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# EFFECT OF VARYING INCLUSION LEVELS OF TEPHOSIA (*TEPHROSIA BRACTEOLATA* PERR. AND GUILL.) LEAF MEAL ON NUTRIENT DIGESTIBILITY AND NITROGEN BALANCE IN RED SOKOTO BUCKS

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## ABSTRACT

A study was carried out to evaluate the effect of varying inclusion levels of *Tephrosia bracteolata* leaf meal (TLM) on nutrient digestibility and nitrogen balance in Red Sokoto bucks. Twelve (12) growing Red Sokoto bucks with average body weight of 14kg were used. The animals were randomly assigned to four (4) dietary treatments containing TLM at 0, 5, 10, and 15% levels of inclusion, respectively. The bucks were individually fed with concentrate diets at 2% body weight in a Completely Randomized Design for a period of 21 days with three replications, while maize stover was fed at 3% body weight. Digestibility coefficients of dry matter (67.06%), crude protein (70.91%), and crude fibre (62.12%) were significantly (P<0.05) higher in bucks fed diet containing 15% TLM compared to bucks on other treatments. The digestibility of ether extract and ash were above 60% and differed significantly (P<0.05) across the dietary treatments. Bucks fed diet containing 15% TLM inclusion level had 33.43% higher digestibility for nitrogen free extract compared to bucks on 0% (control diet). However, neutral detergent fibre (69.17%) digestibility coefficient in bucks fed the control diet was significantly (P<0.05) higher than bucks on other treatments. Also, animals fed diets containing 15% TLM inclusion level had significant higher (P<0.05) nitrogen absorbed (10.89g/day), nitrogen retained (8.40g/day), nitrogen retained as % intake (62.08%) and nitrogen absorbed as % intake (80.57%) compared to animals in other treatments. The results show that inclusion of Tephrosia Leaf Meal up to 15% level of in the diet of growing Red Sokoto bucks increased nutrient intake and digestibility; and nitrogen retention by 23, 19 and 32% respectively. It was therefore, recommended that farmers could incorporate *Tephrosia bracteolata* leaf meal in the diets of Red Sokoto bucks at 15% for better nutrient digestibility and nitrogen retention in Shika, Northern Guinea Savanna of Nigeria.

**keywords**: *Tephrosia*, Nutrient digestibility, Nitrogen balance, Red Sokoto bucks

## INTRODUCTION

One of the major constraints to livestock production in Nigeria is lack of feeds, especially during the dry season. Sources of cheaper alternative forages of high nutritional value for ruminant livestock production have been a subject of research in the recent years, especially for small scale livestock producers in the tropical areas during the dry season (Alan *et al.*, 2013). *Tephrosia bracteolata* is a

tropical shrub-like legume, which belongs to the family *Leguminosae* and subfamily *Papilionaceae* and has over 300 species that are well distributed in tropical, subtropical and arid regions of the world (Babayemi *et al*., 2003). The leguminous shrubs produces seeds, leaves and stems which are useful in feeding animals in either fresh or conserved fodder (Ishiaku *et al*., 2015). They also reported a dry matter yield of 35.67tons/hectare at 12 weeks after sowing with 19.56%CP. Mbomi *et al*. (2011) observed the values of 22.11-24.10% CP, 12.35-14.62% CF, 56.74-60.19% NDF and 38.68-44.44% ADF for *Tephrosia* species. The nutrient composition of this shrub is adequate to provide nutrient required by ruminants and monogastric animals (Ishiaku *et al*., 2015). Furthermore, it provides a valuable source of supplementary protein for goats and could also improve the overall utilization of other nutrients at any season of the year (Babayemi and Bamikole, 2006). Goats and sheep on range and also in pens have shown preference for *T. bracteolata* than *T. candida* and *Leucaena leucocephala* (Lana *et al*., 1989). Products such as meat, milk, wool and skin are usually the aims of rearing small ruminant animals. However, among these four products, meat is the most important preferred product, especially in Nigeria where there is no taboo against consumption of goat meat (Hassan *et al*., 2016). Therefore, the objective of this study was to evaluate the nutrient utilization in Red Sokoto bucks fed diets containing graded levels of *T. bracteolata* leaf meal.

