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Growth performance and carcass characteristics of West African dwarf (WAD) goats fed selected forages in Akwa Ibom State

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ABSTACT: The potential of selected forages was evaluated using West African Dwarf (WAD) goats. Six forages namely, *Andropogon tectorum, Panicum maximum, Aspilia Africana, Gmelina arborea, Alchornea cordifolia* and *Bambusa vulgaris* designated as T_1 to T_6, respectively were the only feed source used for the study. Thirty West African Dwarf goats aged 8 to 9 months, with an average bodyweight of 9.17 to 10.10 kg were used for the study. The goats were assigned to six treatment groups based on the forages used in a completely randomized design. The results obtained showed significant ($p<0.05$) differences for average total weight gain and feed dry matter intake. Animals on *Aspilia africana* (T_3) recorded the highest (1120.18 g/day) feed dry matter intake whereas *Panicum maximum* (T_1) had the lowest 890.30 g/day. *Andropogon tectorum* (T_1) and *Gmelina arborea* (T_4) recorded 410.0 g each for average total weight gain. Initial haematology and serum indices had no significant ($p>0.05$) differences in the parameters tested. However, the PCV values were reduced in the final haematological profile. Similarly, carcass characteristics had no ($p>0.05$) significant differences among the treatment means. Animal on *Andropogon tectorum* (T_1) gave the best (50.29%) dressing percentage with the least (40.47%) in *Panicum maximum* (T_2). It can be concluded that performance of West African Dwarf goats can be better if the forages are offered in combination at equal amounts.

Keywords: Carcass characteristics, forages, performance, WAD goats.

INTRODUCTION

In Nigeria, the high demand for animal protein calls for contribution from different species of livestock which in spite of the large population of chickens and other animal species, protein remains very low (Sofi et al., 2010). The current need for animal protein in Nigeria, like in other developing countries of the world has posed an enormous challenge to Nigerian livestock farmers (Oni, 2002). Consequently, directing attention to the improvement of goat production could contribute towards meeting the protein needs of the Nigerian populace (Aye, 2004). The West African Dwarf (WAD) goats are indigenous to the southern part of Nigeria and are mainly reared for meat, skin and reproduction. They constitute the bulk of the Nigeria goat population and are managed under an extensive, low input, traditional husbandry system (Omoike, 2006). In Nigeria, the decline in the production of livestock stems largely from the lack of livestock. Unbalanced or inadequately feeding is a major constraint to livestock production in the tropics (Aina et al., 2009).

Inadequate feed supply is responsible for low livestock production in the tropics (Eyoh et al., 2015). Tropical browses and shrubs contain appreciable tannins which affect palatability, intake and digestibility (Okoli et al., 2003). The chemical characteristics of browse plants obtained by Okoli et al. (2003) suggested that they are potentially high in crude protein and minerals but low in condensed tannins. Most goats' producers in the tropics incorporate browse plants such as *Panicum maximum,*

Alchornea cordifolia, Grewia pubescens and *Bambusa vulgaris* in the diet of West African Dwarf goats. This research was initiated to study the response of West African Dwarf (WAD) goats fed selected forages with respect to growth and carcass characteristics.

MATERIALS AND METHODS

Experimental site

The study was carried out at the Akwa Ibom State University, Obio Akpa Campus. Obio Akpa is located between latitudes 5^0 17^1N and 5^0 27^1N and between longitudes 7^0 27^1E and 7^0 58^1E with an annual rainfall ranging from 350 to 5000 mm and average monthly temperature of 25^0C. Akwa Ibom is a coastal state, lying between latitudes 4^0 28^1N and 5^0 3^1N and between longitudes 7^0 27^1E and 8^0 20^1E with a relative humidity of between 60 to 90%. It is in the tropical rainforest zone of Nigeria (SLUS-AK, 1989).

Management of experimental animals/feeding

A total of thirty goats, aged 20 weeks and consists of 15 bucks and 15 does of West African Dwarf (WAD) type, which is the predominant ruminant species in the region of study were randomly assigned to six different varieties of forages. The average initial study weight was 9.17 kg for the bucks and 10.10 kg for the does. All animals were treated for both endo and ecto-parasites prior to the start of the experiment. Five replicates per forage, were housed singly in an open pen for the 90 days of the growth trial in a completely randomized design (CRD). Daily for 2 hours (7.00 to 9.00 am), the animals were allowed access to an open, well-fenced area to exercise. The forages were offered to the animals at a rate of 3% of their body weight (on a dry matter basis), in addition to water and mineral salt licks *ad libitum*.

