Performance and Feed Bio-Economics of Red Sokoto Goats fed Different Forms of Neem Leaves Supplemented with a Concentrate Diet.

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ABSTRACT

The study evaluated the performance and feed bio-economics of red sokoto goats fed different forms of neem (Azadirachta indica) leaves and a concentrate diet. The experiment was carried out at the Small Ruminants Unit of the Teaching and Research Farm, Federal University of Kashere.Gombe State,Nigeria. Sixteen red sokoto goats (bucks) 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 experimental design was a completely randomized design; data were analyzed using a one way analysis of variance. The significant means were separated using Least Significant Difference (LSD) contained in SAS 9.4 ,2018 edition statistical package. The concentrate and the neem leaves were analyzed for their proximate composition and fibre fractions using the methods of AOAC 2000 Values for daily neem intake (40.11 - 48.35gW $^{0.75}$), total daily feed intake (76.11 – 84.95g W $^{0.75}$) and feed conversion ratio (3.52 -9.04) were all significantly differentThe cost benefit ratio values ranged from 0.32 – 0.55and were significantrly (P<0.05) different Daily concentrate intake values (36.60 – 37.10)were however not significantly (P.0.05) differentThe fresh neem leaves (T1) evaluated is recommended for feeding goats especially during the long dry season. Processing of neem leaves was not cost effective and therefore not recommendedFurther research should be carried out using other species of ruminants such as sheep and cattle.

Keyword:Performance,Bio-Economics,FeedIntake,Concentrate,RedSokotoGoats ,Neemleaves

INTRODUCTION.

. The main problem confronting ruminant livestock producers in Nigeria today is the seasonal fluctuation in the availability of forages for ruminants during the long dry season.(Ocheja *et al* 2021) According to Ayoade *et al;* (2007), Exploitation of cheap feed resources for animal production would lower the market price of animals and their products in Nigeria .The use of leaves from trees that retain their leaves during the long dry season ,to feed ruminants during the long dry season is very important .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 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.

Feed scarcity during the long dry season and the fact that neem leaves are readily and abundantly available within the study area, offers justification for this work, further more there is dearth of research data on bio-economics of goat feeding in relation to neem leaves, previous studies(Eniolorunda *et al* 2020; Ocheja *et al* 2020; Okpanachi *et al*2016; Ocheja *et al* 2013; Okolo *et al,* 2012 etc) focused on other feed materials

This work was therefore designed to determine the performance of red Sokoto goats fed neem leaves and a concentrate diet.as well as determine the feed bio-economics .

MATERIALS AND METHODS

2.1 Experimental site

The study was conducted at the Teaching and Research Farm, Department of Animal Sccience, Faculty of Agriculture, Federal University of Kashere in Gombe State, Nigeria. The state is situated within latitude 9º54'N and longitude and 10º57º 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) seasons. The annual mean temperature ranges from 30-32^0 C and it experiences a relative humidity of 17-90% (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 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 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), 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 was 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; treatment three (T_3) was neem leaf meal and Treatment four (T_4) was neem leaves silage.

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 animal. The experiment lasted for sixty three (63) days. . The following performance data were collected. Daily feed intake (supplement and forage), daily weight gain, Total weight gain and Feed conversion ratio. The bio economics parameters determined were according to the method of Ocheja *et al* (2020a) for Feed cost/kg, costs of feed consumed, benefit/ live weight gain and cost- benefit ratio

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	0.75
Table salt	2.00
Total	100.00
Calculated nutrient content:	
Crude protein	16.15
Crude fibre	11.30
Metabolizable energy (Kcal/kg diet)	2,700

2.5 Chemical Analysis

Samples of the Neem leaves and the concentrate diet were analyzed for their proximate composition using the method outlined by AOAC (2000). The fibre fraction analysis was according to the method of Van Soest *et al* (1991)

Crude Protein: The usual method employed in determination of protein in feed stuff was Kjeldahl method of nitrogen determination. The known quantity of sample was digested with sulphuric acid (H_2SO_4 and NaSO4 in the ratio of 1:20). The digested sample was then distilled after neutralizing excess of acid with alkali (40% NaOH), and thus the released ammonia was trapped either in N/10 (in macro) or in 2% boric acid solution. The distillate was collected in standard acid (N/10 H2SO4 or standard N/10 HCl) and titrated against standard alkali (N/10 NaOH), but when the distillate was collected in 2% boric acid (micro method) this was titrated against standard acid (N/100 H2SO4 or and crude protein was calculated by multiplying factor 6.25).

