NUTRIENT DIGESTIBILITY AND NITROGEN UTILIZATION OF WEST AFRICAN DWARF GOATS FED DIETS CONTAINING GRADED LEVELS OF *Rauvolfia vomitoria* LEAVES

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ABSTRACT
One of the recent strategies for improving the nutrient utilization in ruminants is using phytogenic additives to manipulate the ruminal microbial ecosystem for efficient feed conversion. This study investigated the potentials of Rauvolfia vomitoria leaves as feed additives for goats. Feed consisted of Megathyrsus maximus and concentrate combined in the ratio of 7:3 on dry matter (DM) basis. Dried milled leaves of R. vomitoria were added into the diet of West African Dwarf goats at 0, 1, 2, and 3% of feed DM to form four dietary treatments for 39d. Four WAD goats were used for digestibility studies in a 4x4 Latin square arrangement. Each animal was fed at 5% body weight (DM) with the concentrate diet offered first to the animals from 8:00am daily and the basal diet an hour after in separate feeding troughs. Data generated were subjected to one – way analysis of variance using SAS (2002). Result showed that the dry mater and crude protein digestibility of WAD goats recorded the highest ($p<0.05$) value of 83.28% and 86.79% at 1% inclusion while the least ($p<0.05$) value were observed at 0% inclusion level. Inclusion of 1% also showed the highest nitrogen utilization of WAD goats. It can therefore be concluded that 1% inclusion is recommended as it enhanced digestibility and nitrogen utilization.
Keywords: *In vivo,* Nutrient digestibility, Nitrogen utilization, Goats, *Rauvolfia vomitoria*.

INTRODUCTION
Feed is the most important element in animal production systems, irrespective of species (Makkar and Beever, 2013). However, feeds offered to ruminants are not efficiently utilized due to some nutritional losses attributed to microbial degradation processes in the rumen. Therefore, ruminant nutritionists are increasingly interested in ensuring that ruminant animals utilize feeds efficiently (Bialey, 2003). Although, antibiotics have been widely used in improving animal performance, there use in livestock feeds have been banned due to some associated risks (Chattopadhyaya, 2014). Medicinal plants such as herbs have been found as effective alternatives to antibiotics (Chaturvedi *et al.,* 2013). Being natural, non-toxic, easily available and residue-free makes them to be highly acceptable as natural feed additives. Herbs in the diets of animals have been observed to have significant impact on feed intake, meat quality and composition (Karami *et al*., 2010). This study therefore investigated the effect of *R. vomitoria* leaves on nutrient utilization in ruminant under *in vivo* condition.

MATERIALS AND METHODS
Experimental site
The experiment was conducted at the Small Ruminant Unit of the Teaching and Research Farm Directorate, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria. The site is in the derived savannah zone of the south-western part of Nigeria on latitude 13′ 49.46″N and longitude 25′ 11.98″E (Google Earth, 2024).
Collection and preparation of *Rauvolfia vomitoria*
Rauvolfia vomitoria leaves were harvested from Eguru village, Owode Egba in Ogun State. The leaves were identified at the Forestry Department of University of Ibadan, Oyo State. Harvested leaves were screened to remove foreign materials and air-dried till a constant weight was attained. Thereafter, the leaves were milled through 1 mm sieve, stored at room temperature in air-tight glass containers and kept away from sunlight for subsequent use as additive.
Experimental diets
The experimental diets consisted of *M. maximus* as the basal diet and concentrate as supplement in ratio of 7:3. *R. vomitoria* leaves were included in the concentrate diet at varying levels of 0, 1, 2 and 3% DM.
Experimental animals and digestibility studies
Four (4) West African Dwarf (WAD) goats with mean body weight of 9.5±1.4 kg were used for nutrient digestibility studies in a 4 × 4 latin square arrangement. The animals were housed in individual metabolic cages with provision for separation collection of faeces and urine. There were four treatments and four periods. The animals were allowed an adaptation period of 7 days which was proceeded by a collection period of 5 days, with a resting period of 3 days during which the animals were being fed with *M. maximus* between each of the four

periods. During the collection period, 10% aliquots of the total faeces and urine output per animal per treatment were measured daily. The faeces were later pooled together per animal and oven dried at 65°C to constant weight to determine the dry matter content. Dried faecal samples were milled, properly labelled and bulked for proximate and fibre fraction analysis to determine nutrients digestibility. Furthermore, urine samples collected daily per animal were stored in sample bottles rinsed with dilute sulphuric acid (H_2SO_4) and then stored in the refrigerator for subsequent analysis of nitrogen contents for estimation of nitrogen utilization.

