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Effect of Graded Levels of *Parkia biglobosa* in a Concentrate Diet on Growth Performance, Digestibility and Nitrogen Utilization of Yankasa Rams

N. I. Wada[1], *A. A. Njidda[2], O. A. Olafadehan[2] & B. Bello[3]

[1]Federal Ministry of Agriculture and Rural Development, P.M. B. 2120, Katsina State, Nigeria.
[2]Department of Animal Science, University of Abuja P.M.B. 117, Abuja, Nigeria.
[3]Department of Animal Science, Bayero University, P.M.B. 3011, Kano State, Nigeria
*Corresponding Author: ahmednjidda7@gmail.com OR ahjidda@yahoo.com

ABSTRACT

The current study was carried out to evaluate the effect of dietary inclusion of *Parkia biglobosa* on growth performance and nutrients digestibility of Yankasa rams. Sixteen (16) growing males Yankasa rams were used in the study. *Parkia biglobosa* was added at graded levels of 0, 5, 10 and 15% and the dietary treatments designated as T_1, T_2, T_3 and T_4 respectively. The experimental animals were allotted to four treatments complete randomize design with four animals per treatment. The feeding trial lasted for 90 days. The result obtained for growth performance showed that body weight gain was higher ($p<0.05$) for T_4 compared to T_1 and T_2 which were similar. The final body weight, average daily body weight gain, average daily dry matter intake and feed conversion ratio showed no significant ($p<0.05$) effect among treatments. Significant difference ($p<0.05$) was observed among treatment groups for nutrient digestibility. Nitrogen utilization recorded significant ($p<0.05$) treatment effect on all the parameters observed. In conclusion the result from this study shows that inclusion of *Parkia biglobosa* in the diet of Yankasa rams increases intake and subsequently increase in live weight. There's also positive nitrogen utilization.

Keywords: *Parkia biglobosa*, Apparent digestibility, growth performance, intake, Yankasa rams

INTRODUCTION

The ever increasing prices of conventional feed ingredients and the vast availability of non conventional feedstuffs make it essential to use the latter in formulating ration that will not adversely affect the health and productivity of livestock (Trivedi *et. al.,* 2005). An underfed animal uses higher portion of its feed for body maintenance and less is converted in to products useful to mankind. In Sub-Saharan Africa, the situation is critical due to an inadequate supply of feed during the drier parts of the year (Sial *et al.* 1988). Of the few options available to overcome feed shortage in livestock production, the use of leguminous browses of high potentials stand out (Simbaya, 2000). Feed is the single largest cost in raising small ruminants, typically accounting for 60% of total production costs. Energy (calories) is usually the most limiting component, whereas protein is the most expensive. Deficiencies, excesses and imbalance of vitamins and minerals can limit animal performance and lead to various health problems second to hunger. Although, fiber content feed is necessary to maintain a healthy rumen environment and prevent digestive upsets, the environmental condition affect maintenance requirements. In cold and severe weather, sheep and goat require more feed to maintain body heat (Susan, 2003). A number of browse plants worldwide serve as alternative feedstuffs for livestock (Ammar. *et al*,. 2004; Rinehart, 2008; Fayemi *et al.*, 2011). Shrub and tree leaves are an important component of diets for sheep goat, cattle, deer and game (Papachristou and Nastic, 1996) and play an important role in the nutrition of grazing animals in areas where few or no alternatives are available (Meuret *et al.*, 1990). The leaves of the evergreen tree and shrubs are used as emergency food by sheep and goat in the semi-arid region of the northern Nigeria. (Njidda and Ikhimioya, 2010).

Browse plant play a significant role in nutrition of ruminant livestock in tropical region. Browse species, because of their resistance to heat, drought, salinity, alkalinity, drifting sand, grazing and repeated cutting, are the major feed resources during the dry season (Fagg and Stewart, 1994). Some part of browse species can be found during the dry season including pods, fruits and leaves. Most trees/shrubs produce their leaves during wet season, thus browse is more available during the spring (August to May) (Palgrave, 1983). The nutritional importance of browse is especially significant for free ranging animals in extensive communal system of production.

