

HAEMATOLOGY AND SERUM BIOCHEMISTRY OF RED SOKOTO BUCKS FED DIETS CONTAINING GRADED LEVELS OF YAM (*Dioscorea Spp*) PEEL MEAL AS SUPPLEMENT TO SHEA BUTTER LEAVES (*Vitellaria paradoxa*)

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ABSTRACT

The study evaluated the haematology and serum biochemistry of Red Sokoto bucks fed diets containing graded levels of yam peel meal as supplement to shea butter leaves. Sixteen (16) Red Sokoto bucks aged about 11 – 12 months old were allocated into four (4) treatments of four (4) bucks each. The bucks were fed shea butter leaves at 500g/buck/day and a concentrate supplement diet containing (0%, 5%, 10% and 15% yam peels) at 250g per buck/day for a duration of fifty (50) days, water was served ad libitum, feed intake was monitored and recorded. The experimental design was a complete randomized design. Concentrate, yam peels and shea butter leaves samples were analyzed for their proximate composition. At the end of the experiment, haematological and serum biochemical parameters were analyzed. Haematological parameters evaluated had significant ($P < 0.05$) difference except Basophil, Eosinophil, Neutrophil, Lymphocyte, MCV and MCHC. All haematological parameters evaluated across the groups were within the normal range of values for goats. Serum biochemical parameters evaluated were statistically significant ($P < 0.05$) except Cholesterol, HDL, total bilirubin, Globulin and Glucose. However, the serum biochemical parameters evaluated across the groups were within the normal range of values for goats. It was concluded that yam peel meal in the concentrate diet of growing Red Sokoto bucks had no adverse effect on haematology and serum biochemistry. Inclusion of graded levels of yam peel meal up to 15% is safe for growing Red Sokoto bucks.

Keywords: Haematology, Serum biochemistry, Yam Peel Meal, Shea Butter Leaves, Feed, Supplement

1.0

INTRODUCTION

The output of some livestock species, such as goats, cattle, pigs, and poultry, has significantly decreased due to the difficulties experienced by livestock farmers in emerging nations, which exacerbates the protein shortage. This is because traditional feed materials and livestock species are becoming more expensive, which drives up production costs. Alternative, inexpensive, and locally accessible sources of feed ingredients are therefore desperately needed, especially those that do not compete with humans for consumption or have no direct bearing on the human food chain (Shettima *et al.*, 2024).

In most tropical ecosystems, seasonal variations in the availability and quality of forage due to modal rainfall patterns pose a significant challenge to the production of ruminant

livestock. Nigerian goats are traditionally raised at subsistence level, typically left to scavenge and provide for themselves (Garba and Ibrahim, 2019). During the dry season, forage yield and quality reportedly decline drastically, for both cultivated pastures and natural pastures (Ocheja *et al.*, 2021).

Yam peel meal (YPM) a by-product of yam processing has shown promise as a viable feed ingredient (Ekpo *et al.*, 2015). The outer skin of yams, which are frequently utilized in a variety of food products, is the source of yam peel meal. Despite its potential for nutrition, this byproduct is frequently underused. However, because of its nutritional and financial benefits, this by-product is drawing interest as a possible substitute feed ingredient in animal husbandry (Shettima *et al.*, 2025b). Yam peel meal (YPM) is currently being studied for its potential use as an animal feed ingredient, particularly for livestock known for rapid growth and strong reproductive performance. The composition of YPM includes 95.34% dry matter, 4.89% crude protein, 12.24% crude fiber, 9.78% ash, 3.34% ether extract, and 69.75% nitrogen-free extract (NFE) (Popoola *et al.*, 2021). In Nigeria, the market prices of livestock and their products could decline if low-cost feed resources were more effectively utilized in animal production and breeding. The connection between nutrition, productivity, and reproductive outcomes is gaining growing attention among farmers, veterinarians, feed suppliers, and agricultural extension personnel. It has long been recognized that nutritional factors significantly influence animal reproduction, with clear implications for overall reproductive success. (Butler, 2000). Dietary ingredients can influence haematological and serum biochemical markers in detectable ways, and notable shifts in these values may provide insight into the safety or potential toxicity of animal feed (Shettima *et al.*, 2021).

The aim of this study therefore was to evaluate the haematological and serum biochemical profile of Red Sokoto bucks fed diets containing graded level of yam peel meal as supplement to shea butter leaves.

2.0

MATERIALS AND METHODS

2.1 Experimental site

The study was conducted at the Animal Science Teaching and Research Farm, Faculty of Agriculture, Federal University of Kashere in Gombe State. The state is situated within latitude 9°54'46N and longitude 9° 46'27E and 10°57° E and altitude of 349m above sea level. The annual rainfall of Kashere ranges between 800mm-900mm per annum and is characterized by distinct dry season (October-May) and rainy season (June-September) seasons. The annual mean temperature ranges from 30-32° C and it

experiences a relative humidity of 17-90% (National Geospatial Intelligence Agency, 2019).