## MATERIALS AND METHODS

### Experimental Site and Location:

The metabolism trial was conducted at the Teaching and Research Farm of the Department of Animal Science, Ahmadu Bello University, Zaria. The farm is located at latitude 11.16° North and longitude 007.64° East at an altitude of 676m, above sea level (GPS, 2016). The climate of the study area is characterized by a defined wet and dry season. Wet season starts from April or early May and ends in late September or early October, while the dry season last from October to April. The total annual rainfall ranged from 748.6-1156.7 mm with long term average of 1058.60mm, with a maximum (35°C) and minimum (11.15°C) air temperature in May and December/January, respectively and relative humidity of approximately 75% (IAR, 2016).

### Experiment animals and management

Twelve (12) growing Red Sokoto bucks weighing 14±1kg were used for the study. The animals were sourced from open market. Each animal was placed in a separate metabolic cage. The metabolic cages, feeding troughs and drinkers were thoroughly washed and disinfected with Morigad before the arrival of the animals. The animals were dewormed with Sambezole (*Albendazole* 10% W/V oral suspension) at 1 ml per 10 kg body weight. All animals received 0.1ml/1kg body weight of Ivermectin (10ml) injection and 0.1mg/kg body weight of Tetranor (*Oxytetracycline Dehydrate*, 20% weight/volume injectable solution) during last two weeks of the quarantine period before commencement of experiment.

### Hay Preparation

Forage materials were harvested manually from 36 plots at 14 weeks after sowing using a machete. The harvested maize materials were chopped to 2cm with a machete and allowed to air-dry under a shade and stored in jute bags. The leaves of *T. bracteolata* were separated from the stems manually and were also dried under a shade. The cured materials were chopped with a forage chopper at the Teaching and Research Farm of the Department of Animal Science, Ahmadu Bello University, Zaria. The harvested forage materials were used for the metabolism trial with 12 growing Red Sokoto bucks.

**Experimental Design**

The twelve (12) growing Red Sokoto bucks were initially balanced for their weights and allotted to four dietary treatments containing *T. bracteolata* leaf meal at 0%, 5%, 10% and 15% inclusion levels, respectively with three animals per treatment in a Completely Randomized Design (CRD). The composition of the experimental diets is shown in Table 1.

**Table 1: Ingredient Composition of the Supplementary Diet fed to Red Sokoto Bucks**

| | Inclusion Levels of Tephrosia Leaf Meal (%) | | | |
|---|---|---|---|---|
| **Parameters** | 0 | 5 | 10 | 15 |
| **Maize Offal** | 41 | 41 | 42 | 40 |
| **Cotton Seed Cake** | 31 | 27 | 21 | 17 |
| **Tephrosia Leaf Meal** | 0 | 5 | 10 | 15 |
| **Rice Offal** | 25 | 24 | 24 | 25 |
| **Bone Meal** | 2.0 | 2.0 | 2.0 | 2.0 |
| **Table salt** | 1.0 | 1.0 | 1.0 | 1.0 |
| **Total Calculated Analysis** | 100 | 100 | 100 | 100 |
| **Crude protein** | 14.00 | 14.00 | 14.00 | 14.00 |

**Metabolism Trial**

The bucks were housed in individual metabolism crates ideal for easy and separate collection of urine and faeces as described by Osuji *et al.,* (1993). Three bucks were assigned to each of the experimental diets and fed once daily in the morning. Each animal was given concentrate at 2% of its body weight and water was given without restriction. Chopped maize stover was provided at 3% body weight. During the metabolism trial, concentrate diet was offered once in the morning (8.00am) before the maize stover was provided. The bucks were fed the experimental diets for twenty one (21) days. The first fourteen (14) days period was for acclimatization and then faecal and urinary collection followed during the subsequent seven (7) days of digestibility study.