The African locust bean tree, *Parkia bigloboso* is a perennial tree legume which belongs to the sub-family *Mimosoideae* and family *Leguminosae.* It grows in the savannah region of West Africa up to the southern edge of the Sahel zone 13^0N (Campbell-Platt, 1980). This trees is not normally cultivated but can be seen in population of two or more in the savannah region of Nigeria (Hopkins, 1983). The tree of *parkia* species are usually and carefully preserved by the inhabitants of the area where they grow because they are valuable source of reliable food, especially the seeds which serves as source of useful ingredients for consumption (Campbell-Platt, 1980). It has been reported that the husks and the pods are good feed for live livestock (Obiozoba 1998). The objective of the study was to investigate the nutritive importance of feeding *Parkia biglobosa* to sheep.

MATERIAL AND METHODS

Experimental Site

The experiment was conducted at the research and training farm, Bayero University, Kano. Annual rainfall and temperature ranges between 787 to 969 mm and 21^oC to 39^oC, respectively (KNARDA, 2001). The climate is characterized by define wet season that normally begins in May and ends in September and dry season that lasts from October to April.

Experimental Animals

The experiment was conducted at the teaching and research farm of the Bayero University Kano, Kano State of Nigeria. A total of 16 sheep weighed between 7 and 10 kg and between 8 – 10 months old were purchase from the livestock market in Kano metropolis.

Feeding and Management of experimental animals

All animal were treated against internal parasites using levamisole (Kepro B.V. Holland, 1ml per 20 kg body weight), sprayed with Triatix (cooper Ltd) and injected with long acting oxytetracycline 200 LA (Invesa Spain 1ml per 10kg body weight) before the commencement of the experiment. All sheep were kept in a house and confined in individual, well-ventilated raised slatted floor cages. Treatment feeds were supplied at 3% of the animals body weight and water was given *ad libitum*. The trial lasted for 90 days during which the animals were grouped into treatments and fed total mixed rations containing *Parkia biglobosa* forage included at graded levels of 0, 5, 10, and 15% and designated as T_1, T_2, T_3 and T_4 respectively. Daily feed intake, water and live weight changes were recorded.

Experimental Design and Treatment

Sixteen (16) Yankasa rams were allotted to four dietary treatments in a randomized complete design, with four animals per treatment. Animal were subjected to 2 weeks adaptation period and 10 weeks of data collection to determine effect of feeding the graded levels of *P. biglobosa* in a total mixed ration on the performance of the animals.

Digestibility trial

After the feeding trial, total collection of daily faeces output of all the rams was done for 7 days, the 10% of the daily collection was taken oven dried at 60^0C for 48h and kept. The dried faeces and feed samples were milled through 2mm screen and stored in polythene bags for chemical analysis.

Chemical analysis of the browse samples

Proximate composition (DM, N, CF and ash) of the feed and faeces were determined according to standard methods of Association of official Analytical chemists (AOAC) (1990). The N content in feed and faeces was then converted into CP by multiplying it with 6.25. Neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were determined according to the procedures of Van soest *et al.* (1991).

Statistical analysis

The data generated were subjected to analysis of variance (ANOVA) in a Complete randomized Deign (CRD) using SAS package (2004) and where significant difference between the means exist, Duncan multiple range test (DMRT) was use to separate the means.

Results

Chemical composition of the experimental diets

The DM, CP, NDF, ADF, ADL and cellulose were similar ($P<0.05$) among the treatments. Ash content was highest ($P<0.05$) for T_1 and lowest ($P<0.05$) for T_4, whereas OM was least ($P<0.05$) for T_1 and highest ($P<0.05$) for T_3. Crude fibre was highest ($P<0.05$) for T_3 and T_4 compared to T_1. Ether extract was highest for T_1, intermediate for T_2 and lowest for T_3 and T_4.

