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Haematological and Biochemical Parameters of Red Sokoto Goats Fed Desert Date (*Balanites aegyptiaca*) Leaves as Supplement to Urea Treated Maize Stover

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Authors' contributions

This work was carried out in collaboration between all authors. Author AJH designed the study, wrote the protocol and wrote the first draft of the manuscript. Author RJW performed the statistical analysis. Authors MMY and JBA managed the analyses of the study. Author AJH managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The study was conducted to investigate the effects of feeding urea treated maize stover and graded levels of *Balanites aegyptiaca* leaves on the haematological and biochemical parameters of Red Sokoto goats.
Study Design: Completely Randomized design.
Place and Duration of Study: Teaching and Research Farm, Department of Animal Science and Range Management, Modibbo Adama University of Technology Yola, Adamawa state, between November 2016 and February 2017.
Methodology: Sixteen (16) Red Sokoto goats weighing 9.36 Kg on average were randomly

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grouped into four and exposed to four dietary treatments with four replicates: A (control), B (100 g *Balanites aegyptiaca*), C (200 g *Balanites aegyptiaca*) and D (300 g *Balanites aegyptiaca*), with each treatment group having four goats. The experiment lasted for 12 weeks. At the end of the experiment, about 10 ml of blood was drawn from the external jugular vein of the animals. The blood samples collected were used for the haematological and biochemical analysis.

Results: $p<0.05$ was considered as level of significance. Haemoglobin concentration (g/dl) ranged from 8.9 to 10.4 g/dl. There were no significant differences ($P>0.05$) between the treatments and T4 had the highest concentration. There were significant differences ($P<0.05$) observed for packed cell volume which ranged from 25.5 to 38.3%. Significant differences ($P<0.05$) were also observed for white blood cells (15.6-20.4 $\times10^3$/µl), red blood cells (2.3-3.3 $\times10^6$/µl), neutrophils (23.9-49.8%), mean corpuscular volume (87.2-117.1 fl) and mean corpuscular haemoglobin concentration (27.2-39.5 g/dl). Monocytes (4-6%) and mean corpuscular haemoglobin (31.8-39.0 pg) had no significant differences ($P>0.05$) between the treatments. Urea concentration, total protein and albumin ranged from 4.8 to 7.2 mmol/l, 5.6 to 6.8 g/l and 3.0 to 3.4 g/l respectively. There were significant differences ($P<0.05$) observed for urea concentration but no significant differences ($P>0.05$) were observed for total protein and albumin.

Conclusion: Supplementation positively influenced the haematology and biochemical parameters of the animals.

Keywords: Goats; supplementation; urea; crop residue; blood; haematology; biochemistry.

1. INTRODUCTION

Livestock subsector plays an important role in the Nigerian economy not only in terms of its contributions to the Gross Domestic Product (GDP), but also contributes substantial supplies of animal protein [1]. The economic importance of sheep and goats lies on the value of products derived from them. These include meat, milk and skin with huge economic potentials that may contribute to the Gross Domestic Product of a developing society [2]. Livestock production in many tropical environments is constrained by low feed availability and quality during the prolonged dry season [3]. Adequate nutrition or feeding, as a factor of production is the major obstacle to livestock productivity in Nigeria [4].

Crop residues represent a high proportion of total feed for herbivorous animals. They are characterised by high content of fibre usually above 40%, low content of nitrogen (0.3-1.0%) and low content of essential minerals such as sodium, phosphorus and calcium [5]. Supplementation of straw based diets is often necessary as these are low in protein and energy so as to meet the nutrient requirements even for maintenance [6]. As a multipurpose tree, *Balanites aegyptiaca* offers food, medicines, cosmetics, fodder, fuel wood and pesticides valued for subsistence living in the arid and semi-arid areas where other options are few [7].

