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RESEARCH ARTICLE

PROTEIN, ANTINUTRIENTS INTAKE AND DIGESTIBILITY OF WEST AFRICAN DWARF EWES FED GRADED LEVELS OF VERNONIA AMYGDALINA LEAF MEAL DIETS

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ABSTRACT

Twenty West Africa Dwarf (WAD) Ewes of 10-12 months old were randomly assigned to five treatments in a completely randomized design experiment to assess the protein, antinutrients intake and digestibility by West African Dwarf ewes fed graded levels of *Vernonia amygdalina* leaf meal (VALM) diets and the experiment lasted 56 days. The diets were formulated such that 0% (A), 25% (B), 50% (C), 75% (D) and 100% (E) of brewer's dried grain was replaced with *Vernonia amygdalina* leaf meal (w/w) respectively. The VALM had the highest crude protein (CP) content, while the profile of antinutients showed that diet E had the highest values. The inclusion of VALM in the diets influenced the intake of Dry matter (DM), crude protein (CP), saponin and alkaloid significantly ($P<0.05$) and the intake values of phytate, oxalate and tannin were statistically similar ($P>0.05$). The treatment effect on the apparent digestibility varied significantly ($P<0.05$), the nitrogen retention and weight gain values of animals fed diets B and C indicated better performance, while the poor response of animals fed diet E might be associated with the astringent property of VALM which might influence depressed appetite and poor feed utilization. It could be concluded that VALM has good potentials to serve as source of protein supplement for growing ewes' diets, substituting for brewer's dried grains at 25% and 50% without adverse effect on the animals' health, but the effective use of VALM in ruminants' diets needs further investigation.

INTRODUCTION

Vernonia amygdalina (bitter leaf) a member of Compositae family is a fast growing drought resistant plant among other medicinal plants. It is locally abundant in sloughs, home gardens and even all over places in the southern Nigeria (Bonsi et al., 1995a). The multipurpose natures of this plant and the tremendous variety of its potential uses have recently been recognized. Among these uses are local medicine against leech which transmits bilharziose (John, 1994), fence post, yam sticks in the villages, human consumption as vegetable and digestive system stimulant (Huffman, 2001). In addition, the plant leaves of Vernonia *amygdalina* are very nutritious and have been observed to be eaten by goats and sheep in Central Zone of Delta State and Akure environment in Ondo State Nigeria (Aregheore et al., 1998 and Fajemisin et al., 2009). Free living Chimpanzees eat the leaves when they were attacked by parasites and reduce pains and prevent fever (John, 1994).

Vernonia amygdalina leaf meal (VALM) being an alternative proteinous (20 -3 4 % CP) feed resource (Aregheore et al., 1998, and Fajemisin et al., 2009) can beused as protein supplement (Teguia et al., 1993 and D'mello 1992), energizer (Huffman et al., 1996a) and even can serve medicinal purpose in treating diarrhea and constipation when consumed by man and animals (John 1994; Okoli et al., 2002).

From the growing body of information on the plant, it is known to be endowed with valuable biochemical properties. Laboratory analyses (Aregheore et al., 1998) showed that the plant contains some antinutritional factors such as alkaloids, saponins, tannins and other glycosides (Bonsi et al., 1995). Vernonia pith examined by bioassay revealed antiparasitic activity against microorganisms that infect both Chimps and human beings. In addition, the analyses revealed chemical categorized as sesquiterpene, lactones and steroid glycosides both of which are known for their bioactivity. Specifically, Vernonioside B1 and Vernoniol B1 isolated from the pith of Vernonia suppressed movement and egg-laying activity in bioassay of Schistosoma japanicum, a parasitic worm (John, 1994). With recent introduction of trees and shrubs into cropping and grazing system to provide fodder that is high in protein to supplement the low quality grass and post

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harvest crop residues, it is conceivable that *Vernonia amygdalina* could play a valuable role in ruminant feeding system.

This study was therefore conducted to assess the protein, antinutritients intake and digestibility of West African Dwarf ewes fed graded levels of *Vernonia amygdalina* leaf meal diets.

MATERIALS AND METHODS

Experimental site

The experiment was conducted at the small ruminant unit of Teaching and Research Farm of the Federal University of Technology Akure, Ondo State, Nigeria. The experimental site within the rainforest zone of Nigeria, located on latitude 07^o 17N, longitude 05^o 18E with elevation of 350m above sea level. The main mean annual rainfall and temperature are about 1200mm and 25^{o}C (min. 19^{o}C and max. 34^{o}C) respectively.

Materials collection and diets preparation

The *V. amygdalina* leaves were harvested within the environment of The Federal University of Technology, Akure, Nigeria. Air-dried for six days and sun-dried for one additional day to ensure perfect drying, milled and packed in jute bags until required for use. The cassava starch residue was collected fraeh and sundried for five days at Matna Foods Limited in Ogbese, Ondo State, Nigeria and transported to the experimental site for use. Bone meal, brewer's dried grain, palm kernel cake, salt and vitamins premix were purchased at Adedom Feedmill Limited, Akure. Five diets were formulated using the above listed ingredients such that brewer's dried grain was replace with *Vernonia amygdalina* (w/w) at levels 0% (diet A), 25% (diet B), 50% (diet C), 75% (diet D) and 100% (diet E) respectively (Table 1).

