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DIGESTIBILITY AND NITROGEN UTILIZATION OF SEMI INTENSIVELY MANAGED WEST AFRICAN DWARF SHEEP FED NEEM LEAF MEAL CONCENTRATE

***ADELUSI, F.T.,[1] ENIOLA, O.,[1] ADEDOKUN, S.A.[2] AND OLUNLOYO, A.A.[3]**
[1]Department of Agricultural Extension and Management, Federal College of Forestry, Forestry Research Institute of Nigeria, Ibadan
[2]Department of Basic Science and General Studies, Federal College of Forestry, Forestry Research Institute of Nigeria, Ibadan
[3]Department of Agricultural Technology, Federal College of Forestry, Forestry Research Institute of Nigeria, Ibadan.
*Corresponding author: temmytdoks@gmail.com

Abstract
Ruminant livestock production in sub-Saharan Africa is based on forage as the major feed resources, which of course is highly seasonal with low nutritive quality during dry seasons. Neem leaf (Azadirachta indica) when added to livestock feed has been found to reduce the problem of feed scarcity which are serious problems of the developing world. A 90-day study was conducted to determine the response of semi intensively managed West African dwarf sheep grazing natural pastures to concentrate supplement containing varying levels of neem leaf meal (NLM). Twenty (20) West African Dwarf sheep aged 5 to 6 months with an average weight of 10kg were used in a Complete Randomized Design with animals grouped into four treatments of five replicates each balanced for weight. The animals were allowed to graze on natural pastures predominantly made up of Panicum maximum in the morning and returned to their individual feeding pens after grazing for 5 hours with a daily supplementation of 100g concentrate diet containing varying levels of neem leaf meal at 0, 5, 10 and 15%. Data collected include nutrient digestibility and nitrogen utilization. Results showed that dry matter digestibility decreased (P < 0.05) with increased inclusion of NLM in the diets. Nitrogen balance was significantly (P < 0.05) better in animals supplemented with NLM with sheep on 5% NLM having the best. This study, however, concluded that Neem leaf inclusion at 5% in West African dwarf sheep's diet had effects on the overall performance of the animals with a potential improvement in nutrient digestibility and nitrogen utilization.

Key Words: *Neem leaf, West African Dwarf Sheep, Nutrient digestibility, Nitrogen utilization*

Introduction

Small ruminants have the ability to convert poor quality foodstuffs, such as grasses, legumes, forages, farm wastes and crop residues that are unsuitable for human body tissue (Fajemisin *et al*., 2010). *P. maximum* commonly called guinea grass, colonial grass and tangayika grass

(FAO, 1989) is a highly productive, palatable, persistent and acceptable grass. It can be fed to livestock solely or with concentrates or legumes. It has been fed to ruminants to yield increased growth rates (Arigbede *et al*., 2005). Ruminant livestock production in sub-Saharan Africa is based on forage as the major feed resources, which of course is highly seasonal with low nutritive quality during dry seasons. Multipurpose trees (MPTs) which are part of the natural vegetation and are accessible to farmers have always been useful protein supplements (Osakwe *et al.,* 2000).

Neem (*A. indica*) is an evergreen tree native to India and predominant in Nigeria. Neem cake has been widely used as animal feed (Bawa *et al*., 2006; Uko and Kamalu, 2007). Kukde *et al*., (1999) recorded an increase in total feed intake when Neem leaves were fed to calves. Digestibility is estimates as the difference between the amount of feed ingested and excreted. Digestibility is one of the major factors which influence animal performance. It is usually positively related to the concentration of nutrients in the forage and to intake. This is because the higher the quantity of nutrients in the feed, the more easily it could be digested. Digestibility of a feed determines the amount that is actually absorbed by an animal and therefore the availability of nutrients for growth,

Improvement in feed intake, digestibility of nutrients and weight gain were reported when concentrate supplements were fed to WAD sheep (Taiwo *et al.*, 1995); Yankasa sheep (Alokan 1998; Fasae *et al.*, 2005); WAD goats (Adejumo, 1998; Arigbede *et al.*, 2005) and lactating does (Abubakar *et al.*, 1998). This study was undertaken to determine the nutrient digestibility and nitrogen utilization of semi-intensively managed West African dwarf sheep fed *A. indica*