Haematological studies are useful in the diagnosis of many diseases as well as investigation of the extent of damage to blood [8]. Haematological studies are of ecological and physiological interest in helping to understand the relationship of blood characteristics to the environment [9] and so could be useful in the selection of animals that are genetically resistant to certain diseases and environmental conditions. Haematological and biochemical parameters are good indicators of the physiological status of animals [10]. Changes in haematological parameters are often used to determine various status of the body and to determine stresses due to environmental, nutritional and/or pathological factors [11].

2. MATERIALS AND METHODS

2.1 Study Area

The experiment was conducted at the Teaching and Research Farm of the Department of Animal Science and Range Management, Modibbo Adama University of Technology Yola, Adamawa state. Yola is located in the North Eastern part of Nigeria. It is situated within the Savannah region and lies between latitude 9° 14' North and longitude 12° 28' East and altitude of about 152 m above sea level. Yola has a tropical climate marked by rainy and dry seasons. Maximum temperature can reach 40°c particularly in April, while minimum temperature can be as low as 18°c, particularly in December and January. Annual rainfall is less than 1000 mm [12].

2.2 Source and Preparation of Feed

Maize stover (obtained from farms around the university area) was chopped to a size of 2-4 cm using a cutlass. The stover was then treated with 4% urea (400 g of urea in 10 litres of water per 10 kg of stover). The treated stover was placed in black polythene bags and covered with sacks for three weeks. The leaves of *Balanites aegyptiaca* were collected around Rumde-Kila village of Yola South Local Government Area, Adamawa state. After collection, the leaves were shade-dried for 7-10 days and then stored in sacks. The chemical composition of the experimental feeds is shown in Table 1.

2.3 Experimental Animals and Their Management

Sixteen (16) Red Sokoto male goats weighing 9.36 Kg on average were used. All the animals were treated against external and internal parasites, using ivermectin and albendozole respectively. The animals were confined in an individual, well ventilated raised pens within a common house. Proper hygiene of the house was ensured all through the period of the experiment. The experiment lasted for 12 weeks.

2.4 Experimental Design and Treatments

Completely Randomized Design (CRD) was used. There were four treatments with four animals per treatment. Urea treated maize stover, mineral salt lick and water were offered *ad-libitum*. The 4 treatments were; T1: Urea treated maize stover + mineral salt lick + 100 g maize bran (control), T2: control diet + 100 g of *Balanites aegyptiaca*, T3: control diet + 200 g of *Balanites aegyptiaca* and T4: control diet + 300 g of *Balanites aegyptiaca*.

2.5 Blood Samples Collection and Analysis

At the end of the experiment, about 10 ml of blood was drawn from the external jugular vein by venipuncture using a hypodermic needle and syringe. The blood samples were collected into tubes containing ethylenediamine tetra acetate (EDTA) - an anticoagulant and the remaining blood samples were collected in plain tubes for haematology and serum biochemistry respectively. The blood samples were labelled and taken to the Adamawa German Hospital laboratory for analysis. Haematology was analysed by Automatic method using Sysmex K_x21 Haematology Analyser and serum biochemistry was analysed by Semi-automatic method using Spectrophotometer that is dependent on Beer Lambert's law.

2.6 Statistical Analysis

All data generated from the analysis were subjected to one way analysis of variance (ANOVA) in a completely randomized design (CRD) according to Steel and Torrie [13]. Treatment means were separated using Duncan's multiple range test (DMRT) [14].

3. RESULTS AND DISCUSSION

3.1 Haematology

The result of the haematological values is shown in Table 2. The haemoglobin concentration (g/dl), which ranged from 8.9 to 10.4 g/dl falls within the range of 7-15 g/dl reported by Daramola et al. [15]. Samira et al. [16] reported a mean value of 8.6 g/dl, which is slightly lower than the least value obtained in this study.

