www.coast.osustech.edu.ng
COAST
JOURNAL OF THE FACULTY OF SCIENCE
Volume 2, Issue 2. November, 2020 ISSN: 2714-3716
Coast, J. Fac. Sci. 2 (2): 469 - 481

PERFORMANCE, HAEMATOLOGY AND SERUM BIOCHEMICAL INDICES OF WEST AFRICAN DWARF BUCKS FED ELEPHANT GRASS (*Pennisetum purpureum*) SUPPLEMENTED WITH UREA-MAIZE STOVER DIETS.

[1]* Okeniyi, F. A., [1]Olawoye, S. O., [2]Adeyonu, A. G., [1]Animashahun, R. A., [3]Onwuka, C. F. I., [4]Aina, A. B. J. and [4]Sowande, O. S.

[1]Landmark University, College of Agricultural Science, Department of Animal Science, Ipetu road, Omu-Aran, Kwara State Nigeria. 251101.

[2]Landmark University, College of Agricultural Science, Department of Agricultural Economics and Extension, Ipetu road, Omu-Aran, Kwara State Nigeria 251101.

[3]Federal University of Agriculture, College of Animal Science and Livestock Production, Department of Animal Nutrition, Abeokuta, Ogun State Nigeria. 110124.

[4]Federal University of Agriculture, College of Animal Science and Livestock Production, Department of Animal Production and Health, Abeokuta, Ogun State Nigeria. 110124.

*Corresponding Author's Email: okeniyi.funmilayo@lmu.edu.ng

Abstract

Twelve (12) West African dwarf (WAD) bucks, averaging 10.50 kg in weight were monitored during a-98 day feeding experiment to investigate the performance (feed intake, change in body weight and linear body parameters) and haematology and serum biochemistry when fed Elephant grass supplemented with Urea-Maize stover (UMS) diets during the dry season. The bucks were randomized into four diet treatments three bucks per treatment balanced for body weight. Each group was assigned randomly to one of the four diet treatments containing Elephant grass + UMS at 0, 3, 4.5 and 6% levels of urea inclusion. Feed intake and weight changes were monitored while blood samples were collected and analysed. One-way analysis of variance was used to analyse the data, in a completely randomized design. Results indicated that the voluntary Dry Matter Intake (DMI) by bucks decreased (P<0.05) as the level of dietary urea increases, changes in body weight and linear body parameters were higher (p>0.05) for bucks on control diet compared to others. Hematological and serum biochemical parameters of goats fed experimental diets showed no significant (p>0.05) difference across treatments except in serum total protein, blood urea and sodium, where dietary treatments had significant (P<0.05) influence.

Keywords: Bucks, Hematology, Performance, Serum biochemistry, Stover, Urea.

Introduction

The West African Dwarf (WAD) goat meat is highly demanded, due to its socio-economic importance and acceptability by Nigerians, thereby flourishing the trade-in goat meat (Kalio and Anyanwu, 2016). The demand for conventional feed stuffs is high especially during the dry seasons and this has necessitated the need for use of crop residues such as maize stover as feed for ruminants. Mesfin and Kabede (2011) recounted that treating forages with urea in a simple practical process would make it popular amongst farmers. Jabbar *et al.* (2009) reported that fertilizer grade urea is suitable for the treatment of crop residue and many studies (Barde *et al.,* 2010; Elias and Fulpagare, 2015; Ngu *et al.*, 2019; Patra and Aschnebach, 2018) had been carried out on the use of urea treatment to improve the feeding quality of maize strovers for ruminants.

In livestock production, blood mineral analysis is often used to monitor mineral nutrition and useful information on the mineral status of an animal can be obtained from blood analysis. However, the variation in mineral concentration in the blood is dependent on many factors of which nutrition is one (Herdt *et al.,* 2000). Also, body tissue mobilization and intravascular transport of metabolites of digestion can reveal the plane of nutrition and physiological status of animals (Caldeira *et al.*, 2007). Pond *et al.* (2004) reported that blood glucose level increases as carbohydrate intake increases and is normalized by the storage of glucose as glycogen, while Cheng *et al.* (2015) revealed that low nitrogen diets lead to a low concentration of plasma urea. Al-Eissan *et al.* (2012) observed that haematological and biochemical variables of blood are often used to evaluate and monitor health, nutritional and physiological status of ruminants.

The unavailability and low quality of feedstuff during the dry season still remains a limiting factor in ruminant production (Han *et al.*, 2002) and in Nigeria many farmers have often wasted the abundant crop residues (Onyeonagu and Njoku 2010) including maize stover after harvesting the crop. Maize stover do not contain sufficient nutrients to support efficient microbial activities in the rumen, therefore, the need for roughage improvement. Researches (Alemu *et al.*, 2005; Barde *et al.,* 2010; Hyeldah *et al.,* 2017) had been carried out on how feeding low-quality feedstuffs ensiled with urea can affect weight changes and venous constituents in goats. However, the different procedures used to improve the feeding value of crop residues are often tedious and more labor intensive for livestock farmers. O'Donovan *et al* (1997) reported that the urea treatment process would be popular if it is simple, practical and the material to be used in the treatment is available on the farm.