Materials and Method

Study Area

The study was carried out in the Sheep unit of Federal College of Forestry, Forestry Research Institute of Nigeria (FRIN), Jericho hill, Ibadan, Oyo State. It is located on the latitude 07°23′32″ N and longitude 03°51′44″ E with altitude 212 m above sea level. The rainfall pattern is bimodal with peaks around June to July, and September to October. The mean annual rainfall is about 420 mm in 109 days with mean maximum and minimum temperature of about 34°C and 24°C respectively. Mean relative humidity ranges from about 82% between June and September to approximately 60% between December and February (FRIN, 2014)

Experimental Management of the Animal

Twenty (20) growing West African Dwarf (WAD) sheep aged 5-6 months with average weight of 10kg were used for this study. The animals were quarantined for a period of 30 days. The experimental pens were disinfected with diazintol solution before the arrival of the animals. For the period of the experiment, the sheep were managed in a semi intensive management system. They were allowed to graze on natural pastures with predominantly *Panicum maximum* in the morning from 8am and returned to their individual feeding pens after grazing for five hours. The animals were supplemented daily with 100g concentrate experimental diet composed of maize, wheat offals, palm kernel cake, soyabean meal, bone meal with salt and premix, Neem leaf was added at varying levels

(Table 1). Fresh, clean water was given to the animals *ad libitum*.

Experimental Diet Preparation

Fresh Neem leaves samples were obtained from Neem trees in and around the Forestry Reasearch Institute of Nigeria, Ibadan. The leaves were chopped for effective drying. The chopped leaves were sun dried for 3-4 days until they were crispy. The dry leaves were milled using a hammer mill to produce leaf meal before they were incorporated into the concentrate supplement at 0g, 5g, 10g, 15g Neem leaf/ 100g concentrate/animal/day respectively and fed to the animals before going out for grazing for a period of 90 days. The animals were grouped into four treatments of five replicates each balanced for weight namely;

Treatment 1: 0g of Neem leaf /100g concentrate/animal/day

Treatment 2: 5g of Neem leaf/100g concentrate/animal/day

Treatment 3: 10g of Neem leaf/100g concentrate/animal/day

Treatment 4: 15g of Neem leaf/100g concentrate/animal/day

Table 1: Composition of the Experimental Diets fed to sheep

Ingredients (%)	Diets			
	0%NLM	5%NLM	10%NLM	15%NLM
Neem leaf meal	0	5	10	15
Maize	24	24	24	24
Palm kernel cake	20	15	10	5
Soyabean Meal	14	14	14	14
Wheat offals	38	38	38	38
Bone meal	2.5	2.5	2.5	2.5
Salt	1	1	1	1
Premix	0.5	0.5	0.5	0.5
Total	100	100	100	100

Dietary Treatment

Each animal was assigned to one experimental diet and fed once daily in the morning. Each animal was supplied 4 litres of water daily. The animals were fed the different experimental feedstuffs for fourteen (14) days. There was seven (7) days period of acclimatization during which their intake was estimated and then adopted during the subsequent seven (7) days of digestibility study.

Data Collection

At the end of the growth trial, the animals were transferred into individual metabolic cages for the digestibility trial; they were allowed to adjust for 7 days to feed and metabolic cages before data collection. Animals were fed *Panicum maximum* at 4% of their bodyweight and 100 g concentrate containing varying levels of Neem leaf at 0 g, 5 g, 10 g and15 g respectively. The animals were fed for 7 days before the collection of faeces and urine for the last 7 days. Also, the faeces were weighed to get the faecal voided. Urine samples were collected each day and 2-3 ml of Sulphuric acid (H_2SO_4) was added to the urine for the preservation of its nitrogen content.

Chemical Analysis

The dried faecal samples and the urine were taken to the laboratory. The proximate composition of the experimental diet and faeces were determined. The composite samples were weighed for fresh faecal weight and then

dried at 60ºC for 48 hours. The dried samples were grinded and allowed to pass through a 1mm screen and then analysed for dry matter, ether extract, ash, crude protein content (AOAC, 1995), and neutral detergent fibre, acid detergent fibre and acid detergent lignin (Van Soest *et al.,* 1991). The urinary nitrogen was also analyzed.

Statistical Analysis

All data collected were subjected to one way analysis of variance in a completely randomized design according to SAS (1999) and means were separated using the Duncan Multiple Range Test (Duncan, 1955).

