Haematological and serum biochemical parameters of West African Dwarf goats fed ensiled cassava leaves with or without molasses and caged layer waste

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Abstract

The study was conducted to evaluate the haematological and serum biochemical parameters of West African dwarf goats fed ensiled cassava leaves with molasses and caged layer waste. Eighteen West African dwarf goats were randomly assigned to three experimental diets consisting of cassava leaves ensiled alone (ECF), cassava leaves ensiled with 5% molasses (ECFM) and cassava leaves ensiled with 5% caged layer waste (ECFP) in a Completely Randomized Design. Results obtained showed that ensiling with molasses resulted in lower DM, CP, NDF, tannin and HCN levels. Crude protein intake was similar in ECF and ECFM but lower ($P < 0.05$) in ECFP ranging from 161.28 - 172.71g/d. The packed cell volume (PCV), haemoglobin (Hb) and lymphocyte concentrations were significantly ($P < 0.05$) highest in ECFP but similar with the values obtained for ECF. There were no significant ($P > 0.05$) differences in the red blood cells (RBC), white blood cells (WBC), neutrophil, basophil, eosinophil and monocytes contents in all the treatments. The highest significant ($P < 0.05$) value of 36.7g/l was obtained in ECFM and values of 29.4 and 24.0g/l in ECF and ECFP respectively for globulin. There was no significant ($P > 0.05$) difference in AST content in all the treatments. ALT value of 16.5 IU/L was significantly ($P < 0.05$) highest in ECF and different from the values of 12.0 IU/L obtained in both ECFM and ECFP respectively. It is concluded that cassava leaves can be conveniently ensiled with 5% of both molasses and caged layer waste without adverse effects on the haematological and biochemical status of WAD goats.

Keywords: *Haematology, serum, molasses, caged layer waste*

Introduction

Goats play a significant role in livelihoods of the rural populace in most developing countries. Apart from serving as a vital protein source, it also provides income for meeting urgent household needs (Peacock et al, 2005). In developing countries, goats play an important role in the economic life of the small holder farmers especially in converting low-cost inputs to high value products. Scarcity of forage during the dry season is a common problem limiting goat production in tropical areas (Nwaigwe, 2011). Excess forage produced during the wet season could be conserved in form of hay or silage and fed during the dry season.

Cassava (*Manihot esculenta* Crantz), a main cash crop, is among the most promising leaf protein source. Leaves from cassava contain compounds such as cyanide (HCN) and tannin which has potential negative effects on livestock performance and, for that reason, may limit the use of these fresh fodders to livestock. Many traditional African communities that consume cassava, which has been reported to contain high levels of cyanogenic glucosides, use fermentation as a means of detoxification of this food crop (Bradbury *et al.,* 1991).

Haematological studies represent a useful process in the diagnosis of many diseases as well as investigation of the extent of damage to the blood (Onyeyili *et al.*, 1991). This is relevant since blood constitutes a change in relation to the physiological conditions of the animals. Haematological studies are important because the blood is the major transport system of the body and

evaluations of the haematological profile usually provide vital information on the body's response to injury of all forms, including feed toxicity (Ihedioha *et al.,* 2004). Haematological constituents reflects the physiological responsiveness of the animal to its internal and external environments which include feed and feeding (Esonu *etal.,* 2001) as well as drugs (Iheukwumere *et al.,* 2007). Serum biochemical analysis is however, used to determine the level of heart attack, liver and kidney as well as to evaluate protein quality and amino acid requirements in animals(Harper *et al.,* 1999). This study is designed to evaluate the haematological and serum biochemical parameters of West African Dwarf goats fed cassava leaves ensiled with molasses and caged layer waste.

Materials and Methods

The experiment was carried out at the Teaching and Research Farm, College of Animal Science and Livestock Production, University of Agriculture, Abeokuta. Cassava foliage (leaves + petiole) were evaluated in ensiling studies with or without additives. Molasses and caged layer waste were used as additives at 5% (w/w) of fresh material. Cassava leaves of TMS 30572 variety of about 12 months old, were collected in the field immediately after root harvesting and allowed to wilt for a minimum of 12 hours in a well-ventilated shed. The leaves were thoroughly mixed with the additives in different silos, which constituted the different treatments as follows:

Treatment 1: cassava leaves alone
Treatment 2: cassava leaves + molasses
Treatment 3: cassava leaves + caged layer waste

Each treatment was replicated four times using a total of 12 plastic containers with capacity to contain 200kg fresh materials each. The cassava leaves were chopped into pieces of 4 – 5 cm length and placed in two inserted polyethylene bags into the plastic containers. Molasses and caged layer waste were mixed with the chopped pieces at the time of filling and the materials were compacted by standing on the bags inside the containers. After filling, the tops of the bags were bound with rubber band and string and pressed by placing about 5kg stones on top. The containers were stored in shade under a roof for a month to allow fermentation to occur.