Fertilizer grade urea (cheaper and easily available urea for crop fertilization) has been confirmed to be equivalent to anhydrous or aqueous ammonia for upgrading cereal straws in the warmer regions of the world (Jabbah *et al* 2009; Sarwar *et al* 2006). The direct mixture of urea into feedstuffs for goats would be less tedious than the ensiling process and the fertilizer grade urea will be more commonly available to farmers. Also, physical or mechanical treatments, such as chopping, grinding, pelleting and steaming have been used to improve the nutritive value of low-quality roughage, therefore, milling of maize stover will increase surface area, improve intake and the possibility for the attachment of rumen microbes. Consequently, this study was conducted to ascertain the effects of feeding varying levels of urea in milled maize stover on feed intake, weight changes and blood constituents of WAD goats.

Materials and Methods

Experimental Site

This study was carried out in the small ruminant experimental unit at Teaching and Research Farm, Federal University of Agriculture, Abeokuta, (FUNAAB). It is located on 76 m above sea level with latitude $7^{0}5.5'$-$7^{0}8.0'$N and longitude $3^{0}11.2'$- $3^{0}12.5'$E.

Experimental Animals and Their Management

Twelve (12) West African dwarf (WAD) bucks weighing between 9 and 12kg were purchased from surrounding villages and local markets. The animals were allowed to acclimatize to the experimental diets for 2 weeks after being quarantined for 4 weeks and were kept individually in separate pens throughout the length of the experiment

Experimental Diet Preparation

Stover was collected from neighbouring maize farms, cut into small pieces of about 2-3cm, sun-dried, and then milled. Milling was done to reduce the particle size and to enhance uniform mixing with the urea. The milling would as well increase the surface area for microbial digestion in the rumen. Fertilizer grade urea, maize stover, wheat offal, palm kernel meal, salt, bone meal and sulphur used for each of the experimental diets were weighed and thoroughly mixed to give a homogeneous ration. Sulphur was added to prevent goats from negative balance (for nitrogen and sulphur) and loss of body weight. Four experimental diets formulated were tagged Diets 1, 2, 3 and 4 containing Elephant grass + 60% by weight of maize stover each plus 0, 3, 4.5 and 6% urea inclusion levels respectively. The experimental diets were kept in a well-ventilated room throughout the experimental period. Experimental diet ingredients and percentage composition are presented in Table 1.

Dietary Treatment of the Experimental Animals

Three animals were randomly selected for each diet making a total of twelve animals for the trial. The animals were divided into four groups containing three replicates each, balanced for body weight. The feeding trial lasted for 98days, elephant grass and maize stover was offered to the animals at 5% body weight. The goats were fed with the wilted elephant grass (basal diet) supplemented with urea-maize stover every morning (8.00am).

Data Collection

The feed leftovers were weighed daily to estimate intake. The goats were weighed using a hanging scale before the commencement of the experiment and then weekly on the same day of the week after denial of feed overnight for 16 hours, to minimize the effect of gut-fill. The measurement of the body parameters (body length, heart girth, and height at wither) of the goats was taken, using meter rule, before the commencement of the experiment and weekly on the same day of the week before the days' feed was offered. Experimental feed samples were analysed with methods described by Association of Analytical Chemist (AOAC) (2012) to determine proximate compositions.

Measurement of Blood Parameters

Blood samples were collected via jugular vein puncture. Red blood cell was determined by manual haemacytometer, packed cell volume was by micro haematocrit method and white blood cell was by leucocyte counts (Benjamin, 1978). Plasma glucose and urea nitrogen were determined by an enzymatic colorimetric method (Bauer *et al.*, 1974). Spectrophotometer (SP6 – 400 UV Pye Unicam) reading was done at wavelengths of 600 nm and 550 nm respectively. Serum concentrations of Ca^{++}, K^{+}, and Na^{+} were determined using a Gallenkamp flame analyzer (FGA-330), phosphate (PO_4) ions in serum were determined in the trichloroacetic acid filtrate. Serum chloride (Cl) was estimated using the colorimetric method of Association of Analytical Chemist (AOAC) (2012).

Statistical Analysis

The one-way Analysis of Variance (ANOVA) in SPSS version 17 (2008) statistical package in a completely randomized design was used to analyze data. Means separation, where necessary, was done using Duncan's (1955) Multiple Range Test.

Table 1. Composition of Urea-Maize Stover (UMS) based diets fed to West African Dwarf buck goat

Ingredient (%)	1	2	3	4
Maize stover	60.00	60.00	60.00	60.00
Wheat offal	30.00	25.00	22.50	20.00
Palm kernel meal	5.00	5.00	5.00	5.00
Urea	0.00	5.00	7.50	10.00
Salt	3.00	3.00	3.00	3.00
Bone meal	1.50	1.50	1.50	1.50
Sulphur	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00

1= Experimental diet containing 0% Urea inclusion level, 2= Experimental diet containing 3% Urea inclusion level, 3= Experimental diet containing 4.5% Urea inclusion level, 4= Experimental diet containing 6% Urea inclusion level. Note: Sulfur is needed by rumen bacteria for synthesis of methionine, cystine, thiamine and biotin