Result

Table 2 presents the proximate components of the experimental feedstuffs. Table 3 shows the proximate and chemical constituent of the experimental diets. Neem leaf meal (NLM) contained 89.64% dry matter (DM), 19.37% crude protein (CP), 40.32% Neutral detergent fibre (NDF), 28.22% Acid detergent fibre (ADF), 5.21% Acid detergent lignin (ADL), 6.82% of ash and 5.32% ether extract (EE). The experimental diets contained 87.12%, 88.20%, 88.35% and 88.52% dry matter for treatments 1 to 4, respectively. Crude protein contents were 17.57% in 0%NLM, 18.18% in 5%NLM, 18.36% in 10%NLM and 18.59% in 15%NLM. Ether extract and crude fibre contents increased with increasing amounts of NLM.

Table 2: Proximate and Chemical Constituents (%DM) of Experimental Diets fed to WAD sheep

Parameters	0%NLM	5%NLM	10%NLM	15% NLM	NLM	*Panicum maximum*
Dry matter	87.12	88.2	88.35	88.52	89.64	29.24
Crude protein	17.57	18.18	18.36	18.59	19.37	8.45
Neutral Detergent Fibre	35.12	36.24	36.48	37.35	40.32	63.21
Acid Detergent Fibre	27.11	28.45	29.55	30.16	28.33	45.01
Acid Detergent Lignin	6.86	7.01	7.56	7.72	5.21	3.25
Ash	8.47	8.55	8.75	8.9	6.82	7.34
Ether extract	15.84	16.52	16.57	16.83	5.32	5.77

NLM- Neem leaf meal

The apparent digestibility of the various dietary combinations is shown in Table 3. Results showed that there was significance difference ($P<0.05$) in digestibility values among the treatments. The crude protein digestibility of 0% NLM was significantly different ($P<0.05$) from the other 3 dietary groups. Diets with 5% NLM had the highest crude protein digestibility. There was no significance difference ($P>0.05$) in the dry matter digestibility of 5% NLM and 10% NLM. 5% NLM had the highest dry matter digestibility of 62.59% while 0% NLM had the lowest dry matter digestibility of 54.90%. There was no significant difference between the ADF digestibility of 5% NLM and 10% NLM while the ADL digestibility was significantly similar ($P>0.05$) across the NLM supplemented diets.

Table 3: Apparent digestibility (%) of concentrate supplement containing varying levels of Neem leaf meal fed to WAD sheep

PARAMETERS	0%NLM	5%NLM	10%NLM	15%NLM	±SEM
Dry Matter	54.90[b]	62.59[a]	60.11[a]	59.15[b]	7.53
Crude Protein	56.57[b]	68.79[a]	67.74[a]	67.52[a]	9.17
Neutral Detergent Fibre	58.86[b]	63.22[a]	62.34[a]	60.45[ab]	7.13
Acid Detergent Fibre	40.25[b]	43.44[a]	45.13[a]	41.23[a]	6.25
Acid Detergent Lignin	56.40[b]	57.21[a]	58.86[a]	59.87[a]	7.32
Ash	41.63[b]	47.70[a]	48.10[a]	45.02[b]	13.14
Ether Extract	54.08[b]	59.04[a]	62.01[a]	57.02[b]	10.61

[a, b] Means value followed by the same superscripts in the same row are not significantly different (P≤0.05)
NLM- Neem leaf meal

Table 4 shows the mean values of the nitrogen utilization of WAD sheep fed varying levels of Neem leaf meal. There were significant difference (P<0.05) observed in all the parameters. Nitrogen intake was significantly similar (P>0.05) among the animals fed NLM supplemented diets, this intake values were higher (P>0.05) than for the control animals. Faecal nitrogen differ significantly (P<0.05) among the diets. The faecal nitrogen, 0% NLM (1.78g/day) and 10% NLM (1.75g/day) were significantly similar (P>0.05) but differ significantly (P<0.05) from 5% NLM (1.56g/day) and 15% NLM (1.65g/day). The treatment effects on nitrogen balance were significant (P<0.05). Nitrogen balance values for WAD sheep on 5% NLM (3.49g/day), 10% NLM (3.20g/day) and 15% NLM (3.42g/day) were significantly higher than the mean values for sheep on control (2.18g/day). The sheep fed inclusion level of neem leaf possessed nitrogen balance required for body growth and maintenance with animals on 5%NLM having the highest value (3.49g/day) followed by those on diet 4 (3.42g/day) and diet 1 having the least value (2.18g/day).

