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HAEMATOLOGICAL AND BIOCHEMICAL CHARACTERISTICS OF UDA LAMBS FED CAMEL FORE-STOMACH DIGESTA ENSILED WITH LOCUST BEAN PULP AND NON PROTEIN NITROGEN SOURCES

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ABSTRACT

Sixteen growing Uda lambs weighing 20-25kg were used in this experiment to determine the haematology and biochemical characteristics of camel Fore-stomach Digesta (FSD) ensiled with Locust Bean Pulp (LBP) and non-protein nitrogen (NPN) sources. The study was conducted at Usmanu Danfodiyo University Livestock Teaching and Research Farm, Sokoto. The animals were randomly allocated to four dietary treatments groups A, B, C and D in a completely randomised design (CRD). The research lasted for 84 days of feeding and 14 days digestibility trial, Blood samples were collected and analysed for various parameters. The results indicate no significant difference in all the haematological parameters ($P > 0.05$). The results of biochemical indices showed that BUN, bilirubin and creatinine significantly ($P<0.05$) differs among treatment groups. Glucose, Total protein, ALP, ALT, AST, Albumin and Globulin showed no significant ($P>0.05$) differences. It was concluded that ensiled camel fore-stomach digesta with locust bean pulp and NPN source (urea and poultry litter) fed to uda lambs did not affect haematology and blood chemistry of the animals and the study recommends that the test diets should be used for optimum production in dry season feeding of ruminant animals.

Keywords: Uda lambs; Non-Protein nitrogen source; Locust bean pulp

INTRODUCTION

Ruminant animals play active role in converting cheap agro industrial by-products and other waste materials to meat and other products. In recent years, several authors (Garba and Maigandi, 2008; Maigandi *et al*., 2008; Fawolu and Fajemisin, 2011; Olorunnisomo *et al*., 2011) investigated the use of cheap agro-industrial by-products and waste materials; such as slaughter/abattoir waste, poultry droppings and cassava peels at various levels of inclusions in small ruminant diets to determine their efficiency of utilization in term of growth and production. Also with a view to identifying the most suitable one in terms of nutrition, cost effectiveness and year round availability.

The semi-arid region of Nigeria is a good habitat for small ruminant animals that serves as sources of income to farmers and animal protein to the populace. The region is

generally confronted with severe food scarcity during the long dry season that leads to nutritional deficit which predispose the animals to disease and other health problems and also low productive performance (Ben Salem and Smith, 2010). Competition between humans and animals on available grains make it difficult to meet the nutritional requirements of animals at reasonable costs. The high cost and seasonality of feeds have stimulated the search for alternative feed resources that can economically supplement the conventional feed ingredients in rations without adverse effects on health and performance of animals (Lufadeju and Olorunju, 1986; Smith, 1988).

Fore-stomach Digesta (FSD) is one of the slaughter house/abattoir waste products that can be used as an alternative cheap source of feed ingredients (Maigandi *et al*., 2008), FSD contain an appreciable amount of nutrient that can support animal performance (Boda, 1990). Research evidence has shown that, it is rich in carbohydrates, proteins, vitamins and minerals due to the millions of bacteria and protozoa present in the fore-stomach of camels and ruminants (Kumar, 1990).

Fore-stomach Digesta (FSD) is one of such cheap materials found abundant in slaughter houses as by-product and mainly considered as a waste material creating environmental pollution (Maigandi, 2001). It constitutes a substantial waste at abattoir in Nigeria where about 50,000 metric tonnes is generated annually (Adeniji, 1995; Odunsi *et al*., 2004). Fore-Stomach digesta is a plant material found in the fore-stomach of ruminating animals and in the first compartment of the camelids. FSD is found at various stages of digestion rich in microbial protein (Sommer, 1990). Utilization of Fore-Stomach digesta (FSD) as feed ingredient provide an alternative means of waste disposal, reducing environmental pollution and more importantly reducing cost of livstock feeding (Maigandi and Tukur, 2002).