Table 1. Chemical composition of experiment feeds (%DM)

Parameters	Urea treated maize stover	*Balanites aegyptiaca*	Maize bran
Dry matter	91.0	92.5	94.0
Crude protein	9.7	11.9	10.3
Crude fibre	28.0	20.0	7.5
Ash	8.1	10.4	4.8
Ether extract	3.6	3.3	9.6
Nitrogen free extract	41.6	46.9	61.8
Organic matter	91.9	89.6	95.2
Neutral detergent fibre	74.4	33.8	28.6
Acid detergent fibre	52.5	26.4	9.2

The animals possess relatively high haemoglobin concentration values, and this is an advantage in terms of the oxygen carrying capacity of the blood. Opara et al. [17] reported a packed cell volume of 28.4% for apparently healthy West African dwarf goats, which falls within the range (24.9-38.3%) obtained. The packed cell volume obtained can be compared to the mean volume of 29.4% reported by Daramola et al. [15]. White blood cell count ($\times10^3$/µl) obtained falls within 13.3±0.6, 18.3±0.65 and 24.5±1.11 $\times10^3$/µl for Borno white, Kano brown and Sokoto red goats respectively fed on natural grazing rangeland [18]. Red blood cell count ($\times10^6$/µl) obtained is similar to 2.7±0.1 $\times10^6$/µl reported by Opara et al. [17]. When compared to the values (1.80±0.9-2.10±1.2 $\times10^6$/µl) reported by Okunlola et al. [19], the red blood cell count obtained in this study is relatively higher.

The neutrophils (%) values obtained agrees with the result obtained for Sokoto Red (38.50±3.76%) and West African dwarf goats (39.46±3.89%) reported by Ezenwenyi [20]. The lymphocytes (%) values obtained is similar to the range of 40-70% reported by NseAbasi et al. [21] for sheep. Opara et al. [17] reported a mean lymphocytes value of 70.3±1.3% for West African dwarf goats, which is similar to the highest value obtained in this study. The findings of this study is in agreement with the statement of Olusanya et al. [22] who stated that in goats like other ruminants, there are more lymphocytes than neutrophils in circulation. Lymphocytes are the key elements in the production of immunity. Low levels can be seen in some bacterial infections, aplastic anaemia, and in some forms of leukaemia while high values can be observed in viral infections, and in some forms of leukaemia [23]. The monocytes (%) values obtained are higher than 2.0±0.1% reported by Njidda et al. [18] for Borno white buck kid. The values are also higher than 2.4±0.3% observed by Opara et al. [17] but similar to 0-6% observed for sheep [21].

The values of mean corpuscular volume (fl) increased ($P<0.05$) with increase in supplementation. The increase in values indicate macrocytosis [24]. The values of mean corpuscular volume obtained can be compared to 105.5±2.23, 119.1±3.76 and 32.69±0.7 fl for Kano brown, Sokoto red and Borno white male goats respectively as reported by Njidda et al. [18]. The mean corpuscular haemoglobin (pg) obtained is similar to 37.8±2.2 pg reported by Opara et al. [17] for West African dwarf goats and 35.94±0.02 pg reported by Njidda et al. [18] for Kano brown goat kids. Okunlola et al. [19] reported higher values (40.95-51.00 pg) of mean corpuscular haemoglobin for Sokoto Red goats fed *Adansonia digitata* fruit meal supplement. The values of mean corpuscular haemoglobin concentration (g/dl) observed are comparably to 35.2±19.1 g/dl reported by Egbe-Nwiyi et al. [25] for Sahel goats. The red blood cell, packed cell volume, haemoglobin concentration, mean corpuscular volume, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration values help to determine and classify anaemia [26]. From the findings of this study, the animals were free of anaemia infection. Also, the animals did not show signs of pallor and fatigue.

