Haematological and Serum indices of West African Dwarf Goats fed *Panicum maximum* hay and leaf meal supplement

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Abstract: The Performance of West African dwarf goats were evaluated by feeding concentrates consisting of mixture of *Vernonia amygdalina* and *Tithonia diversifolia* leafmeal in varying proportions. The study lasted 105 days. The goats were allotted to dietary treatments consisting of 0%, 5%, 10%, 15% and 20% leafmeal mixture in compounded ration in a completely randomized design with *Panicum maximum* hay as basal diet. The crude protein (CP) and ether extract (EE) of *V. amygdalina and T. diversifolia* were 17.2 and 4.3 g/100g DM while CP and EE were 18.3 and 5.1 g/100g DM respectively. The CP of compounded ration ranged from 19.7 g/100g DM in control diet (T1) to 17.6 g/100g DM in 20% leaf meal mixture (T4). The EE (3.7 – 3.0 g/100g DM), NDF (41.7 – 55.3 g/100g DM). Packed Cell Volume (PCV) ranged from 24.0 % in T1 to 31.8 % in T3. Goats on T3 had the highest Hb (11.2 g/d) and red blood cell (13.1 x 10^{12}/L). The white blood cell (WBC) ranged from 8.7 x 10^{9}/L in T1 to 11.4 x 10^{9}/L in T5. Glucose (53.7 g/L – 72.7 g/L) and Urea N (6.4 – 16.7 mmol/L). Cholesterol decreased from T1 (1.9 mmol/L) to T5 (1.4 mmol/L). It is concluded that the mixture of *Vernonia amygdalina* and *Tithonia diversifolia* leafmeal improved the PCV, Hb, RBC, WBC and serum glucose of the goats with reduction in their cholesterol content.

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1. Introduction

The nutrition from natural pastures is usually not sufficient to sustain satisfactory animal production and health in Nigeria even under optimal livestock management and socking rate because they are of low quality. These results in low digestibility and utilization by ruminants; except supplement are offered to these animals, their productivity remains at low ebb. One of the ways to mitigate low animal production is to harness alternative feedstuffs which are accessible to livestock rearers to reduced cost. The wild or Mexican sunflower (*Tithonia diversifolia*) and bitter leaf (*Vernonia amydgalina*). Wild sunflower (*Tithonia diversifolia)* is one of the new foliages, which is considered by many to be a valuable green manure. In Western Kenya, it is renowned as a component of agro-forestry systems as it is rich in N, P and K which are essential for soil fertility. It has a proper foliage nutritional value (Ibrahim et al., 2005) and may accumulate as many proteins in its leaves (up to 33%) as legumes. It has high values of phosphorous, high DM digestibility and oils in leaves and flowers. It has about 39.8 % of total sugars.

Mahecha and Rosales (2005) reported that the crude protein content in the foliage of Tithonia was 24.2% on DM basis and that about 40% of the protein was soluble. Odedire and Oloidi (2011) reported 35.3 g/100g DM and 30.4 g/100g DM for NDF and ADF respectively. The low content of tannins reported for Tithonia foliage (Wambui et al., 2006) supports the idea that the protein may well be highly soluble with poor "bypass" characteristics (Preston and Leng, 1987). The fact that loss of nitrogen in the urine was higher for Tithonia than for Calliandra or Sesbania in the study of Wambui et al (2006) supports this suggestion that rumen ammonia levels are high in Tithonia, resulting in high excretory levels of urea in the urine. A high proportion of N released in the rumen could contribute to higher N retention if it is fed in combination with high tannin foliage in the diet.

Bitter leaf (*Vernonia amygdalina*) is a shrub with petiole leaf of about 6mm diameter, green with a characteristic odour and bitter taste, grows under a range of ecological zones in Africa, produces large mass of forage and it is drought tolerant and contain considerable amount of tannin in its foliage. (Bonsi et al., 1995). The objective of this study was to study the heamatology and serum biochemical indices of growing West African Dwarf goats fed *Panicum maximum* hay and concentrate consisting leaf meal mixture of wild sunflower and bitter leaf.

2. Materials and Methods

2.1 Animal management

This study was conducted at the Goat Unit, Teaching and Research Farm, Institute of Agricultural Research and Training, Moor Plantation, Ibadan, Nigeria. Twenty (20) post-weaned West African Dwarf (WAD) goats of approximately 5-6 months old were purchased from smallholder farmers in and around Ibadan city. The goats were quarantined for one week before they were kept for adaptation for another one week. During this period, they were introduced to free feeding of forages of *Panicum maximum* and dry cassava peel ad libitum. Animals were also treated against helminthes and mange using albendazole® bolus orally and ivermectin® injection (subcutaneously) respectively.

