*IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)*
*e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 11, Issue 5 Ver. I (May 2018), PP 57-63*
*www.iosrjournals.org*

# Haematological Parameters and Serum Biochemistry of West African Dwarf Sheep Fed Ensiled Maize Stover and Concentrate Supplements

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***Abstract:*** *An experiment was conducted to evaluate the haematological and serum biochemistry of twenty West African Dwarf (WAD) Sheep fed diets contained ensiled maize stover (EMS) and concentrate supplements (CS) after fifteen weeks of feeding trial. The five tested diets were: A (75% EMS+25 %CS), B (50% EMS+50% CS), C (25% EMS+75% CS), D (100% EMS) and E (100% CS). The sheep were divided into five groups of four animals each. Each group of sheep was randomly allocated to one of the experimental diets in 105 days of feeding trials. Blood samples were collected at the end of 15 weeks of feeding trial for haematological and serum chemistry analysis. The results obtained showed that Packed Cell Volume (PVC) and haemoglobin (Hb) concentrations in the blood did not differ significantly (P>0.05) between the dietary treatments. However, there was significant (P<0.05) differences in red blood cells concentration between dietary treatments such that it was highest in diet A (3.51x10$^6$ µ/ml). The white blood cell (WBC), neutrophil (NEUT), lymphocyte (LYMP) and eosinophil (EOSI) counts of WAD sheep fed experimental diets were significantly (P<0.05) influenced by the treatments. The serum biochemistry results showed that the total protein of WAD sheep fed diet D was significantly (P<0.05) lowest among the treatments means while the serum protein of animals fed diet E was significantly (P<0.05) highest between the dietary treatments but similar to animals fed diets A, B and C. The mean serum albumin, albumin/globulin ratio and creatinine of the animals assessed in this study, were not significantly influenced by the dietary trearments. However, serum urea, cholesterol and glucose were significantly (P<0.05) affected. The result obtained in this study showed that ensiled maize stover as a sole feed or supplemented with concentrate did not have adverse effects on health status of WAD sheep.*

***Key words:*** *WAD sheep, ensiled maize stover, haematological, serum biochemistry and creatinine.*

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Date of Submission: 01-05-2018 Date of acceptance: 17-05-2018

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## I. Introduction

To meet the high demand for meat as a source of animal protein in the future, much of the increase in meat production would have to come from short-cycle animals which require a little management practice to rear them. Examples are the domestic goat, sheep and other mini-livestock such as the grasscutter.

Sheep are believed to have evolved in the dry and mountainous regions of Southwest and Central Asia. Present day domesticated sheep were derived from strains of the wild animals in existence in Southwest Asia some 8,000 – 10,000 years ago [1]. They can survive in many areas especially in arid tropics where cattle would perform poorly and play a significant role in the economy and nutrition of rural and urban dwellers. In Nigeria where production of small ruminants is largely extensive, and fodder provision erratic throughout the year, survivability of sheep has been low due to poor nutrition. Available reports [2, 3] that post-weaning mortality in small ruminants in Nigeria is between 30 – 40%. Among other reasons, poor postnatal weights of kids and lambs, which invariably is linked to poor nourishment has been majorly implicated [3].

Furthermore, carcass products and by-products are important indicators of type and level of feeding [4]. Nutrition is one of the most important factors in production. So animals on good plane of nutrition regardless of breed are likely to dress out better [5]. However, the high cost of conventional feed ingredients which has resulted to high cost of animal production [6] limits profitable production. Thus the need for search and usage of unconventional feedstuffs which if properly harnessed can constitute potential feedstuffs for livestock feeding. Harvested crop residues constitute an important feed for ruminants. Estimates in Africa alone show that more than 340 million tones of fibrous crop residues are produced annually most of which are unutilised [7]. Maize stover is a residue from maize plant after harvested the cob. The residues are estimated to be about 4.11 million tones per year [8]. Ruminants have potential to utilise the stover but the stover dries up quickly. There is thus a need for preservation. Ensiling has been reported to effectively conserve forages and fodder crops [9]. Silage

can be an economical source of nutrients for sheep and goats especially on large farms where feeding can be mechanized [10].