Table 2. Nutrient composition (g/100g DM) of UMS fed to the WAD goats

Diets	DM	CP	CF	EE	ASH	NFE	GE (Kcal/Kg)
1	89.87	16.98	33.86	3.59	8.29	37.28	3.987
2	90.03	17.33	34.03	3.67	8.34	36.63	3.994
3	89.91	17.50	33.97	3.78	8.49	36.26	3.979
4	90.08	17.85	34.11	3.73	8.43	35.88	3.968
Elephant grass	39.24	6.24	18.24	0.86	5.97	68.69	1.247
Maize Stover	89.67	8.95	29.79	1.96	8.75	50.55	2.380

1= Experimental diet containing 0% Urea inclusion level, 2= Experimental diet containing 3% Urea, 3= Experimental diet containing 4.5% Urea, 4= Experimental diet containing 6% Urea, DM=Dry matter, CP= Crude Protein, CF= Crude fiber, EE= Ether extract, ASH= Ash, NFE= Nitrogen free extract, GE= Gross energy

Results and Discussion

Performance of Goats

Dry Matter Intake (DMI) and performance of the West African dwarf (WAD) goats fed Elephant grass supplemented with UMS diets were shown in Table 3. Results showed that feed intake and dry matter intakes were inversely correlated to the percentage of urea inclusion in diets. The UMS intake and dry matter intake from UMS were higher ($p<0.05$) for goats on diets with 0% urea (329.58 and 296.19g/d respectively) than for goats on diets with 3-6% urea (218.28 – 265.41 and 196.63 - 238.95g/d respectively). The decrease in DMI may be caused by the metabolic effects of urea and, or, poor palatability due to the presence and taste of urea in the diets. Barde *et al.* (2010) and Burque *et al.* (2008) reported decrease in DMI as urea level increased in test diets.

Performance indices (feed conversion ratio, total and daily weight gains,) were different but not significant ($p>0.05$), across the dietary treatment. However, bucks fed the control diet (diets with 0% urea) gained more weight (2.69 kg) than others. This result supported the findings of Ngu *et al.* (2019), who reported that live weight changes were not significantly affected by urea-treated straws fed to cattle. Barde *et al.* (2010) equally reported lower weight gains in goats fed diets with increasing urea levels. Other earlier contrasting studies (Adegbola, 2002; Elias and Fulpagare, 2015) reported improvement in weight changes with increasing levels of urea in the diet.

DMI had a maximal effect on animal performance as observed in the present study where goats on the control diet had the highest DMI and hence the better weight gain. Cabral *et al.* (2008) reported that variations of about 60–90% in animal performance are connected with the intake of metabolizable energy while 10–40% is associated with the digestibility of the diet. Also, productivity (growth) in ruminant has been reported to be influenced primarily by feed intake and digestibility (Gatenby, 2002). There could be a negative effect of urea increased in the diet on dry matter intake, and hence weight gains, as viewed in the study. This observation corroborates the report by Reed *et al.* (2017) that increasing the level of urea in diets produces a slightly negative effect on energy intake, DM intakes and less efficient utilization of Nitrogen from urea, leading to the lower gains. The beneficial effects of urea through urinalysis and ammonolysis may have been reduced in the present study since maize stovers were not ensiled with urea but were added directly into and thoroughly mixed with milled (to expand the surface area) stover. Also, the non-provision of the needed moisture to accelerate the process of degrading a fibrous portion of the forage may have reduced the effective use of urea in the urea included diets. Oliveira *et al.* (2016) reported that urea acts beneficially on fibrous forages through the processes of urinalysis and ammonolysis and also, the cell wall components of forage tissues can expand and rupture more easily because ammonia has a high capacity to attract water when forages are ensiled with urea.

The urea adaptation feeding schedule followed in the present study may have been ineffective. Kertz (2010) reported that urea preconditioning is required to create physiological feedback by which cows can identify with the urea-included rations. The authors however observed that preconditioning to high urea containing rations can subsequently alert cows causing them to avoid high intake. In the present study, bucks may have received physiological feedback mechanism of sub-lethal ammonia toxicity, causing a mild negative aversion, since the diets were still consumed though not as expected.

The linear body growth performance (Table 4) was noticed to be proportional to body weight gain and feed intake. Feed intake and consequently live weight gained had been observed to affect body parameters (Babale *et al.*, 2015, Lukuyu *et al.,* 2016). In this study, it was observed that animals on diet with 0% urea inclusion, having the highest feed intake equally had the overall best linear body growth performance. Results of linear body changes from the study agrees with the findings of Ayuk *et al.* (2007) whereby overall best performance and linear body measurement of West African Dwarf bucks resulted from best feed intake when *Panicum maximum* plus concentrate diet were fed.