Growth performance of Yankasa rams fed graded levels of *Parkia biglobosa*

The results of growth performance of Yankasa rams fed graded level of *Parkia biglobosa* is shown in Table 3. Treatment (T_4) had higher body weight gain (BWG) of 3.43 kg compared to other treatment groups with T_1 having the least 2.33 kg. Metabolic weight of the animals differ significantly ($P<0.05$) between diets. The values ranged from a low value of 15. 28 to a high value of 16.32 $LW^{0.75}$. This follows similar pattern in terms of statistical significance ($P<0.05$) in body weight gain. The average daily body weight gain (kg day^{-1}) was higher (0.04 kg day^{-1}) in T_4. The dry matter intake (DMI) (kg day^{-1}) was higher for T_4 (0.28 kg day^{-1}) (15% *Parkia biglobosa* inclusion) and lowest for T_1 and T_2 (0.02 kg day^{-1}). Feed conversion was best in T_4 and poorer in animals on diet T_2.

Nutrients digestibility of Yankasa rams fed graded levels of *Parkia biglobosa*

Apparent digestibility of DM, OM, CF, NDF, ADF, and celluloses were higher ($P<0.05$) for animals fed T_1 compared to other treatments whereas digestibility of hemicellulose was lowest for T_1,

Nitrogen utilization of Yankasa rams fed graded level of *Parkia biglobosa*

The positive N balance observed in the current study shows the positive influence of the dietary treatment feeds in feeding of yankasa rams. All parameters observed showed significant difference ($P<0.05$) among treatments. Nitrogen in faeces and urine N, intake, absorbed and retained as percent of N intake tended to decrease with increase in levels of *Parkia biglobosa* while N absorbed as percent of nitrogen intake increases with increase the in levels of *Parkia biglobosa*.

DISCUSSION

The result of chemical composition of experimental diet is presented in Table 2. The high crude protein content of the concentrate diet shows that its high enough to meet the optimum microbial need in the rumen. The values for all the treatment groups are above the 7% protein requirement for optimum microbial growth in the rumen. The values also falls within the 10 to 12% crude protein requirement for growth performance of sheep and goats (Gatemby, 2002).

The fibre fraction CF, NDF, ADF, ADL and Cellulose is observed to increase with increasing levels of *Parkia biglobosa*. The increase in levels of these fibre components may be attributed to the increase in level of *Parkia biglobosa*. The result follows similar pattern to the report of Njidda (2011) that semi arid browses are high generally high in fibre. Rittner and Reed (1992) also reported values for NDF and lignin contents across different ecological zones as follows: 401 and 117 g kg DM in the Sahelian zone, 457 and 105 g kg DM in Sub humid zone and 436 and 93 g kg DM in the humid zone respectively.