Locust bean pulp is one of the principal components of the carob fruit that comes from the pulp after the seed. The seed represent 10% of the weight of the fruit and the pulp represents the remaining 90%. Its composition depends on the variety, climate and growing techniques (Morton, 1987; Petit and Pinilla, 1995; El-shatnawi and Mohawesh, 2000; Bouzouita *et al*., 2007). The plant is of high commercial value and has been used as a source of food, medicinal agents and for timber (Dike and Ounfa, 2003).

Non protein nitrogen sources such as poultry litter and urea, are combined and used as feedstuffs at different proportions. Poultry litter is a mixture of bedding materials that may include rice hulls, saw dust, wood chips etc together with the animal excreta. The fertilizer value of poultry litter is well recognised, due to high contents of nitrogen and other organic materials. The nutrient concentration of litter can be extremely variable, depending on a variety of factors (Tasistro *et al*., 2004). The nutrient contents of the litter varies between houses and within the same house depending on location and management (Kelly *et al.*, 1996)

Urea is an important endogenous product of mammalian metabolism and appears to cause little or no toxicity to most mammalian species when used appropriately. Urea is a simple compound that contains 46.7 percent of nitrogen compared to 16 percent for most proteins (Mc Donald *et al.*, 1998). It is therefore, economical to use urea as a protein supplement in ruminant rations than plant protein that are highly priced, such as soybean meal.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the Usmanu Danfodiyo University Livestock Teaching and Research Farm. The farm is situated within the Main Campus of the University at about 10 km north of Sokoto Metropolis in Wamakko Local Government Area of Sokoto State.

Sokoto State is located in the Sudano-Sahelian zone in extreme North-western part of Nigeria. It falls between longitude $4^0$8E and 6^0 54'E and latitudes $12^0$0'N and $13^0$58'N (Mamman *et al*., 2000) and at an altitude of 350m above sea level.

The State has a semi-arid climate, which is characterized by alternating wet and dry seasons. The hot dry spell extends from March to May, a cool dry period (the harmattan) last between October and late February. The annual precipitation last between May/June and September/October, intensity of the annual precipitation also varies from 635mm to 750mm (Malami *et al*., 2001). Diurnal and seasonal temperature fluctuations are very wide, where minimum temperature has been recorded to be 13^oC in January and maximum of 44^oC in April (SSGD, 2002). Sokoto State as part of the semi-arid region of Nigeria is blessed with abundant livestock resources because of its climate which is more suitable for livestock production, due to absence of Tse tse fly on the open grass land (SSGD, 2002).

Experimental Materials

Fresh fore-stomach digesta from Camel, locust bean powder, poultry litter, Urea, water, mixing bowl, masking tape, Marker and weighing scale, were sourced and used for this experiment.

Collection and Preparation of Experimental Ingredients

Fresh camel fore-stomach digesta (FSD) was collected from Sokoto Central Abattoir. The FSD was sun dried on a tarpaulin sheets for a period of one week. The locust bean pulp and Urea were obtained from Sokoto Central Market. Fresh poultry litter was collected from the University Poultry Farm, located at the State Veterinary Centre along Aliyu Jodi Road Sokoto and was sun dried for a week.

Ensiling Procedure

The ingredients were combined and made into four dietary treatments A, B, C & D as shown in Table 1. The procedure of Roy and Rangneker (2006) was followed in which 1kg Urea was dissolve in 15 litres of water and sprinkled on 25kg mixture of ingredients. Diets A, B, C and D were ensiled for 21 days in a 300 litre capacity plastic tank used as silo (Wilhelm and Wurm, 1999). Polyethene was used to further seal the silo after filling with feed materials and compressed.

Table 1: Proportion FSD ensiled with LBP and NPN

Treatments	FSD (kg)	LBP (kg)	NPN
A	40	60	0
B	40	60	Urea 4kg
C	40	40	20kg poultry litter
D	40	40	20kg poultry litter +2kg Urea

Note: Urea was included at the rate of 1kg/25kg of diet (Banerji, 2007).