Haematological and serum biochemical values have been considered useful for the evaluation of body condition and the nutritional and immune status in animal where other tissue related measurements are not available [11, 12, 13 and 14]. The significance of determining haematological and biochemical indices of domestic animals have been well documented [15] and changes of these parameters have been studied in cattle [16], sheep [17, 18, 19 and 20] and goat [3 and14]. When blood is examined, it provides a good opportunity to clinically investigate the presence of several metabolites and other constituents in the body of an animal. This is in line with the recommendation of WHO [21] on the use of blood biochemical values in medical nutritional assessment. Blood examination is also a good way of assessing the health status of an animal as it plays a vital role in the physiological, nutritional and pathological status of an animal/organism [22]. Haematological and serum biochemical parameters are good indices of the physiological status of animals and changes in the values of these parameters can be used to assess the response of animals to various physiological situations [23]. Tewe *et al*. [24] reported that the importance of investigating blood composition is to have a way of distinguishing normal status from state of stress. Such stress factor can be nutritional, environmental or physical; thus, this study was designed to evaluate the haematological and serum biochemical values of WAD sheep fed ensiled maize stover and concentrate supplements.

## II. Materials And Methods

**Collection and Evaluation of Blood Samples**

At the end of the experiment, blood samples were collected from the jugular vein of each animal (sheep) for haematology and serum biochemistry analysis. Blood samples for haematology were collected into sterile vacutainer tubes containing EDTA (Ethylene diamine tetra acetic acid) while that of serum separation was without EDTA to allow blood clotting and serum was decanted for the analysis. During the collection, care was taking to avoid contamination with hairs, dirt and microorganism.

**Haematology**

The packed cell volume (PCV) and haemoglobin (Hb) were determined using micro haematocrit method and cyanmethaemoglobin method as described by Mitruka and Rawnsley [25]. Red Blood Count (RBC) and White Blood Count (WBC) were determined using Neubauer haemocytometer after appropriate dilution [26] and Kelly [27].

**Serum Biochemistry**

Serum total protein was determined using Buiret method as described by Reinhold, [28] and Kohn and Allen [29] while albumin was determined using bromocresol green (BCG) method as described by Peter *et al*.,[30]. The globulin concentration was obtained by subtracting albumin from the total protein while the albumin/globulin ratio was obtained by dividing the albumin value by the calculated globulin value. Serum urea was determined by urease method and creatinine by Folinwu filtrate methods as described by Toro and Ackermann [31]. Also, serum glucose was determined by O-Tluidine method using acetic acids [32] while serum cholesterol was determined using appropriate laboratory kits [33and34].

**Statistical Analysis**

The experimental design was completely randomized design (CRD). Data obtained were subjected to analysis of variance (ANOVA) using the procedure of SAS [35] package to determine the effect of dietary treatments on the various parameters studied. Significant means were separated using Duncan multiple range test of the same software.

**Table .1:** Ingredient composition (%) of experimental diets fed to WAD sheep

| Ingredient | Experimental Diets | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| EMS | 75 | | 25 | 100 | - |
| CS | 25 | | 75 | - | 100 |
| Total | 100 | 100 | 100 | 100 | 100 |

EMS = Ensiled Maize Silage

CS = Concentrate supplements

**Table. 2:** Ingredient and crude protein composition (%) of concentrate supplement Fed to WAD sheep

| Ingredient | Percentage |
|---|---|
| Wheat bran | 60.00 |
| Palm kernel cake | 25.00 |
| Corn bran | 10.00 |
| Oyster shell | 3.00 |
| Salt | 1.00 |
| Premix (Ruminants) | 1.00 |
| Total | 100.00 |
| Crude protein | 15.30 |

## III. Results

**Haematological response of West African Dwarf Sheep fed ensiled maize stover and concentrate supplements**

The results of haematological response of the animals are shown in Table 3. The results obtained showed that Packed Cell volume (PVC) and haemoglobin (Hb) concentrations in the blood did not differ significantly ($P > 0.05$) between the dietary treatments. However, there was significant ($P < 0.05$) differences in red blood cells concentration between the dietary treatments such that it was highest in diet A ($3.51 \times 10^6$µ/ml).