Table 1: Chemical composition (% DM) of *M. maximus* and concentrate used as experimental diet

Parameters	*M. maximus*	Concentrate[1]
Dry matter[2]	36.00	86.60
Crude protein	8.92	21.23
Ether extract	9.23	13.55
Ash	12.12	7.05
Nitrogen free extract	49.58	49.25
Organic matter	87.88	92.95
Neutral detergent fibre	64.32	43.34
Acid detergent fibre	40.15	15.11
Acid detergent lignin	23.10	11.00
Hemicellulose	24.17	28.23
Cellulose	17.05	4.11
Metabolizable energy (MJ/kg DM)[3]	12.11	12.75

[1]Concentrate contained 44% wheat offal, 38% rice bran, 15% dried brewers′ grain, 2% bonemeal and 1% common salt; [2]As-received basis; [3]Calculated according to De Boever *et al.* (1999).

Nutrient digestibility calculations

The dry matter, crude protein, crude fibre, ether extract, ash and nitrogen free extract content in feeds and faeces samples collected were determined. Digestibility of each nutrient was calculated using the equation below:

$$Nutrient\ digestibility\ (\%) = \frac{Nutrient\ consumed - Nutrient\ voided}{Nutrient\ consumed} \times 100$$

Nutrient consumed was estimated from the quantity of feed consumed daily on dry matter basis by each animal multiplied by the individual nutrient composition of the feed.

Nitrogen utilization

Nitrogen absorbed, nitrogen retained and nitrogen balance percentage were used to evaluate the utilization of nitrogen in animals.

Nitrogen intake (g/d) = Feed intake DM x Nitrogen content in the feed

Faecal nitrogen (g/d) = Faecal DM x Nitrogen content in faeces

Total nitrogen voided (g/d) = Faecal nitrogen + Urinary nitrogen

Nitrogen absorbed (g/d) = Nitrogen intake – Faecal nitrogen

Nitrogen balance (g/d) = Nitrogen intake – Total nitrogen output

Chemical analysis: Oven-dried and milled samples of *M. maximus,* concentrate and feaces were analyzed for proximate composition using the method of A.O.A.C. (2000) while the fibre fractions were determined according to Van Soest *et al.* (1991).

Statistical analysis: Data generated in the study were subjected to one-way analysis of variance (SAS, 2002) software package. Significant differences were accepted at $P<0.05$ and means were compared using Duncan Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The apparent nutrient digestibility of West African dwarf goats in response to varying levels of *R. vomitoria* leaves is presented in Table 2. Dry matter, crude protein and fibre degradation were improved ($P < 0.05$) at 1% and 2% inclusion of *R. vomitoria* leaves in the diet of West African dwarf goats. The higher crude protein and neutral detergent fibre digestibility particularly in goats fed diets with 1% inclusion of *R. vomitoria* leaves implied better utilization of the nutrients. Values of dry matter digestibility obtained in this study 76.62 – 83.28% were higher than 69.60 – 74.12% while the crude protein digestibility values 71.79 – 86.97% slightly falls with the range of 71.70 – 85.12% obtained by Adelusi *et al.* (2016) with the use of diets containing *Azadirachta indica, Newbouldia laevis* and *Spondias mombin* leaves.

