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Utilization of *Scelocarya birrea* kernel meal (SBKM) as protein supplement in the diets of fattening Uda sheep

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ABSTRACT

An experiment was conducted at Usmanu Danfodiyo University Teaching and Research Farm Sokoto, Nigeria to determine the utilization of *Scelocarya birrea* kernel meal (SBKM) as protein supplement in the diet of Uda sheep. Sixteen intact male animals were used for the experiment. The animals were divided into four (4) treatment groups replicated five times. The animals were fed diets containing 0, 5, 10 and 15% *Scelocarya birrea* kernel meal (SBKM). Data generated from the study were subjected to analysis of variance (ANOVA). Where significant difference exists, least significant different (LSD) was used to separate the means. Results indicated that total feed intake increased with increased level of SBKM up to 5% inclusion level; thereafter, it declined ($P<0.05$). Average daily gain (ADG) decreased from 99.90g/day for treatment 2 (5% SBKM) to 59.5g/day for treatment 4 (15% SBKM) ($P< 0.05$). Digestibility of dry matter (DM), crude protein (CP), crude fibre (CF), Nitrogen free extract (NFE) and ether extract (EE) were higher for treatment 2 (5% SBKM) ($P< 0.05$). Cost of fed per kg live weight gain (N 553.33/kg was lower ($P<0.05$) for treatment 2 (5% SBKM) compared to other treatments. It was concluded that inclusion of SBKM in the diet of Uda sheep should not exceed 5%.

***Keywords*:** *Scelocarya birrea* kernel meal (SBKM); protein supplement; fattening sheep

1. INTRODUCTION

The ever – increasing prices and scarcity of the main source of energy and protein in livestock feeds in Nigeria have necessitated the search for cheaper alternatives. Such alternatives includes multi-purpose trees and shrubs which are valuable sources of proteins, vitamins and minerals to herbivores in the dry tropical and sub-tropical regions where feed quality and selection limits livestock production. Fodder tree legumes have been associated with improved milk yield, wool growth and live–weight gains (Makker *et al.*, 1996). Browse constitutes an abundant biomass in farm lands, bush fallows, and forest in the sub-humid, humid, arid and semi-arid environment of Nigeria (Okoli *et al.*, 2001).

They are commonly utilized in the wild by small-holder livestock farmers for feeding ruminants. Examples: *Leucaena Leucocephala, Gliricidia, Sepium, Acacia spp, Cajanus cajan, Tamarindus indica, Parkia clappertonian, and Sclerocarya birrea* (Okoli *et al.*, 2001).

The potentials of leaves, fruits and pods from these tropical trees and shrubs to yield relatively high levels of crude protein and minerals and lower crude fiber levels than tropical grasses has also been recognized (D'Mello, 1992). Browse legumes are shrubs and trees that are of considerable nutritional importance as livestock feed during the dry season. *S. birrea* is one of the potential browse plants. it is a medium sized multi-purpose tree plant widely distributed in semi-arid zone. The Pulp (fruits and seed) become abundant during the dry season (January to April) and a single tree may yield as much as 538.34kg of fruits yearly (Leakey, 1999). Aganga and Mosase (2001) reported that the fruits contained an average of 30.96% crude protein and 2.97% Nitrogen free extract. Despite the nutritional value of this plant, there is little information on the utilization of the fruits as feed for ruminant animals.

This study was carried out to assess the utilization of SBKM in the diets of Uda sheep.

Fig.1. *Sclerocarya birrea* (Marula) tree

Fig. 2. Sclerocarya *birrea* (Marula) fruits

2. MATERIALS AND METHODS

2. 1. Experimental Location

The study was conducted at the Usmanu Danfodiyo University livestock teaching and Research farm located about 10Km North of Sokoto metropolis in Wamakko Local Government area of Sokoto State. Sokoto is located in the Sudano-Sahelian zone in extreme North-Western part of Nigeria. It lies between longitude 4°8'E and 6°54'E and latitudes 12°0'N and 13°58'N and at altitude of 350 m above sea level (Mamman *et al.*, 2000).