The white blood cell (WBC), neutrophil (NEUT), lymphocyte (LYMP) and eosinophil (EOSI) counts of WAD sheep fed the experimental diets were significantly ($P < 0.05$) influenced by the treatments. The mean WBC counts of animals fed diets A and B were significantly higher than those animals that were fed diets C and D but similar to diet E. However, lymphocyte counts of animals fed diet E was significantly ($P < 0.05$) lower to those fed diet A but similar to those fed diets B, and D. The values for EOSI counts were significantly highest in diet E and D while it was lower in diet B. However, values for monocytes counts for animals in experimental diets were similar ($P > 0.05$) across the treatments.

**Table 3:** Haematological parameters of WAD sheep fed Ensiled maize stover and Concentrate supplements

| | Dietary treatment | | | | | |
|---|---|---|---|---|---|---|
| Parameters | A | B | C | D | E | SEM |
| PCV (%) | 22.50 | 30.33 | 27.80 | 29.50 | 28.25 | 3.19 |
| HB (g/dl) | 8.30 | 10.07 | 9.24 | 9.80 | 9.33 | 1.05 |
| RBC ($x10^6$µl/ml) | $3.51^a$ | $2.39^c$ | $3.19^{ab}$ | $2.79^b$ | $3.44^a$ | 2.09 |
| WBC ($x10^3$µl/ml) | $11.51^a$ | $11.08^a$ | $8.66^b$ | $8.58^b$ | $10.31^{ab}$ | 2.21 |
| NEUT (%) | $43.00^b$ | $56.33^a$ | $46.60^b$ | $57.00^a$ | $55.25^a$ | 4.80 |
| LYMP (%) | $51.67^a$ | $37.33^b$ | $48.00^{ab}$ | $36.00^b$ | $34.00^b$ | 4.91 |
| MONO (%) | 1.67 | 1.67 | 1.20 | 1.00 | 2.00 | 0.64 |
| EOSI (%) | $3.67^b$ | $2.00^b$ | $4.20^b$ | $6.00^a$ | $6.50^a$ | 1.33 |

a b c-Means on the same row differently superscripted are significantly ($P<0.05$) different.
PCV - Park Cell Volume, Hb - Haemoglobin, RBC - Red Blood Cell, WBC - White Blood Cell,
NEUT - Neutrophils, LYMP - Lymphocytes, MONO - Monocytes, EOSI - Eosinophils
WAD - West African Dwarf, SEM - Standard Error of Means.
Diet A - 75% Control + 25% Concentrate supplements, B - 50% Control + 50% Concentrate supplements, C - 25% Control + 75% Concentrate supplements, D - 100% Control (Silage only) E = 100% Concentrate supplements

**Serum Biochemistry of West African Dwarf Sheep fed ensiled maize stover and concentrate supplements**

Presented in Table 4 are the serum biochemistry of the WAD sheep fed ensiled maize stover and concentrate supplements. The total protein of the WAD sheep fed the experimental diet D was significantly ($P < 0.05$) the lowest among the treatments means while the serum protein of animals on diet E was significantly ($P < 0.05$) highest between the dietary treatments but similar to animals fed diets A, B and C. The mean serum albumin, albumin/globulin ratio and creatinine of the animals assessed in this study, were not significantly influenced by the dietary treatments. However, serum urea, cholesterol and glucose were significantly ($P < 0.05$) affected. The mean serum urea of animals fed diet B was significantly ($P < 0.05$) higher than animals fed diets A and D but similar to animals on diet C and E. The mean serum cholesterol of animals fed diets A, C, D and E were similar but significantly ($P < 0.05$) higher than for animals fed diet B. There was significant ($P<0.05$) differnce in the value for serum glucose such that it was highest in diet E and lowest in diet B.

