

Full Length Research Paper

Blood Characteristics of Uda Lambs Fed Graded Levels of Sweet Potato (*Ipomea Batata*) Peels in the Semi - Arid Zone, Nigeria

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Received: 20 September, 2022, Accepted: 12 October, 2022, Published: 24 October, 2022

This study was conducted to determine the blood characteristics of Uda lambs fed graded levels of Sweet Potato (*Ipomea batata*) Peels in the semi - arid Zone, Nigeria. Twelve (12) weeks feeding trial was conducted using sixteen (16) weaned male Uda lambs of about 8-12 months old weighing 17-22kg at the Livestock Teaching and Research Farm (LTRF), Department of Animal Science, Kebbi State University of Science and Technology, Aliero. Four complete experimental diets were formulated with graded levels of sweet potato peels at 0, 10, 20 and 30% inclusion levels. The animals were randomly allocated to these four (4) dietary treatment groups in a Completely Randomised Design (CRD). Blood samples were collected and analysed for haematological and biochemical indices. Haematological and biochemical parameters analysed were not significant at ($P>0.05$). It was concluded that feeding Uda ram lambs with sweet potato peels did not affect blood chemistry and haematological indices. Therefore, it is recommended that Sweet Potato (*Ipomea batata*) Peels can be included in Uda lambs diet to about 30% without any detrimental effect to the animals.

Keywords: Blood characteristics; *Ipomea batata*; Livestock; Semi - arid Zone; Uda lambs.

INTRODUCTION

In the semi-arid zone of northern Nigeria, as the dry season progresses, the small scale farmers cannot afford the investments required to establish improved pastures and feed concentrate supplements to alleviate dry season growth checks. The scarcity of high quality conventional feeds especially in the dry season and also the competition between man and animals for the conventional feeds (Maigandi *et al.*, 2002) inevitably compelled the stakeholders in the livestock industry to exploit other sources of feed ingredients that are locally available, nutritious and affordable (Maigandi *et al.*, 2008). Example of which is un-conventional feeding stuff like sweet potato, yam and cassava peels, rumen digests, municipal waste, domestic refuse, animal excreta, rumen content, tannery wastes, browse plants

among other products (Boda, 1990).

Blood is known to be vital to the life of an organism. This is a medium through which nutrients are conveyed to various parts of the body system of an organism. A readily available and fast means of assessing clinical and nutritional status of an animal on feeding trial may be the use of blood analysis (Olabanji *et al.*, 2009). Haematological parameters are important and reliable medium used to monitor and evaluate health and nutritional status of animals (Gupta *et al.*, 2007). It therefore becomes imperative to evaluate blood parameters of an animal particularly when unconventional feeds are fed to animals in order or so as to ascertain the performance and health status of the animals as well as suitability of same on the specie of livestock (Garba and Abubakar, 2012).

However, such unconventional feed must be used with caution, because some of them could contain toxic substances, the consumption of which could be harmful

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to animals (Kwaido *et al.*, 1992). Sweet potato (*Ipomea batatas*) is produced in large quantities in Nigeria and form important energy source for human and livestock feeding. The peels from the processing of these roots are readily available at cheap costs in many parts of the country because they have limited or no human food value. In Kebbi State, sweet potato is mainly cultivated in the rural areas like Kardi, Harasawa, Gulumbe, Bami, Makera, etc. The cultivation is done all year round as farmers make use of irrigation pumps during dry season, making it available at all times in this part of Nigeria.

The objectives of the Study includes to find out haematological characteristics of the Uda lambs fed graded levels of sweet potato peels and to evaluate graded level of sweet potato peels on the serum chemistry and electrolyte of the Uda lambs fed graded levels of sweet potato peels.

MATERIALS AND METHODS

Experimental Location

The research was conducted at the Livestock Teaching and Research Farm (LTRF), Department of Animal Science, Kebbi State University of Science and Technology, Aliero. Aliero Local Government is one of the Local Government Areas under Gwandu Emirate of Kebbi state. It covers a geographical land area of 412 square kilometres with an estimated population of about 125,783 inhabitants (NPC, 2006). The study area is located on latitude 11.6781° north and longitude 4.0695° east of the equator. The climate of the area is generally characterized by high temperatures ranging between March and May, with annual temperatures varying between 38°C to 42°C. The area experiences harmattan wind between late November to early February, with temperatures as low as 23°C. The study area is located in the Sudan Savannah agro ecological zone of Nigeria, and it experiences serious moisture deficiency for greater part of the year. Rainfall usually begins in early May, while heavy fall is experienced between July and October with mean annual rainfall varying between 500mm to 800mm. The climate of the area encourages the production of crops and rearing of animals both during rainy and dry seasons, which makes majority of the inhabitants to choose peasant farming as an occupation.

