



**Performance of Yankasa rams fed different ratios of *Brachiaria ruziziensis* forage and Concentrate in a total mixed ration.**

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**Abstract**

A feeding trial which lasted for (12) weeks was carried out to determine feed intake, nutrient digestibility and nitrogen balance by growing Yankasa rams fed different ratios of *Brachiaria ruziziensis* and concentrate in a total mixed ration at the National Animal Production Research Institute Shika, Zaria in Northern Guinea Savanna of Nigeria. Sixteen healthy Growing Yankasa rams with an average live weight of 21.75kg±1kg were randomly allocated to four treatments with four replicates in a Complete Randomized Design (CRD). The treatment diets were ratios of *Brachiaria ruziziensis* to concentrate mixtures: (90:10), (80:20), (70:30) and (60:40). Feed intake (57.19kg), Daily feed intake (635.48g/day), Average daily gain (61.11g/day), and feed conversion ratio (10.47) were significantly higher ( $P<0.05$ ) for animals' fed 60:40 ratio of *B.ruziziensis* to concentrate mixture and showed a decline across the treatments as the quantity of concentrate inclusion in the mixture decreased. Feed conversion ratio (10.47) was significantly ( $P<0.05$ ) lower in animals fed the 60:40 ratio. It was concluded from this study that feeding Yankasa rams with 60:40 ratio *B.ruziziensis* to concentrate mixture in a total mixed ration improved utilization, and gave the highest weight gain (5.5kg) and revenue (₦4887.7). Thus it is recommended for smallholder farmers and livestock owners in the Northern Guinea Savanna of Nigeria.

**Keywords:** *Brachiaria ruziziensis*, Yankasa rams, Total mixed ration, Forage.

**Introduction**

Small ruminants play a key role in bridging the wide gap in the supply of animal protein for human consumption (Osinowo *et al.*, 1991) because of their special features with relatively short generation interval as compared to cattle, and also have high reproductive rate and low production cost. Given the estimated population of 72.5 million goats and 41.3 million sheep (NASS, 2011) and specifically about 70 percent of the sheep and goat populations are concentrated in the northern region of the country. Concentration of Nigeria's livestock-base in the northern region is most likely to have been influenced by the ecological condition of the region, which is characterized by low rainfall duration, lighter sandy soils and longer dry season. Therefore, the importance and advantages of small ruminants cannot be over looked.

The main feed resources for ruminant animals are pastures, crop residues and other agro-industrial by-products. In the dry season and post-harvest periods, these feed resources become the main sources of energy for use by ruminants when poor quality forages from the range land prevail (Kibon and Ørskov, 1993). The quantity and quality of available feedstuffs are the major factors influencing productivity of ruminants in many parts of the world, especially regions with high animal numbers. Crop residues are potential feed resources especially during the dry season. However, cereals from these crop residues are generally low in digestibility, because of high fibre content and are deficient in nitrogen, minerals and vitamins. The cell walls of low quality roughages are generally high in indigestible fractions of lignin and silica (Jayasuriya, 1986). However, animal performance with such feedstuffs can be poor due to low voluntary

intake and digestibility, which result from low protein concentrations and high levels of indigestible or slowly degradable fibre (Abdel Hameed *et al.*, 2013).

*Brachiaria* is one of the most important forage grasses grown for pastures in the tropics (Singh, 2009). *Brachiaria* is a species of grass originating from the Savanna of the Eastern part of Africa. The grass species is widely used as livestock feed. *Brachiaria* species are either annual or perennial grasses, with most of the species lacking rhizomes. The inflorescence has panicle branches composed of racemes and the entire plant usually do not grow higher than 1m. *Brachiaria* belongs to the C4 plants which tolerate drier conditions and more light exposure than many other plants (Watson and Dallwitz, 2008). In this context, Silva *et al.* (2004) reported that species of the genus *Brachiaria* are frequently used in no-till systems because these plants are highly adaptable and tolerant to limiting conditions that would affect other forage species negatively. *B. ruziziensis* has a good nutritive value and is more palatable than most other *Brachiaria* spp. Its crude protein (CP) content commonly ranged from 7–13% and up to 20% with dry matter digestibility of 55–75%. For *B. ruziziensis* grass hay cut 45 days after seeding in northeast Thailand, the IVDMD, crude fibre, NDF and ME concentrations were 61%, 80.5%, 72.8% and 7.9 MJ/kg, respectively (Cook *et al.*, 2005). Selective grazing, heavy grazing pressure and the need for high soil fertility can result in the loss of *B. ruziziensis* grass (Schultze-Kraft and Teitzel, 1992).

#### The Objectives of the study include.

1. To evaluate the growth performance of Yankasa rams fed different ratios of *Brachiaria ruziziensis* and concentrate in a total mixed ration.
2. To determine the cost benefit of feeding Yankasa rams with *B. ruziziensis* and Concentrate in different ratios of inclusion.