2. 1. 1. Climate and Livestock Resources

Sokoto has a semi-arid climate, which is characterized by low rainfall with mean annual rainfall of between 500 – 1300 mm varying in amount from year to year and it is seasonal in incidence. Heat is more severe in the state in March and April, but the weather in the state is always cold in morning and hot in afternoons save in peak harmattan.

Diurnal and seasonal temperature fluctuations are very wide, where minimum temperature has been recorded to be 13 °C in January and maximum temperature of 44 °C in April (SSGD, 2002). Sokoto has two main seasons; the dry season, which lasts from October to May/June, and the rainy season that lasts from June to September/October. Sokoto state is part of the North Western Nigeria with abundant livestock resources.

This is because the climate is more suitable for livestock production, due to absence of Tse-tse fly and an open grass land (SSGD, 2002). Sokoto ranks second in livestock production in the country with livestock population of over 8 million (SSGD, 2002).

2. 2. Experimental Animals and their Management

Sixteen entire (intact) male rams Uda breed with an average live weight of 27.30kg were purchased from village markets around Sokoto and used in the experiment. The animals were quarantined in the Teaching and Research Farm of the Usmanu Danfodiyo University, treated against ecto and endo parasite with ivermectin (1ml per 10kg live body weight) and treated with oxytetracyline HCl (a broad spectrum antibiotic) at dosage rate of 2ml/10kg/live weight against possible bacterial infection. Prior to the commencement of the experiment, the animals were managed intensively and group-fed with cowpea hay and wheat offal.

2.3. Experimental feed preparation

Scelocarya birrea fruits were obtained from different locations in Sokoto state. The pulps were manually separated from the kernels. The kernels were sun dried and ground using grinding machine and used as *Scelocarya birrea kernel* meal (SBKM).

Fig. 3. Harvested fruits of Sclerocarya *birrea* (Marula)

2. 4. Other Feed Ingredients

Other feed ingredients that were used in the preparation of the experimental diet include cotton seed cake, cowpea husk, rice offal, wheat offal, salt, Premix and maize. The ingredients were purchased from Sokoto Central Market.

2. 5. Experimental diets formulation

Four complete experimental diets were formulated with graded levels of *Scelocarya birrea* kernel meal (SBKM) at 0, 5, 10, 15% inclusion levels. The four experimental diets were used to feed the sixteen (16) rams. The diets were designated as diets 1, 2, 3 and 4 in the experiment. The gross compositions of the experimental diet are shown in Table 1.

Table 1. Composition of the experimental diets.

Ingredients (%)	Treatment (SBKM inclusion (%))			
	1(0)	2(5)	3(10)	4(15)
Scelocarya birrea kernel meal	0.00	5.00	10.00	15.00
Wheat offal	9.96	16.10	5.37	0.85
Maize	37.60	33.97	32.63	31.90
Cotton seed cake	10.00	0.00	0.00	0.00
Cowpea husk	14.47	14.07	9.99	7.20
Rice offal	2.78	4.21	15.31	30.55
Cowpea hay	24.19	25.65	25.70	13.50
Salt	0.50	0.50	0.50	0.50
Premix	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00
Calculated CP(%)	12.03	12.03	12.04	12.02
Calculated energy (KcalME/kg)	2599	2600	2600	2600
Calculated fibre (%)	18.87	17.73	18.89	17.69
Cost of feed (N/kg)	82.62	76.49	69.95	61.64

2. 6. Experimental design and feeding procedure

A completely randomized experimental design (CRD) was used in this experiment with number of animals representing replication and graded levels of *Scelocarya birrea* kernel meal representing treatments. Five animals were allocated to each treatment and were balanced for weight. Each animal was housed in a pen measuring 2m× 1m, which had been previously disinfected. Each group were assigned to one of the experimental diets and fed ad *libitum* in the morning and evening for 90 days. Water and salt lick was also offered ad *libitum.*

2. 7. Data Collection

The animals were weighed prior to the commencement of the experiment and every week on the same day of the week between 8:00am and 9:00am after feed withdrawal of 14-16 hours to avoid error due to gut-fill. Daily records of feed intake were taken throughout the 90 days feeding trial.