Experimental Animals and Their Management

Sixteen (16) weaned male Uda lambs of about 8-12 months old weighing 17-22kg were used for the research. The animals were purchased from the livestock market in Birnin Kebbi. The animals were quarantined for four weeks, dewormed with Banmith II® (12.5mg/kg body weight) to treat against gastrointestinal parasites. They

were also sprayed with Triatic® against ectoparasite and treated with Oxytetracycline HCL (long lasting broad-spectrum antibiotic). The animals were kept in pens and group fed for two (2) weeks to acclimatize to the environment. The animals were balanced for weight for each treatment and thereafter allocated to four treatments diets with four replicate each. The lambs were housed individually in a pen measuring 2m × 1m, which was disinfected prior to the commencement of the experiment.

Experimental Feed Preparation and Formulation

Four complete experimental diets were formulated with graded levels of sweet potato peels at 0, 10, 20 and 30% inclusion levels. The ingredients used for the diet formulation were purchased from Birnin Kebbi central market. The peels were sourced from local markets in Jega and Aliero. The peels were sun dried to enhance formulation, eliminate protozoa and fungi as well as reduce bacterial contamination. As much as possible isonitrogenous and isocaloric diets were formulated and were designated as diets 1, 2, 3 and 4 in the experiments. The gross compositions of the experimental diets were shown in Table 1.

Experimental Design and Procedure

Complete Randomized Design (CRD) was used in this experiment as outlined by Steel and Torrie (1980). A total of sixteen (16) growing Uda lambs were used in which four animals per treatment were used, each animal served as replicate. Each animal was individually housed in a pen, which was previously disinfected. Each group was served one of the experimental diets and fed *ad-libitum* for eighty four (84) days. Water was also offered *ad-libitum*.

Health Management of the Experimental Animals

Daily routine management such as cleaning and washing of pens and drinkers was maintained during the period of the experiment.

Data Collection

Blood Samples Collection

Blood samples were collected from the experimental animals at the last week of the feeding trial. Blood samples were collected from the jugular vein (Coles, 1986). Bleeding was done early morning before feeding. About 7ml of the blood was collected from each animal and 3ml of each sample was placed in an Ethylene Diamine Tetracetate (EDTA) (anti-coagulant) bottle for haematological studies. The remaining 4ml was placed in

Table.1 Gross Compositions of the Experimental Diets

Ingredients (%)	Treatments (inclusion levels of sweet potato peels)			
	1(0%)	2(10%)	3(20%)	4(30%)
Sweet potato peels	0	10	20	30
Maize	12	07	03	0
Groundnut Haulms	19	19	17	22
Cowpea Husk	19	19	19	15
Wheat Offal	20	10	05	0
Soya Bean Meal	15	18	19	19
Rice Milling Wastes	14	16	16	13
Salt	1	1	1	1
Total	100	100	100	100
Calculated Energy kcal/kg ME	2102	2104	2010	2108
Calculated Crude Protein (%)	17.0	17.1	16.8	16.6
Calculated Crude Fibre (%)	20.3	20.0	19.1	18.2

Table 2: Chemical Composition of the Experimental Diets

Variables	Treatment (% inclusion level of potato peels)				Sweet Potato Peels
	1(0%)	2(10%)	3(20%)	4(30%)	
Dry Matter	94.20	93.30	90.10	91.00	91.76
Crude Protein	17.00	17.10	16.80	16.60	4.64
Crude Fibre	21.30	21.00	20.10	19.20	3.80
Ether Extract	4.50	4.00	3.50	4.50	4.06
Nitrogen Free Extract	45.20	46.90	47.60	48.20	74.70
ASH	12.00	11.00	12.00	11.50	4.56

an universal bottle and allowed to stand for about 2hours at room temperature; this allows the coagulation to take place. The universal bottle was thereafter centrifuged at 4000RP/M for 5 minutes to separate and decant the serum. The serum was stored in a freezer for biochemical analysis.

Haematological Indices Determination

Blood samples were analysed at the Federal Medical Centre Birnin Kebbi. Whole blood sample in Ethylene Diamine Tetracetate (EDTA) bottles was analysed for haemoglobin (Hb) content using Cyanomethemoglobin method (Coles, 1986). Packed Cell Volume (PVC), red blood cell (RBC) and white blood cell (WBC) counts were determined according to Microhaematocrit method and microscopic method respectively (Bush 1991). Differential counts were determined from the leucocytes counts. Erythrocyte indices including mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were derived from the values obtained from RBC count, haemoglobin concentration and PCV values (Jain, 1993).