Table 2: Gross composition of concentrate diet

Ingredients	% Inclusion level
Maize	19.00
Cotton Seed Cake	30.00
Wheat Offal	30.00
Cowpea Husk	20.00
Salt	1.00
Total	100.00
Calculated CP	16.21
Calculated Energy (kcal/kg)	2381.8

Experimental Animals and their Management

Sixteen (16) growing Uda lambs weighing 20-25kg were purchased from Bodinga market in Sokoto State for the experiment. The rams were transported to the Livestock Teaching and Research Farm located at the Main Campus, Usmanu Danfodiyo University, Sokoto. The lambs were quarantined for a week, dewormed with *albendazole* at the rate of 3mls/10kg live weight of the animal and treated against ectoparasite with *Ivermectin* injection (a broad spectrum antibiotic) at the dose of 1ml/10kg liveweight) administered subcutaneously.

The lambss were group fed and managed intensively for two weeks before the commencement of the experiment.The Weight of the animals were balanced for each treatment and thereafter allocated to five treatments diets with four replication each. The lambs were housed and fed individually in a pen.

Experimental Design and Feeding Procedure

Complete Randomised Design (CRD) was used in this experiment as outlined by Steel and Torrie (1980). A total of 16 growing Uda lambs were used and each treatment contained four animals. Each group of four animals were served one of the experimental diets and fed *ad-libitum* for 84 days.

Chemical Composition of Experimental Diets

The experimental diets were analysed for crude protein (CP), crude fibre (CF), ether extracts (EE), total ash and Nitrogen free extracts (NFE) according Association of Official Analytical chemist procedure (AOAC, 2005). Fibre fraction such as neutral detergent fibre

(NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were also analysed according to method described by Van Soest *et al,* (1991) while cellulose and hemicellulose contents were calculated by differences.

Sample Collection

Blood Samples were collected from the experimental animals at the last day 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 an anti-coagulant free plastic tube and allowed to stand for about 2 hours at room temperature; this allows the coagulation to take place. The serum was stored in a freezer for biochemical analysis and liver function test.

Haematological Indices Determination

Blood Samples were taken to the haematology unit of Usmanu Danfodio University Teaching Hospital Sokoto for analysis.

Whole blood sample in ethylene diamine tetraacetate (EDTA) bottles was analysed for haemoglobin (Hb) content using Cyanomethemoglobin method (Coles, 1986). Packed Cell Volume (PVC), erythrocyte and leucocyte counts were determined according to Microhaematocrit method and microscopic method respectively (Coles, 1986). Differential count was determined from the leucocyte counts.

Blood Chemistry Indices Determination

The Blood Urea Nitrogen was estimated by method of Tanis and Naylor (1968). Total protein and Albumin were determined by Biuret and Bromocressol green (BCG) methods (Peter *et al*., 1982). Globulin was determined by obtaining the difference between total protein and Albumin. Blood glucose and bilirubin were determined by glucose oxidase and sulphanylic acid methods respectively as described by Stone (1954). Aspartate amino transferase (AST), alanine amino transferase (ALT), alkaline phosphate (ALP) activities were determined using spectrophotometric method, as described by Rej and Hoder (1983). The Samples were taken to chemical pathology unit of Usmanu Danfodiyo University Teaching Hospital Sokoto for the analysis.

Data Analysis

The data generated from the experiments were subjected to analysis of variance (ANOVA) using completely randomized design(CRD) according to Steel and Torrie (1980).Where significant differences between the means were indicated, Duncan's Multiple Range Test (DMRT) was used to separate the means (Duncan, 1955).

RESULTS

Chemical Composition of the Experimental Diets and Concentrate Mixture

Results in Table 3 shows that dry matter (DM) content which ranges between 89.71 for treatment D and 91.39 for treatment A. crude protein (CP) content was lower (7.54) for treatment A and higher (16.14) in treatment D, while crude fiber content decreased from 27.14 in treatment D to 21.61 in treatment A. Ether extract varied between treatments B, D and similar in treatment A and C (1.50).

