, 44.55, 43.35 and 36.25 for T1, T2, T3, T4 and

T5 respectively. Mean Corpuscular Haemoglobin Concentration (MCHC) in this haematology study produced 30.95, 28.00, 32.65, 29.15 and 31.15 for T1, T2, T3, T4 and T5 respectively.The values for MVC were not significant (P>0.05) and recorded 70.45, 65.30, 83.40, 67.35 and 77.39 for bucks in T1, T2, T3, T4 and T5 respectively. The MCV values 65.30 – 77.39 (fl) agrees with the works of Oduguwa[17] & Grunwaldt[13] for healthy WAD goats, but contradicts the report of Elitok[16] for healthy Saanen goats. The normal and similar values go to buttress the assertion by Fradson[18] that normal values could imply that the animals may neither stand the risk of hemoconcentration nor anaemia. This is supported by adequacy of the nutrient contents of the dietary treatments as well as nutrient intake by the experimental animals.

Table 1 Haematological parameters of wad bucks fed diets containing untreated and fungal biodegraded groundnut shells

	Experimental diets						
Parameter	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**	**LOS**
Packed cell volume (%)	29.00^{c}	29.50^{b}	26.50^{d}	27.50^{d}	30.50^{a}	1.77	*
Haemoglobin concentration (g/dl)	9.00^{d}	11.46^{a}	11.65^{a}	9.05^{c}	10.35^{b}	0.36	*
Leucocytes count (x10^{3}/µl)	6.00^{b}	6.30^{a}	5.50^{d}	5.75^{c}	4.10^{e}	0.58	*
Erythrocyte (x10^{6}/ µl)	9.74^{a}	7.25^{c}	6.84^{d}	6.62^{d}	8.45^{b}	0.45	*
Mean corpuscular haemoglobin (Pg)	39.25^{c}	47.15^{a}	44.55^{a}	43.35^{b}	36.25^{d}	3.95	*
Mean corpuscular volume, (fl)	70.45	65.3	83.4	67.35	77.39	2.62	ns
Mean corpuscular haemoglobin concentration (g/dl)	30.95^{b}	28.00^{d}	32.65^{a}	29.15^{c}	31.15^{a}	2.68	*

a,b,c,d,e – Means on the same row with different superscripts are significantly different (P<0.05).

SEM, standard error of the mean; LOS, level of significance; ns, not significantly different (P>0.05). * - Significantly different (P<0.05) T1=100% UGN, T2=75% UGN + 25% PT-GNS, T3= 50% UGN + 50% PT-GNS, T4= 25% UGN + 75% PT-GNS, T5= 100% PT-GNS.

The serum biochemical parameters are presented in (Table 2). The result showed significant (P<0.05) difference among the treatments. Serum sodium in this study ranged from 140.50 – 145.50 mmol/L with the highest value in T4 and lowest value in T3. The value reported in this study is higher than the ranged value of 126.1+2.2 – 138.76+9.71 mmol/L reported by Akinrinmade & Akinrinde[19] of serum biochemical indices of West African dwarf goats with foreign body rumen impaction. The value in this study is also higher than ranged value of 119.32 – 130.72 mmol/L of Serum Biochemical Profiles of Dwarf Goats Fed Elephant Grass and Varying Levels of Combined Plantain with Mango Peels.[20] The variation in the serum sodium between this study and other findings could be as a result of differences in feeds. Potassium obtained in this study were 3.70, 3.90, 3.30, 3.45 and 3.55 mmol/L for T1, T2, T3, T4 and T5 respectively which is lower than the potassium (4.59mmol/l) reported.[20] Urea levels of the buck's serum obtained in this study were 5.85, 6.45, 6.56, 6.05 and 7.70 mmol/L for T1, T2, T3, T4 and T5 respectively. The urea values (5.85 – 7.70 mmol/L) reported in this study agree with the findings of Daramola[15], Grunwalt[13] and Opara[21] for healthy WAD bucks. The range of urea values obtained may be attributed to sufficient of protein quality fed to the experimental animals. Daramola[15] reported that higher values of urea (above reference range 2.5-7.1mmol/L) could be attributed to an imbalance in amino acids, indicating that the diet had lower biological values. Chloride Cholesterol concentration obtained in the study were 4.65, 5.50, 5.25, 5.45 and 4.80 for T1, T2, T3, T4 and T5 respectively. Cholesterol result obtained in this study agrees with the finding of Opara[21] for healthy WAD bucks. The cholesterol values are within the reference range and are thus expected to be beneficial to the animals. According to Zubcic,[22] that blood cholesterol is not affected by feeding system; but shows an increasing trend after puberty. It is also reasoned that with this cholesterol level, the animals would not face the risk of myocardial infractions usually associated with high blood cholesterol content and emaciation due to low serum cholesterol.[23] Glucose content was 7.05, 4.50, 5.25, 4.35 and 6.55 for T1, T2, T3, T4 and T5 respectively. The glucose was high in control T1 and followed T4. Konlan[24] reported that blood glucose level is maintained as a result of glucose exclusion from the tissue together with an increase in the use of ketone and fatty acids. Total protein in the serum gave 56.00, 61.50, 57.50, 62.50 and 67.50 g/L for T1, T2, T3, T4 and T5 respectively. Total protein values (56.0 – 67.50 g/l) in this study agree with the result of Elitok[16] & Babayemi[12] but disagree with results of. Grunwalt.[13] Oduguwa[17] reported that high values of total protein are attributed to high quality of the diet and health status of the animals. Since the diets provided suitable nutrient in quantity and quality, it is reasoned that the similarity in total protein value is normal. Values for albumin obtained were 27.48, 27.13, 25.22, 30.17 and 28.71 g/l for T1, T2, T3, T4 and T5 respectively. The Albumin values obtained in this study agrees with the works of Elitok[16] & Grunwalt.[13] Imasuen & Isidahomen[25] had reported significant effect of location and high tannin content feeds on albumin of WAD goats. In this study, the experimental animals were kept in the same location and also high tannin was not in the experimental diets. Globulin values obtained were 36.37, 40.15, 48.24, 43.18 and 49.00 g/l in that order too. Calcium level in this study showed no significant (P>0.05) difference among treatments. The Globulin obtained in this work showed a significant difference as was earlier reported by Opara[21] for healthy WAD bucks. The report however contradicts that of Elitok[16] for Saanen goat. The significantly different globulin values are however of no consequence because they all fell within the reference range.