Crude fibre in feeding stuffs was estimated through digestion of dry and fat free amount of feed sample by boiling it in a weak solution of acids for 30minutes followed by boiling in weak solution of alkali for 30minutes and then deducting the ash from the residue obtained.

Ether extract was estimated by extracting the amount of feed sample through fat solvents like petroleum ether for a period of 5-6 hours at $55\text{-}60^0$c in specially made soxlet apparatus.

Moisture: The moisture content of feed sample was determined by heating it to constant weight at 100^0c under atmospheric pressure the water content of feed removed as vapour.

Ash: The feed contains both organic and inorganic matter in it. The sample was heated at 550^0c for 5 hours. The organic matter got oxidized as CO_2. The remaining material left was the inorganic matter.

Nitrogen Free Extract (NFE): Contains soluble carbohydrate, hemicellulose, part of lignin and acid insoluble ash. Value of NFE was derived by deducting

the total value of crude protein, crude fat, crude fibre, moisture and ash from 100.

2.6 Experimental Design and Statistical Analysis:
The experimental Design was Completely Randomized Design (CRD). Data obtained was analyzed using a one-way Analysis of variance (ANOVA), means with significant differences were separated using Least Significant Differences (LSD) with the aids of Statistical Package identified as Statistical Analysis System , SAS , 9.4 2018 edition.

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 6.44-9.19% for the neem leaves were 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 ether extract values of 3.60% for the Neem leaves were within recommended values for ruminants while that of the concentrate diet was at par with the upper limits values of 5-6% and if exceeded may impede appetite and fibre digestion (Maithison *et al*., 1997).

Table 2:Proximate Composition of Experimental Diets

Nutrient	Treatments				
	T1	T2	T3	T4	Conc
Crude protein	9.19	8.55	6.44	7.88	16.80
Crude fiber	8.50	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
NFE	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 Performance Data of Experimental Goats

Performance of red sokoto goats fed different forms of neem *(Azandirachta indica)* leaves and concentrate diet is presented in T_3. Daily concentrate intake values (36.60 - 37.$_{10}$ $_{gW^{0.75}}$)were notsignificantly(P>0.05) different.The feed conversion ratio values ranged from 3.52 – 9.40 and were significantly (P<0.05) different

Ocheja et al (2020b) reported significant values of 20.10 – 43.35 , while Eniolorunda *et al* (2020) obtained non significant values of 8.23 – 8.59 for yearling West African dwarf goats fed diets containing graded levels of cashew nut shell as supplement to bamboo leaves The values for daily concentrate intake did not show significant (P>0.05) difference, where as Okolo *et al* 2012 obtained significant (P<0.05) differences in daily concentrate intake These discrepancies could be due to the type of concentrate and browse fed to the goats as well as the ages and breeds of the goats used for the experiments Values for daily weight gain, daily neem intake, total daily feed intake were all significantly (P< 0.05) different , total daily feed intake values of 76.11 – 84.95gW$^{0.75}$ was higher than 56.49 – 65.04 gW$^{0.75}$ reported by Ocheja *et al (* 2020b) for West African dwarf goats fed diets containing varing levels of cashew nut shell as supplement to bamboo leaves.