For the Ash content, the highest value was obtained in treatment B (14.40) and the lowest in treatment D (7.40). Nitrogen free extracts (NFE) was recorded higher in treatment A (57.60) and treatment B had the low value (41.43). Neutral detergent fiber (NDF) tent to decreses from 51.70 for treatment A to 45.90 for treatment C. Acid detergent fiber ranges from 43.00 in treatment C to 48.30 in treatment A. Cellulose content was higher in treatment B (31.40) and lower in treatment C (25.60). For Hemi Cellulose content, the higher value was obtained in treatment A (3.40) and the lower value in treatment B (1.10).

The concentrate mixture contained 98.10% DM, 14.93% CP, 28.00% CF, 4.50% EE, 6.00% Ash, 46.50% NFE, 63.20% NDF, 34.30% ADF, cellulose 27.20%, H. cellulose 4.40% and ADL 12.30%.

Table 3: Chemical composition of the experimental diets and concentrate mixture

Parameters	Treatments				
	A	B	C	D	Concentrates
Dry Matter	91.39	90.90	91.05	89.71	98.10
CP	7.54	15.35	9.58	16.14	14.93
Crude fiber	21.61	26.52	24.13	27.14	28.00
Ether extract	1.50	2.30	1.50	2.00	4.50
Ash	11.75	14.40	8.85	7.40	6.00
NFE	57.60	41.43	55.94	47.32	46.50
NDF	51.70	47.80	45.90	46.90	63.20
ADF	48.30	46.70	43.00	43.70	34.30
Cellulose	31.10	31.40	25.60	28.30	27.20
H. cellulose	3.40	1.10	2.90	3.20	4.40
ADL	14.80	12.50	14.90	13.20	12.30

NFE = Nitrogen Free Extract, NDF = Neutral Detergent Fiber and ADF = Acid detergent fiber ADL= Acid detergent lignin.

Haematological Characteristics of the Experimental Animals

Urea concentration in the serum of the experimental animals for treatments B, C and D were similar ($P>0.05$) except for animals on treatment A. Total protein, glucose, ALP, AST, ALT, Albumin and Globulin for all the animals in this trial showed no significant difference across the treatment means. Bilirubin concentration varied ($P<0.05$) across the treatment means, with treatment B having the highest value (1.27mg/dl) and the least figure (0.56mg/dl) was obtained from treatment D. Creatinine concentration was also differed significantly ($P<0.05$) with the highest value observed in treatment D (1.40mmol/l) and the least in treatment A (0.73mmol/l).

Table 4: Haematological parameters of the experimental animals fed ensiled FSD, LBP and NPN

Parameters (%)	Treatments					
	A	B	C	D	SEM	Reference value
BUN (mmol/l)	3.38^{b}	9.20^{ab}	10.75^{a}	10.85^{a}	16.97	3.0-10
Glucose (mmol/l)	5.15	5.82	5.25	5.40	0.73	2.4-4.5
Total protein (g/dl	6.28	5.70	6.48	6.45	0.70	5.9-7.8
ALP (IU/L)	57.00	94.73	103.52	77.30	38.66	70.0-360
ALT (IU/L)	10.25	13.57	15.43	12.67	5.34	14.8-43.8
AST (UI/L)	127.75	133.00	131.00	134.50	14.40	60-280
Albumin (g/dl)	3.25	3.17	2.95	2.97	0.37	2.7-3.7
Biliubin (mg/dl)	0.94^{ab}	1.27^{a}	0.92^{ab}	0.56^{b}	0.42	0.0-0.5
Globulin (g/dl)	3.02	2.52	3.56	3.47	0.86	3.2-5.0
Creatinine (mmol/l)	0.73^{b}	0.78^{ab}	1.32^{a}	1.40^{a}	0.41	1.2-1.9

*means within the same row with different superscript are significantly different ($P<0.05$)
BUN= Blood Urea Nitrogen, AST= Aspartate aminotransferase, ALT= Alanine Aminotransferase, ALP= Alkaline Phosphate. (Source of Reference value: Radostits *et al*., 2000).