2. 8. Sanitation and Health Management

Faeces and urine were removed every day from the feeding pens to ensure adequate ventilation, less ammonia accumulation, adequate cleanliness of the experimental pens and ensure minimum discomfort of the experimental animals.

2. 9. Metabolism Trial

At the end of the feeding trial, metabolism study was conducted using three animals from each treatment. The animals were fed the same experimental diets used in the feeding trial. The trial lasted for 14 days with 7 days for adaptation and 7 days for faecal sample collection using harness bags. Total faecal output from each animal was recorded daily and 5% of it were oven-dried at 70 °C for dry matter determination and then stored for subsequent analysis.

2. 10. Chemical Analysis

Thoroughly mixed representative samples of the experimental diets and faeces were analyzed for proximate composition as outlined by the Association of Official Analytical Chemists (AOAC, 1990).

2. 11. Statistical Analysis

The data generated from the experiment were subjected to analysis of variance (ANOVA) using completely randomized design using Statview Statistical Package (SAS, 2002). Where significant differences exist, least significant difference (LSD) was used to separate the means.

3. RESULTS AND DISCUSSION

3. 1. Results

3. 1. 1. Proximate composition of experimental diets

The chemical composition of experimental diets and concentrate mixture are presented in Table 2.

Table 2. Proximate composition of the experimental diets

Parameter	Treatment (SBKM inclusion (%))			
	1 (0)	2 (5)	3 (10)	4 (15)
Dry matter	96.0	94.0	94.0	95.5
Crude protein	11.62	11.85	12.14	12.30
Crude fibre	17.33	18.46	18.81	18.03
Ether extract	5.0	6.0	7.5	8.0

Ash	9.0	6.0	8.0	13.0
NFE	53.05	51.69	47.55	44.17

The dry matter (DM) contents of the experimental diets range between 94 and 96%. The crude protein (CP) increased from 11.62 (for treatment 1) to 12.30 (for treatment 4). There is irregular variation in the crude fibre, ash and nitrogen free extract content EE contents of the diets increased with increasing SBKM from treatment 1 to treatment 4 (Table 2).

3. 1. 2. Performance characteristics of the experimental animals

Performance characteristics of the experimental animals are presented in Table 3.

Table 3. Performance characteristics of the experimental animals.

Parameter	Treatment (SBKM inclusion (%))				SEM	Prob.
	1 (0)	2 (5)	3 (10)	4 (15)		
Initial weight (kg)	27.25	27.25	27.35	27.35	0.99	0.10
Final weight (kg)	35.25^{a}	35.62^{a}	32.50^{ab}	27.88^{b}	1.35	0.02
Weight gain (kg)	8.00^{a}	8.38^{a}	5.13^{bc}	0.50^{c}	0.79	0.01
ADG (g/day)	96.24^{a}	99.70^{a}	61.01^{b}	59.5^{c}	9.46	0.04
Feed Intake as % Body Weight	4.34^{a}	4.34^{a}	3.23^{b}	2.92^{c}	0.15	0.03
Average feed intake (kg)/day	1.08^{a}	1.10^{a}	0.90^{b}	0.74^{c}	0.03	0.01
Total Cost of Feed Consumed (₦)	4804.86^{a}	4565.71^{a}	3285.44^{b}	2252.69^{c}	118.83	0.04
Cost of feed (₦/kg) LWG	625.98^{c}	553.33^{c}	824.81^{b}	2058.23^{a}	144.28	0.04

abc, Means the same row with different superscript are significantly different (P<0.05)

Result indicated higher values for final body weight (kg), weight gain (kg), average daily gain (ADG); F1% BW, Average feed intake (kg) and total feed intake (kg) for treatment 2 (P<0.05). Cost of incorporating SBKM on the performance of experimental animal

indicated that feed/kg live weight gain was significantly lower (P< 0.05) (₦ 553.33/kg) for treatment 2 (5% SBKM) compared to treatments 1 (0% SBKM) and 3 (10% SBKM) (₦ 625.98/KG, ₦ 824.81/kg respectively).