2.3 Forage collection and feed preparation

Tithonia diversifolia and *Vernonia amygdalina* leaves were both harvested within the premises of Institute of Agricultural Research and Training, Moor Plantation, Ibadan, Nigeria. The leaves were air dried under shade and then ground in feed mill. Five experimental diets were formulated and designated T1, T2, T3, T4 and T5 respectively, (T1) = 0% *V. amygdalina and T. diversifolia*; (T2) = 5% *V. amygdalina and T. diversifolia*; (T3) = 10% *V. amygdalina and T. diversifolia*; (T4) = 15% *V. amygdalina and T. diversifolia*; (T5) = 20% *V. amygdalina and T. diversifolia*. The dietary treatments consisted of different inclusion levels of ground 1:1 mixture of *Vernonia amygdalina* (VA) and *Tithonia Diversifolia* (TD) leaf meal in a compounded ration (Table1). The twenty animals were weighed and randomly divided into five groups of four goats per treatment.

2.4 Experimental Design and treatments

Twenty WAD goats were randomly group into 5 treatments. Each group consist of 4 animals per treatment in a completely randomized design.

The statistical model was: $\gamma ij = \mu + \alpha i + \Sigma ij$

Where:

γij = individual observation

μ = general mean of population

αi = treatment effect due to diets

Σij = error effect

2.5 Feeding trial

Experimental diets were fed in the morning and *Panicum maximum* (hay) in the afternoon i.e. 08.00 and 16.00 hrs. Fresh water was given every ad lib. Block of saltlick was permanently placed in the pen of each animal. During the first two weeks, the animals were served 200g of the experimental diet and 300g of grass (hay) allowing a proportional refusal of 10% of total daily amount offered. Refusals were collected daily, weighed and recorded. Animals are weighed weekly and this was recorded.

2.6 Nutrient digestibility and nitrogen balance

At the end of twelve weeks, the animals were transferred into individual metabolic cages equipped for separate collection of urine and feaces. Feaces and urine voided were collected. Individual total urine was collected and a 10% aliquot were kept in a refrigerator (0 – 4 ^{0}C) for analysis. Feacal samples were dried at 65 ^{0}C for 48hrs to a constant weight wrapped in aluminium foil, milled and stored in air-tight bottles until analyzed.

2.7 Chemical composition

Chemical composition of *Panicum maximum* hay, *Vernonia amygdalina*, *Tithonia diversifolia* and the diets were analysed. The crude protein, Ether extract, ash were determined according to AOAC (1990). Neutral detergent fibre (NDF), acid detergent fibre and lignin components of the diets were also analysed according to Van Soest et al (1991).

2.8 Statistical analysis

All data collected were subjected to analysis of variance (ANOVA) using the procedure of SAS (2008). Significant treatment mean values were compared using the Duncan Multiple Range Test of the same package.

3.0 Results and Discussion

Table 1: Gross composition (g/100g DM) of experimental diets

	TREATMENTS				
Ingredients	Diet1	Diet 2	Diet 3	Diet 4	Diet 5
Maize	20	20	20	20	20
Brewers dry grain	30	25	20	15	10
VTL Meal	-	5	10	15	20
Wheat offal	15	15	15	15	15
Groundnut cake	5	5	5	5	5
Palm kernel cake	25	25	25	25	25
Limestone	4.5	4.5	4.5	4.5	4.5
Salt	0.25	0.25	0.25	0.25	0.25
Grower Premix	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100
Calculated:					
Crude Protein (%)	19.65	19.14	18.63	18.12	17.61
Metabolizable energy (Kcal/Kg DM)	2522.30	2491.25	2460.20	2429.15	2398.10

VTL= *Vernonia amygdalina* and *Tithonia diversifolia* leaf meal

The gross composition of experimental diets fed to the goats is shown on Table 1. The higher the inclusion level of the leaf meal in diets the lower the crude protein and metabolizable energy values.

Table 2 revealed the chemical composition of grass, sunflower and bitter leaf used for the diets. Sunflower (*Tithonia diversifolia*) had the highest crude protein (CP) (18.26 g/100g DM) and ether extract (EE) (5.11 g/100g DM) whereas the bitter leaf (*Vernonia amygdalina*) was high in the ash contents (12.24 g/100g DM) and fibre fractions (NDF, ADF and ADL) compared to the sunflower. The values obtained in this study far exceed the minimum protein requirement of 10-12% for ruminant. (ARC, 1985).