## Materials and Method

### Location of the Study

This Experiment was carried out at the calf house of the Dairy Research Programme (DRP) of the National Animal Production Research Institute (NAPRI), Ahmadu Bello University, Shika-Zaria, 22km North West of Zaria in the Northern Guinea Savannah zone of Nigeria. Shika is geographically located between latitude 11° 12'N and longitude 7° 33'E at an altitude of 660m above sea level (Ovimaps, 2015), Wet season starts from April to early May and ends in late September to early October. Long-term annual rainfall ranges from 1110 to 1580 mm with maximum temperature of 30°C and relative humidity of approximately 70% (I.A.R, 2017).

### Management and Experimental Animals:

Sixteen (16) healthy growing yankasa rams of about 12 months old and similar weight ( $21 \pm 0.3$  kg) were used. The Experimental animals were given profilactic treatment against both endo and ecto parasite using *Albendazole* 20 ml/ 10 kg, *Amiticks* spray (200 ml/ 20 ltr), *Ivermectin* (subcute) 0.1ml/10kg and Long Acting Tetracycline (antibiotics) against bacterial infection. The Animals were housed in a stall and fed the experimental diet. The pen was washed with detergent and disinfectant against microorganisms before the commencement of the experiment.

### Treatments and Experimental Design. and Feeding

The rams were weighed and randomly allocated to four different dietary treatment groups, consisting of 4 rams (replicates) per group, in Complete Randomize Design (CRD). The animals were fed experimental Diets at 8am in the morning in their individual pen *ad-libitum*, T<sub>1</sub> were fed *B. ruziziensis* to concentrate ratio at (90:10) Ratio, T<sub>2</sub> were fed *B. ruziziensis* to Concentrate in a ratio of 80:20, T<sub>3</sub> were fed 70:30 and T<sub>4</sub> 60:40 ratio respectively and each serve as treatment and was fed *ad-libitum*. Clean water and Mineral lick was also offered

*ad-libitum*. Parameters measured were feed intake, live weight change, feed conversion ratio and

### Feed intake

The feeding was done ad-lib the daily record of feed intake was obtained by subtracting the quantity of left (ort) from the feed offered the previous feeding before next day feeding to determine the daily intake.

### Live weight Change

Prior to the commencement of the experiment the animals were balanced for weight and allocated into four treatment groups, the animals were weighed on fortnightly basis in order to find out their live weight changes. The live weight changes were determined by difference (final – initial).

### Chemical Analysis

A Sub-sample from the bulk of the experimental diet and faecal sample were obtained, dried and milled for the determination of Crude Protein, Crude Fiber (CF), Ether Extract (EE), and Ash content while soluble carbohydrates (NFE) by subtracting the sum of % ash, % crude fiber, % crude fat and % crude protein from 100. That is:  $NFE = 100 - (\% \text{ ash} + \% \text{ crude fiber} + \% \text{ crude fat} + \% \text{ crude protein})$ . N-content was determined using the method of Micro Kjeldahl procedure of A.O.A.C. (2005). Neutral detergent fibre (NDF), and Acid detergent fibre (ADF), by the method of (Van-Soest *et al.*, 1999). Mineral content (Calcium and Phosphorus) was determined by AOAC (2005) Methods using the Atomic Absorption Spectrophotometer.

### Statistical Analysis:

All data collected on the animal experiment was subjected to analysis of variance (ANOVA) using SAS package (SAS, 2002) and the means were separated using Duncan Multiple Range Test (Duncan, 1955).

## Results and Discussion

### Chemical composition and Energy content of *Brachiaria ruziziensis* and Concentrate ratios in a total mixed ration.

Table 1 presents the chemical composition of the experimental diet. Organic Matter (89.70) of the concentrate diet was similar to (89.55) of the *Brachiaria ruziziensis* hay. C.P content of the concentrate diet (12.63) is higher ( $P < 0.05$ ) than the hay (8.25) which is above the minimum requirement of a ruminant animal for maintenance as reported by NRC (2007) and Van Soest (1994) which ranges between 6-8% CP as efficient for rumen function and maintenance. The organic matter of the different experimental diet mixtures presented in table 2 was similar across the treatments 90:10, 80:20, 70:30 and 60:40, (92.21, 92.01, 91.39 and 92.60) respectively. The C.P content of the mixture ratios was within the range of (6-8%) C.P in 90:10 and 80:20 but higher (8.13 and 11.75) in 70:30 and 60:40 respectively. M.E was similar (3807.75, 3876.30 and 3893.26) in 80:20, 70:30 and 60:40 respectively and the least was 2292.9 kcal/kg in 90:10.