Table 2. Haematological values of sokoto red goats fed urea treated maize stover and graded levels of *Balanites aegyptiaca* leaves

Parameters	T1 (0 g)	T2 (100 g)	T3 (200 g)	T4 (300 g)	SEM
Hb conc. (g/dl)	10.0^a	9.6^a	8.9^a	10.4^a	0.53^{NS}
PCV (%)	25.3^c	27.8^b	24.9^c	38.3^a	0.21*
WBC ($\times10^3$/µl)	16.8^b	19.2^a	20.4^a	15.6^b	0.35*
RBC ($\times10^6$/µl)	2.9^b	2.6^b	2.3^c	3.3^a	0.05*
Neutrophils (%)	23.9^d	35.8^c	31.3^b	49.8^a	0.21*
Lymphocytes (%)	71.1^a	60.2^c	62.7^b	50.2^d	0.16*
Monocytes (%)	5.0^a	4.0^a	6.0^a	5.0^a	1.00^{NS}
MCV (fl)	87.2^d	106.1^c	109.2^b	117.1^a	0.10*
MCH (pg)	34.5^a	36.6^a	39.0^a	31.8^a	1.51^{NS}
MCHC (g/dl)	39.5^a	34.5^b	35.7^b	27.2^c	0.25*

Means with different superscript in the same row differ significantly ($p<0.05$)

*SEM = Standard error of mean, ^{NS} = Not Significant, * = Significant at ($p<0.05$), Hb = Haemoglobin Concentration, PVC = Packed Cell Volume, WBC = White blood cell, RBC = Red blood cell, MCV = Mean Corpuscular Volume, MCH = Mean Corpuscular Haemoglobin, MCHC = Mean Corpuscular Haemoglobin Concentration, Conc. = Concentration*

Table 3. Biochemical values of sokoto red goats fed urea treated maize stover and graded levels of *Balanites aegyptiaca* leaves

Parameters	T1 (0 g)	T2 (100 g)	T3 (200 g)	T4 (300 g)	SEM
Urea concentration (mmol/l)	5.3^{b}	5.2^{b}	4.8^{b}	7.2^{a}	0.18*
Total protein (g/l)	5.6^{a}	6.0^{a}	6.4^{a}	6.8^{a}	0.53^{NS}
Albumin (g/l)	3.0^{a}	3.2^{a}	3.2^{a}	3.4^{a}	0.53^{NS}

Means with different superscript in the same row differ significantly (p<0.05)
*SEM = Standard error of mean, ^{NS} = Not Significant, * = Significant at (p<0.05)*

3.2 Biochemical Parameters

The result of the biochemical values is shown in Table 3 above. Njidda et al. [18] reported a urea concentration of 5.6±0.03 mmol/l for Kano brown goats, which falls within the range of values obtained. The values obtained falls in the range of 0.8-9.7 mmol/l reported by Daramola et al. [15], but higher than 4.7±2.1 mmol/l reported by Tambuwal et al. [27]. A high level of serum urea has been attributed to excessive tissues protein catabolism associated with protein deficiency [28]. The values obtained in this study are within normal range which entails that the goats did not suffer from protein deficiency.

Total protein (g/l) values obtained for the supplemented treatments are higher than 5.41±0.06 and 5.77±0.09 g/l for West African dwarf goats and Sokoto Red goats respectively [20]. Oduye and Adadevoh [28] reported a mean total protein value of 6.3±0.7 g/l for West African dwarf sheep, which is comparable to the values obtained. Similarly, Tambuwal et al. [27] reported a lower mean value (4.4±1.5 g/l) for Sokoto Red goats and Daramola et al. [15] reported a relatively higher mean value (7.1±0.1 g/l) for West African dwarf goats.

The albumin (g/l) values obtained are comparable to 2.9±0.1 g/l reported by Opara et al. [17] for West African dwarf male goats. Daramola et al. [15] reported a mean albumin value of 3.4±0.7 g/l, which is similar to the value obtained in T4. Ezenwenyi [20] reported higher values of 3.93±0.22 and 4.10±0.18 g/l for West African dwarf goats and Sokoto Red goats respectively. T4 had the highest values for all the biochemical parameters measured.

4. CONCLUSION

The use of *Balanites aegyptiaca* as a supplement to urea treated maize stover improved the haematological and biochemical parameters of the goats. *Balanites aegyptiaca* had no deleterious effects on the haematological and biochemical parameters of the animals and can therefore be utilized when feeding goats with low quality basal feeds in order to upgrade their blood profile.

ETHICAL APPROVAL

As per international standard or university standard ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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