Variety of forages

The forages fed to the six groups of experimental animals were: *Andropogon tectorum (AT), Panicum maximum (PM), Aspilia africana (AA), Gmelina arborea (GA), Alchornea cordifolia (AC) and Bambusa vulgaris (BV).* These forage were designated as T_1 toT_6, respectively. The forages were cut and kept for use the following day, weighed (i.e. 2kg each, and was increased as the consumption rate or intake increased) and offered to the animals in their different pens.

Haematology and serum biochemistry

Blood samples were collected twice – at the beginning and on the last day of the 90 day experimental period with the aid of a 10 ml syringe and a 20 gauge needle. Each two sets of blood samples were taken from each of the 2 animals per treatment group via jugular venipuncture. One set of the blood samples (5 ml) were collected into plastic bottles containing the anti-coagulant ethylene diamine tetracetci acid salt (EDTA) for the determination of haemoglobin parameters. The other set of blood samples (10 ml) were collected into anti-coagulant-free plastic bottles, allowed to coagulate at room temperature and centrifuged for 10 mins at 3000 rmp. The sera were then stored at a temperature of -70°C for subsequent biochemical analysis.

Haematological values of the blood were estimated for packed cell volume (PCV) and hemoglobin (Hb) concentration. Total red blood cells and total white blood cells were determined using the Naibauer haemocytometer after appropriate dilutions. Biochemical constituents of the serum samples that were measured included calcium, total protein, albumin, globulin, chloride, blood urea, potassium and creatinine. Data obtained from haematology and serum biochemistry for the differences were compared statistically using completely randomized design and differences between means separated using the Duncan Multiple Range Test (Duncan, 1955; Steel and Torrie, 1980).

Carcass components

At the end of the trial period, a total of 10 animals per treatment group were fasted for 24 hours, weighed and humanely slaughtered. Following slaughter, the carcass was subjected to open fire to remove the fur and then thoroughly washed with portable water. Thereafter, the warm carcass weight (WCW) was determined. The carcass was eviscerated to separate the internal organs (stomach, intestine, kidney etc). The warm carcass were split into two halves along the vertebral axis and subsequently separated into the various wholesale cuts using a sharp implement. The wholesale cuts included the hind and fore leg, loin, flank, breast, rack, shoulder, neck and tail.

The shoulder was separated between the 5th and 6th vertebrae perpendicular to the back line, 1.25 cm above the elbow joint. The breast, shank and flank were separated from the other body parts. Leg removal was at the top of the ileum perpendicular to the backline, while the loin and rack were cut along the back of the 13th rib perpendicular to the backline (Omojola and Attah, 2006).

RESULTS AND DISCUSSION

The growth performance of West African Dwarf goats fed selected forage plants is presented in Table 1. There were significant ($p<0.05$) differences among the treatment means for average total weight gain and feed intake. For average total weight gain, goats fed *Andropogon tectorum* (T_1) and *Gmelina arborea* (T_4) were statistically similar but differed significantly ($p>0.05$) from those fed *Panicum maximum* (T_2), *Aspilia africana* (T_3), *Alchornea cordifolia*

Table 1. Performance of WAD goats fed selected forages

Parameter	T1 (AT)	T2 (PM)	T3 (AA)	T4 (GA)	T5 (AC)	T6 (BV)	SEM
Initial body weight (kg)	10.10	9.74	9.74	9.64	9.17	9.28	0.64
Final body weight (kg)	10.51	9.90	10.05	10.05	10.31	9.49	0.65
Average total weight gain (g)	410.0^{a}	160.0^{d}	310.0^{b}	410.0^{a}	114.0^{e}	210.0^{c}	2.18
Feed DM intake (g/day)	950.05^{bc}	890.30^{e}	1120.18^{a}	1090.40^{ab}	910.15^{bc}	980.20^{b}	1.26
FCR (intake/gain)	5.06	5.03	6.24	6.07	5.10	5.78	1.48

$^{a-e}$ means of treatment in a row with different superscript are significantly different ($p<0.05$); SEM standard error of mean, T_1 (AT) = *Andropogon tectorum*; T_2 (PM) = *Panicum maximum*; T_3 (AA) = *Aspilia africana*; T_4 (GM)= *Gmelina arborea;* T_5 (AC) = *Alchornea cordifolia* and T_6 (BV)= *Bambusa vulgaris.*

Table 2. Initial and final haematological profile of WAD goats fed the selected forages.

