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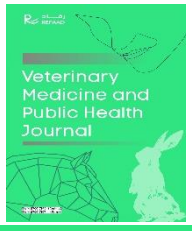

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DOI: https://doi.org/10.31559/vmph2022.3.2.3 **Received Date:**6/8/2022 **Revised Date:** 1/9/2022 **Accepted Date:**11/9/2022

Abstract: The study evaluated the nutrient intake and digestibility of red sokoto goats fed different forms of neem (Azadirachta indica) leaves and a concentrate diet. The experiment was carried out at the small ruminant's unit of the Teaching and Research Farm, Federal University of Kashere. Gombe state, Nigeria. Sixteen red sokoto goats (bucks) aged between 7 to 9 months, with weight range of 6.8 to 7.2 kg were allotted into four (4) treatments of four goats each. The goats were fed fresh neem leaves, neem leaves hay, neem leaves meal and neem leaves silage at 300g/goat/day for treatments 1, 2, 3 and 4 respectively; and concentrate diet at 125g/goat/day for a duration of sixty-three (63) days. Water was served ad-libitum. The goats were housed individually in pens the nutrient intake was calculated from the proximate composition of the diets and the neem leaves as well as the feed intake records. In the last 2 weeks of the experiment, the goats were fitted with harnesses forfeacal collection, a seven-day adjustment period was allowed for the goats to get used to the harnesses, feacal collection lasted for 7 days, the collected feaces were prepared appropriately and then analyzed for their proximate composition, using the method of AOAC, (2000), and thereafter used to calculate the dry matter and nutrient digestibility. The experimental design was a completely randomized design; data were analyzed using a one-way analysis of variance. The significant means were separated by Least Significant Difference using SAS 9.4, 2018 version statistical package. The concentrate and the neem leaves were analyzed for their proximate composition using the method of AOAC 2000. Values for nutrient intake were all not significantly ($P>0.05$) different except dry matter intake (46.18 – 51.45g/day/W 0.75).The digestibility values were not significantly ($P<0.05$) different except that of nitrogen free extracts (61.93 – 66. 79). Conclusively, fresh Neem leaves (T1) was the most preferred by the goats in terms of intake, it also had the best array of nutrients. The fresh neem leaves (T1) evaluated was recommended for feeding goats especially during the long dry season. Further research should be carried out using other species of ruminants such as sheep and cattle.

Keywords: *Digestibility; NutrientIntake; RedSokotoGoats; NeemLeaves; FeedIntake.*

1. Introduction

Goats can survive in large numbers under extensive, underdeveloped, semi-arid, overgrazed, denuded sites and particularly on mountain slopes (Nuru,1985). These goats can, however, be improved through adequate management.

Good nutrition is a prerequisite for good health, good reproduction, high milk yield, fast growth rate and a successful goat production system (Peacock, 1996).

The problem of scarcity of feeds and high cost of feeds especially during the long dry season calls for the use of leaves from trees that retain their leaves during the long dry season (Ocheja *et al*, 2018).

One of such leaves that can be used is leaves from Neem (*Azadirachta indica)* tree.Neem leaves as supplement to basal diets of crop residues have been shown to improve feed utilisation and animal performance in ruminants (Raghuvansi *et al.,* 2017). Neem leaves are high in crude protein. There are, however, wide variations in the reported values. Crude protein concentrations of between 17.5% and 18.7% have been reported (Bhowmik *et al.,* 2010). Neem leaves are reported to be deficient in copper, manganese (Niranjan *et al.,* 2008), zinc and phosphorus (Rao *et al.,* 2011). Levels of minerals, especially trace minerals, are expected to vary widely due to differences in the mineral content of the soil in which the trees grow.

According to Norton (1994) the nutritive value of a feed is measured by its ability to deliver nutrients to an animal for maintenance and growth in absence of toxic factors. It is a function of feed digestibility and voluntary feed consumption. NRC (1996) reported the critical protein requirement for goats to be 8 %. Preston (1986) reported that for any feed stuff to be considered a ruminant feed it should have a dry matter digestibility coefficient of 40 – 50 %.