2.2 Experimental Animal and their Management

Sixteen (16) red Sokoto bucks aged between 11-12 months were sourced from Kashere Market. They were brought to the Animal Science Teaching and Research Farm, Faculty of Agriculture, Federal University of Kashere and housed in individual pens for one week for acclimatization. They were randomly allocated into four (4) Treatments of four (4) goats each (T1, T2, T3 and T4). The Experimental animals were treated with Albendazole oral solution for endo parasites at 1ml per 10kg body weight and pour-on (Cypermectrin 1%) for ecto parasites at 1ml/10kg. Antibiotic (Oxytetracycline L.A) was administered at 1ml/10kg body weight and multivitamin injection at 1ml/10kg body weight, both was given to take care of bacterial infection/stress and to provide a common health status prior to the commencement of the experiment.

2.3 Experimental Diets

The Yam Peels used for the experiment were collected from within Kashere and the University Campus. The feed ingredients consist of Yam peels, Cassava peels, Sweet potato peels, Maize offal, Groundnut Cake, Egg shell and Table salt. These components were thoroughly mixed after pounding and grinding to form Yam Peel Meal (YPM).

Table 1 Composition of Experimental Diet (%)

Ingredients	T1	T2	T3	T4
Yam peels	0.00	5.00	10.00	15.00
Sweet potato leaves	18.37	18.37	18.37	18.37
Groundnut cake	37.84	37.84	37.84	37.84
Cassava peels	8.10	8.10	8.10	8.10
Maize offal	32.45	21.62	10.81	0.00
Egg shell	1.08	1.08	1.08	1.08
Table salt	2.16	2.16	2.16	2.16
Total	100	100	100	100
Calculated Nutrients Content				
Crude Protein	15.52	15.50	14.97	16.12
Crude fibre	13.49	13.44	13.39	13.34
ME (Kcal/kg)	2916.43	2918.48	2920.52	2972.03

Calculated compositions of the experimental diets using Ponzenga (1985) formula (kCal/kg)

2.4 Chemical Analysis

Samples of the experimental diets, yam peel meal and shea butter leaves were analyzed for their proximate composition using the method outlined by AOAC (2000).

2.5 Experimental Procedure

The Bucks were randomly allocated into four (4) treatments after balancing the weight; each treatment had four (4) replicates. Treatment one (T1) was given 0.00% level of yam peel meal; treatment two (T2) was given 5.00% level of yam peel meal; treatment three (T3) was given 10.00% level of yam peel meal and Treatment four (T4) was given 15.00% level of yam peel meal.

Each treatment had (4) goats; each goat was fed 250g of the concentrate per day, and Shea butter leaves at 500g per Goat per day, of which the Shea butter leaves was fed first, then the concentrate one hour later, the Goats were served water *Ad-libitum*. The bucks were fed the experimental diets for 50 days, after which the experiment was terminated.

2.6 Haematology and Serum biochemistry

At the last day of the feeding trial, blood samples for haematology and serum biochemistry analysis were collected via the jugular vein from all the experimental animals using 10ml syringes and needles. 5mls was transferred into a well labeled test tube containing ethylene diamine tetra acetic acid (EDTA) as anticoagulant for haematological analysis. The un-coagulated blood samples were analysed for packed cell volume, haemoglobin concentration, red blood cell count, white blood cell count, mean corpuscular haemoglobin, mean corpuscular volume and mean corpuscular haemoglobin concentration using methods described by Ogbuagu *et al.*, (2022). 5mls of the blood sample were transferred into a test tube without anticoagulant for serum biochemical analysis. The blood samples for serum biochemical analyses were kept at a temperature of 25-26°C for 15 minutes for the blood to clot. The samples were centrifuged at 3000r for 10minutes and the serum samples obtained were refrigerated at -25°C until analysis, serum biochemical parameters were determined as described by Ogbuagu *et al.*, (2022). The Serum was analyzed for lipid profile (cholesterol, triglyceride, high density lipoprotein, low density lipoprotein); serum electrolytes (sodium, potassium, chloride, creatinine, urea); liver function test (aspartate aminotransferase, alanine aminotransaminase, total bilirubin, total protein, albumin, globulin) and blood glucose.

2.7 Experimental Design and Statistical Analysis

The experimental Design was Completely Randomized Design (CRD). Data obtained was analyzed using a one-way Analysis of variance (ANOVA), means with significant differences were separated using Least Significant Differences (LSD) with the aids of Statistical Packages identified as Statistical Analysis System (SAS) version 9.04, 2018.