The nitrogen utilization in West African Dwarf goats fed experimental diets is presented in Table 3. The faecal nitrogen, total nitrogen output, nitrogen absorbed, nitrogen balance and nitrogen retention were significant ($P<0.05$) across the treatments. Animal groups fed diets containing 1% *R. vomitoria* leaves had lower faecal

nitrogen, total nitrogen output and better nitrogen absorption and retention compared to other treatments. The improved retention with additive inclusion in goat particularly at 1% infers that at higher inclusion levels the cumulative effect of secondary metabolite in *R. vomitoria* may have led to excessive microbial inhibition or protein binding thus reducing the digestibility and nitrogen utilization (Sliwinski *et al.,* 2002). Nitrogen utilization in the rumen depends on the quality and solubility of the diets, which might have been lost from the rumen as ammonia and later converted to urea before excreted as urine (Ahamefule and Udo, 2010). The higher positive N – balance observed indicated that the diets were well utilized and efficiently used as fermentable nitrogen sources for microbial growth in the rumen of the goats as noted by Osakwe *et al.* (2003). Nitrogen retention was best in goats on 1% *R. vomitoria* leaves. Nitrogen utilization in the rumen indicates excellent utilization efficiency in relation with Okeniyi *et al.* (2010) who reported that nitrogen retention is the proportion of nitrogen utilized by farm animals from the total nitrogen intake for body process. Dietary supplementation of tannin or saponin at a very low dose reduced nitrogen losses through ruminal ammonia which show tendency of higher nitrogen retention (Sliwinski *et al.,* 2002).

CONCLUSION AND RECOMMENDATION

It can be concluded that the inclusion of 1% *R. vomitoria* leaves resulted in improved apparent nutrient digestibility and nutrient utilization. *R. vomitoria* leaves at 1% could be recommended for use in WAD goat diet to achieve better digestibility and nitrogen utilization

Table 2: Apparent nutrient digestibility (%) of West African Dwarf goats fed experimental diets containing *R. vomitoria* leaves as additives

	Inclusion level (%) of *R. vomitoria*					
Parameters	**0**	**1**	**2**	**3**	**SEM**	**P-value**
Dry matter	73.62^{c}	83.28^{a}	78.90^{b}	78.07^{b}	0.722	0.002
Crude protein	71.79^{c}	86.79^{a}	85.79^{ab}	83.64^{b}	0.813	0.000
Ether extract	84.95	86.64	80.67	84.09	0.532	0.080
Ash	65.89^{c}	71.79^{a}	68.35^{b}	70.71^{b}	1.011	0.045
Neutral Detergent Fibre	70.15^{c}	82.89^{a}	78.40^{b}	78.19^{b}	0.651	0.007
Acid Detergent Fibre	63.81^{b}	67.33^{a}	66.04^{a}	64.79^{ab}	0.452	0.039
Acid Detergent Lignin	52.05^{b}	55.58^{a}	53.27^{ab}	53.02^{b}	0.217	0.024

^{abc}Means on the same row having different superscripts are significantly different (P < 0.05)
SEM: Standard error of means

Table 3: Nitrogen utilization of West African Dwarf goats fed diets containing *Rauvolfia vomitoria* leaves as additives (g/day)

	Inclusion levels (%) of *R. vomitoria*					
Parameters	**0**	**1**	**2**	**3**	**SEM**	**P-valu**
Total Nitrogen intake	5.78	6.18	6.17	6.30	0.083	0.131
Faecal Nitrogen	1.00^{a}	0.70^{c}	0.74^{bc}	0.87^{b}	0.027	0.000
Urinary Nitrogen	1.70	1.45	1.53	1.63	0.037	0.102
Total nitrogen output	2.70^{a}	2.15^{c}	2.27^{bc}	2.50^{b}	0.048	0.030
Nitrogen absorption	4.78^{b}	5.48^{a}	5.43^{a}	5.43^{a}	0.085	0.010
Nitrogen balance	3.08^{b}	4.03^{a}	3.90^{a}	3.80^{a}	0.096	0.040
Nitrogen retention (%)	53.29^{c}	65.21^{a}	63.20^{b}	60.32^{b}	0.964	0.011

^{abc}Means on the same row having different superscripts are significantly different (P < 0.05)
SEM: Standard error of means

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