Biochemical Characteristics the Experimental Animals

Table 5 shows the biochemical parameters of the experimental animals. Hb Concentration was similar ($P>0.05$) for all the animals across the treatments. Treatment D recorded highest value of 9.78g/dl while lowest value of 9.20g/dL was recorded for treatment C. PCV was not significantly different ($P>0.05$) between the treatments. RBC Concentration was not statistically different ($P>0.05$) between treatments. WBC concentrations were similar for animals in all the treatment.

Table 5: Biochemical parameters of the experimental animals fed ensiled FSD, LBP and NPN

Parameters (%)	Treatments					
	A	B	C	D	SEM	Reference value
HB (g/dl)	9.30	9.45	9.20	9.78	1.15	8-16
PCV (%)	36.75	37.25	37.00	38.50	3.41	34-45
RBC ($x10^{6}$/l)	8.03	8.16	6.52	7.59	1.47	8.9-9.3
WBC ($x10^{3}$/l)	11.64	11.30	11.90	12.23	1.9	4-12

HB = Haemoglobin, PCV = Packed Cell Volume, RBC = Red Blood Cell, WBC = White Blood Cell, LYMP= Lymphocyte and MONO= Monocytes. (Source for reference values: Research Animal Resource, 2009).

DISCUSSION

Chemical Composition of the Experimental Diets

CP content was higher in treatment D (16.14%) and treatment C (15.35%) which was higher than the 8% CP recommended by Norton (2003) for growing sheep and goats.

Gatenby (2002) indicated 10-12% CP as moderate level for ruminant production. However, the CP Values in present study fell within the CP requirement of 15-18% for growing lamb as reported by Church, (1978) and ARC (1990).

The DM value (91.39%) obtained in this study was higher than the values of 87.61-87.71% observed by Ochepo *et al*. (2012) in diets containing sugarcane peels. The higher DM value might be attributed to the types of materials used which were all drieds. Higher DM suggests a good source of energy and roughage that could enhance rumination and prevent digestive upset in the rumen (Van soest, 1982). The crude fiber values (27.14-21.61%) in the present study were lower than the value of (31.30 -33.60%) obtained by Ahmed *et al*. (2007) when sugarcane baggase was ensiled with chicken manure. This may be as a result of the experimental material present in the ensiled mass. However, Wallace (1994) reported that lower fiber is better for growing animals due to insuffients micro flora for efficient degradation of the fiber.

Ether extract values (2.30-1.50%) obtained from this trial were lower than those reported by Tukur and Maigandi (2010). The Ash values (8.85-11.75%) in the present study were comparable to the values of 8.98-11.10% obtained by Nayawo *et al*. (2010). But lower than (12.91-19.54%) reported by Garba *et al*. (2010) when *Guiera senegalensis* was fed to Yankasa rams as complete diets. The variation could be attributed to *Guiera senegalensis* being a browse plant rich in minerals. The NFE values in the diet of present study is comparable to that of Muhammed *et al*. (2016a) when ensiled FSD and cowpea hay were fed to Fattening sheep.

The values of 45.90-51.70% recorded in the present trial for NDF correspond to what was reported by Iyange (2010) when ensiled cassava waste and *Albizia saman* pod mixture was fed to West African dwarf sheep. ADF values of 43.00-48.30 in the present trial were higher than the values (32.00-40.90%) reported by Muhammad *et al*. (2016). Cellulose, hemicellulose and Acid detergent Lignin content in this study were lower than what was obtained by Wada *et al*. (2014a) when fed graded levels of *Parkia biglobosa* in a concentrate diets to Yankasa rams. The differences could be due to the ensiling process and microbial activities during fermentation.

Haematological Parameters

The PCV and Haemoglobin concentration observed for animals in all the treatments did not show negative effect to the health of the animals; the values fall within the normal range of 24-25% for PCV and 8-16g/dl for Hb as outline by Coles (1986). RBC values recorded were lower than the normal value (8-15x10^{12}/l) reported for sheep by Coles (1986). WBC values in this study were higher than the values observed by Aruwayo *et al.* (2009) when FSD and poultry litter were fed to growing lambs.