Total faecal output from individual animal was collected daily in the morning, weighed, mixed thoroughly and 10% sub sample was taken for DM determination. The total faecal sample collected over the seven (7) days period was bulk and sub sampled for laboratory analyses. The total urine output for 24 hours was collected from individual animal for a period of 7 days. Urine was collected using graduated plastic containers placed under the metabolism crates containing 10ml 0.1N $H_2SO_4$ so as to trap the nitrogen. . Ten percent (10%) of the daily urine output (aliquot) was taken from each buck, bulked for each treatment and stored in a freezer at $0^0$C (Osuji *et al.,* 1993).

**Laboratory Analyses**

Feed and faecal samples were analysed for dry matter (DM), crude protein (CP), crude fibre (CF), ether extract (EE) and Ash using procedure of AOAC (2005). Nitrogen free extract (NFE) was calculated by difference: NFE = 100 – (CP + CF + EE + Ash). Acid detergent fibre (ADF) and neutral detergent fibre (NDF) were determined according to the method of Van-Soest *et al*. (1991). Urine was

analysed for nitrogen using Kjeldahl Procedure (AOAC, 2005). The analyses were carried out at the Biochemical Laboratory of the Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria. Organic matter (OM) was obtained as the difference between the dry matter and the residual ash content. Metabolizable energy of the diets was estimated using the method described by Alderman (1985):

$$ME\ (MJ/kg\ DM) = 11.78 + 0.00654CP + (0.000665EE)^2 - CF\ (0.00414EE) - 0.0118A$$

Where: A = Ash Content, CP = Crude Protein, EE = Ether Extract, CF = Crude Fibre

**Statistical Analysis**

Data collected on daily feed intake, coefficients of apparent nutrient digestibility and nitrogen retention were analysed by Analysis of Variance using General Linear Model of SAS (2005). Significant ($P<0.05\%$) differences among treatment means were separated using Duncan's Multiple Range Test (Duncan, 1955) in the SAS package. The following model was used:

$$Y_{ij} = \mu + I_j + E_{ij}$$

Where:

$Y_{ij}$ = Record of observations

$\mu$ = Population mean

$I_j$ = Effect of treatment (j= 1, 2, 3, 4)

$E_{ij}$ = Random error.

## RESULTS

**Chemical Composition and Metabolizable Energy of the Experimental Diet Fed to Growing Red Sokoto Bucks**

The chemical composition and metabolizable energy of the supplementary diets, *Tephrosia bracteolata* leaf meal (TLM) and maize stover used in the experiment are presented in Table 2. The maize stover had a dry matter (DM) content of 93.51%, CP (6.25%), organic matter (87.95%) and crude fibre (27.50%). Tephrosia leaf meal had a CP content of 22.33%, organic matter (64.68%) and crude fibre (23.45%). The organic matter and crude protein contents of the supplementary diets were similar across the treatments. However, the highest value of crude fibre (17.82%) was observed in 15% TLM inclusion level while 10% TLM had the least (16.30%) crude fibre content. The NFE content ranged from 53.75% in 15% TLM to 54.98% in 5% TLM. The metabolizable energy content for 0%, 5%, 10% and 15% TLM inclusion levels were 11.35, 11.36, 11.45 and 11.68MJ/kg, respectively. The neutral detergent fibre (NDF) content of the experimental diets ranged from 60.56% in diet with 10% TLM, to 58.68% in 0% TLM. Also, the acid detergent fibre content of the diets were highest in 0% TLM inclusion (29.67%) and lowest was observed in 10% TLM inclusion (26.86%). The highest value of 12.18% for acid detergent lignin was recorded in 5% TLM.