Blood Chemistry

The samples were taken to chemical pathology unit of Federal Medical Centre Birnin Kebbi for analysis. Total protein and Albumin were determined by the Biuret and

Bromocressol green (BCG) methods (Peter *et al.*, 1982). Globulin was determined by obtaining the difference between total protein and Albumin. The serum enzymes, Aspartate aminotransferase (AST), alanine amino transferase (ALT), alkanine phosphate (ALP) activities were determined using spectrophotometric method, as described by Rej and Hoder (1983).

Serum Electrolytes

The serum electrolytes such as serum sodium, calcium and potassium were determined using flame spectrophotometry as described by Duncan *et al.* (1994).

Statistical Analysis

All the data obtained from the experiment were subjected to analysis of variance (ANOVA) using completely randomized design (Steel and Torrie, 1980) and probability level at $P < 0.05$ was considered significant. Least significant difference (LSD) was used to separate the means.

RESULTS

Proximate Compositions of Experimental Diets

Results (Table 2) indicated the chemical composition of

Table 2: Haematological Values of the Experimental Animals Fed Graded Levels of Sweet Potato (*Ipomea batata*) Peels

Variables	Treatments				SEM	Reference
	1	2	3	4		
PCV (%)	30.67	32.00	24.33	29.67	0.84	24 – 45
Hb (g/dl)	10.23	10.67	8.10	9.87	0.29	8 – 16
RBC ($\times 10^{12}/L$)	6.20	7.07	5.20	6.57	0.45	4 – 12
WBC ($\times 10^{12}/L$)	5.50	6.33	7.27	6.70	0.48	4 – 12
Platelets	1050	1148	1440	1120	27.20	400 - 2000
MCV	49.70	45.60	47.10	45.50	2.63	23 – 48
MCH	16.57	15.19	15.69	15.14	0.85	31 – 38
MCHC	33.36	33.33	33.29	33.26	0.06	31 – 38
Lymphocyte	47.00	35.30	41.00	37.30	5.62	40 – 70
Monocyte	3.00	3.33	2.33	3.33	0.33	0 – 6
Eosinophils	2.33	2.67	1.33	2.67	0.75	0 – 10
Neutrophils	48.30	58.30	56.70	56.70	5.60	25 - 60
Basophils	00	00	00	00	00	0 – 3

the experimental diets and the test ingredient (sweet potato peels). The dry matter (DM) content of the experimental diets was similar. It ranges from 90 % to 94 % with treatment 1 recording the highest followed by treatment 2 and treatment 3 the lowest. The crude protein (CP) content of the experimental diets ranged from 16.50 % to 17.40 % with treatment 2 recording the highest followed by treatment 1 and treatment 4 the lowest. The crude fibre (CF) content was within the range of 19 - 21.50 % with treatment 1 recording the highest followed by treatment 2 and then treatment 4. Values for the ether extract (EE) were 4.50 % for treatment 1, 4.00 % for treatment 2, 3.50 % for treatment 3 and 4.50 % for treatment 4. The Ash content of the diets was 12 % for treatments 1 and 3, 11% for treatment 2, and 11.50 % for treatment 4. The lowest value of the Nitrogen Free Extract (NFE) was obtained in the control diet (45.20 %) while treatment 2, 3 and 4 had an NFE value of 46.90 %, 47.60 % and 48.20 % respectively.

The Proximate composition of the test ingredient (sweet potato peel) shows that it contained 8.24% moisture, 4.64% Crude protein, 4.56% Ash, 4.06% ether extract, 3.80% fibre and 74.70% Nitrogen Free Extract (NFE).

Haematological Characteristics of the Experimental Animals Fed Graded Levels of Sweet Potato (*Ipomea batata*) Peels.