Haematology of Goats

The haematology for bucks fed UMMS diets is shown in Table 5. The red blood cells (RBC), White Blood Cells (WBC), Packed Cell Volume (PCV), hemoglobin, Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular

Hemoglobin concentration (MCHC), and Mean Corpuscular Volume (MCV) values were not significantly (p>0.05) different across the varied urea included diet groups. WBC values at 0% urea ($11.26 x10^9/L$), 3% urea ($10.63 x10^9/L$), 4.5% urea ($9.73 x10^9/L$) and 6% urea ($6.04 x10^9/L$) were within the standard range ($4-13 x10^9/L$) for goats reported by Fielder (2016) but lower than WBC values reported for goats by Njidda *et al.* (2013), which may be attributed to goat breed differences. The normal WBC count in this study indicates the absence of disease organisms and that the experimental bucks were exhibiting a potent defense mechanism against disease agents. It was however observed that WBC value decreased as the percentage of urea included in the diet increases, implying that increasing urea intake in goat diets may have a decreasing effect on the WBC count. Although abundance of WBCs should be an indication of the animals ability to fight infections, in this study, the increase in dietary urea level apparently caused a decrease in feed intake which might have resulted in production of free radicals, thereby causing damage to WBCs and hence the its subsequent decrease. Bendich (1987) suggested that vitamin c fights free radicals in the body, while Abdalla et al. (2014) also reported that goats on restricted feeding diets had significant decrease in white blood cell count.

Table 3. Performance and Dry Matter Intake (DMI) of WAD Goats fed Elephant grass supplemented with UMS Diets

Parameters	1	2	3	4	SEM
Average initial live weight (Kg)	8.49	8.34	8.40	8.25	0.39
Average final live weight (Kg)	11.18	10.56	10.07	9.82	0.48
Mean TWG (Kg)	2.69	2.22	1.67	1.57	0.27
Average DWG (g)	27.45	22.65	17.04	16.02	1.98
Average TFI (Kg)	57.77^a	51.99^{ab}	49.92^b	46.95^b	1.06
Average DGI (gd^{-1})	259.95	265.16	265.85	260.83	0.96
Average DSI (gd^{-1})	329.58^a	265.41^{ab}	243.56^b	218.28^b	12.96
Average DFI(gd^{-1})	589.53^a	530.57^{ab}	509.41^b	479.11^b	14.02
Feed conversion ratio	21.48	23.49	29.90	29.85	1.00
DMI from diets (gd^{-1})	296.19^a	238.95^b	218.98^b	196.63^b	13.38
DMI from grass (gd^{-1})	102.01	104.05	104.32	102.35	0.69
Total DMI	398.20^a	343.00^{ab}	323.30^b	298.98^b	13.61

Means on the same row having different superscripts are significantly ($P< 0.05$) different, DMI=Dry matter intake, TWG = Total Weight Gain, DWG= Daily Weight Gain, TFI= Total Feed Intake, DUMSI- Daily Urea-Maize Stover Intake, DGI- Daily Grass Intake, DFI- Daily Feed Intake, 1= Experimental diet containing 0% Urea inclusion level, 2= Experimental diet containing 3% Urea inclusion level, 3= Experimental diet containing 4.5% Urea inclusion level, 4= Experimental diet containing 6% Urea inclusion level, UMS= Urea-Maize stover

Table 4. Linear Body Measurements of WAD Goats Fed UMS Diets

Parameters	1	2	3	4	SEM
Average IBL (cm)	42.01	42.99	40.04	41.03	0.93
Average FBL (cm)	50.13	49.80	47.10	46.96	1.06
Average BLG (cm)	9.12	6.82	7.70	5.93	0.59
Average BLG/animal (cm/d)	0.093	0.070	0.079	0.061	0.006
Average IHG (cm)	48.61	48.26	47.83	47.66	1.06
Average FHG (cm)	59.91	58.35	56.56	53.96	1.18
Average HGG (cm)	11.30	10.10	8.72	6.30	1.03
Average HGG/day (cm/d)	0.115	0.103	0.089	0.064	0.011
Average IHW (cm)	37.68	36.28	35.93	37.32	0.63
Average FHW(cm)	43.60	41.50	41.49	41.85	0.85
Average HWG(cm)	5.92	5.22	5.56	4.53	0.40
Average HWG/day (cm)	0.060	0.053	0.057	0.046	0.004

IBL = Initial Body Length, FBL = Final Body Length, BLG - Body Length Gained, IHG = Initial Heart Girth, FHG = Final Heart Girth, HGG = Heart Girth Gained, IHW = Initial Height at Withers, FHW = Final Height at Withers, HWG = Height at Withers Gained, 1= Experimental diet containing 0% Urea inclusion level, 2= Experimental diet containing 3% Urea inclusion level, 3= Experimental diet containing 4.5% Urea inclusion level, 4= Experimental diet containing 6% Urea inclusion level.

Table 5: Hematology of WAD Goats fed UMS Diets

Parameters	Diets					
	1	2	3	4	SEM	RV*
Packed cell volume (%)	26.17	24.17	23.50	25.17	0.86	22-38
Haemoglobin (g/dl)	9.22	8.17	7.47	8.63	0.41	8-12
White blood cells x10^9/L	11.26	0.63	9.73	6.04	3.56	4-13
Red blood cells x10^{12}/L	2.84	2.55	2.39	2.77	0.12	8-18
MCHC(g/dl)	32.90	32.9	32.9	32.5	0.01	30-36
MCH(pg)	30.00	9.98	30.12	29.89	0.23	5.2-8.0
MCV(fl)	90.85	90.85	90.75	90.70	0.33	16-25

*Reference values according to Fielder (2016), RV= Reference Values, MCHC= Mean Corpuscular Haemoglobin Concentration, MCH= Mean Corpuscular Haemoglobin, MCV= Mean Corpuscular Volume, 1= Experimental diet containing 0% Urea inclusion level, 2= Experimental diet containing 3% Urea inclusion level, 3= Experimental diet containing 4.5% Urea inclusion level, 4= Experimental diet containing 6% Urea inclusion level