**Table 2: Chemical composition and Metabolizable Energy of the Experimental diet fed to Growing Red Sokoto Bucks**

| | Inclusion Levels of TLM (%) | | | | | |
|---|---|---|---|---|---|---|
| **parameters** | **0** | **5** | **10** | **15** | **TLM** | **Maize stover** |
| Dry matter (%) | 91.50 | 90.40 | 91.05 | 92.00 | 70.03 | 93.51 |
| Organic matter (%) | 81.65 | 81.45 | 81.65 | 80.80 | 64.68 | 87.95 |
| Crude protein (%) | 15.15 | 15.17 | 15.22 | 15.24 | 22.33 | 6.25 |
| Crude fibre (%) | 17.00 | 17.25 | 16.30 | 17.82 | 23.45 | 27.50 |
| Ether extract (%) | 6.40 | 5.83 | 5.10 | 5.75 | 2.64 | 0.76 |
| Ash (%) | 6.85 | 6.77 | 7.40 | 6.73 | 5.35 | 5.15 |
| Nitrogen free extract (%) | 54.10 | 54.98 | 54.15 | 53.75 | 46.23 | 60.34 |
| Metabolizable Energy (MJ/Kg) | 11.35 | 11.36 | 11.45 | 11.68 | 11.89 | 11.67 |
| Acid detergent fibre (%) | 29.67 | 28.60 | 26.86 | 26.88 | 27.94 | 15.15 |
| Neutral detergent fibre (%) | 58.68 | 59.22 | 60.56 | 60.40 | 46.00 | 57.29 |
| Acid detergent lignin (%) | 11.56 | 12.18 | 10.72 | 10.68 | 11.76 | 14.50 |

TLM = *Tephrosia bracteolata* leaf meal

**Nutrient Intake**

The result of the nutrients intake (Table 3) showed that the DMI (455.67g/d), OMI (411.13g/d), CPI (67.67g/d) and CFI (84.67g/d) were highest at 15% TLM inclusion in the supplement and were statistically similar to 446.00g/d DM, 404.38g/d OM, 62.22g/d CP and 86.61g/d CF for bucks fed diet containing 10% TLM. Treatment diet with 10% TLM recorded 43% higher (P<0.05) NFE intake compared to the control (0%TLM). Ether extract intake ranged from 62.88g/d to 52.27g/d and was highest for T4 (15% TLM inclusion). Also, ash intake (44.54g/d), neutral detergent fibre intake (284.34g/d), acid detergent fibre intake (122.48g/d) and acid detergent lignin intake (48.85) were best in 15%TLM and poorest in 0%TLM.

**Table 3: Nutrient Intake of Red Sokoto Bucks Fed Diet Containing Graded Levels of *T. bracteolate* Leaf Meal with Maize Stover as Basal Diet.**

| | Inclusion Levels of TLM (%) | | | | |
|---|---|---|---|---|---|
| **Parameter (g/d)** | **0** | **5** | **10** | **15** | **SEM** |
| **Dry matter** | **363.00$^{c}$** | **400.00$^{b}$** | **446.00 $^{a}$** | **455.67$^{a}$** | **12.74** |
| Organic matter | 325.39 $^{c}$ | 364.35 $^{b}$ | 404.38 $^{a}$ | 411.13 $^{a}$ | 10.42 |
| Crude protein | 58.35 $^{b}$ | 61.66 $^{b}$ | 62.22$^{a\ b}$ | 67.67 $^{a}$ | 2.77 |
| Crude fibre | 47.60 $^{c}$ | 68.02 $^{b}$ | 86.61 $^{a}$ | 84.67 $^{a}$ | 5.49 |
| Ether extract | 159.74 $^{c}$ | 194.26 $^{b}$ | 279.47 $^{b}$ | 240.24 $^{a}$ | 18.05 |
| Ash | 52.27 $^{b}$ | 57.2 0 $^{b}$ | 58.43 $^{a\ b}$ | 62.88 $^{a}$ | 1.82 |
| Nitrogen free extract | 37.61 $^{c}$ | 35.65 $^{c}$ | 41.62 $^{a}$ | 44.54 $^{b}$ | 3.02 |
| Neutral detergent fibre | 216.64 $^{c}$ | 244.88 $^{b}$ | 287.05$^{a}$ | 284.34 $^{a}$ | 7.69 |
| Acid detergent fibre | 111.33 $^{c}$ | 114.40 $^{b}$ | 120.24 $^{a\ b}$ | 122.48 $^{a}$ | 3.83 |
| Acid detergent lignin | 35.03 $^{c}$ | 40.72 $^{b}$ | 38.71 $^{b}$ | 48.85 $^{a}$ | 1.23 |