Table 2 Serum biochemical parameters of wad bucks fed diets containing untreated and treated groundnut shells using white-rot fungus (pleurotus tuber-regium)

	Experimental diets						
Parameter	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**	**LOS**
Serum sodium (mmol/L)	144.50^{ab}	141.50^{b}	140.50^{c}	145.50^{a}	143.50^{ab}	3.51	*
Potassium (mmol/L)	3.70^{a}	3.90^{a}	3.30^{c}	3.45^{b}	3.55^{a}	0.63	*
Chloride (mmol/L)	98.50^{a}	96.50^{a}	94.50^{c}	96.50^{b}	92.50^{d}	2.11	*
Calcium (mmol/L)	2.30	2.20	2.70	2.30	2.75	0.4	Ns
Urea (mmol/L)	5.85^{c}	6.45^{b}	6.55^{b}	6.05^{b}	7.70^{a}	0.3	Ns
Cholesterol (mmol/L)	4.65^{d}	5.50^{a}	5.25^{b}	5.45^{a}	4.80^{c}	0.44	*
Glucose (mmol/L)	7.05^{a}	4.50^{c}	5.75^{c}	4.35^{d}	6.55^{b}	0.28	*
Total protein (g/l)	56.00^{d}	61.50^{c}	57.50^{d}	62.50^{b}	67.50^{a}	1.79	*
Albumin (g/l)	27.48^{c}	27.13^{d}	25.22^{e}	30.17^{a}	28.71^{b}	0.94	*
Globulin (g/l)	28.52	34.37	32.28	32.33	38.79	0.36	

a,b,c,d,e – Means on the same row with different superscripts are significantly different (P<0.05).

SEM, standard error of the mean; LOS, level of significance; ns, not significantly different, * - Significantly different (P<0.05). T1=100% UGN, T2=75% UGN + 25% PT-GNS, T3= 50% UGN + 50% PT-GNS, T4= 25% UGN + 75% PT-GNS, T5= 100% PT-GNS.

Conclusion

Results obtained in the present study showed significant (P<0.05) difference in all the haematological indices except mean corpuscular volume showed non significance (P>0.05) difference and serum biochemical except calcium and urea. This means that Groundnut shells have shown to be a good substrate when treated with white rot fungi (*Pleurotus tuber-regium* in the diet WAD buck in the solid state fermentation. Groundnut shells are lignocellulosic in nature and poor in protein content, so it cannot support rumen microbes for optimum activity. For groundnut shells to make a substantial contribution to ruminant nutrition, it must be treated in some ways to improve its nutritional potentials and make it easier for rumen microbes to attack the fibre.

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None.

Conflicts of interest

The authors declare no conflicts of interest.

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