Table 4: Nitrogen Utilization of West African Dwarf Sheep fed concentrate containing Varying inclusion levels of Neem leaf meal

Parameters	0%NLM	5%NLM	10%NLM	15%NLM	±SEM
Nitrogen intake (g/day)	4.50[b]	5.50[a]	5.57[a]	5.65[a]	0.12
Faecal Nitrogen (g/day)	1.78[a]	1.56[c]	1.75[a]	1.65[b]	0.08
Urinary Nitrogen (g/day)	0.54[ab]	0.45[b]	0.62[a]	0.58[ab]	0.02
Total Nitrogen Excreted (g/day)	2.32[a]	2.01[b]	2.37[a]	2.23[a]	0.11
Nitrogen Balance (g/day)	2.18[b]	3.49[a]	3.20[a]	3.42[a]	0.86
Nitrogen Retention (%)	48.44[c]	63.46[a]	57.45[b]	60.53[a]	3.98

[a,b,c] Mean values followed by the same superscripts in the same row are not significantly different (P>0.05)
NLM- Neem leaf meal

Discussion

The NLM concentrate diet used in this study could be considered as ruminant diet. Preston (1986) suggested that for any feedstuff or ration to be considered as ruminant feed, it should have a dry matter digestibility coefficient of 40-50%. The CP digestibility values obtained in the

present study contradicts the finding of Adewumi and Ajayi (2010) that reported a range value of 28.50 and 32.50% for WAD Sheep fed full fat neem fruit and corn bran, however, the values obtained were similar to the findings of Okah *et al.,* (2012) that reported a higher crude protein digestibility value of 56.27 to 68.05% in WAD sheep fed graded levels of pigeon pea seed meal.

The fibre digestibility observed in this study is lower than the range of 57.33 to 70.11% reported for WAD sheep fed pigeon pea seed meal Okah *et al.,* (2012). This agreed with previous reports (Olaleru and Adegbola, 2001; Fasae *et al*. 2005), that crude fibre digestibility and crude protein digestibility decreased with decreasing level of CP in diets. The information on fibre contents of a diet is essential for the assessment on their digestibility (Njidda and Ikhimioya, 2010). The comparatively high nutrient digestibility of animals on NLM supplemented diets associated with the gradual solubility of the diets, thereby making nitrogen available over a long period of time which enhances microbial activity. Similar observation has been reported (Silva and Orskor, 1984) that it is possible to improve the digestibility of feed by either treatment or supplementation.

Digestion of feed in ruminant animals is highly influenced by the level of protein and fibre in the diet. The result of this study agrees with other reports that increased level of protein in ruminant diets improved the digestibility of such diets (Peyraud and Astigarraga, 1998). Among the diets, 5% NLM had the highest digestibility, lower digestibility values of 10% NLM and 15% NLM may be due to increasing levels of neem leaf meal leading to higher fibre and ether extract content of the treatment diets and this could have inhibited digestibility (Baiden *et al.,* 2007) This is because the rate of microbial colonization of a feed with high fibre content is lower compared to another with lower fibre content.

The addition of neem leaf meal in the sheep diets improved nitrogen intake in 5% NLM, 10% NLM and 15% NLM than the control (0% NLM). This observation agrees with the findings of Black *et al.,* (1973), who reported that faecal nitrogen was not affected by nitrogen intake and also consistent with the study of Ahamefule (2005). The significant increase observed in Neem leaf meal supplemented treatments suggests that the higher Nitrogen intake improved Nitrogen balance of the animals on neem leaf diets. This is comparable with the work of Okah *et al.,* (2012) that recorded higher nitrogen balance value in the treatment diets compared to the control diet when graded levels of Pigeon pea Seed meal were fed to WAD sheep. Moreover, the nitrogen retention in neem leaf supplemented treatments were higher than in the control treatment (48.44%). This is comparable to the work of Oduguwa *et al.,* (2006) that recorded higher nitrogen retention value in the treatment diets compared to the control diet when WAD sheep were fed with graded levels of soybean stovers and malted sorghum sprouts.

The nitrogen balance for all the values falls within the range of some literature values (1.36-5.35 g/animal/day) reported by some researchers (Asaolu *et al.,* 2009; Adegun *et al.,* 2011). This could have been related to the higher nitrogen intake observed in this study. The nitrogen balance observed in all the animals suggested that nitrogen absorbed was well tolerated and utilised by the animals.

Conclusion

Animals on dietary inclusion of 5% NLM showed higher digestibility values for dry matter, crude protein, neutral detergent fibre and ether extract than other diets. Sheep fed diets containing NLM showed higher nitrogen balance and nitrogen retention values compared to the control. However, animals fed 5% NLM utilized their nitrogen better than animals on other diets.

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