$^{abc}$ Means with different superscripts within the same row differed significantly (P<0.05), SEM= standard error of mean

**Apparent Nutrient Digestibility**

Table 4 shows the results of the apparent nutrient digestibility study. There were significant (P<0.05) differences across in all the apparent digestibility coefficients measured. The values of the dry matter, organic matter, crude protein, crude fibre, ash, nitrogen free extract and acid detergent lignin were significantly (P<0.05) higher for diet containing 15% TLM compared to the control diet fed to the animals. However, the digestibility of ether extract (86.18%), neutral detergent fibre (69.17%), acid detergent fibre (68.60%) were significantly (P<0.05) higher in control diet and lowest in diet contain 10% *T. bracteolata* fed to the animals.

**Table 4: Apparent nutrient digestibility of diet containing graded levels of *T. bracteolata* leaf meal with Double-red maize stover as basal diet fed to Red Sokoto bucks.**

| | Inclusion Levels of TLM (%) | | | | |
|---|---|---|---|---|---|
| **Parameter (%)** | 0 | 5 | 10 | 15 | SEM |
| Dry matter | 65.52$^{c}$ | 62.27$^{bc}$ | 64.12$^{ab}$ | 67.06$^{a}$ | 1.41$^{*}$ |
| Organic matter | 56.05$^{b}$ | 62.51$^{ab}$ | 66.66$^{a}$ | 65.41$^{a}$ | 4.49$^{*}$ |
| Crude protein | 57.03$^{c}$ | 64.47$^{b}$ | 65.03$^{b}$ | 70.91$^{a}$ | 2.09$^{*}$ |
| Crude fibre | 41.10$^{b}$ | 45.73$^{b}$ | 61.98$^{a}$ | 62.12$^{a}$ | 5.12$^{*}$ |
| Ether extract | 86.18$^{a}$ | 79.43$^{b}$ | 75.53$^{c}$ | 81.16$^{b}$ | 1.40$^{*}$ |
| Ash | 62.22$^{c}$ | 64.59$^{bc}$ | 67.27$^{b}$ | 70.44$^{a}$ | 1.43$^{*}$ |
| Nitrogen free extract | 42.27$^{b}$ | 60.97$^{a}$ | 57.85$^{a}$ | 63.50$^{a}$ | 6.50$^{*}$ |
| Neutral detergent fibre | 69.17$^{a}$ | 66.27$^{b}$ | 66.16$^{b}$ | 67.69$^{ab}$ | 1.14$^{*}$ |
| Acid detergent fibre | 68.60$^{a}$ | 62.61$^{b}$ | 54.82$^{c}$ | 57.70$^{c}$ | 1.87$^{*}$ |
| Acid detergent lignin | 65.19$^{a}$ | 58.51$^{a}$ | 45.17$^{b}$ | 67.32$^{a}$ | 5.02$^{*}$ |

$^{abc}$ means with different superscripts within the same row differed significantly (P<0.05), * = significant at 5% level of significant, SEM= standard error of mean

**Nitrogen balance in Red Sokoto bucks fed diet containing graded level of *T. bracteolata* leaf meal with maize stover as basal diet.**

The result of nitrogen balance is presented in table 5. The result showed that there was significant (P<0.05) difference in nitrogen balance across all the treatments. The nitrogen intake increased (P<0.05) with increasing level of TLM inclusion in the diets. The lowest (2.62 g/day) faecal nitrogen loss obtained in bucks fed diet containing 15% TLM, which was not significantly (P>0.05) different from the control (2.92 g/day). Nitrogen absorbed (g/day) was significantly (P<0.05) higher in bucks fed diets containing 10% and 15% TLM compared to the control. Animal fed diet containing 15% TLM had 24% and 17% higher nitrogen absorbed compared to the animals fed the control and 10% TLM inclusion level, respectively. The highest amount of nitrogen retained (8.40 g/day) and nitrogen retained as percentage of intake (62.08%) were obtained in bucks fed diet containing 15% TLM compared to the other treatments. The highest (80.57%) amount of nitrogen absorbed as percentage of intake was recorded in bucks fed diet containing 15% TLM, which did not differ significantly ((P<0.05) from (73.74%) of bucks fed control diets.