Table 2: Chemical composition (g/100g DM) of *Panicum maximum*, *Vernonia amygdalina*, *Tithonia diversifolia* and diets fed to WAD goats.

Parameter	*Panicum maximum*	*Vernonia amygdalina*	*Tithonia diversifolia*
Dry matter	86.79	87.96	87.74
Crude protein	11.28	17.18	18.26
Ether extract	3.26	4.28	5.11
Ash	9.88	12.24	11.38
Neutral detergent fiber	65.58	59.21	57.15
Acid detergent fiber	39.79	35.44	31.47
Acid detergent lignin	11.28	10.35	9.21
Nitrogen free extract	30.98	37.47	37.17

The crude protein decreases with higher inclusion level of the leaf meal (Table 3). The value of CP obtained for the mixtures of the leaf meal is comparable to reported values for Mexican sunflower flower leaf meal (Tian et al., 1998) and *Aschynomene histrix* and *Stylosanthes guianensis* (Ajayi et al., 2007). The control diet (T1) has the highest values of Ether extracts and ash content. The least value of ether extract (2.96 g/100g DM) was obtained in diet 5. Neutral detergent fibre (NDF), ADF and ADL values increased with higher inclusion levels of the leaf meal.

Table 3: Chemical composition (g/100g DM) of leafmeal consisting of *Vernonia amygdalina* and *Tithonia diversifolia* in varying proportions

Parameter	Control T1	5% leaf meal mixture T2	10% leaf meal mixture T3	15% leaf meal mixture T4	20% leaf meal mixture T5
Dry matter	86.31	87.14	86.25	86.46	87.03
Crude protein	19.65	19.14	18.63	18.12	17.61
Ether extract	3.67	3.54	3.47	3.63	2.96
Ash	9.67	8.75	8.73	8.89	8.92
Neutral Detergent Fibre	41.69	51.96	52.37	54.88	55.26
Acid Detergent Fibre;	23.48	27.24	27.85	28.15	28.56
Acid Detergent Lignin	5.26	6.28	6.37	8.38	8.43
Nitrogen Free Extract	35.84	36.20	34.50	33.90	34.58

Table 4: Haematological values of goats fed leafmeal consisting of *Vernonia amygdalina* and *Tithonia diversifolia* in varying proportions

Parameters	Control T1	5% leaf meal mixture T2	10% leaf meal mixture T3	15% leaf meal mixture T4	20% leaf meal mixture T5	SEM
PCV (%)	24.0^{c}	26.67^{c}	31.8^{a}	29.60^{b}	25.40^{c}	2.12
Hb (g/L)	90.0^{b}	92.40^{a}	96.20^{a}	88.60^{b}	84.27^{b}	1.05
RBC (x 10^{12}/L)	11.98	12.02	13.10	12.04	12.85	0.94
WBC (x 10^{9}/L)	8.67^{c}	9.88^{b}	10.05^{b}	10.62^{b}	11.44^{a}	0.73
MCH (pg)	7.51^{c}	8.65^{a}	8.55^{a}	7.14^{c}	6.44^{c}	0.77
MCV (fl)	20.0^{c}	22.2^{b}	24.3^{a}	24.6^{a}	19.7^{c}	1.02
MCHC (g/dl)	37.6^{a}	39.0^{a}	35.20^{b}	29.02^{d}	32.74^{c}	1.61
Lymphocyte (%)	61.07^{a}	29.67^{c}	35.03^{b}	35.05^{b}	35.14^{b}	2.43
Monocyte (%)	1.47^{a}	3.14^{b}	3.58^{c}	3.60^{c}	3.75^{c}	3.07
Neutrophil (%)	30.13^{d}	46.07^{a}	36.08^{c}	30.05^{d}	42.10^{b}	2.44

abc= Means in the same column with similar superscripts are not significantly (P>0.05)