**Table 4:** Serum Biochemistry Constituents of WAD sheep fed Ensiled Maize Stover and Concentrate supplements

| Dietary treatments | | | | | | |
|---|---|---|---|---|---|---|
| Parameters | A | B | C | D | E | SEM |
| Total protein (g/dl) | $13.44^{ab}$ | $12.50^{ab}$ | $13.50^{ab}$ | $9.40^{b}$ | $14.26^{a}$ | 1.23 |
| Albumin (g/dl) | 6.02 | 5.82 | 5.56 | 4.77 | 5.56 | 0.67 |
| Globulin (g/dl) | $7.42^{a}$ | $6.68^{ab}$ | $7.94^{a}$ | $4.63^{b}$ | $8.70^{a}$ | 0.58 |
| Albumin/globulin ratio | 0.81 | 0.87 | 0.70 | 1.03 | 0.64 | 0.12 |
| Urea (mg/dl) | $26.36^{b}$ | $47.27^{a}$ | $34.54^{ab}$ | $23.63^{b}$ | $34.32^{ab}$ | 4.22 |
| Creatinine (mg/dl) | 1.03 | 1.05 | 0.97 | 1.33 | 1.24 | 0.16 |
| Cholesterol (mg/dl) | $73.40^{ab}$ | $62.12^{b}$ | $71.20^{ab}$ | $79.50^{a}$ | $73.65^{ab}$ | 4.81 |
| Glucose (mg/dl) | $69.03^{c}$ | $67.32^{c}$ | $89.10^{b}$ | $106.62^{a}$ | $114.80^{a}$ | 4.07 |

a, b, c= Means on the same row with different superscripts are signinficantly ($P < 0.05$) different

Diet A = 75% Ensiled Maize Stover + 25% Concentrate supplements
B = 50% Ensiled Maize Stover + 50% Concentrate supplements
C = 25% Ensiled Maize Stover + 75% Concentrate supplements
D = 100% Ensiled Maize Stover (Silage only)
E = 100% Concentrate supplements

SEM = Standard Error of Means

## IV. Discussion

**Haematological Responses of Experimental Animals**

The PCV range of 22.50 – 30.33% obtained in this study were within values (22.00 – 37.00%) reported by Sowande *et al*.,[19] and Fajemisin *et al*. [20] for normal healthy sheep. These values were also relatively close to 29.9 – 33.6% reported by Mitruka and Rawnsley [25] for clinically healthy sheep except for animals on diet A that had PCV value of 22.57. The value obtained for this study was conformed with the values (21.5-33.7%) obtained by Abdul and Daniel [36] for Yankaassa rams fed sorghum stover supplemented with graded levels of dried poultry droppinps based diets for healthy sheep. The Hb values obtained in this study fell within normal values (8.4-9.7g/dl) recorded for healthy sheep [37and36], an indication that diets A, B, C, D and E seemed to be capable of supporting high oxygen carrying capacity in the animals. West African Dwarf sheep seem to possess relatively high Hb values, and this is an advantage in term of the oxygen carrying capacity of the blood.

For RBC, the range of value of 2.39 to 3.51 obtained for the current study fell relatively within the range value of 2.40 – 4.20 reported by Sowande *et al*. [19]. The values for white blood cells (WBC) neutrophils (NEUT) and eosinophil (EOSI) were above normal range reported for healthy sheep [25] while values for lymphocyte and monocyte were within normal range reported by the same authors for clinical healthy sheep. However WBC values of 8.58 - 11.51x$10^3$µl/ml reported in this study were within the values (7.0-12.9 x$10^3$µl/ml) reported by Abdul and Daniel [36]. WBC in animals possesses phagocytic function [38], differential WBC counts were used as an indicator of stress response, and sensitive biomarkers crucial to immune function [39]. The higher WBC and differential counts reported in this study indicated that, the WAD sheep seems to possess protective system, providing a rapid and potent defense against any infectious agent. This probably is the physiological basis for the adaptation of this species to this ecological zone characterised by high prevalence of disease.