3.0

RESULTS AND DISCUSSION

3.1 Proximate Composition of Experimental Diets Containing Graded Levels of Yam Peel Meal (YPM) and Dried Yam Peel (DYP) Actual Basis (% Dry Matter)

The proximate composition of dried yam Peel, concentrate diets and shea butter leaves is summarized in Table 3.1.

The protein content of 7.20% for the dried yam Peels is lower than the values of 12-18% recommended for growing ruminants in the tropics (NRC, 2001). However, the supplement is expected to take care of this deficiency, while the protein content of the concentrate diets (17.80 – 18.00) was within the values of 12 - 18% recommended by NRC (2001). The crude fiber content of 12.80% for the yam Peel and 7.70 - 7.90% for the concentrate diets are adequate for the goats (Lakpini, 2002). The ether extract value of the yam Peel 2.20% is below the recommended values for ruminant, while that of the concentrate diets 4.33 – 4.80% is within the recommended values (Maithison *et al.*, 1998). The ash content of 8.84% in the yam Peel shows that the mineral content is high in the Peel, while that of the concentrate diets 4.50 – 5.61% is optimum for productivity. The nitrogen free extract (60.45%) and carbohydrate (56.80 – 58.07%) values in the yam Peel and the concentrate diets are high, which will support optimum growth and productivity.

Table 2: Proximate Composition of Experimental Diets, Dried Yam Peels and Shea butter leaves

Nutrients	Treatments					
	T1	T2	T3	T4	DYP	SBL
Crude Protein	18.60	18.00	17.95	17.80	7.20	10.10
Crude Fiber	7.80	7.90	7.85	7.70	12.80	13.90
NFE	56.80	57.60	56.80	58.07	60.45	29.99
Ether Extract	4.80	4.40	4.50	4.33	2.20	10.50
ASH	4.50	4.80	5.61	5.40	9.84	3.00
Moisture Content	7.50	7.30	7.20	6.70	8.50	32.70
Total	100	100	100	100	100	100
Dry Matter	92.50	90.70	92.80	93.30	91.50	67.30

ASH = Ash, NFE = Nitrogen-Free Extract, DYP = Dried Yam Peel, SBL = Shea Butter Leaves

3.2 Haematological Parameters of Experimental Bucks

Haematological profile of Red Sokoto bucks fed diets containing graded levels of yam Peel Meal is presented in Table 3.

Haematological parameters evaluated had significant ($P < 0.05$) difference except Basophil, Eosinophil, Neutrophil, Lymphocyte, MCV and MCHC. All haematological parameters evaluated across the groups were within the normal range of values for goats reported by Duncan *et al.* (1994) and Radostits *et al.* (2005). The normal values of PCV, Hb and RBC indicate that the protein utilization of the bucks was not adversely affected. The normal WBC values indicate that there is no allergic reaction. The findings of this work agrees with the findings of Shettima *et al.* (2025a) who fed diets containing graded levels of cassava peel meal on the haematology of red Sokoto bucks and reported no adverse effect. It also agrees with the findings of Amaza *et al.* (2020) who fed graded levels of Yam peel meal as replacement for maize to growing rabbits and reported no adverse effect on haematology.

Table 3: Haematological Profile of Experimental Bucks

Parameters	Treatments				SEM	Reference Value
	T1	T2	T3	T4		
PCV (%)	14.33 ^b	22.00 ^a	24.00 ^a	23.00 ^a	1.69	14.00 – 30.00
Hb (g/dL)	4.90 ^b	7.30 ^a	7.76 ^a	7.63 ^a	0.54	4.0 – 9.5
RBC (g/dL)	1.53 ^b	2.70 ^a	2.76 ^a	2.86 ^a	0.29	1.5 – 4.9
WBC ($\times 10^9/L$)	8.70 ^a	6.70 ^{ab}	5.96 ^b	8.30 ^{ab}	0.72	4.50 – 11.00
Basophil (%)	0.33	0.33	0.33	0.33	0.33	0.00 – 3.00
Monocytes (%)	5.00 ^b	7.33 ^a	7.66 ^a	5.66 ^{ab}	0.71	0.00 – 8.00
Eosinophil (%)	3.00 ^a	2.33 ^a	3.33 ^a	2.33 ^a	0.41	0.00 – 10.00
Neutrophil (%)	59.00 ^a	56.67 ^a	57.00 ^a	57.00 ^a	7.12	30 - 70
Lymphocytes (%)	32.67 ^a	33.00 ^a	31.33 ^a	34.67 ^a	8.06	20.00 – 70.00
MCV (fl)	79.00 ^a	81.66 ^a	81.00 ^c	86.00 ^a	5.51	70– 100
MCH (pg)	20.00 ^b	25.66 ^b	25.00 ^a	26.66 ^a	1.52	20.0– 34.6
MCHC (%)	313.0 ^a	313.6 ^a	311.6 ^a	326.6 ^a	4.60	300 – 360

a, b, c; means in the same row with different superscripts differ significantly ($P < 0.05$).