Table 3: Performance Data of Experimental Goats

Parameter	Treatments				
	T1	T2	T3	T4	SEM
Initial weight (kg)	7.47	7.90	8.33	8.63	0.28
Final weight (kg)	9.33	9.33	9.10	9.53	0.32
Total weight gain (kg W^{075})	1.52^{a}	0.88^{b}	0.55^{c}	0.51^{c}	0.10
Daily weight gain (g W^{075})	24.13^{a}	13.96^{b}	8.73^{c}	8.09^{c}	0.21
Daily Neem Intake (g W^{075})	48.35^{a}	47.08^{a}	41.10^{b}	40.11^{b}	3.05
Daily concentrate intake (g W^{075})	36.60	37.10	36.90	36.70	1.33
Total Daily Feed Intake (g W^{075})	84.95^{a}	84.18^{a}	77.00^{b}	76.11^{b}	3.67
Feed conversion ratio	3.52^{a}	6.03^{b}	6.82^{b}	9.40^{c}	0.40

a b c;Means within row with different superscripts are significantly different (P<0.05), SEM= standard error of mean

3.3 Feed Bio economics of Red Sokoto Goat Fed Different Forms of Neem (*Azandirachta indica*) leaves and a Concentrate Diet.

The bio economics data of growing red Sokoto goats fed different forms of neem leaves and a concentrate dietl is presented in Table 4. The cost of supplement across the treatments was 87,1 Naira/kg, the cost of neem leaves across the treatments ranged from 50 – 65 Naira /kg and the values were significantly (P<0.050) different . The cost of neem leaves consumed , cost of supplement consumed , actual cost of total feed intake and benefit /live weight gain were all significantly (P<0.05) different The cost benefit ratio range of 0.32 – 0.55 were better than 0.84 – 1.63 obtained by Ocheja *et.al*.(2020) for West African dwarf goats fed diets containing graded levels of cashew nut shell as supplement to bamboo leaves and1.18 – 1.21 reported by Okpanachi *et.al*(2016) for West African dwarf goats fed cashew nut pulp meal based diets, but inferior to 0.053 – 0.060 reported by Eniolorunda *et al* (2020) This could be due to differences in the breeds of goats used and the concentrate as well as the forage used for the experiments.

Table 4: Bio economics of Red Sokoto Goat Fed Different Forms of Neem (*Azandirachta indica*) leaves and a Concentrate Diet.

Parameters	Treatments				
	T_1 (0 % CNS)	T_2 (5 % CNS)	T_3 (10 % CNS)	T_4 (15 % CNS)	SEM
Cost of Supplement (₦/kg)	85.71	85.71	85.71	85.71	0.00
Cost of Supplement Consumed (₦/kg)	525.10[a]	592.90[a]	449.30[b]	493.20[b]	36.72
Cost of Neem Leaves/kg (₦/kg)	50.00[a]	55.00[a]	60.00[b]	65.00[b]	1.69
Cost of Neem Leaves Consumed (₦/kg)	460.00a	508.60a	388.30[b]	335.80[b]	45.00
*Actual cost of total feed intake (₦/kg)	989.90[b]	1063.00[a]	837.70[b]	808.70[b]	77.62
**Benefit/live weight gain (₦)	3133[a]	2200[b]	1533[b]	1460[b]	397.03
***Cost-benefit ratio	0.32[a]	0.49[b]	0.54[b]	0.55[b]	0.07

a, b, – Means on the same row with different superscripts differ significantly (P<0.05)
SEM = Standard Error of the Means.
* Cost of supplement intake plus cost of forage intake (on actual basis)
** Total weight gain multiplied by cost of a kg of Goat meat at ₦ 2000
*** Actual cost of total feed intake (₦) ÷ Benefit/ live weight gain

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

Neem leaves contain adequate array of nutrients to meet the dry season feeding of red Sokoto goats . Goats on T1 (fresh neem leaves) performed best, treatment/processing of neem leaves involving costs was not worthwhile.

4.2Recommendations

Neem leaves should be fed fresh to red Sokoto Goats , treatment methods involving is not recommended, the same experiments can be carried out using other breedsof goats as well as other species of ruminants such as cattle and sheep.

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