The values for PCV ranged from 23.50 – 26.17% in this study and these fell within values (21.00 – 35.00%) reported by Daramola *et al.* (2005) and Oni *et al.* (2012) for WAD goats. Opara *et al.* (2010) suggested that WAD goat can rapidly normalize PCV during stress and disease condition by its capacity for compensatory accelerated PCV production which may be the case in this study. In this study, RBC (2.39 - 2.84 x 10^{12}/L) and hemoglobin (7.47 - 9.22g/dl) values conformed to values reported for these parameters in WAD goats by previous studies (Anya *et al.*, 2018 and Opara *et al.*, 2010). However, the RBC values which were at variance with reports of Fielder (2016) may be due to breed, feed type, and environmental differences.

The high hemoglobin values in the study corroborated the observation of Daramola *et al.* (2005) that WAD goat's possession of a higher hemoglobin value is beneficial to oxygen transport within the blood circulatory system and hence, energy production and utilization. Furthermore, the non-significant difference in values of RBC and hemoglobin of bucks fed urea-maize stover diets when compared with the control diet eliminates the incidence of an anemic condition, and the goats were agile, with no sign of weakness or paleness throughout the experimental period. Levels (32.50 - 32.90 g/dl) of MCHC (Mean Corpuscular Haemoglobin Concentration) observed for bucks in this study were within the values reported by Daramola *et al.* (2005), Fielder (2016) and Opara *et al.* (2010) but MCV (Mean Corpuscular Volume) and MCH (Mean Corpuscular Haemoglobin) levels were higher than the level of the reference values. MCV (29.89 - 30.12 fl) and MCH (90.70 - 90.85 pg) levels were comparable to the values (87.20 - 117.10 fl) and (31.8 - 39.0 pg) respectively obtained by Hyeldal *et al.* (2017) for Red Sokoto goats. MCHC, MCV and MCH values in this study confirmed that bucks were anemia-free since these parameters are being used to determine and classify anemic conditions.

Serum Biochemistry of Goats

The serum biochemistry of goats fed urea-mixed milled stover diets is shown in Table 6. The serum albumin, glucose, cholesterol, creatinine values obtained in this study were not different significantly ($p>0.05$) while serum urea and total protein were different ($p<0.05$) across the dietary treatment. Serum albumin values (36.40 - 38.94 g/L) obtained were within reference values (27-39g/L) reported by Fielder (2016). The albumin values in the present study are comparable to results reported by previous authors (Daramola *et al.*, 2005 and Njidda *et al.*, 2013), but higher than results from Anya *et al.* (2018). Sokunbi and Egbunike (2000) (as cited in Aderemi and Wuraola, 2013) observed that serum levels of albumin remain constant after attaining a maximum age, throughout life. Albumin functions to maintain colloidal osmotic pressure and consequently blood pressure. Goats fed experimental diets had serum glucose concentration values (2.16 – 2.33 mmol/l) which were within (2.78 – 4.16 mmol/l) values reported by (Fielder 2016). The glucose concentration values indicated the normalcy of the energy value of diets. Cholesterol values were highest in bucks fed 6% urea included diet, while creatinine values were highest for goats fed 0% urea included diet. However, both cholesterol and creatinine values in goats fed the varied test diets were within normal reference values. High creatinine implies poor metabolism of protein and amino acid which can impair renal and cardiac functions (Metra *et al.*, 2012).

Serum total protein and urea concentrations were different ($p<0.05$) across the dietary groups. Serum protein values for bucks on 4.5 and 6% urea level of inclusion diets were higher ($p<0.05$) than serum protein values in bucks on 0 and 3% urea level of inclusion diets. Serum protein values for goats on 0 and 3% urea included diets were within reference values, while bucks on 4.5 and 6% urea level were higher than reference values. Serum protein values for all bucks were higher than values reported by Opara *et al.* (2010) for WAD goats, but fell within the values reported by Daramola *et al.* (2005). Zubcic (2001) observed that the value of total protein in goat serum could be increased by up to 7.5 g/dl in grazing animals.

Blood urea values increased ($p<0.05$) from 12.16 to 34.50mmol/L as urea level in the diet was increased from 0 to 6% across the dietary treatment. Vilela *et al.* (2005) reported that as urea consumption increases, the level of NPN increases, resulting in increased rumen ammonia production. The increasing rate of serum urea in the present study is a result of the increase in the urea levels in the goat diet which probably resulted in greater nitrogen flow into the liver of the experimental bucks thereby increasing the blood urea concentration. Patra and Aschenbach (2018) observed that an increase in the level of dietary nitrogen results in a greater influx into tissues, liver, and consequently the blood.