Digestibility is an important measure of the nutritive value of food stuffs and is defined as the difference in value between the food eaten and materials voided out by the animals in form of feaces expressed as percentage of food eaten (Javier,1995). *In-vivo* Method that involve feeding experiments with animals and indirect laboratory estimation methods (*in vitro* nylon bag techniques) have been developed to measure digestibility of feeds (Javier, 1995). Factors that affect digestibility are feed composition, ration composition, preparation of feed, animal factor, level of feeding etc. It is therefore necessary to evaluate the nutrient and digestibility potentials of feed materials for ruminant.

It is important to use leaves from trees to feed goats during the long dry season, due to unavailability of grasses.Neem leaves are readily and abundantly available within the study area and the use of neem leaves as feedstuff will help in reducing the problem of feed shortage during the long dry season in Nigeria.

This study was therefore designed to determine the nutrient intake, dry matter and nutrient digestibility of red Sokoto goats fed different forms of neem leaves and a concentrate diet.

2. Materials and Methods

2.1. Experimental site

The study was conducted at the Teaching and Research Farm, Faculty of Agriculture, Federal University of Kashere in Gombe State, Nigeria. The state is situated within latitude 9°54'46N and longitude 9° 46°'27E and 10°57° E and altitude of 349m above sea level. The annual rainfall of Kashere ranges between 800mm-900mm per annum and is characterized by distinct dry season (October-May) and rainy season (June-September). The annual mean temperature ranges from 30-32^0 C(National Geospatial Intelligence Agency, 2012).

2.2. Experimental Animals, Management, Feed preparation and Experimental procedure

Sixteen (16) red sokoto goats aged between 7-9 months with a weight range of 6.8 to 7.2kg were sourced from within Kashere and its environs and randomly allocated into four (4) treatments of four (4) goats each. The animals were treated with Ivomec for endo and ecto parasites control at 0.3ml each and oxytetracycline, hydrochloride and procaine penicillin at 2.0ml each to take care of scouring and nasal discharge and to provide a common health status. The Neem (*Azadirachta indica)* leaves used for this experiment were collected from within the Federal University of Kashere Campus. The concentrate diet consisted of bambara nut offal (BNO), beans offal meal (BOM), cassava peel meal (CPM), yam peel meal (YPM), maize offal (MO), full fat soya bean (FFSB), egg shell meal (ESM), and wood ash (Ash). These components were thoroughly mixed after pounding and grinding as the case may be.

Each treatment had (4) goats, each goat was fed 125g of the concentrate per day, and the Neem leaves at 300g per Goat per day of which the Neem leaves were fed first, then the concentrate one hour later, the Goats were served water *Ad-libitum.*

Treatment one (T_1) was fresh neem leaves; treatment two (T_2) was neem leaves hay; (the leaves were air dried) treatment three (T_3) was neem leaf meal (the leaves were air dried and later crushed) and Treatment four (T_4) was neem leaves silage. (the leaves were put in air tight polythene bags and allowed to ferment for 3days).

The concentrate offered the goats were weighed daily and the left over was also weighed and subtracted from the quantity of feed that was served to determine the feed intake of the animasl. The experiment lasted for sixty-three (63) days.

The nutrient intake was calculated from the proximate composition of the concentrate diets

andthe neem leaves as well as the feed intake records.(Ocheja, 2020)

In the last 2 weeks of the experiment, the goats were fitted with harnesses for feacal collection, a seven day adjustment period was allowed for the goats to get used to the harnesses, feacal collection lasted for 7 days, the collected feaces were prepared appropriately and then analysed for their proximate composition, using the method of AOAC, (2000), and thereafter used to calculate the dry matter and nutrient digestibility from the formula.

$$\text{Nutrient Digestibility (\%)} = \frac{\text{Nutrient Consumed} - \text{Nutrient output}}{\text{Nutrient in Feed}} \times 100$$