3. 1. 3. Growth performance of Uda Sheep fed Experimental Diets containing graded Levels of SBKM (%)

Growth performance curve of Uda Sheep fed diets containing graded levels of SBKM is presented in Fig. 1.

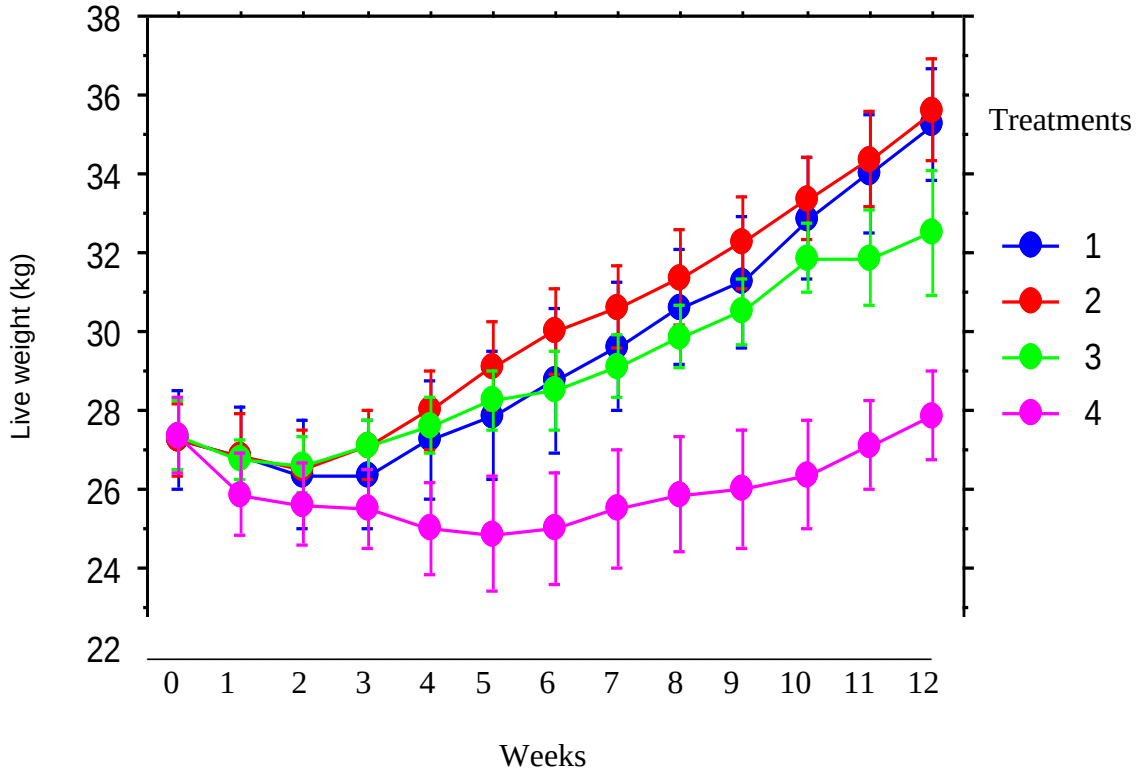

Figure 1. Growth performance of Uda Sheep fed diets containing graded Level of SBKM (%)

Fig. 1 indicated a slight decrease in growth for treatments 1, 2 and 3 for the first three weeks of the experiment. Treatments 1 and 2 assume same trend in growth from week three to the end of the experiment. Treatment 4 showed irregular growth pattern up to tenth week of the experiment.

3. 1. 4. Nutrient intake and digestibility of Uda sheep fed experimental diets containing graded levels of SBKM (%)

Nutrient intake of Uda sheep fed experimental diets with varying levels of SBKM (%) are presented in Table 4.

Table 4. Nutrient intake and digestibility of Uda sheep fed experimental diets with graded levels of SBKM.