Experimental layout

Twenty (20) West African Dwarf ewes with average live weight of 13.65$\pm$ 3.50kg and 10-12 months old were selected from the sheep flock of Teaching and Research Farm of Federal University of Technology, Akure Ondo State, Nigeria and treated against external and internal parasites with diasuntol® solution and bendamizole® bolus respectively.

The animals were randomly distributed into five treatment groups (two males and two females per group) using the completely randomized experimental design. The experiment lasted for fifty-six days during which the animals were allowed to adapt to both their individual pens and feed for a period of fourteen days before the commencement of data collection. During the experimental period, diets and fresh clean water were offered *ad libitum* at 8.00hr every morning. Feed left unconsumed was weighed and discarded.

Voluntary intake was estimated as the difference between daily feed offered and orts. The animals were weighed weekly to determine changes in liveweight. The last fourteen days of the experimental period was used for digestibility trial during which the animals were kept in the individual metabolism cages. The first seven days of digestibility trial was allowed for adjustment to the environment followed by seven days of total faecal and urine collection.

Laboratory and Statistical analysis

Samples of experimental diets, *Vernonia amygdalina* leaf meal, faeces and urine were analyzed for dietary nutrients and antinutritional factors according to AOAC (2000). The data collected were subjected to one-way analysis of variance (SAS, 1999). Where significance differences were found, the means were compared using Duncan's New Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The proximate composition and the antinutrients of the VALM and experimental diets is presented in Table 2. The dry matter (DM) values varied with from 72.09 (diet D) to 86.88% (VALM), crude protein (CP) values of the experimental diets were low compare with the CP content of VALM. The observed CP value was 22.10% and compare favourably with value reported by Bonsi et al. (1995b) and Okoli et al. (2003).

The crude fibre (CF) content of VALM is low when compared with that of tropical grass species which may be as high as 45 to 50% at more matured stages of growth (Uwechue, 1990). The tannin content of VALM obtained in this study is higher than the values (0.20% and 0.38%) reported by Aregheore et al. (1998) and Okoli et al. (2003) respectively. The variation might be due to stage of maturity and seasonal effect, since the content of tannin in plants varies directly with stage of maturity (Okoli et al., 2003). Phytate values of the experimental diets and VALM varied between 0.30 and 1.98%. The VALM had the highest value, which compare favourably with the value reported by Okoli et al, (2003).

Table 3 presents the summary of dry matter (DM), crude protein (CP) and antinutrients intake. The inclusion of VALM in the diets influenced the nutrients intake significantly ($P<0.05$), the low intake values of DM and CP by the animals fed diet E in this study might be the consequence of VALM's astringent taste (bitter taste) and the presence of secondary compounds such as saponin, alkaloid and tannin (Cook and Kyriazakis, 2001). However, the DM intake values varied significantly ($P<0.05$) from 266.35 (diet E) to 455.61g/day (diet C). The DM values expressed as percentage of the animal's bodyweight (2.85%) compare favourably with the recommended value of ARC (1985).

The values of tannin intake were similar ($P>0.05$), varied between 2.19 (diet A) and 2.79g/day (diet E) and the observed values increased with the inclusion levels of VALM. Although, the values were low compare with beneficial value of 35g/day of condensed tannin recommended by Athanasiadou et al, (2005) when sole bioactive forage was fed to sheep.The dietary treatment effects on phytate and oxalate intake were statistically similar ($P>0.05$), but the values increased numerically with inclusion of VALM in the diets.

Saponin and alkaloid intake values were influenced significantly ($P<0.05$) with increasing inclusion levels of VALM in the diets. The main apparent digestibility of DM, CP and antinutrients were influenced significantly ($P<0.05$) with inclusion of VALM (Table 4) however, the digestion coefficient values of DM and CP varied from 55.70 (diet E) to 77.99% (diet C) and between 76.66 (diet E) and 95.10% (diet C) respectively. The favourable digestibility of DM and CP might be due to laxative, antihelmithic potentials (John 1994), beneficial effect of tannin (Athanasiadou *et al.,* 2005) and protein quality of VALM supplementation in the diets.

However, the digestion value of CP recorded for animals fed diet E is low compare with the values of other diets. This observed value might be the effect of increased faecal nitrogen output as observed by Komolong et al, (1999) when weaner sheep were fed basal diet of lucerne hay and dosed with quebracho tannin.

tannin and alkaloid except phytate and oxalate increased from diet A to diet E with inclusion levels of VALM in the diets. While digestibility values reported in this study for phytate and oxalate decreased with the inclusion of VALM in the diets. The observation in this study might be associated with effective metabolism of these secondary compounds by the ruminal microorganisms as claimed by Norton (1994a). The treatment effect on average nitrogen retention,weight gain and feed/gain ratio values were significant (P<0.05).