Table (1): Composition of Experimental Diet

Feed ingredients	Value (%)
Bambara nut offal	15.00
Beans offal meal	1.50
Cassava offal meal	4.50
Sweet potato peel meal	3.00
Maize offal	56.00
Yam peel meal	10.25
Full fat soya bean meal	5.00
Egg shell meal	1.00
Wood Ash	0
Table salt	.75
Total	**2.00**
Calculated nutrient content:	
Crude protein	16.15
Crude fibre	11.30
Metabolizable energy (Kcal/kg diet)	2.700

2.3. Chemical Analysis

Samples of the Neem leaves and the concentrate diet were analyzed for their proximate composition using the method outlined by AOAC (2000).

2.4. Experimental Design and Statistical Analysis

The experimental Design was Completely Randomized Design(CRD). Data obtained were analysed using a one-way Analysis of variance (ANOVA), means with significant differences were separated using Least Significant Differences (LSD) contained in SAS, 9.4 statistical package, 2018 edition.

3. Results and Discussion

3.1. Proximate Composition of Neem (*Azadirachta indica*) Leaves and Concentrate Diet

The proximate composition of neem leaves and concentrate diet is summarized in Table 2.

The protein content of 6.4-9.19% for the neem leaves were lower than 18.10% reported by Obikanu (2020) the values were also lower than the values of 12-18% recommended for growing ruminants in the tropics (NRC 1996). However, the supplement is expected to take care of this deficiency while the protein content of the concentrate diet (16.80%) was within the values of 12.18% recommended by NRC (1996). The crude fibre content of 9.5% for the supplement diet and 18.00% to 23.80% for the neem leaves were adequate for the goats (Lakpini et al., 2002). The crude fibre values for the neem leaves were higher than 11.3 % and 15.56 % reported by Bhowmik et al (2008) and Obikanu 2012). The ether extract values of 3.00% - 4.80 % were lower than 7.33 % obtained by Fasae et al. (2018), the values were within recommended values for ruminants while that of the concentrate diet (5.58%)was at par with the upper limits values of 5-6% which if exceeded may lower appetite and fibre digestion (Maithisonet al., 1997).

Table (2): Proximate Composition and Fibre Fractions of Neem Leaves and Concentrate Diet

Nutrient	Treatments				
	T1	T2	T3	T4	Conc
Crude protein	9.19	8.55	6.44	7.88	16.80
Crude fiber	18.50	19.30	18.00	23.80	9.50
Ash	11.50	11.80	8.00	14.50	3.15
Ether extract	3.60	3.70	3.00	4.80	5.85
Moisture	34.00	15.00	40.50	10.00	5.05
Dry matter	64.00	85.00	59.50	90.00	94.95
NF	23.20	41.65	22.76	41.02	60.65
Neutral Detergent Fibre	54.00	55.00	54.55	52.35	60.00
Acid Detergent Fibre	37.40	36.30	37.00	40.15	34.50
Acid Detergent Lignin	8.60	8.70	8.45	7.50	5.50
Ceellulose	28.80	27.60	28.55	32.65	29.00
Hemicellulose	16.60	18.70	16.45	12.20	25.50