Differences in values of serum K, Cl, Ca, and P in the study were not significant ($p>0.05$) across dietary groups, however, serum Na levels in goats on diets containing 4.5% urea inclusion were higher ($p<0.05$) than in goats on other diets. Rao *et al.* (2016) observed that countries in the tropics have low phosphorus concentration in their soil and plants, while Sowande *et al.* (2008) observed a significant decrease in serum phosphorus concentration of WAD goats and sheep on free-range. Bowen *et al.* (2019) observed that phosphorus deficiency is generally common and has an economic impact on grazing livestock. Olayemi *et al.* (2015) observed that there may be a loss of sodium ions through evaporative heat loss and higher urine output during the dry season. Result from the study shows that serum Na, K, Cl, Ca and P concentrations of experimental bucks were all within reference values (Fielder 2016) for healthy goats, the values for these serum metabolites were equally in consonance with reports from earlier studies on WAD goats (Kalio & Anyawu, 2016; Daramola *et al.*, 2005).

Table 6: Serum Biochemistry of WAD Goats Fed UMS Diets

Parameters	Diets					
	1	2	3	4	SEM	RV*
Albumin(g/L)	38.94	37.87	36.40	37.78	0.48	27-39
Total Protein(g/L)	70.67^{b}	70.00^{b}	77.34^{a}	78.17^{a}	1.27	64-70
Glucose (mmol/L)	2.33	2.25	2.33	2.16	0.04	2.78-4.16
Cholesterol(mmol/L)	1.36	1.76	1.76	1.91	0.10	2.07-3.37
Urea (mmol/L)	12.16^{c}	30.87^{b}	31.87^{b}	34.50^{a}	2.78	3.6-7.1
Creatinine (mmol/L)	84.13	67.63	59.38	76.51	6.60	88.4-159
Sodium(mmol/L)	142.34^{b}	142.67^{b}	45.67^{a}	143.67^{b}	0.49	142-155
Potassium(mmol/L)	5.60	5.17	4.80	5.00	0.14	3.5-6.7
Chloride(mmol/L)	108.50	107.67	09.85	108.33	0.51	99-110.3
Calcium(mmol/L)	2.40	2.39	2.36	2.46	0.03	2.23-2.93
Phosphorus(mmol/L)	3.48	3.76	3.07	3.00	0.15	1.4-2.9

Means on the same row having different superscripts are significantly ($P< 0.05$) different, *Reference values according to Fielder (2016), UMS= Urea- Maize Stover, 1= Experimental diet containing 0% Urea inclusion level, 2= Experimental diet containing 3% Urea inclusion level, 3= Experimental diet containing 4.5% Urea inclusion level, 4= Experimental diet containing 6% Urea inclusion level.

Conclusion

Increasing urea levels up to 6% in maize stover and *pennisetum purpureum* diet for bucks depressed dry matter intake, promoted increased blood urea concentration of goats and decreased WBC count. There could be a negative effect of urea increased in the diet on dry matter intake and hence, weight gains. Stovers were milled to enhance feed intake and improve digestion by increasing surface area for microbial enzyme digestion in the rumen, however, the effect may have been overriden by increasing urea level in the diets. When urea is mixed directly in maize stover diet, a level of moisture may be required to accelerate the degradation of fiber portion in stover.

Acknowledgment

We thank staffs of the College of Animal Science and Livestock Production (COLANIM) Farms for their help during the harvesting and Stover preparation work. We also appreciate the effort of the Central Laboratory Services staff of the Institute Agricultural Research and Training (I.A.R.&T), Obafemi Awolowo University, Nigeria.

References

Abdalla, B.E., El-Rayes, M.A.H., Khalil, F.A., Abou El-Ezz, S.S., Ibrahim, N.H., Younis, F.E. and Askar, A. (2014). Effect of restricted feeding on body weight, some hematological and biochemical parameters in sheep and goats raised under semi-arid conditions. ADSA-ASAS-CSAS Joint Annual Meeting. *J. Anim. Sci.* Vol. 92, E-Supplement 2/ J. Dairy Sci. Vol. 97, E-Supplement 1. Kansas City, MO.

Adegbola, T.A. (2002). Nutrient intake digestibility and rumen metabolites in bulls fed rice straw with or without supplements. *Nig. J. Anim. Prod.*, 29(1): 40-46.

Aderemi, F. and Wuraola, A. (2013). Effects of dietary replacement of maize with malted or unmalted sorghum on the performance of weaner rabbits. *Afri. J. Food Agric., Nutri. Dev.*, 10(9): 4032-4046.

Al-Eissa, M.S., Alkahtani, S., Al-Farraj, S.A., Alarifi, S.A., Al-Dahmash, B., and Al-Yahya, H. (2012). Seasonal variation effects on the composition of blood in Nubian ibex (Capra nubiana) in Saudi Arabia. *Afr J Biotechnol.* 11:1283–1286. doi: 10.5897/AJB11.2004

Alemu, T., Chairatanayuth, P., Vijchulata, P., and Tudsri, S. (2005). The Potential of Urea Treated Maize Stover for Growth Performance of Weaned Crossbred Calves. *Kasetsart J. (Natural Science),* 39 (1): 638-646.

Anya, M.I., Ozung, P.O. and Igwe, P.A. (2018). Blood profile of West African dwarf (WAD) bucks fed raw and processed cocoa pod husk meal based-diets in the humid high rainforest zone of Nigeria. *Global J. of Pure Appl. Sci.*, 24: 125-134.

Association of Official Analytical Chemists. (2012). Official Methods of Analysis of the Association of Official Analytical Chemists International (19th Ed.). Gaithersburg, USA: MD publishing.