The result of the growth performance is shown in Table 3. In spite of the adaptation to harsh environment and poor quality feeds, sheep require for optimum growth, an efficient utilization of nutrients that supply adequate energy and protein. Knowledge of nutrient requirements is therefore important for the estimation of genetic potential of the animals. Sahlu *et al.*, (2002) reported that nutrients requirements depend on body size or growth rate with the quality of the feed and environmental condition. The final body weight was lower in treatment T_1 compared to T_2, T_3 and T_4, this might be a good indication of low intake of feed and diet that was not well utilized then interfered with weight gain. The final body weight reported in this study was within the range (7600 to 9050 g day^{-1}) reported by Lawan *et al.* (2008). The daily body weight gain followed a similar pattern of variation as observed in the final body weight. Similarly, Average daily body weight gain is best in T_4 compared to T_1, T_2 and T_3, the observed higher daily weight gain value with T_4 might be as a result of the of the ability of the rams to property utilize the diet for bodyweight gain when compared with either of the other dietary treatments. This is in consonance with the report of (Njidda 2008) that an efficient utilization of nutrients supplying adequate energy and protein is required for optimum growth performance in ruminants. The daily weight gain recorded in this study is within the range of 19.8 to 77.00 g day^{-1} reported by Sanon (2010). The total dry matter intake (DMI) recorded a significantly ($P<0.05$) higher DMI for the treatments with *Parkia biglobosa* inclusion. The values increase with increase in the levels of *Parkia biglobosa*. Thus, the results of the DMI showed that animals on diet T_1 consume less dry matter compared to animals on T_2, T_3 and T_4. The differences observe in intake of the supplemented groups may be due to the different levels of *Parkia biglobosa* inclusion in the diets. The daily DMI of the experiment sheep compare favourablly with the report of Devendra and McLeroy (1982) who reported that sheep with higher live weights (40, 50, 60 and 70 kg live weight) consume 0.9, 1.0, 1.1 and 1.2 kg DM daily. The findings in this study shows that lower liveweight (18 to 19 gk LW) consume less DM (0.02 to 0.28) kg day^{-1}). The feed conversion ratio was similar across the treatments indicating a better feed conversion ratio of the diet with T_4 having the best. The efficiency at which rams converted feeds for body weight in the present study compared unfavorably with the previous study of (Gatemby, 2002) for sheep. However the marked reduction in feed intake and weight gain in T_1 could be as a result of low intake and utilization of the diet.

The nutrient digestibility of Yankasa rams is shown in Table 4, the dry matter digestibility (DMD) and Organic matter (OMD) ranges from 36.4 to 62.00% and 29.80 to 56.79% with highest value recorded in T1 and lowest value in T4. Cheng *et al*., 1984; Gutteridge and Shelton 1998 reported that dry matter digestibility characteristics may be due to the wall configuration of their polysaccharides and their effect on microbial attachments and colonization of digest particles.

The nutrient digestibility observed in this study may be attributed to the high level of NDF ADL. Several studies (Norton, 1998; Njidda and Ikhimioya 2010; Njidda *et al*., 2014) have reported decrease in digestibility as a result of high level of NDF and ADL. Bakshi and Wadhwa, (2004) also reported that high NDF and ADL depress DM intake and DM digestibility. Several studies (Buxton and Redfearn, 1997; Moore and Jung, 2001) have reported a negative correlation between lignin concentration and cell wall digestibility by its acton as physical barrier to microbial enzymes. Luginbuhl and Poore (1998) also reported that increased dietary NDF is shown to decrease DM intake linearly in growing ruminant. Many other factor, including particle size, chewing frequency and effectiveness, particle fragility, indigestible fraction, rate of fermentation of the characteristics of reticular contraction are also involved. Hence information on the NDF, ADF, Lignin and tannin content of tree foliage is essential for the assessment of their digestibility. The low crude protein value obtain in the nutrient digestibility confirms that they are not good source of protein and oil the concentrate supplements was above the 10 to 12% crude protein moderate level required by ruminant for minimum growth performance (Gatenby, 2002), thus, concentrate supplement was included in the diets to provide fermentable carbohydrate and nitrogen to augment the supplement of nutrient in the diet and encourage rumen degradation (Yousuf and Adeloye, 2011). Minson (1990) reported that lignin is bound to all plant cell walls, and is a significant limiting factor in their digestion in the rumen. Lignin is also a limiting factor in the digestion of legumes, but is bound largely to the vascular tissue (Wilson, 1993) with often high concentration of other free and bound phenolic compounds (Phenolic acid, coumarins and flavonoids) in floral, leaf and seed tissue (Mcleod 1974). Many studies Moore and Jung, (2001) have reported a negative correlation between lignin concentration and cell wall digestibility by its action as a physical barrier to microbial enzymes. Hence information on NDF, ADF and Lignin content of tree foliage is essential for the assessment of their digestibility. Luginbuhl and Poore (1998) noted that goat is not able to digest cell walls as well as cattle because the feed stays in their rumen for shorter period of time. On the other hand, Morand-Fehr (2005) reported similar retention time of feed particles in the whole digestive tract of sheep and goat eating the same quantity of good quality forage, but retention time of goat was longer. Hence sheep and goat have similar pattern of digestion of moderate to high quality forage, but goat are better in digesting forage rich in cell walls and poor in nitrogen. This seems to be related to their ability to recycle urea nitrogen (Silanikove, 2000)