Conc.=Concentrate, NFE=Nitrogen Free Extract

3.2. Nutrient Intake (g/day/W0.75 DM) of Red Sokoto Goats fed Different Forms of Neem Leaves and a Concentrate Diet

The nutrient intake of red Sokoto goats fed different forms of neem leaves and a concentrate diet is summarized below. All the nutrient intake parameters determined were all not significant (P<0.05) except dry matter intake. The dry matter intake of 46.18 – 51.45 g/day/ $W^{0.75}$ and crude protein intake of 11.20 – 13.65 g/day/$W^{0.75}$ .were higher than 42.18 – 51.85 g/day/$W^{0.75}$ and 11.07 – 13.19 g/day/$W^{0.75}$ reported by Ocheja *et al.* (2018)for growing West African dwarf goats fed bamboo leaf and supplementary diets with graded levels of steam-treated cashew nut shell but lower than 165.58 – 174.30 g/day/$W^{0.75}$ and 10.31 – 13.87 g/day/$W^{0.75}$ reported by Adenkola*et al.* *(*2009) for weaner of West African dwarf goats fed natural pasture supplemented with graded levels of a mixture of bambara nut waste and dried *burukutu* spent grains (50;50). The dry matter intake of 2.60 – 2.80 % of live weight were within the range of 2.50 – 4.0% reported by Ogundipe (2002) but much lower than about 7.80% reported by Adenkola *et al.* (2009), these differences may be attributed to differences in the breeds and ages of the goats as well as the forages and concentrates used in the experiments. The intakes of all the nutrients were adequate for the goats (Ocheja*et al* 2018; Lakpini 2002 and NRC 1996).

Table (3): Nutrient Intake (g/day/$W^{0.75}$ DM) of Red Sokoto Goats fed Different Forms of Neem Leaves and a Concentrate Diet

Parameters	Treatments				
	T_1	T_2	T_3	T_4	SEM
Dry matter	51.45[a]	51. 30[a]	47.00[b]	46.18[b]	1.95
Crude protein	13.65	12.90	11.75	11.20	0.69
Crude fibre	12.80	13.01	12.95	12.60	0.90
Nitrogenfree extracts	14.55	15.15	14. 85	14.72	0.85
Ether extracts	28.90	29. 70	26.33	26.25	0.75
Ash	7.08	7.54	7.20	7.18	0.14

a, b = Means on the same row with different superscripts differ significantly (P<0.05).
SEM = Standard error of the Means.

3.3. Dry Matter and Nutrient Digestibility (%) of Red Sokoto Goats fed Different forms of Neem leaves and a Concentrate Diet

All digestibility parameters determined were not significantly (P>0.05) different, except nitrogen free extracts (61.55 – 66.79 %) which showed slight significance (P<0.05). This trend is almost compared with the report of Ahmed et al. (2020) who obtained non significance in all the parameters except crude fibre that was significantly (P<0.05) different, for yearling West African dwarf goats fed cashew nut shell based diets as supplement to bamboo leaves, Yahaya et al. (2020) however reported significant (P<0.05) differences in all the parameters examined but Ether extracts digestibility was significantly (P<0.05) different. These discrepancies may be attributed to differences in the breeds of goats used, as well as the concentrates and browse/ forages used in the experiments. This result

showed that the different forms of neem leaves had no influence on digestibility values. The various forms of neem leaves were suitable ruminant diets since they all had a dry matter digestibility value of 61.44 – 65.56, these values were well above the benchmark of 40 – 50 % reported by Preston (1986) though lower than 77.56 – 83.73 % reported by Ocheja et al. (2018)

Table (4): Dry Matter and Nutrient Digestibility (%) of Red Sokoto Goats fed Different forms of Neem leaves and a Concentratev Diet

Nutrient	Treatments				
	T1	T2	T3	T4	SEM
Dry matter	62.20	65.56	61.44	62.08	1.66
Crude protein	70.10	61.83	63.33	60.87	2.37
Crude fibre	55.64	54.90	55.83	53.93	0.84
Nitrogen free extract	66.79[a]	67.77[a]	66.27[a]	61.53[b]	0.83
Ether extracts	76.94	75.50	73.56	72.65	1.97

a, b: Means on the same row with different super scripts differ significantly (P<0.05).
SEM: Standard Error of the Means

4. Conclusion and Recommendations

Conclusion:

Fresh Neem leaves were the most preferred by the goats in terms of intake, (T1).

It also had the best array of nutrients, the digestibility values for the different forms of neem leaves fed to the goats were almost at par.

Recommendations:

The fresh Neem leaves (T1) evaluated is recommended for feeding goats especially during the long dry season. Further research should be carried out using other species of ruminants such as sheep and cattle.

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