Ayuk, A.A., James, M. and Wogar, G.I.S. (2007). Blend of oil palm slurry and rice bran as feed ingredient for broiler chickens. *Anim. Feed Sci. Technol.*, 38: 185-193.

Babale, D.M., Kibon, A., and Yahaya, M.S. (2015). Performance and linear body measurements of Red Sokoto male goats on replacement levels of corn cobs for maize bran with cowpea husk basal diet. *Net J. Agric. Sci.*, 3(2): 35-40.

Barde, R.E., Aya, V.E., Ari, M.M., Musa, M. and Yakubu, A. (2010). Performance of West African Dwarf (WAD) goats fed urea treated maize offal as a supplement to natural herbage. *Vom Work Book J.* 6(b): 219-223.

Bauer, T.D., Ackermann, P.G. and Toro, G. (1974). *Methods in clinical chemistry*. In: Clinical Laboratory Methods (8th Ed.). Saint Louis, Missouri, USA: C. V. Mosley Company.

Bendich, A. (1987). Vitamin C and immune responses, *Food Technol.* 14:112-114.

Benjamin, M.M. (1978). *Outline of Veterinary Clinical Pathology* (2nd Ed.). Iowa, USA: Iowa State University Press.

Bowen, M.K., Chudleigh, F., Dixon, R.M., Sullivan, M.T., Schatz, T., and Oxley, T. (2019). The economics of phosphorus supplementation of beef cattle grazing northern Australian rangelands. *Anim. Prod. Sci*. https://doi.org/10.1071/AN19088

Burque, A., Abdullah, M., Babar, M., Javed, K., and Nawaz, H. (2008). Effect of urea feeding on feed intake and performance of male buffalo calves. *J. Anim. and Plant Sci.*, 18: 1-6.

Cabral, L.S., Santos, J.W., Zeivoudakis, J.T., Abreu, J.G., Souza, A.L., and Rodrigues, R.C., (2008). Intake and feed efficiencies in lambs. *Rev. Brasil. de Saúde e Prod. Anim.*, 9(4): 703-714.

Caldeira, R.M., Belo, A.T., Santos, C.C., Vazques M.I. and Portugal A.V. (2007). The effect of long- term feed restriction and over-nutrition on body condition score, blood metabolites and hormonal profiles in ewes. *Small Rumin. Res.*, 68(3): 242-255.

Cheng, Z., Oguejiofor, C.F., Swangchan-Uthai, T., Carr, S. and Wathes, D.C. (2015). Relationship between circulating urea concentrations and endometrial function in postpartum Dairy Cows. *Animals (Basel*), 5(3):748-773. doi: 10.3390/ani5030382

Daramola. J.O., Adeloye, A.A., Fatoba, T.A., and Soladoye, A.O. (2005). Haematological and biochemical parameters of West African dwarf goats. *Livest. Res. Rur. Dev.*, 17: 7-8. Retrieved October 18, 2019 from http://www.lrrd.org/lrrd17/8/dara17095.htm

Duncan, D.B. (1955). *Multiple range and Multiple F-tests*. Biometrics, 11: 1-42.

Elias, S.T., and Fulpagare, Y.G. (2015). Effects of urea treated maize stover silage on growth performance of crossbred heifers. *IOSR J. Agric. Vet. Sci.*, 8: 58-62.

Fielder, S.E. (2016). Hematologic reference ranges. Merck Veterinary Manual, Centre for Veterinary health sciences (CVHS), Oklahoma State University.

Gatenby, R.M. (2002). Sheep. Revised edition. Tropical Agricultural series. Macmillan Published Limited.

Han, L. J., Yan, Q. J. and Liu, X. Y. (2002). The resource of crops straw and their currentsituation of utilization in China. *J. Agric Engnr* 18:87-91.

Herdt, T.H., Rumbeiha, W. and Braselton, W.E. (2000). The use of blood analyses to evaluate mineral status in livestock. The Veterinary clinics of North America Food Animal Practice 16: 423–444.

Hyeldal, A.J., Yahya1, M.M., Abakura, J.B. and Wafar R.J. (2017). Haematological and biochemical parameters of Red Sokoto goats fed Desert date (Balanites aegyptiaca) leaves as supplement to urea treated maize stover. *J. Advan. Biol. and Biotec.*, 15(2): 1-7.

Jabbar, M.A., Muzafar, H., Khattak, F.M., Pasha, T.N., and Khalique, A., (2009). Simplification of urea treatment method of wheat straw for its better adoption by the farmers. *S. Afric. J. Anim. Sci.*, 39(5): 58-61.

Kalio, G. A. and Anyanwu, N. J. (2016). Performance and haemato-biochemical profiles of West African Dwarf (WAD) does fed selected crop by-products in Nigeria. *Agrosearch*, 6(2): 41-50.

Kertz, A. F. (2010). Urea Feeding to Dairy Cattle: A Historical Perspective and Review. *The 288 Prof. Anim. Scient.*, 26: 257–272.