Table 3 present the values of the haematological parameters for the present study. There was no significant difference ($P > 0.05$) between treatments in all the parameters under study. The Packed Cell Volume (PCV), haemoglobin (Hb) were higher for treatment 2 followed by treatment 1. PCV ranged from 24.33 – 32.00 while Hb ranged from 8.10 – 10.67. The Red Blood cell (RBC) was higher for treatment 2 followed by treatment 4. RBC ranges from 5.20 – 7.07. The white blood cells

(WBC) and Platelets were higher for treatment 3 and lower for treatment 1. The WBC ranged from 5.50 – 7.27 while Platelets ranged from 1050 – 1440. The Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC) were higher for the control group ($P > 0.05$). The MCV ranged from 45.50 – 49.70, MCH 15.14 - 16.57 and MCHC 33.26 – 33.36. The Monocytes and Eosinophils records from treatments 2 and 4 are the same ($P > 0.05$). The former ranged from 2.33 – 3.33 while the later ranged from 1.33 – 2.67. The Lymphocyte ranged from 35.30 – 47 and it had the highest record from treatment 1 followed by treatment 3. The Basophils values are the same across treatments. Neutrophils values ranged from 48.30 – 58.30 ($P > 0.05$).

Blood Chemistry of Uda Lambs Fed Graded Levels of Sweet Potato (*Ipomea batata*) Peels in Their Diets

Table 4 presents the result of the serum biochemical parameters. The serum biochemical parameters did not differ significantly ($P > 0.05$) between the treatments. Blood Sodium (Na) ranged from 142.00 – 145.67 with treatment 4 having the highest value ($P > 0.05$). Potassium (K) had its highest record from treatment 3 followed by treatment 2. K ranges from 6.00 – 7.20 whereas Bicarbonates (HCO_3) ranged from 28.7 – 30.70 ($P > 0.05$). Calcium (Ca) and Phosphorus (P) were higher for treatment 1, is followed by treatment 3 ($P > 0.05$). Values for Chlorine (Cl) are the same treatments 3 and 4 ($P > 0.05$). It ranges from 106.67 – 111.33. The Magnesium ranged from 3.30 – 4.83 ($P > 0.05$). Total Albumin and Total Protein were higher for treatment 1 followed by treatment 4. Total Albumin and Total Protein ranged from 25.67 – 30.00 and 60.70 - 68.30 respectively ($P > 0.05$). Treatment 4 had the highest globulin followed by treatment 3. Treatment 2 had the lowest ($P > 0.05$). Aspartate Aminotransferase (AST), Alanine

Table 4: Blood Chemistry of Uda Lambs Fed Graded Levels of Sweet Potato (*Ipomea batata*) peels in Their Diets

Variables	Treatment (%inclusion levels of potato peels)				
	1(0%)	2(10%)	3(20%)	4(30%)	SEM
Sodium (Na) (mmol/l)	143.33	142.00	143.67	145.67	0.88
Potassium (K) (mmol/l)	6.23	6.40	7.20	6.00	0.53
Chlorine (Cl) (mmol/l)	106.67	106.67	111.33	111.33	1.97
(HCO ₃) (mmol/l)	29.70	30.7	28.7	29.00	2.45
Calcium (Ca) (mmol/l)	5.80	4.17	5.43	4.97	0.44
Phosphoru (PO ₄) (mmol/l)	7.00	5.13	4.93	5.70	1.56
Magnesium (Mg) (mmol/l)	3.83	4.83	3.40	3.30	0.62
Total Albumin (g/l)	30.00	26.00	25.67	27.00	1.28
Total Protein (g/l)	67.30	60.70	66.00	68.30	2.57
Globulin (g/l)	37.30	34.70	40.30	41.30	2.26
AST (iu/l)	180.00	116.00	109.00	103.30	4.84
ALT (iu/l)	29.20	27.60	26.40	28.70	0.39
ALP (iu/l)	703.00	655.30	661.30	659.30	5.34

Aminotransferase (ALT) and Alkaline Phosphate (ALP) were higher for treatment 1, followed by treatment 2. Treatment 4 had the lowest AST. ALT ranged from 26.40 – 29.20 while ALP ranged from 655.30 – 703.00 (P>0.05).

DISCUSSION

Chemical Composition

The high crude protein (CP) content of the diet shows that it is adequate to meet the optimum microbial need of the rumen. The values of all the treatment groups are above the 7 % protein requirement for optimum microbial growth (Gatenby, 2002). The energy and protein were similar across the treatment because the experimental diets were formulated to be iso-nitrogenous and iso-caloric. The CP values obtained from this study ranged from 19.20 % to 21.30 %. This is higher than the values reported by Gatenby (2002) who reported 12 % as CP requirement for growth performance of sheep and goat.

The values of the dry matter (DM) was higher than 87.61 - 87.71 % observed by Ochepeo *et al.*, (2012) in diets containing sugarcane peels. The higher DM value might be attributed to the types of materials used which were all dried. Higher DM value suggests a good source of energy and roughage that could enhance rumination and prevent digestive upset in the rumen (Van soet, 1982).