The effect of the diets at different proportion of *Parkai biglobosa* leaf on Nitrogen (N) utilization of rams followed the pattern of the feed intake of the diet. Hence the rams could have increased N- intake with increased in daily feed intake to meet their protein requirement from the diets. The observed increase in N-output in treatments could be attributed to inhibitory effects of residual toxic and astringent factor associated with dried *Parkia biglobosa* leaf. Okoruwa *et al.* (2013) made similar observation with west African Dwarf sheep fed pineapple waste. The higher urinary N-output observed in T_1 and T_2 compared with T_3 and T_4 could be probably due to a reflection of nitrogen in the rumen that depend on the quantity and solubility of the diets, which might have been lost from the rumen as ammonia and later converted to urea before excreted as urine. This confirm the report of Ahamefule and Udo (2010) that nitrogen excreted in urine would depend on urea recycling and the efficiency of ammonia utilization produced in the rumen by microbes for microbial protein synthesis. However, Nitrogen retention is the proportion of nitrogen utilized by farm animals from the total nitrogen intake for body process, hence the more the nitrogen is consumed and digested the more the nitrogen retained and vice versa, as observed by Okeniyi *et al.* (2010). Nitrogen retention in g day^{-1} and in percentage was best in T_1 and T_3 respectively possibly because of nitrogen utilization in the rumen. This observation further buttressed by the fact that the diet was well balance in energy and protein which reduced nitrogen excretion in the urine (Noblet and Van Milgen, 2004) which were attributed to better nitrogen retention in T_1. The percentage of nitrogen retention values recorded in this study was higher than the range value of (17 to 79%) reported by Okoruwa and Adewumi (2010). Amount of nitrogen absorbed differed ($P<0.05$) among the treatment with rams in T_1 having the highest value compared to the other treatment. Generally the faecal, urinary, intake and absorbed nitrogen was significantly ($P<0.05$) influenced by the dietary treatment groups.

Conclusion

It can be concluded that, dietary inclusion of *Parkia biglobosa* in the diet of Yankasa rams upto 15% level of inclusion increased intake and performance, digestibility and Nitrogen utilization of Yankasa rams.

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Annexure

Table 1: **Composition of experimental diets (%)**

	Treatments			
Ingredients	T_1	T_2	T_3	T_4
Parkia biglobosa	0	5	10	15
Groundnut cake	30	25	20	15
Rice Bran	19	19	19	19
Maize Offal	10	10	10	10
Sorghum Stover	10	10	10	10
Wheat Offal	20	20	20	20
Sorghum Offal	10	10	10	10
Bone meal	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5
Total	**100**	**100**	**100**	**100**
Metabolizable Energy (MJ)	10.50	10.16	9.72	9.36
Crude Protein (CP)	18.58	18.60	17.80	17.10

Table 2: Chemical composition of experimental diets

	Treatments				
Parameter	T_1	T_2	T_3	T_4	SEM
DM	891.10	871.80	896.30	878.90	42.42
Ash	101.30^{a}	94.30^{b}	86.40^{c}	81.40^{d}	1.65
OM	789.80^{c}	777.50^{d}	809.90^{a}	797.50^{b}	1.21
CP	148.30^{a}	137.30^{a}	135.30^{a}	128.90^{a}	30.77
CF	182.30^{b}	202.30^{ab}	221.10^{a}	229.30^{a}	15.19
EE	89.40^{a}	81.00^{b}	78.10^{c}	77.30^{c}	1.23
NDF	361.40	372.30	384.40	394.00	48.60
ADF	271.00	301.10	312.50	333.40	32.17
ADL	102.90	113.40	131.10	122.40	16.42
Cell	246.20	257.40	266.10	284.30	52.87
Hcell	90.40^{a}	71.20^{b}	69.90^{b}	61.60^{b}	5.50