**Table 5: Nitrogen Balance in Red Bucks Fed Diet Containing Graded Levels of *T. bracteolata* Leaf Meal with Maize Stover as Basal diet.**

| | Inclusion Levels of TLM (%) | | | | |
|---|---|---|---|---|---|
| **Parameter (g/day)** | 0 | 5 | 10 | 15 | SEM |
| Nitrogen intake | $11.15^{c}$ | $11.71^{c}$ | $12.75^{b}$ | $13.51^{a}$ | $0.33^{*}$ |
| Faecal nitrogen loss | $2.92^{b}$ | $3.55^{a}$ | $3.76^{a}$ | $2.62^{b}$ | $0.19^{*}$ |
| Urinary nitrogen loss | 2.52 | 2.08 | 2.36 | 2.50 | $0.46^{NS}$ |
| Total nitrogen outgo | 5.54 | 5.63 | 6.11 | 5.12 | $0.54^{NS}$ |
| Nitrogen absorbed | $8.23^{c}$ | $8.16^{c}$ | $9.00^{b}$ | $10.89^{a}$ | $0.32^{*}$ |
| Nitrogen retained | $5.71^{b}$ | $6.08^{b}$ | $6.64^{b}$ | 8.40a | $0.53^{*}$ |
| N retained as % intake | $51.12^{b}$ | $52.04^{b}$ | $52.18^{b}$ | $62.08^{a}$ | $1.40^{*}$ |
| N absorbed as % intake | $73.74^{ab}$ | $69.69^{b}$ | $70.55^{b}$ | $80.57^{a}$ | $3.95^{*}$ |

$^{abc}$ means with different superscripts within the same row differed significantly (P<0.05), *= significant at 5% level of significant, NS = not significant, SEM= standard error of mean, N= nitrogen

## DISCUSSION

### Chemical composition and Metabolizable Energy of the Experimental diet fed to growing Red Sokoto bucks

Chemical composition and Metabolizable Energy contents of the experimental diet fed to growing Red Sokoto bucks are shown in Table 4. The dry matter content of maize stover (93.51%) observed was similar to 93.55% reported by Hassan *et al*. (2014). The crude protein content (6.25%) was higher than 4.31% reported by Hassan *et al.* (2014) for maize stover. This might be attributed to the different companion crop used in the intercropped during the crop growth stage. The crude protein content of the supplementary diet increases with increase in the inclusion levels of *T. bracteolata* leaf meal (TLM) in the diets. The crude protein content ranged from 15.15-15.24%. This might be attributed to increase in the levels TLM in the diets. Crude protein is one of the parameters used in evaluating pasture quality. However, the CP content of all the treatments were greater than the critical level of seven recommended by ARC (1980) and 8% suggested by Norton (2003) for ruminal function. The CP values recorded met the requirement of 10-12% for sheep and goats (Wada *et al.*, 2016). The crude fibre and its fractions of the concentrate diets were similar to what Hassan *et al*. (2014) recorded for concentrate fed to growing Red Sokoto bucks but slightly lower than the values obtained by Ishiaku (2016). This might be attributed to differences in ingredients used in formulating the diet. The neutral detergent fibre (NDF) values recorded were slightly above 60% suggested by Muia (2000) as critical limit for efficient utilization of roughages. The metabolizable energy obtained ranged from 11.35-11.68MJ/kg which is above the range of values (10.85-11.16MJ/kg) reported by Sani *et al*. (2015) for fattening bulls.