The Ether extract (EE) values (3.25 - 4.75 %) were similar to those reported by Tukur and Maigandi (2010). These authors obtained EE values ranging from 4.3-5.5 % when fattening rams were fed varying levels of fore-stomach digesta (FSD). The higher EE in diets indicates fats content which gives rise to high concentration of volatile fatty acid (VFA) which is also opinioned by

Maigndi *et al.*, (2004). Higher levels of EE may depress fibre digestion. Maithiason *et al.*, (1997) reported a depression in fibre digestion when fat level exceeds 5-6 % in ruminant ration. The crude fibre (CF) obtained in this research ranged from 19.20 – 21.30 and this is close to the CF estimate range of 25.5 – 26.2 % reported by Aruwayo *et al.*, (2013) when alkali treated neem kernel was fed to fattening Uda rams.

Effect of the Sweet Potato (*Ipomea batata*) Peels on the Health Profile of the Uda Lambs Effect on Packed Cell Volume (PCV)

Many factors influence PCV (for example breed, age, sex and disease), nutrition (diets and ANFs) is one of the critical factors (Etim *et al.*, 2014). In healthy growing lambs the normal PCV ranges from 25 to 36 % (Pampori, 2003). Higher than normal reference PCV values could be as a result of diarrhoea, congenital heart disease, polyeythemia and or hypoxia (Thrall, 2014). Lower than normal reference PCV values could be as a result of anaemia, haemorrhage or haemolysis, erythropoietin deficiency, copper and iron deficiency and or vitamin B₆ and B₁₂ deficiency (Bunn, 2011). Experimental animals in the present study did not show any of the physiological abnormalities brought about by deviated PCV values. The PCV across the treatments ranged from 24 – 32 % hence within normal as observed by Pampori (2003). This finding further indicates that Sweet potato peels can be used in Uda lamb feeding without triggering some physiological disorder that would negatively impact the Packed Cell Volume.

Effect on Liver Function

In the present study, the serum total protein, albumin and globulin concentration of the lambs were similar across

dietary treatments. Importantly, findings from the study showed that the serum total protein, albumin and globulin concentration ranged from 6.07 – 6.83 g/dl, 2.57 – 3.00 g/dl, 3.47 – 4.13 g/dl, respectively. These values are consistent with the reported serum concentration of these proteins (Antunovic *et al.*, 2011; Al-Hadithy *et al.*, 2015), suggesting that the dietary feed with sweet potato peels did not have impact on the liver's synthesis of these proteins amongst the various factors that influence serum protein concentration.

Serum activities of ALT, AST and ALP have a bearing on the integrity of the hepatocytes (Ambrojo *et al.*, 2013). In the present study, similarities in the serum ALT and ALP activities were observed in Table 4. Importantly, results from the study recorded serum ALT and ALP activities ranging from 26.4 to 29.20 and 655 to 703 U/L respectively. These findings are similar to the ALT (30.00 to 47.00 U/L) and ALP (17.00 to 1411.00U/L) values reported by Sitmo (2014) for healthy growing lambs. It is important to note that the enzymes (ALT and ALP) are non- tissue specific and thus, not solely limited to the liver. The ALP can also be released from bone, intestine and adipose tissue (Yang *et al.*, 2012). Nevertheless, taking into account the findings of the study with regards to surrogate markers of liver function, results pointed out that the dietary feeds with sweet potato peels neither compromise the synthetic capacity, nor did it cause hepatocytes or biliary cell damage in the lambs.

Effect on General Health

The serum Pi concentration from the animal in the present study, was similar across dietary treatments. This finding suggests that the dietary feed with sweet potato peels did not negatively impact on the availability of the mineral to the lambs. Importantly, the serum Pi concentration of lambs from the current study (range: 49.30 to 70.00mm/dl) fall within the serum Pi range of healthy growing lambs as reported by Kaneko *et al.* (2008). This suggests that the use of dietary feed with sweet potato peels did not alter the minerals availability from the GIT and that it did not perturb its normal physiological regulation.

In the present study, the concentration of serum calcium in lambs was similar across dietary treatments. Importantly, the serum calcium concentration of the lambs ranges from 41 to 58 mg/dl. As observed from the experimental animals, serum calcium concentration was lower than the range of 9.3 to 12.8 mg/dl (Merck and Dohm, 2011).

CONCLUSION

It was concluded that inclusion of sweet potato peels up to 30% in the diet, did not have negative impact on the

blood characteristics of growing lambs

RECOMMENDATION

Further studies should be focused on increased level of potato peels on different species of ruminants.

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