Experimental Animals, Management and Diets

Eighteen West African Dwarf (WAD) male goats aged 12-15months with an average live weight of 7.2 ± 1.2kg were used for the experiment. The animals were housed intensively in well-ventilated individual pens (1.2m×0.90 m), in an open-sided type of house with corrugated aluminium roofing sheet and a wooden floor, which had been disinfected with Izal solution before the arrival of the animals. The goats were vaccinated against *Peste des petit de ruminant* (PPR), given prophylactic treatments, which consisted of intramuscular application of oxytetracycline and Vitamin B complex at the dosage of 1ml/10kg body weight of the animal. They were dewormed with 1 ml/10 kg body weight of albendazole® and treated against ectoparasites with 0.5 ml/10 kg body weight of Ivomec®. They were allowed an adaptation period of four weeks during which they were maintained on elephant grass and concentrate supplement with gradual withdrawal of the grass. Fresh water was supplied *ad libitum*. The experimental animals were divided into 6 animals per treatment and offered the different silage materials as indicated

above. A basal diet of 1kg *Gmelina arborea* foliage was offered daily to each goat. During the 84-days experimental period, quantities of feeds offered and refused were measured daily to compute feed intake on DM basis. Animals were fed at least 5% of their body weight. Water and salt lick was given *ad libitum*.

Collection of blood samples

Blood samples (approximately 10 ml) were collected from each goat via jugular vein puncture using hypodermic syringes before feeding. Blood collection was done at the end of the experiment. Blood, 5 ml, was drawn into a heparinized tube to prevent coagulation while the remaining 5 ml was left in the syringe to coagulate. Blood samples were then analysed for packed cell volume (PCV), Hb, white blood cells (WBC), red blood cells (RBC), serum protein, serum glucose, serum albumin and globulin, serum creatinine, serum urea, mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), Aspartate aminotransferase (AST) and Alanine aminotransferase (ALT).

Chemical analyses

Aliquots of daily feed samples (concentrate and basal) were collected, oven-dried, ground and sieved through a 2-mm sieve and stored in airtight containers for proximate (AOAC 1995) and fibre (Van Soest *et al.* 1991) analyses. The packed cell volume was measured for each animal in fresh ethylene diamine tetra acetic acid (EDTA) anticoagulant samples within 24 h of collection using the micro-haematocrit method. Haemoglobin concentration was also measured in fresh EDTA anticoagulant samples using the Sahl's (acid haematin) method (Benjamin 1978). RBC was measured in fresh EDTA with the aid of Neubaur counting chamber (haemocytometer). Blood smears were used for total thrombocyte, total WBC counts (Tavares-Dias *et al.* 2008), and WBC differential relative and absolute counts. Differential relative and absolute counts were classified as lymphocytes, neutrophils, eosinophils, basophils and monocytes. Plasma glucose was measured in fluoride oxalate anticoagulant blood samples using the enzymatic glucose oxidase method (Bauer *et al.* 1974). MCH and MCHC values were calculated from PCV, Hb and RBC values (Jain 1986). Total serum protein was measured in serum for individual animal using the biuret method. Aspartate aminotransferase (AST) and Alanine aminotransferase (ALT) were analysed spectrophotometrically by using commercially available diagnostic kits (Randox® Test Kits). Serum albumin and globulin were determined using bromocresol purple method of Varley *et al.* (1980). Serum creatinine was determined using the principle of Jaffe reaction as described by Bousnes and Taussky (1945).

Statistical analyses

All data were laid out as Completely Randomized design and analysed with One-way Analysis of Variance using SPSS (1999). Significant means were separated by Duncan's Multiple Range Test (Duncan, 1955).

Results and Discussion

The DM concentration of 252.4, 238.9 and 267.9 g/kg DM obtained for ECF, ECFM and ECFP respectively (Table 1) were below the values of 329 and 363 g/kg DM obtained by Man and Wiktorsson (2001) for cassava tops silage with 0 and 6% molasses. Khang and Wiktorsson (2004) obtained value of 390.1 g/kg DM for ensiled cassava tops while Eduardo *et al.* (2004) reported

Table 1: Chemical Composition of the experimental diets (g/kg DM)

	Treatments				
Parameters[a]	**ECF**	**ECFM**	**ECFP**	**FCF**	***Gmelina arborea***
Dry matter	252.4	238.9	267.6	218.7	524.6
Crude protein	207.6	198.5	212.8	221.0	158.4
Organic matter	921.2	917.3	916.9	937.5	903.4
Neutral detergent fibre	561.4	547.9	591.2	622.5	447.0
Acid detergent fibre	413.7	372.7	391.8	414.0	159.5
Acid detergent lignin	26.1	24.5	27.3	25.1	103.5
Tannin	12.8	12.1	12.3	32.0	6.6
HCN (mg/kg)	95.8	84.7	89.3	112.3	-