PCV = Packed cell volume, Hb = haemoglobin, RBC = Red blood cell, WBC = white blood cell, MCV= Mean Corpuscular Volume, MCH = Mean Corpuscular Haemoglobin, MCHC = Mean Corpuscular Haemoglobin Concentration, SEM = standard error of mean, Reference Value = normal haematological value for goats.

3.3 Serum biochemical Parameters of Experimental Bucks

Serum Biochemistry of growing Red Sokoto bucks fed diets containing graded levels of Yam Peel Meal is presented in Table 4. Serum biochemical parameters evaluated were statistically significant ($P < 0.05$) except Cholesterol, HDL, total bilirubin, Globulin and Glucose. All Serum biochemical parameters evaluated across the groups were within the normal range of values for goats reported by Duncan *et al.* (1994) and Radostits *et al.* (2005). Serum biochemical components are sensitive to elements of toxicity in feeds. The findings of this work agrees with the findings of Shettima *et al.* (2025a) who fed diets containing cassava peel meal and reported no adverse effect on serum biochemistry of red Sokoto bucks. It also agrees with the findings of Amaza *et al.* (2020) who fed graded levels of Yam peel meal as replacement for maize to growing rabbits and reported no adverse effect on haematology.

Table 4: Serum Biochemistry of Experimental Bucks

Parameters	Treatments				SEM	Reference Value
	T1	T2	T3	T4		
Cholesterol (mg/dl)	1.20 ^a	1.16 ^a	1.36 ^a	1.60 ^a	0.21	1 – 5
Triglyceride (mg/dl)	0.23 ^d	0.83 ^b	0.56 ^c	1.20 ^a	0.06	0 – 3
HDL (mg/dl)	0.70 ^a	0.80 ^a	0.86 ^a	1.00 ^a	0.12	0 – 1.5
LDL (mg/dl)	0.43 ^a	0.40 ^a	0.23 ^b	0.23 ^b	0.04	0 – 4
Sodium (mmol/L)	135.00 ^b	144.00 ^{ab}	147.66 ^a	144.33 ^a	2.76	130 – 150
Potassium (mmol/L)	10.03 ^a	6.26 ^b	5.90 ^b	6.40 ^b	0.70	3 – 15
Chloride (mmol/L)	95.00 ^b	102.33 ^{ab}	105.66 ^a	103.00 ^a	2.27	90 – 110
Urea (mmol/L)	6.86 ^b	10.20 ^a	7.86 ^b	7.00 ^b	0.36	2.5 – 10.8
Creatinine (mmol/L)	51.66 ^a	50.33 ^{ab}	42.66 ^b	50.00 ^{ab}	2.40	40 – 132
AST (IU/L)	133.00 ^a	114.67 ^a	118.00 ^a	160.00 ^a	25.68	58 - 170
ALT (IU/L)	23.00 ^a	22.66 ^a	18.00 ^{ab}	13.00 ^b	2.52	10 – 29
Tbilirubin (mmol/L)	0.86 ^a	0.56 ^a	1.40 ^a	0.70 ^a	0.31	0 - 22
Tprotein (mmol/L)	57.66 ^b	60.00 ^b	62.00 ^{ab}	66.00 ^a	1.64	44 – 86
Albumin (mmol/L)	30.33 ^b	34.66 ^{ab}	35.66 ^{ab}	40.00 ^a	1.71	30 – 44
Globulin (mmol/L)	27.33 ^a	25.34 ^a	26.34 ^a	26.00 ^a	1.70	24 – 48
Glucose	4.86 ^a	4.26 ^a	4.26 ^a	5.26 ^a	0.37	3.5 – 6.5

a, b, c; means in the same row differ significantly ($P < 0.05$), HDL = high density lipoprotein, LDL = low density lipoprotein, AST = Aspartate aminotransferase, ALT = Alanine aminotransferase, Tb = Total bilirubin, Tp = Total protein, SEM = standard error of the mean.

4.0

CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The compounded diets of T1, T2, T3 and T4 met the nutrient requirements for Red Sokoto goats. The experimental diets did not have adverse effects on the haematological and serum biochemical parameters. The treatment diet supports the normal physiological functioning of the body.

4.2 Recommendations

- Further research can be carried out using more than 50 days trial; to see what effect the treatment diets will have on haematology and serum biochemical parameters.
- Higher inclusion levels of yam Peels, can be used; to see what effect the treatment diets will have on haematology and serum biochemical parameters.
- Farmers can include yam Peels up to 15% in the diet of Red Sokoto bucks.



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