Furthermore, non significant values of PCV and Hb of WAD sheep fed ensiled maize stover and concentrate supplements diets relative to the control group is an indication that the animals were not anaemic. The PVC and RBC values reported in this study were within the range of values reported by Eniolorunda *et al*. [40], Sowande *et al*. [19] and Jain [41] respectively for sheep in separate experiments, which indicated that the animals used in this study were not susceptible to anaemia related diseases. The ranged values (34.0 - 51.69%) obtained for lymphocyte were within the the ranged values reported by Abdul and Daniel [36] while the values (1.00 - 2.00%) reported for monocyte in this work fell below the values (13.6 – 16.8%) reported by the same authors for Yankassa rams fed sorghum stover supplemented with graded levels of poultry droppings. Moreover, the ranged values (34.00 - 51.67%) obtained for Lymphocytes in this study were lower than values (43.0 - 57.0%) obtained for Neutrophils which is contrary to the report of Olusanya *et al*., [42] that the Lymphocytes are more in blood circulation than Neutrophils in ruminant animals. However, the range values obtained in this study thus suggestive of a well developed immune system in WAD sheep with such number of immune cells to offer good health. The Hb values go against the report of Talebi *et al*., [43] that nutrition affects the blood profile of the animals and this implies that up to 100% inclusion of maize stover silage had a positive effect on the relative quantity of the blood cell as well as total volume of blood. No indication of leukemia or leukocytosis was observed which showed that the feed was not toxic to the animals and has no adverse effect on their health status.

**Serum Biochemical response of experimental animals**

Serum biochemical constituents of WAD sheep fed experimental diets are shown in Table 4. Most studies involving the use of combinations of ensiled maize stover and concentrate supplements did not include haematological and biochemical constituents. Therefore, little comparison could be made. The mean ranged values (9.40 – 14.26g/dl) for serum protein examined in the animal for all dietary treatment were below ranged values (45 - 51mg/dl) reported by Oduguwa *et al*., [18], for sheep fed high proteineous diets and (35.00 - 59.00g/L) reported by Sowande *et a*l., [19] for sheep fed elephant grass, layer droppings and cassava peels. However, the serum protein values obtained in this study were above the normal ranged values (5.70 – 9.10g/dl) reported by Mitruka and Rawnsley [25] and the ranged values (6.3 – 7.2g/dl) reported by Abdul and Daniel [36], Elkholy *et al*., [44]) and El-Ashry *et al*., [45] respectively. It was also above the values (6.3 – 8.5g/dl) and (5.0 - 12.3g/dl) reported for WAD goats and Afec-Awasssi sheep by Daramola *et al*., [46] and Jawasreh *et al*., [47]. Information regarding nutritional status and malnutrition is often obtained from the total protein [48 and14]. The increased level of serum protein observed in this study may be due to high protein content of the diets except diet D that was low in protein and the serum protein value of animals in the group was within normal range values. However, serum creatinine, globulin and albumin/globulin ratio mean values fell within the normal range reported for healthy sheep by Mitruka and Rawnsley [25] and Amuda [49]. However, the range value (4.63 – 9.13 g/dl) of serum globulin obtained in this study was higher than ranged value (3.6 – 4.4 g/dl) reported by Elkholy *et al*. [44] for sheep fed ensiled green stover and stalk treated with urea and yeast.

The albumin mean range value (4.77 – 6.02g/dl) obtained in this study was slightly higher than normal value 2.70 – 4.55g/dl) reported by Mitruka and Rawnsley [25] and ranged value (2.7 – 3.0g/dl) reported by Elkholy *et al*., [44] for healthy sheep. The serum albumin values (4.77 - 6.02g/dl) of the animals were also above the values (3.5-4.1g/dl) reported by Abdul and Daniel [38]. The level of albumin in the present study seemed to be adequate in all the treatments. This was in agreement with Miller *et al*., [50] cited by Babayemi *et al*., [51] that the level of albumin tends to remain constant throughout life after reaching a maximum at about three weeks of age. Lower values for albumin than what were obtained for animals on diets have the major physiochemical function of just maintaining colloidal osmotic pressure, which is required to maintain blood pressure.