Parameter	Treatment (SBKM inclusion (%))				SEM	Prob.
	1 (0)	2 (5)	3 (10)	4 (15)		
DM intake (kg/day)	1.04^{a}	1.03^{a}	0.84^{b}	0.70^{c}	0.09	0.01
CP Intake (g/day)	182.43^{b}	196.05^{a}	184.18^{b}	154.01^{c}	5.89	0.03
CF Intake (g/day)	252.42^{bc}	334.39^{a}	280.83^{b}	358.95^{a}	11.13	0.04
NFE Intake (g/day)	576.35^{ab}	624.65^{a}	577.15^{ab}	492.28^{c}	19.66	0.04
EE In take (g/day)	48.11^{c}	77.47^{b}	117.77^{a}	118.73^{a}	2.85	0.03
DM Digestibility (%)	81.17^{a}	79.62^{a}	69.34^{b}	61.96^{bc}	2.98	0.03
CP Digestibility (%)	77.40^{a}	79.40^{a}	58.77^{c}	67.00^{b}	1.88	0.02
CF Digestibility (%)	71.08^{a}	73.58^{a}	64.07^{b}	67.97^{b}	1.42	0.02
NFE Digestibility (%)	76.82^{a}	78.74^{a}	69.53^{b}	64.62^{bc}	1.86	0.01
EE Digestibility (%)	54.33^{a}	53.84^{a}	49.55^{ab}	47.00^{b}	1.83	0.03

abc, Means the same row with different superscript are significantly different (P<0.05)

Results indicated that animals feed diets containing 5% SBKM (Treatment 2) had a significantly higher CF, CP and NFE intakes (P < 0.05). However, there is no significant difference between Treatment 2 and 3 in terms of NFE intake (P> 0.05). Ether Extract (EE) intake is significantly higher for animals fed diet containing 10% and 15% SBKM (P < 0.05). Results indicated a significantly higher DM, CP, CF and NFE digestibility for animals fed diets containing 5 and 10% SBKM (Treatments 1 and 2 respectively) (P< 0.05). There were no significant differences between treatments 3 and 4 (10% and 15% SBKM respectively) in terms of NFE and EE digestibility (P < 0.05).

3. 2. Discussion

3. 2. 1. Proximate composition of Experimental diets

Incorporation of SBKM in the diets led to slight increase in CP content from 11.62-12.30%. Results of proximate composition showed that crude protein content of the experimental diets were within the values recommended by ARC (1994) for fattening sheep. The increase in CP content from treatment 1 to treatment 4 could be due to increase level of SBKM from treatment 1 to treatment 4. It was reported that SBKM have higher CP content than CSC which was used as a protein source for the control diet (Treatment 1) (Aganga and Mosase, 2001). Ether extract and Ash contents increase as the level of SBKM increase due to the fact that SBKM contained higher fat content as indicated by Weinert *et al.* (1990). The

crude fibre values of 17.38-18.81% obtained in the present study were lower than the values 36.30 – 36.62% reported by Maigandi and Abubakar (2004) when they Fed Red Sokoto goats with varying levels of *Faidherbia albida* pods. This variation could be attributed to low content of crude fibre in SBKM. The values of Ether extract (5-8.0%) obtained from the present study were higher than the values of 4.90-6.80 % reported by Maigandi and Abubakar (2004) when nutrient intake and digestibility by Sokoto Red goats fed varying levels of *Faidherbia albida* pods were determined. The differences might be due to inclusion of SBKM in the present study. However, EE contents of the diets were similar to the values reported by Muhammad *et al.* (2008). However, Ash contents of the present study is within the range of (10.20-12.00%) as reported by Maigandi and Abubakar (2004) when nutrient intake and digestibility of small ruminant fed varying levels of *Faidherbia albida* pods were determined.