Parameter	T_1 (AT)	T_2 (PM)	T_3 (AA)	T_4 (GA)	T_5 (AC)	T_6 (BV)	SEM
Initial							
PCV, (HCT %)	34.50	29.50	37.00	34.00	34.00	33.50	0.99
Hb (g.dl)	10.11	10.03	9.07	9.50	10.01	9.81	0.16
RBC x (10^6/µL)	10.50	9.50	8.00	8.50	8.50	7.50	0.44
MCV (fl)	15.00	20.50	17.50	19.20	15.00	11.50	1.34
MCH (fmol)	6.90	3.70	3.50	4.80	5.25	4.15	0.51
MCHC (%)	30.50	27.00	33.50	28.50	31.50	29.50	0.93
WBC x (10^3/µL)	3.00	2.50	4.00	4.50	5.00	3.00	0.40
Neutrophils (%)	29.33	30.00	33.32	31.31	28.71	30.29	0.67
Lymphocytes (%)	60.00	55.00	50.00	45.00	58.00	45.00	2.65
Monocytes (%)	2.33	2.33	0.00	2.00	2.33	0.00	0.48
Eosinophil (%)	4.00	3.02	0.01	20.00	6.00	8.00	2.86
Final							
PCV, (HCT %)	21.08	28.00	31.51	26.06	29.09	25.06	1.47
Hb (g.dl)	9.73	9.53	10.01	9.97	10.30	8.43	0.27
RBC x (10^6/µL)	10.07	9.10	7.79	8.00	8.38	7.89	0.36
MCV (fl)	18.02	19.08	16.96	16.83	17.92	19.80	0.48
MCH (fmol)	6.50	5.72	4.50	3.80	5.20	4.17	0.42
MCHC (%)	30.50	31.09	30.11	27.50	29.09	29.91	0.52
WBC x (10^3/µL)	9.57	8.79	11.02	10.04	9.20	7.70	0.46
Neutrophils (%)	33.82	30.31	23.79	30.91	32.95	31.33	1.45
Lymphocytes (%)	42.00	57.33	65.00	54.00	62.00	50.33	3.40
Monocytes (%)	2.33	2.67	0.00	2.35	2.65	0.00	0.53
Eosinophil (%)	4.00	4.00	0.00	24.00	6.00	7.00	3.44

Means on the same row are not significantly different ($p>0.05$). PCV = Packed cell volume (Haematocrit); Hb = Haemoglobin; RBC = Red blood cell; MCV = Mean corpuscular volume; MCH = Mean corpuscular haemoglobin; MCHC = Mean corpuscular haemoglobin concentration; WBC = White blood cell; T_1 (AT) = *Andropogon tectorum*; T_2 (PM) Panicum maximum; T_3 (AA) = *Aspilia africana*; T_4 (GM) *Gmelina arborea;* T_5 (AC) *Alchornea cordifolia* and T_6 (BV) *Bambusa vulgaris.* SEM = Standard error of mean, Creat = creatinine; Total Prot = Total protein; BUN = Blood Urea Nitrogen; Bld Gluc = Blood glucose; Ca = Calcium; Cl = Chlorine; K= Potassium; Na = Sodium.

(T_5) and *Bambusa vulgaris* (T_6), respectively. Goats fed *Andropogon tectorum* (T_1) and *Gmelina arborea* (T_4) recorded the highest value (410.0 g), while *Bambusa vulgaris* (T_6) had the lowest (210.0 g) for average total weight gain. Goats fed *Aspilia africana* (T_3) and *Gmelina arborea* (T_4) were statistically similar in feed intake but differed ($p<0.05$) significantly from goats in T_1, T_2, T_5 and T_6. The lower weight gain recorded in T_6 (210.0 g) may have been due to moderately low feed intake occasioned by *Bambusa vulgaris* which was increasingly becoming more fibrous during the period of the experiment (October to December). This corroborates with the reports of Obua et al. (2012) that the nutritive content of forages decline with age and time of harvest.

Results of initial and final haematological profiles of West African Dwarf (WAD) goats fed selected forages is presented in Table 2. There were no significant ($p>0.05$) differences observed among the parameters in the initial

Table 3. Initial and final serum indices of goats fed selected forages.