ADF= Acid detergent fiber; ADL= Acid detergent lignin; CL= Cellulose; CF= Crude fiber; CP =Crude protein; DM=Dry matter; EE= Ether extract; HC= Hemi cellulose; NDF= Nutrient detergent fiber; Mean within the same row with different super are significantly different (p<0.05); NS=Not significant

Table 3: Growth Performance of Yankasa rams fed *Parkia biglobosa*

	Treatments				
	T_1	T_2	T_3	T_4	**SEM**
Initial body weight (kg)	18.05	18.35	18.60	18.33	NAS
Final body weight (kg)	20.38	20.87	21.32	21.76	0.96
Body weight gain (kg)	2.33^{b}	2.52^{b}	2.72^{ab}	3.43^{a}	0.87
Average daily body weight gain (kg day^{-1})	0.02^{bc}	0.03^{b}	0.03^{b}	0.04^{a}	0.005
Dry matter intake (g/kg $W^{0.75}$)	1.9^{c}	2.0^{b}	2.1b	2.4^{a}	0.02
Dry matter intake (kg day^{-1})	0.02	0.02	0.25	0.28	0.001
Metabolic Mass (kg $W^{0.75}$)	15.28^{ab}	15.65^{ab}	15.99^{ab}	16.32^{a}	0.87
Feed conversion ratio	0.94	0.95	0.88	0.81	0.21

Table 4: Nutrients Digestibility of Yankasa rams fed *Parkia bigloboso* (%)

	Treatments				
Parameters	T_1	T_2	T_3	T_4	SEM
DM	62.00^{a}	53.12^{b}	48.76^{c}	36.21^{d}	0.46
OM	56.79^{a}	47.26^{b}	42.73^{c}	29.80^{d}	1.23
CP	24.48^{a}	26.44^{c}	30.30^{b}	32.27^{a}	0.31
CF	45.36^{a}	32.25^{b}	25.42^{c}	21.37^{d}	1.27
EE	67.67^{d}	73.74^{c}	74.64^{b}	82.66^{a}	0.23
NDF	32.30^{a}	29.55^{b}	28.30^{c}	18.05^{c}	0.28
ADF	11.04^{a}	18.33^{b}	15.65^{c}	13.24^{d}	0.20
ADL	34.50^{d}	42.95^{c}	55.45^{a}	54.10^{b}	0.27

ADF= Acid detergent fiber; ADL= Acid detergent lignin; CF= Crude fiber; CP =Crude protein; DM=Dry matter; EE= Ether extract; NDF= Nutrient detergent fiber; a, b, c, d =Mean within the same row with different super are significantly different ($p<0.05$); NS=Not significant

Table 5: Nitrogen absorption and retention (g day^{-1}) in Yankasa rams fed *Parkia bigloboso*

	Treatments				
Parameter	T_1	T_2	T_3	T_4	SEM
N intake	23.72^{a}	21.97^{b}	21.64^{b}	20.62^{bc}	0.42
N in faeces	1.23^{a}	1.08^{a}	0.9^{b}	0.61^{b}	0.02
N in urine	1.37a	1.11a	0.98a	0.89a	0.01
N Absorbed	22.51^{a}	20.89^{b}	20.75^{bc}	20.02^{c}	0.37
N Retained	21.17^{a}	19.78^{c}	20.67^{b}	19.13^{d}	0.17
N Absorb as % N intake	94.81^{a}	95.08^{a}	95.84^{a}	97.04^{a}	2.06
N Retain as % N intake	89.04^{d}	90.03^{c}	95.47^{a}	92.83^{b}	0.41

Mean within the same row with different super are significantly different ($p<0.05$); NS=Not significant