3. 2. 2. Performance Characteristics of the animals

Variation in feed intake between treatments could be as a result of individual differences among the experimental animals. One possible explanation for this is that the animals were purchased from different sources with possible differences in management system, even though measures were taken to eliminate these differences at the beginning of the experiment. Muhammad *et al.* (2008) had earlier reported that individual difference affected the rate of feed intake in sheep and other ruminants. The ADG values (51-96g/day) of animal recorded in this experiment is comparable to the values of 53-140g/day reported by Abil *et al*. (1992) when cotton seed cake and maize were replaced by wheat bran in the diets of Yankasa sheep. Maigandi and Wasagu (2002) reported a better ADG values (75.95g 141.19 g/day) when they used *Ficus sycomorus* leaves as feed for Yankasa rams. These differences could be due to breed and age variations. The variations in ADG could also be attributed to varying digestibility and utilization of nutrients by animals as reported by Saleh *et al.* (2005). However, the higher ADG obtained for treatment 2 (5%) SBKM could be attributed to the inclusion level of SBKM that is consumed by the animal. Adaptation, acceptability and utilization of diets could cause variation in feed intake and other performance characteristics such as the ADG (Kaleijaiye and Balogun, 2008).

Cost of incorporating SBKM on the performance of animal in the study indicated that even though ADG was not significantly affected up to 10% SBKM content inclusion levels, the cost of feed per kilogram live weight gain for treatment 2 (5% SBKM) (N553.33/kg) was lower than N 625.98/kg obtained for control diet and significantly higher ($P < 0.05$) for treatments 4 (15% SBKM) (N 2058.23/kg) 3 (10% SBKM) (N. 824.81/kg). This indicated that if SBKM is included in the diets of growing sheep at 5 %, the cost of feed per kilogram live weight will significantly reduce. It is evident, therefore, that the use of non-conventional feeds can reduce the cost of livestock production. Similar observations were made by Muhammad *et al.* (2008) when rice milling waste was fed to Uda sheep in a semi-arid zone of Nigeria.

The slight decrease in growth for treatment 1, 2 and 3 (fig 1) for the first three weeks could be attributed to the fact that the animals were adjusting in order to adapt to the diet which resulted in lowered feed intake, diarrhoea and loss of weight. Observed variations in growth between the treatments could be due to the variation in the composition of the experimental diets which shows varying degree of intake, utilization, and ADG between treatments. Acceptability and utilization of diets could affect the growth rate of animals (Kaleijaiye and Balogun, 2008).

3. 2. 3. Nutrients intake and digestibility

The increased CP, CF and NFE nutrient intake with increasing level of SBKM content especially for treatment 2 (5% SBKM) tend to point to the fact that SBKM improves nutrients digestibility. One reason for the improved nutrient intake especially for CP, CF and NFE could be related to the nutritional physiology of ruminants. It is known that, rumen micro-organisms have the ability to synthesize microbial protein from nitrogenous substance and carbon skeleton originating from the diets (McDonald *et al.*, 2002). CP intake value of 154-196g/day obtained in the present study is higher than value of 128-135g/day reported by Maigandi and Abubakar (2004). Similarly CF, NFE and EE intake values obtained in the present study were higher compared to values reported by Maigandi and Abubakar (2004). However, decrease in DM and EE digestibility as the level of SBKM% increased above 5% could be due to anti-nutritional factosr such as lectins, antitrypsin, tannins, saponins as indicated by Leng (1997). This could also induce variation among the experimental animals particularly in feed and nutrient intakes as well as nutrient digestibility.

Increased EE content of the diets with increased level of SBKM might have contributed to decreased intake of nutrients and digestibility. It was observed that increased fat content of diets could depress the activities of rumen microbes as observed by McDonald *et al.* (1995). However, the DM digestibility of 62-81% obtained in the present study was within the range reported by Muhammad *et al.* (2006) and Muhammad *et al.* (2008) for Uda sheep. The CP and CF digestibility values obtained from the present study were less than 89.6-91.4% and 79.3-80.6% respectively reported by Maigandi and Abubakar (2004). In addition values obtained for DM, CP, CF and EE digestibility were less compared to the report of Maigandi and Nasiru (2006). However, NFE digestibility values 64.6-78.7% were comparable to the work of Muhammad *et al.* (2006) when Uda sheep were fed diets containing Varying levels of rice milling waste.

4. CONCLUSION

Growth rate of the animals as indicated by live weight gain (LWG) and ADG were higher at 5% inclusion level of SBKM. It is therefore concluded that SBKM shall be included in the diet of Uda sheep at 5% level.

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