### Nutrient Intake

Feed intake is an important factor in the utilization of feed by livestock and is a critical determinant of energy and protein availability as well as performance in small ruminant (Ajayi *et al*., 2005). Dry matter intakes, Nutrients (crude protein, crude fibre, nitrogen

free extract, ether extract and ash) are indices for acceptability of this forage to the goats. The nutrient intake was observed to increase with increasing levels of tephrosia leaf meals. This suggests that TLM is palatable and acceptable to goats. This corroborated with the report of Ogungbensan *et al*., (2011) who also observed the highest nutrients intake with increasing level of *Tephrosia bracteolata* hay in the diets. Legumes are characterized by a quantity of readily fermentable substrate available for microbial use after mastication; legumes are high in soluble substrates and stored starch that might increase the number of both holotrichs and entodiniormorphs (Jones and Wilson, 1987). Njidda *et al.,* (2014) obtained the best dry matter intake in T4 (15% *Ziziphus mucrotana* inclusion) and poorest in T1 (0% *Ziziphus mucrotana* inclusion). The work also corroborated with previous findings. Wada *et al.* (2014) found that the dry matter intake was higher for T4 (15% *Parlia biglobosa* inclusion) and lowest for T1 (0%) and T2 (5%). Higher nutrients intake were observed when maize stover with poor nitrogen level was supplemented with lablab hay and *Ficus sycomorus* forage (Hassan *et al.*, 2016: Abdu *et al*., 2012a).

**Apparent Nutrient Digestibility**

Crude protein content of the maize stover basal diet was below 7 %, which is the critical level required for ruminal function (ARC, 1980). Relative to digestion of grasses, legumes are characterized by a quantity of readily fermentable substrate available for microbial use after mastication; legumes are high in soluble substrates and stored starch that might increase numbers of both holotrichs and entodiniormorphs (Jones and Wilson 1987). The dry matter and crude protein digestibility ranged from 62.27-67.06% and 57.03-70.91%, respectively. These values were higher than the range of values for crude protein digestibility (49.64-62.102%) reported by Babayemi and Bamikole (2006) when *Tephrosia candida* was included in the diet fed to West African Dwarf bucks. The increase in the apparent digestibility of dry matter, organic matter, crude fibre, ash and nitrogen free extract as a result of TLM inclusion is in agreement with the findings of Ogungbesan *et. al*., (2011) that tephrosia forage improves digestibility of poor quality roughages. Also, Amodu *et al.,* (2008) observed an increase in digestibility coefficients in Yankasa rams fed millet-lablab silage mixtures at 50:50 proportion compared to sole millet fed to the animals. Forage legumes are good sources of digestible nitrogen and fermentable energy so their inclusion in low quality diets is likely to increase the rumen population of cellulolytic microbes, thereby improve the rumen concentration of fermentable products and nitrogen utilization (Ahamefule *et al*., 2006).

**Nitrogen balance**

Nitrogen balance is the major indicator for assessing the protein nutritional status of ruminant livestock (Abdu *et al*., 2012b; Hassan *et al*., 2016). It is also the proportion of nitrogen utilized by the farm animals from the total nitrogen intake for the animal body process, hence the more nitrogen consumed and digested the more nitrogen retained and vice versa (Okeniyi *et. al.,* 2010). The higher nitrogen absorbed and retained in bucks fed diet containing 15%TLM could be attributed to higher nitrogen intake (13.51g/day) and lowest (2.62g/day) faecal nitrogen loss. Similar results were also reported in Sokoto Red bucks fed maize stover basal diet supplemented with lablab hay (Hassan *et al*., 2016). The higher N retention in diet containing 15%TLM inclusion can be attributed to the additional N supplied by TLM in the diet. Khan *et al.* (2009) reported a similar result when some selected leguminous tree leaves were used as replacements for cotton seed cake in dairy goats in Mansehra, Pakistan. The bucks were in positive nitrogen balance with bucks on diet containing 15%TLM inclusion having the highest. This shows that more than enough protein needed was released to the body by the diets thereby

precluding the possibility of endogenous addition.

## CONCLUSION

It was concluded from the results of the study that inclusion of Tephrosia Leaf Meal up to 15% level of inclusion in the diet of growing Red Sokoto bucks increased nutrient intake and digestibility; and nitrogen retention by 23, 19 and 32% respectively. It is therefore recommended that farmers could incorporate Tephrosia Leaf Meal at 15% level for better nutrient digestibility and nitrogen retention.

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