The serum urea level (23.63 – 34.54 mg/dl) of animals on diets A, C, D and E in this study fell within the normal values reported (15.0 – 36.0 mg/dl) by Mitruka and Rawnsley [25] for healthy sheep except for animals on diet B that had serum urea value of 47.27mg/dl. However, the mean ranged values of urea (23.63 – 47.27 mg/dl) obtained was relatively close to range values (29.7 – 40.50 mg/dl) reported by Sowande *et al*., [19]) for normal healthy WAD sheep. Furthermore, the blood urea-N concentration value obtained from this study was also higher than value (19.5 mg/dl) reported by Taghizadeh *et al*., [52] for sheep fed corn silage treated with 1% urea.

The high level of serum urea observed in animals on diet B may be attributed to excessive tissues protein catabolism [17] and high releasing of ammonia in rumen as a result of high absorption of ammonia from the rumen to the blood [52] while decreased levels are most commonly due to inadequate protein intake, malabsorption or liver damage. The observed values (0.97- 1.33mg/dl) for creatinine in this study were within the values (1.1 – 1.9mg/dl) reported by Abdul and Daniel, [36]. Creatinine values showed no significance difference between treatments. This result suggests that increasing levels of the concentrate supplements in the diets did not likely have deleterious effects on the lean tissue mass of the growing sheep. The urea and creatinine concentrations in the blood were used as kidney and liver function test [53]. Kung [54] reported that blood or milk urea nitrogen could be used as an indicator of excess ruminal - degraded protein (RDP).

For serum cholesterol and glucose levels of 62.12 – 79.50 mg/dl and 67.32 – 114.80 mg/dl obtained in this study were within the normal range of 50.00 – 140.00mg/dl and 55.0 – 131.00 mg/dl reported respectively for normal healthy sheep by Mitruka and Rawnsley [25]. However, the serum cholesterol level observed in this study was lower than values (133-147mg/dl) and (96 – 117 mg/dl) reported by Oduguwa *et al*.,[18] and Elkholy *et al*., [44] for normal healthy sheep while the value reported for serum glucose level was higher than ranged value (50-60mg/dl) reported by Oduguwa *et al*., 1[8] and (59 – 65 mg/dl) reported by Elkholy *et al*. [44], Briggs, [55] and Ayyat *et al*., [56] who reported that supplementation of readily available carbohydrates with non-protein nitrogen (NPN) to the basal diet increased the level of blood glucose. Cholesterol is a group of fats vital to cell membranes, nerve fibres and bile salts, and a necessary precursor for the sex hormones. High levels indicate diet high in carbohydrates/sugars while low levels indicate low fat diet, malabsorption, or carbohydrate sensitivity. Glucose is the chief source of energy for all living organism. The levels obtained across the dietary treatments suggest that feed was adequate in energy supply for the animals. Generally, levels of biochemical blood profile of WAD sheep fed ensiled maize stover and concentrate supplements were within reported range values for same species by Oduye and Adadevoh [17] and Elkholy *et al*. [44].

## V. Conclusion And Recommendation

The results of haematological and serum biochemical constituents of WAD sheep fed ensiled maize stover and concentrate supplements showed no adverse effect on the health status of the animals at 100% level of maize stover silages. Consequntly, it is recommended that maize stover silage with or with concentrate can be fed to sheep without adverse effect on the animal's health status.

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1Amuda A. J "Haematological Parameters and Serum Biochemistry of Westafrican Dwarf Sheep Fed Ensiled Maize Stover And Concentrate Supplements." IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS) 11.5 (2018): 57-63.