Lukuyu, M.N., Gibson, J.P., Savage, D.B., Duncan, A.J., Mujibi, F.D., and Okeyo, A.M. (2016). Use of body linear measurements to estimate liveweight of crossbred dairy cattle in small holder farms in Kenya. *Springer Plus*, 5: 1-14. doi:10.1186/s40064-016-1698-3

Mesfin R. and Kebede G. (2011). On-farm experience of feeding urea molasses treated barley straw to crossbreed dairy cows in Jeldu District, highlands of Ethiopia. *Livest. Res. Rur. Dev.*, 23(2). Retrieved October 18, 2019 from http://www.lrrd.org/lrrd23/2/mesf23041.htm

Metra, M., Cotter, G., Gheorghiade, M., Cas, L.D., and Voors, A.A. (2012). The role of the kidney in heart failure. *Europ. Heart J.*, 33(17): 2135-2142. https://doi.org/10.1093/eurheartj/ehs205

Ngu, N.T., Nhan, N.T.H., Hon, N.V., Anh, L.H., Thiet, N., and Hung, L.T. (2019). Effects of urea, soybean meal and blood and feather meal mixture on rumen characteristics and performance of Brahman crossbred cattle. *Livest. Res. Rur. Dev.* 31. Retrieved October 3, 2019 from http://www.lrrd.org/lrrd31/6/ntngu31086.html

Njidda, A.A., Hassan, I.T. and Olatunji, E.A. (2013). Haematological and biochemical parameters of goats of semi-arid environment fed on natural grazing rangeland of Northern Nigeria. *J. Agric. Vet. Sci.*, 3(2): 01-08.

O'Donovan P B, Soomro F M, Wagennar J P, Rehman S and Bukhari F A 1997. Urea treatment of straw. Friendly system improved upon in Balochistan. Livestock Research for Rura Development 9 (5). http://www.lrrd.org/lrrd9/5/pak951.htm

Olayemi, O.D., Jegede, O.C., Obudu, E. and Obeta S S. (2015). Effect of dry and wet seasons on some haematological parameters in Sokoto Red goat and Balami sheep. *Vom J. Vet. Sci.,* 10: 96-103.

Oni, A.O., Arigbede, O.M., Sowande, O.S., Anele U.Y., Oni, O. O. Onwuka, C.F.I., Onifade, O.S., Yusuf, K.O., Dele, P.A., and Aderinboye, R.Y. (2012). Haematological and serum biochemical parameters of West African Dwarf goats fed dried cassava leaves-based concentrate diets. *Trop. Anim. Health Prod.* 44: 483-490.

Opara, M.N., Udevi, N. and Okoli, I.C. (2010). Haematological parameters and blood chemistry of apparently healthy West African dwarf goats in Owerri, South Eastern Nigeria. *New York Sci. J.*, 3(8): 68-72.

Patra, A. K., and Aschenbach, J. R. (2018). Ureases in the gastrointestinal tracts of ruminant and monogastric animals and their implication in urea-N/ammonia metabolism: A review. *J. Advan. Res.*, 13:39–50. doi: 10.1016/j.jare.2018.02.005

Pond, W. G., Church, D. B., Pond, K. R., and Schoknecht, P. A. (2004). Basic Animal Nutrition andFeeding (5th Ed.). New Jersey, USA: John Wiley & Sons.

Rao, I.M., Miles, J.W., Beebe, S.E., and Horst, W.J. (2016). Root adaptations to soils with low fertility and aluminium toxicity. *Ann. Botany*, 118(4):593–605 doi:10.1093/aob/mcw073

Reed, K.F., Bonf, H.C., Dijkstra, J., Casper, D.P., and Kebreab, E. (2017). Estimating the energetic cost of feeding excess dietary nitrogen tos dairy cows. *J. Dairy Sci.,* 100(9): 7116-7126. https://doi.org/10.3168/jds.2017-12584

Oliveira, J.S., Santos, E.M. and Santos, A.P.M. (2016). Intake and digestibility of silages. In: Advances in silage production and utilization. *Intech Open Online Publ.*, 101-121. doi:10.5772/65280.

Sarwar, M., Nisa, M., Hassan Z. and Shazad M A. (2006). Influence of urea molasses treated wheat straw fermented with cattle manure on chemical composition and feeding value for growing buffalo calves. *Livestock Sci* 105 (1-3), pp 151-161.

Sokunbi, O. A. and Egbunike, G. N. (2000). Physiological response and organ weight of young Rabbits on Neem (Azadirachta indica) Leaf meal –based diets: Hematology and serum biochemistry. *Trop.Anim.prod. invest.* 2: 81-87.

Sowande, O.S., Odufowora, E.B., Adelakun A.O. and Egbeyale, L.T. (2008). Blood minerals in WAD sheep and goats grazing natural pastures during wet and dry seasons. *Arch. de Zootec.*, 57: 275-278.

Statistical Package for Social Sciences Inc. SPSS (2008). SPSS Statistics for Windows, Version 17.0. Chicago: SPSS Inc.

Vilela, F.G., Teixeira, J.C., and Reis, S.T. (2005). Efeito da substituição do farelo de soja pela amiréia 150 S nos parâmetros sanguíneos, consumo, produção e composição do leite de vacas Girolandas. *Revist. Ceres*, 52: 275-291.

Zubcic, D. (2001). Some biochemical parameters in the blood of grazing German improved fawn goats from Istria, Croatia. *Veter. Arhiv.*, 71(5): 237-244.