Parameter	T_1 (AT)	T_2 (PM)	T_3 (AA)	T_4 (GA)	T_5 (AC)	T_6 (BV)	SEM
Initial							
Creat (mmol/L)	59.20	62.40	60.01	65.90	60.00	60.51	0.90
Total prot (g/dl)	68.30	54.40	71.90	69.90	56.60	57.50	3.16
BUN (g/dl)	25.17	21.40	20.10	31.30	20.00	19.88	1.86
Blood Gluc (mmol/L)	2.13	2.20	3.01	2.90	2.50	2.10	0.16
Ca (mmol/L)	4.20	4.50	5.20	4.30	4.50	4.17	0.16
Cl (mmol/L)	100.00	92.10	86.20	82.17	88.31	89.28	2.47
K (mmol/L)	3.49	4.80	4.10	4.10	4.10	3.80	0.18
Na (mmol/L)	235.50	132.00	139.50	138.50	138.50	137.00	16.44
Final							
Creat (mmol/L)	55.04	60.10	62.62	61.17	67.76	60.92	1.27
Total prot (g/dl)	61.43	42.35	45.60	56.47	53.14	44.01	3.13
BUN (g/dl)	19.22	16.39	23.43	28.10	18.21	18.98	1.75
Blood gluc (mmol/L)	1.33	1.84	2.01	1.98	2.00	1.87	0.11
Ca (mmol/L)	1.40	1.23	1.30	1.33	1.30	1.33	0.02
Cl (mmol/L)	90.33	86.50	87.00	86.67	91.00	82.31	1.28
K (mmol/L)	3.02	3.16	2.95	3.10	3.11	3.00	0.03
Na (mmol/L)	130.22	128.00	129.01	131.33	132.00	130.12	0.60

PCV = Packed cell volume (Haematocrit); Hb = Haemoglobin; RBC = Red Blood cell; MCV = Mean corpuscular volume; MCH = Mean corpuscular haemoglobin; MCHC = Mean corpuscular haemoglobin concentration; WBC = White blood cell; T_1 (AT) = *Andropogon tectorum*; T_2 (PM) *Panicum maximum*; T_3 (AA) = *Aspilia africana*; T_4 (GM) *Gmelina arborea*; T_5 (AC) *Alchornea cordifolia* and T_6 (BV) *Bambusa vulgaris.* SEM = Standard error of mean, Creat = creatinine; Total Prot = Total protein; BUN = Blood Urea Nitrogen; Bld Gluc = Blood Glucose; Ca = Calcium; Cl = Chlorine; K= Potassium; Na = Sodium.

haematology study. Values for the haematological indices were within the reference interval reported by Daramola et al. (2005). However, haematological parameters measured at the end of the experiment showed no significant ($p>0.05$) differences but slight deviations from the reference interval reported by Tambuwal et al. (2002), Banerjee (2004) and Olorunnisomo et al. (2005). The non-significant differences in the values recorded in this study does not mean that the forages were not utilized by the animals but that there were variations in feed conversion ratio 5.03 as evidenced in goats fed *Panicum maximum* (T_2).

The initial and final serum biochemistry values for WAD goats fed selected forage plants are presented in Table 3. There were no significant ($p<0.05$) differences observed among all the parameters measured for the initial blood samples. The values obtained for blood glucose, potassium and sodium, though not statistically different, were within the reference interval of 2.10 to 3.01, 3.49 to 4.80 and 132.00 to 235.50 mmol/l, respectively. Creatinine levels recorded in this study were lower than the 70.72 μmol/L as reported for bucks in south eastern Nigeria by Opara et al. (2010). However, the levels in this study were within the base line serum creatinine reference interval of 59.7 to 134.8 μmol/L as reported by Tambuwal et al. (2002). The creatinine levels in blood and urine may be used to calculate the creatinine clearance (CrCl), which reflects the glomerula filtration rate (GFR). The GFR is clinically important because it is a measurement of kidney function (Nabili and Shiel, 2010). However, the final serum biochemical parameters for blood urine nitrogen were lower than 57.5 to 134.8 mmol/l reference intervals as reported by Daramola et al. (2005), Olafadehan (2011) and Olorunnisomo et al. (2005).