Goats on diet 3 had the highest PCV (31.8%), Hb (11.2 g/L) and RBC (12.02 x 10^{12}/L) (Table 4). However, PCV and RBC values were observed to be low in goats fed diet 1. The PCV values of goats on diet 1, 2 and 5 were significantly (P> 0.05) different. The values obtained for the PCV were within the ranges (20 – 28 %) for clinically healthy goats. (Sirois 1995) Similarly, goats fed diet 1, 4 and 5 did not differ (P> 0.05) in the haemoglobin values. The RBC of the goats on diet 1 – 5 was similar (P> 0.05). These values were within the range of 8 – 17 x 10^{12}/L for clinically healthy goats (Sirois, 1995). Goats on diet 5 had the highest value of white blood cell (WBC) (11.44 x 10^{9}/L). It was observed that the high inclusion level of leafmeal mixture in diet 4 and 5 resulted to high values of RBC and WBC. The lymphocyte value of goats on diet 1 was the highest (61.0%) while goats on diet 2 had the least value (29.67%). However, goats on diets 3 – 5 had values that were not significantly (P> 0.05) different. The values for WBC, lymphocyte and monocyte which reflect the immune system were within the ranges for clinical healthy goats (Sirois, 1995). Monocytes are essential for the immune system as they are precursors of macrophages and lymphocytes essential for humoral and cell-mediated immunity responses (Mahgoub et al., 2008).

The serum biochemistry indices of the goats fed the leafmeal differed (P> 0.05) significantly among the treatments (Table 5). Goats fed diet 3 had the highest serum glucose (72.67 mg/dl). The value is not significantly (P> 0.05) different from that of goats fed diet 1 and 4. However, the least glucose concentration was observed in the goats fed diet 5 (53.67 mg/dl). The glucose concentrations in the serum of the goats are within the normal range of 48.2 – 76.0 mg/dl) (Jain, 1986). The high glucose concentration is a reflection of the high energy value of the diets. The urea N concentration in the serum of the goats decreased with increasing levels of the leaf meal; the highest value was observed in the goats fed diet 1 (control) (16.70 mmol/L). The decrease in the urea N level is an indication of reduced quality of the diets with increased inclusion level of the leaf meal. Amongst the goats fed leaf meal, goats on diet 2 had the highest urea (11.17 mmol/L) while the least was observed in goats fed diet 5, the values for goats fed diet 1,3 and 5 are not significantly (P> 0.05) different.

Serum urea N of goats fed diets 1 and 2 were above the normal range of 3.5 – 10.7 mmol/L for clinically healthy goats implying increased catabolism of the nitrogen rich diets. Goats on diet 5 had the least total protein and albumin which are 52.6 g/L and 26.3 g/L respectively compared to goats on treatments 1 – 4. These values reflect the poor quality of the diet at the highest inclusion level of the leaf meal as the values are below the normal range for clinically healthy goats (Sirois, 1995; Daramola, 2005). The cholesterol values of the goats decreased with increasing inclusion level of the leafmeal from diet 2 – 5 but the values did not differ (P> 0.05) significantly. The decreased in the cholesterol level in serum of the goats is an indication that the leaf meal can reduce cholesterol in livestock thereby safe for human consumption. The highest value of globulin was observed in goats fed diet 2, however the value is similar (P> 0.05) to the globulin values for goats on diet 1, 3 and 5. Goats fed diet 4 had the least value (10.4 g/L) of globulin.

Table 5: Serum biochemistry indices of goats fed leafmeal consisting of *Vernonia amygdalina* and *Tithonia diversifolia* in varying proportions

Parameters	Control T1	5% leaf meal mixture T2	10% leaf meal mixture T3	15% leaf meal mixture T4	20% leaf meal mixture T5	SEM
Glucose (mg/dl)	68.67^{a}	57.07^{b}	72.67^{a}	69.05^{a}	53.67^{b}	7.46
Urea (mmol/L)	16.70^{a}	11.17^{b}	9.60^{b}	8.20^{b}	6.40^{b}	3.17
Total Protein (g/L)	70.67^{b}	80.60^{a}	70.67^{b}	60.47^{c}	52.60^{b}	6.24
Albumin (g/L)	50.30^{b}	60.07^{a}	50.40^{b}	30.07^{c}	26.30^{b}	4.17
Cholesterol (mmol/L)	1.93^{a}	1.58^{b}	1.40^{b}	1.37^{b}	1.38^{b}	0.32
Globulin (mg/L)	20.37^{a}	20.57^{a}	20.27^{a}	10.40^{b}	20.30^{a}	2.45

abc= Means in the same column with similar superscripts are not significantly (P>0.05)

4. Conclusion

The study reveals that mixture of the leaf meal of *Vernonia amygdalina* and *Tithonia diversifolia* can be incorporated in compounded ration to improve the PCV, Hb, RBC and WBC as well as the serum glucose and cholesterol concentration of growing West African dwarf goats. Ten percent inclusion of mixture of *Vernonia amygdalina* and *Tithonia diversifolia* would results in optimal performance of the goats in prevention of anaemia and increase immunity against diseases.

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