[a]Mean values (n = 2)
HCN: Hydrocyanic acid; ECF: Ensiled cassava leaves without additives; ECFM: Cassava leaves ensiled with molasses; ECFP: Cassava leaves ensiled with caged layer waste
FCF: Fresh cassava leaves

values of 25 and 27.7% for wilted and non-wilted aerial parts of cassava plants. Values obtained for CP are similar to those reported by several authors (Man and Wiktorsson, 2002 and Khang and Wiktorsson, 2004). The CP intake from silage (Table 2) was higher than values of 60.9g/d obtained by Bunyeth and Preston (2006) and values of between 41 to 55.5g/d reported by Seng Sokenya and Preston (2003). The high CP intake recorded in ECFM was due to the high DM intake of the animals on this treatment.

The haematological parameters of WAD goats fed ensiled cassava leaves indicated that PCV values of 17.5, 21.5 and 23.0% obtained fall within the range of 18-38% cited by Orheruata and Aikhuomobhogbe (2006) for WAD goats (Table 3). Animals on ECF and ECFM diets showed lower Hb concentration, which might be linked to depressed serum thyroxine function; however, whatever negative influence the toxicity of HCN and tannin could have

Table 2: Nutrient intake of West African Dwarf goats fed ensiled cassava leaves with or without additives

	Treatment			
Parameters	**ECF**	**ECFM**	**ECFP**	**P**
DM intake (g/d)				
Silage	213.49 ± 1.79^{b}	246.86 ± 6.15^{a}	203.15 ± 4.20^{b}	0.01
Gmelina	279.72 ± 11.97	256.55 ± 2.75	255.16 ± 4.05	0.25
Total	483.21 ± 11.54^{ab}	503.42 ± 8.49^{a}	458.43 ± 7.87^{b}	0.04
CP intake	172.71 ± 3.47	173.08 ± 5.71	161.28 ± 4.83	0.17
NDF intake	347.10 ± 5.77^{ab}	364.00 ± 11.87^{a}	325.9 ± 9.41^{b}	0.05
HCN intake (mg/kg)	876.88 ± 10.64^{a}	823.79 ± 20.52^{ab}	786.13 ± 13.19^{b}	0.01
Tannin intake	16.57 ± 0.55	15.90 ± 0.31	15.76 ± 0.27	0.82

[abc:] Means along the same row with different superscripts are significantly different ($P < 0.05$)
ECF: Ensiled cassava leaves without additives
ECFM: Ensiled cassava leaves with molasses
ECFP: Ensiled cassava leaves with caged layer waste

Table 3: Haematological parameters of West African dwarf goats fed ensiled cassava leaves with or without additives

Parameters	Treatments				
	Normal[c] Values	ECF	ECFM	ECFP	P
Packed cell volume (%)	22 – 38	21.5 ± 1.44[ab]	17.5 ± 0.29[b]	23.0 ± 1.73[a]	0.05
Haemaglobin concentration (g/dl)	8 – 12	7.6 ± 0.43[ab]	6.1 ± 0.35[b]	8.0 ± 0.58[a]	0.05
Red blood cells ($x10^{12}$/l)	8 – 18	10.3 ± 0.66	11.2 ± 2.80	14.5 ± 3.75	0.55
White blood cells ($x10^{9}$/l)	4 – 13	7.8 ± 0.14	8.6 ± 0.40	7.4 ± 0.26	0.67
MCH (pg)	5.2 – 8.0	7.4 ± 0.05	7.3 ± 0.34	7.4 ± 0.13	0.90
MCHC (%)	30 – 36	35.2 ± 2.13	34.9 ± 2.41	34.9 ± 2.33	0.96
Neutrophil (%)	30 – 48	37.5 ± 3.18	52.5 ± 4.33	32.8 ± 7.95	0.10
Lymphocyte (%)	50 – 70	57.5 ± 1.44[a]	46.5 ± 3.75[b]	59.0 ± 3.46[a]	0.05
Basophil (%)	0 – 2	0.8 ± 0.33	0.0 ± 0.00	0.0 ± 0.00	0.07
Eosinophil (%)	3 – 8	2.0 ± 1.00	0.0 ± 0.00	0.7 ± 0.33	0.14
Monocyte (%)	0 – 4	3.0 ± 0.58	1.0 ± 0.58	1.0 ± 0.58	0.08

[ab]: Means along the same row with different superscripts are significantly different ($P < 0.05$)