Table 1. Percentage composition of diets fed to WAD Ewes

Ingredients	Diets (%)				
	A	B	C	D	E
Cassava Starch residue	34.00	34.00	34.00	34.00	34.00
Brewers dried grains	40.00	30.00	20.00	10.00	0.00
VALM	0.00	10.00	20.00	30.00	40.00
Palm Kernel cake	25.00	25.00	25.00	25.00	25.00
Bone meal	0.52	0.52	0.52	0.52	0.52
Salt	0.24	0.24	0.24	0.24	0.24
Premix	0.24	0.24	0.24	0.24	0.24
Total	100.00	100.00	100.00	100.00	100.00

VALM = Vernonia amygdalina leaf meal

Table 2. Proximate composition and antinutrients (%) of VALM and diets fed to WAD ewes

Ingredients	Diets (%)					*VALM
	A	B	C	D	E	
Dry Matter	73.64	75.39	72.33	72.09	73.40	86.88
Crude Protein	14.00	15.00	14.90	16.30	15.50	22.10
Crude Fibre	18.67	16.76	15.56	17.18	17.02	14.65
Ether Extract	7.63	13.60	6.11	10.30	11.75	4.50
Ash	6.11	7.50	8.50	5.95	7.19	7.56
Nitrogen Free Extract	53.59	47.14	54.93	49.84	48.54	51.19
Phytase	0.30	0.36	0.37	0.38	0.48	1.98
Oxalate	0.07	0.08	0.09	0.11	0.15	1.25
Saponin	0.02	0.05	0.06	0.07	0.26	4.60
Tannin	0.51	0.56	0.63	0.69	1.05	2.59
Alkaloid	0.11	0.16	0.19	0.25	0.27	0.91

VALM = Vernonia amygdalina leaf meal

Table 3. Dry matter, protein and antinutrients intake (g/day) of WAD ewes fed VALM diet

Nutrients	Diets (%)					
	A	B	C	D	E	SEM
Dry Matter	421.59^{a}	421.01^{a}	455.61^{a}	372.70^{a}	266.35^{b}	21.02
Crude Protein	59.02^{a}	63.15^{a}	67.89^{a}	60.75^{a}	41.28^{b}	2.98
Phytase	1.29	1.51	1.70	1.41	1.28	0.66
Oxalate	0.30	0.35	0.40	0.41	0.40	0.02
Saponin	0.09^{d}	0.22^{c}	0.29^{b}	$0.25b^{c}$	0.69^{a}	0.05
Tannin	2.19	2.56	2.86	2.58	2.79	0.11
Alkaloid	0.47^{b}	0.65^{ab}	0.85^{a}	0.88^{a}	0.73^{a}	0.05

abcd = Means within the same row within different superscripts are significantly (P<0.05) different.

The apparent digestibility of antinutriets was influenced significantly (P<0.05), the values recorded for saponin,

The feed/gain ration values compared favourably with the values reported by Budima and Djamal (1994) when elephant grass was supplemented with glricidia and leucaena in separate diets fed to sheep and goats. However, the poor response of animals fed diet E might be the consequence of astringency, inhibiting and interactive effect between protein and secondary metabolites of VALM (Aganga and Tshwenyane, 2003 and Silanikove et al., 1999) which resulted into depressed appetite, digestion, poor nitrogen utilization and weight gain.

Table 4: Summary of digestibility coefficient (%) and nitrogen utilization (g/day) of WAD ewes fed VALM diets

Nutrients	Diets (%)					
	A	B	C	D	E	SEM
Digestibility coefficient						
Dry Matter	63.00^{c}	73.83^{b}	77.99^{a}	66.67^{c}	55.76^{d}	2.12
Crude Protein	88.86^{b}	94.92^{a}	95.10^{a}	84.52^{c}	76.66^{d}	1.86
Phytase	90.98b^{c}	92.15^{b}	94.12^{a}	91.28^{b}	89.30^{c}	0.47
Oxalate	64.26^{b}	80.54^{a}	78.28^{a}	75.05^{a}	70.87^{ab}	1.96
Saponin	27.20^{d}	53.09^{c}	70.17^{b}	69.43^{b}	85.57^{a}	5.51
Tannin	44.50^{c}	63.36^{b}	69.53^{ab}	70.36^{ab}	80.30^{a}	3.45
Alkaloid	71.08^{b}	81.63^{a}	86.17^{a}	84.45^{a}	86.69^{a}	1.72
Nitrogen Utilization						
Nitrogen retention	7.88^{ab}	9.04^{ab}	9.70^{a}	7.37^{b}	4.07^{c}	0.57
Weight gain (g/day)	66.07^{a}	77.02^{a}	69.41^{a}	41.31^{b}	28.16^{b}	5.68
Feed/gain ratio	6.79^{b}	5.38^{b}	6.65^{b}	9.89^{a}	10.98^{a}	

abcd = Means within the same row within different superscripts are

CONCLUSION

Results of this study indicate that *Vernonia amygdalina* leaf meal (VALM) has good nutrient profile to serve as source of protein for growing ewes. Substituting VALM for brewers' dried grains at 25% and 50% (w/w) could support growth performance but sole *Vernonia amygdalina* leaves feeding to small ruminants needs further investigation.

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