Table 4 shows the carcass and organ characteristics of West African dwarf (WAD) goats fed selected forages .The fasted live weights, dressed weights and dressing percentages ranged from 8.65 to 10.50 kg, 4.95 to 6.50 kg and 44.16 to 50.29%, respectively. The values of these parameters for each of the treatment groups were not significantly ($p>0.05$) different. The dressing percentages obtained among the West African Dwarf goats in this study were similar to the 45 to 50% reported by Raghavan (1988), except for T_2 (40.47%) which recorded the least. The results of the whole and retail parts namely, tail, loin, hind-limb, fore-limb and head, though not significantly ($p>0.05$) different, ranged from 0.36 to 0.46%, 12.00 to 14.10%, 12.00 to 15.27%, 13.00 to 15.25% and 0.92 to 12.59%, respectively. These values were similar to those reported by Omojola and Attah (2006). The results also revealed that among the internal organs, the stomach had the highest weight followed by the intestine. This might be due to increase in the intake of *Panicum maximum* which was relished by WAD goats as compared to others.

Table 4. Carcass and organ characteristics of WAD goats fed selected forages.

Parameters	T_1 (AT)	T_2 (PM)	T_3 (AA)	T_4 (GA)	T_5 (AC)	T_6 (BV)	SEM
Live weight (kg)	8.65	10.50	8.88	9.85	8.85	9.15	0.33
Warm carcass weight (kg)	4.95	6.50	5.55	6.05	4.95	5.35	0.25
Dressing percentage (%)	50.29	40.47	48.99	44.16	49.25	47.54	10.83
Major cuts (%) of chevon							
Tail	0.46	0.39	0.35	0.45	0.36	0.32	0.02
Loin	11.49	12.18	11.50	12.24	11.54	11.20	16.76
Hind Limb	13.90	13.02	12.00	13.26	14.10	12.26	0.35
Forelimb	13.90	13.44	13.00	13.77	15.25	13.21	0.33
Head	12.06	10.92	11.00	11.49	12.61	12.59	0.56
Flank	5.64	5.29	5.50	7.14	5.76	6.65	0.30
Rack	4.25	4.79	4.70	4.29	4.49	5.26	0.15
Breast	5.81	5.04	4.50	4.59	3.84	4.23	0.28
Neck	5.98	4.78	5.00	4.59	3.84	4.23	0.28
Feet	3.68	3.94	4.30	3.98	3.95	2.26	1.49
Shoulder	12.64	12.60	13.00	11.74	11.95	12.26	1.76
Thigh	12.55	12.53	12.98	12.97	12.21	13.37	0.17
Internal Organs (%)							
Stomach with contents	17.30	11.90	13.80	16.80	16.20	15.30	0.83
Empty stomach	4.62	3.49	4.50	3.35	5.36	5.15	0.34
Intestine with content	6.40	6.50	6.50	6.60	9.30	7.10	0.46
Empty intestine	3.17	2.79	3.65	3.68	3.95	2.86	0.20
Heart	0.50	0.45	0.55	0.40	0.63	0.61	0.04
Spleen	0.17	0.11	0.15	0.13	0.16	0.14	0.01
Paired kidney	0.36	0.26	0.36	0.26	0.34	0.36	0.02
Liver	0.10	0.13	1.71	0.54	1.76	1.79	0.34
Trachea	0.10	0.13	0.21	0.15	0.17	0.10	0.02
Oesophagus	0.10	0.15	0.21	0.15	0.21	0.19	0.01
Gall bladder	0.07	0.06	0.07	0.05	0.05	0.09	0.01
Penis	0.10	0.20	0.60	0.40	0.40	0.40	0.05
Pancrease	0.58	0.38	0.59	0.73	0.27	0.53	0.07
Lungs	0.87	0.64	0.90	0.75	0.84	0.90	0.04

Means on the same row are not significantly ($p>0.05$) different. T_1 (AT) = *Andropogon tectorum*; T_2 (PM) *Panicum maximum*; T_3 (AA) = *Aspilia africana*; T_4 (GM) *Gmelina arborea*; T_5 (AC) *Alchornea cordifolia* and T_6 (BV) *Bambusa vulgaris.* SEM = Standard error of mean.

Conclusion

The results of the present study underscore the potentials of studied forages as nutritive fodders for ruminant animals. However, there is possibility of improved productivity in animals if fed in combination of other forages, as this will furnish the critical nutrients required for effective growth of the ruminant animals.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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