[c]Normal values according to Fraser and Mays (1986); ECF: Ensiled cassava leaves alone
ECFM: Ensiled cassava leaves with molasses; ECFP: Ensiled cassava leaves with poultry manure;
MCH: Mean Corpuscular Haemoglobin; MCHC: Mean Corpuscular Haemoglobin Concentration

produced, the Hb levels of the animals was not drastic enough to alter the oxygen transportation within the animals physiological system (Oni *et al.* 2008, Oduguwa *et al,* 2013). A high neutrophil value was obtained in goats fed ECFM diet. The concentration of neutrophil was determined by the level of stress the animal was exposed to (Brij *et al.* 1977). The higher level of neutrophil was generated by livestock in a bid to fight against foreign bodies and this may also have been responsible for the higher values of WBC recorded in this treatment. From the result of the absolute leukocyte count, it could be observed that lower values were obtained in the lymphocyte for ECFM which indicates a less effective antibody production as reported by Frandson (2003) that, one of the major functions of lymphocyte is their response to antigen (foreign bodies) by forming antibodies that circulate in the blood or in the development of cellular immunity. A lower lymphocyte count recorded in this study for animals on ECFM is therefore, considered to be of immense clinical importance as reported by Ihedioha (2008) who stated that lymphocytes are responsible for immune-mediated defense of the body (cell-mediated and humoral immunity) and that low percentage of lymphocyte implies that the animals appears to be more susceptible to secondary and opportunistic infections.

The serum biochemical and enzyme parameters monitored were not significantly different ($P > 0.05$) except

globulin and ALT (Table 4). The high serum protein obtained in ECFM was indicative of good performance characteristics of the animals. Iyayi and Tewe (1998) reported a high, significant correlation between serum total protein and performance parameters in livestock. The low total protein obtained in ECFP implies that there is an alteration in protein metabolism of the animal since protein synthesis is related to the amount of protein available (Iyayi and Tewe, 1998) in the diet. The values reported for serum urea were within the value of 19.0 mg/dl reported by Taiwo and Ogunsanmi (2003). These values explain the availability of high quality protein and a proper functioning of the kidney.

The low levels of globulin obtained in this study were contrary to values reported by Esugbohungbe and Oduyemi (2002) and Ikhimioya and Imasuen (2007). However, this low level suggests that the effect of tannin in the diets may be interfering with protein metabolism in the animals. Higher globulin value was recorded in ECFM and a lower value than the normal range for ECFP. This is indicative of low immunity and poor resistance to disease in these animals as reported by Frandson (2003) that the gamma globulin fraction of the plasma protein is associated with immunity and resistance to disease. There was no significant ($P > 0.05$) difference in AST but the values of 52.0, 46.5 and 41.0 IU/L obtained for ECF, ECFM and ECFP respectively, were below the normal values of 66-230 IU/L for WAD goats. However, the values reported here for ALT and AST were within the range reported by Daramola *et al*. (2005). The relatively close but low mean levels observed for AST in silages with additives could be an indication that the test diets did not differ in their influences or on enzyme secretion

Table 4: Serum biochemical and enzyme parameters of West African dwarf goats fed ensiled cassava leaves with or without additives

Parameters	Normal[c] Values	Treatments ECF	ECFM	ECFP	P
Glucose (mg/dl)	48.2 – 76	56.5 ± 6.64	53.1 ± 1.24	62.0 ± 1.15	0.33
Total protein (g/l)	61 – 74	62.9 ± 4.94	68.6 ± 1.67	58.8 ± 0.98	0.15
Urea (mg/dl)	12.6 – 25.8	18.5 ± 0.03	19.7 ± 1.53	19.5 ± 0.89	0.69
Albumin (g/l)	23.5 – 35.7	33.5 ± 0.03	32.0 ± 1.24	34.9 ± 1.24	0.21
Globulin (g/l)	27 – 44.3	29.4 ± 4.91[ab]	36.7 ± 2.92[a]	24.0 ± 2.22[b]	0.01
Creatinine (g/l)	0.7 – 1.5	0.9 ± 0.03	0.9 ± 0.06	0.9 ± 0.06	0.73
AST (IU/L)	66 – 230	52.0 ± 3.81	46.5 ± 4.23	41.0 ± 4.02	0.63
ALT (IU/L)	15.3 – 25.3	16.5 ± 0.87[a]	12.0 ± 1.15[b]	12.0 ± 0.56[b]	0.01

[ab]: Means along the same row with different superscripts are significantly different ($P < 0.05$)

[c]Normal values according to Fraser and Mays (1986)

AST: Aspartate aminotransferase; ALT: Alanine aminotransferase; ECF: Ensiled cassava leaves alone; ECFM: Ensiled cassava leaves with molasses; ECFP: Ensiled cassava leaves with poultry manure

mechanism.

Conclusion

It can be concluded from this study that both molasses and caged layer waste can be used to ensile cassava leaves without adverse effects on the haematological and serum biochemical parameters of West African dwarf goats.

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