WBC count in this study fell within the normal value of 4-12x10^{12}/L for sheep (Jain, 1993) indicating that the animals were healthy (Frandson and Spurgeon, 1992). The results of RBC and WBC counts also showed that feeding animals waste like FSD and PLW to growing lambs did not cause any health hazard to the animals.

Biochemical Indices

Blood urea concentration in this study showed significant ($P<0.05$) effects between the treatments. Values ranges from 3.38mmol/L in treatment A to 10.85mmol/L in D. This

values were in agreement with the value obtained by Okah and Ibeawuchi (2011) but higher than the findings of Aruwayo *et al*. (2009). The values (3.38-10.75mmol/L) were higher than the normal range (2.5-6.5mmol/L) and this could be attributed to the Urea and poultry litter inclusions that have high content of nitrogen in the ensiled material.

The serum glucose in the present study was not significantly (P>0.05) different among the treatments. However, higher value was recorded in treatment B (5.82mmol/L). The results of this study were higher than the reports of Cockcroft (2002) who reported 2.4-4.0mmol/L. Serum glucose is an indication of carbohydrates metabolism in high energy diets (Coles, 1976). Lower glucose level is an indication of hypoglycaemia while higher levels are indication of hyperglycemia (Olurunnisomo, 2012). The higher value recorded in this study could be due to high percentage of LBP in treatment B (60% +4% urea). Total protein was not statistically (P>0.05) differerent between treatments. Values observed in this study were comparable with that of (Freedeen, 1990). Protein helps to transport calcium and phosphorous together with other substances in the body. The Albumin and Globulin did not significantly (P>0.05) differ among the treatment means and the values fell within the range (3.5-5.0g/dl) for small ruminants reported by Coles (1986). Low albumin (hypoalbuminemia) might be caused by liver diseases; high albumin (hyperalbuminemia) is almost caused by hydration and in some cases vitamin A deficiency.

The ALP, ALT and AST in this present work were not statistically (P>0.05) different between treatments. ALT values (10.25-15.43) recorded in this trial were lower than the values (11.00-15.00UI/L) reported by Wada *et al* (2014). AST observed in this study was higher than the findings of of Wad *et al.* (2014) whose values were within the range of 48.00-61.00UI/L. Serum Aspartate Aminotransferase is found in practically every tissue of the body, inducing red blood cell. The measurement of the AST levels is helpful for the diagnosis of skeletal muscle disorders, In trauma or in disease affecting skeletal muscle and in various hemolytic condition (Alex and Laverne, 1983).

The creatinine concentration (0.73-1.40mmol/l) in this study were within the normal range (0.1-1.40mmol/l) and differ (P<0.05) between the treatments with highest value 1.40mmol in treatment D and the lowest value 0.73mmol in treatment A. High creatinine is an indication of poor protein and amino acid metabolism that can lead to impaired renal function and cardiac infection (Gray and Howara, 1980). Increased creatinine has been associated with tanin toxicosis in cattle consuming tannin-rich fodder (Garg *et al*., 1992).

The bilirubin values (0.56-1.27mg/dl) in present study were significantly different (P<0.05) across the treatment means and fell within the normal physiological range (0.0-1.2mg/dl) as reported by (Susan, 1998). The normal bilirubin values of the animals signifies the absence of haemolysis (destruction of red blood cells and release of the haemoglobin they contain) since bilirubin is an insoluble molecule derived from the breakdown of haemoglobin in the spleen (Sirois, 1995).

CONCLUSION

It was concluded that ensiling of FSD with locust bean pulp and NPN source (urea and poultry litter) and fed to Uda lambs did not affect haematology and blood chemistry of the experimental animals and the parameters analysed are within the recommended levels, this implies that the test diets were not harmful. Therefore, they are fit for animal consumption. The study recommends that the test diets should be used for optimum production in dry season feeding of ruminant animals.

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