### Growth Performance of Yankasa rams fed *Brachiaria ruziziensis* and concentrate ratios in a total mixed ration.

The results obtained from growth performance of yankasa rams are shown in Table 3 above. Weight gain shows significant ( $P < 0.05$ ) difference among the treatments with the highest recorded in animals fed (60:40) ratio *Brachiaria ruziziensis* to concentrate mixture (5.5kg). The result of this study show a trend that weight gain increases with increased levels of the concentrate because 60:40 ratio had the highest level of inclusion recorded the highest

**Table 1. Composition of concentrate diet**

Ingredient	Percentage (%)	
Maize	31.2	
Maize offal	15.6	
Wheat offal	15.6	
Cotton seed cake	34.6	
Bone meal	2	
Salt	1	
Total	100.0	
Chemical Analysis (%)	Concentrate	Hay
O.M	89.70	89.55
C.P	12.63	8.25
E.E	7.68	4.35
C.F	7.30	26.41
Ash	4.03	2.88
NFE	68.36	58.11
ADF	22.31	35.15
NDF	39.95	61.58
M.E (kcal/kg)	3934.34	2104.75
Cost/kg	₦72.24/kg	₦39.28/kg

**Table 2. Chemical Composition and Energy Content of *Brachiaria ruziziensis* to concentrate mixture ratios in a total mixed ration.**

Percentage (%)	(90:10)	(80:20)	(70:30)	(60:40)
Dry Matter	92.21	92.01	91.39	92.60
Organic Matter	87.55	85.14	87.22	86.86
Crude Protein	7.56	7.88	8.13	11.75
Ether Extract	9.49	7.26	8.26	8.04
Nitrogen free Extract	56.96	49.59	62.36	57.10
ASH	4.66	6.87	4.17	5.74
NDF	53.14	48.85	49.97	40.42
ADF	32.01	32.56	25.13	22.95
Hemicellulose	21.13	16.29	24.84	17.47
M.E (Kcal/kg)	2292.96	3807.75	3876.30	3893.26

values of mean weight gain. There was a linear trend for the live weight gain with a significant improvement along the treatments as a result of inclusion level of concentrate, feed intake

(57.19kg), Daily feed intake (635.48g/day), Average daily gain (61.11g/day), and feed conversion ratio (10.47) were significantly higher ( $P < 0.05$ ) with animals' place on (60:40)

ratio *B.ruziziensis* concentrate mixtures and show a decline across as the quantity of concentrate inclusion in the mixtures decrease as in (90:10) ratio *B.ruziziensis* and concentrate mixture. Feed conversion ratio, the lower the better and in this study the feed conversion ratio was significantly ( $P<0.05$ ) lower in animals on (60:40) ratio *B.ruziziensis* and concentrate mixture (10.47), this indicates the better efficiency of converting feed to flesh and adipose tissue. Sani *et al.* (2014) reported a lower weight gain compared to this study when they fed *B.ruziziensis* with different protein supplements. However, basal diet in itself alone is not sufficient to meet the animal's maintenance and production requirements. The improvement in feed conversion efficiency at 60:40 ratio mixture meant that the efficiency of absorbed amino acids and energy VFA available from digestion corresponded to the animals' requirement needed for efficient

utilization of poor quality resources Preston and Leng, (1987). Average daily gain (g/day) is within the range of 33.56 – 62.89g/day as reported by Abdullahi *et al.* (2016) but lower than the value 109.32 – 160.67g/day as reported Alabi *et al.* (2010) when the authors fed *Brachiaria decumbens* as a basal diets supplemented with sorrel seed (*Hibiscus sabdariffa*) to Yankasa rams. On the other hand, the values 61.11 g/day obtained were higher than the values (49.04g) and (52.98g) as revealed Ajayi *et al.* (2014) who fed concentrate diets with corn cob at varying inclusion levels. Ferdous *et al.* (2011) who reported that higher levels of concentrate supplementation increase live weight gain. The growth rate in ruminant is highly correlated with the energy and protein intake; with energy intake being the major limiting factor affecting tissues deposition Leng, (1990).

**Table 3: Growth Performance of Yankasa rams fed *Brachiaria ruziziensis* to concentrate mixture ratios in a total mixed ration.**

Parameters	Treatment (B.ruzi/Conc.)				SEM
	(90:10)	(80:20)	(70:30)	(60:40)	
Initial body weight (Kg)	21.75	22.0	21.75	21.75	
Final body weight (kg)	24.0 <sup>b</sup>	24.88 <sup>ab</sup>	25.25 <sup>ab</sup>	27.25 <sup>a</sup>	0.96*
Weight gain (kg)	2.25 <sup>c</sup>	2.88 <sup>bc</sup>	3.50 <sup>b</sup>	5.5 <sup>a</sup>	0.25*
Average daily weight gain (g/day)	25.00 <sup>c</sup>	31.94 <sup>bc</sup>	38.89 <sup>b</sup>	61.11 <sup>a</sup>	2.74*
Total Feed intake (kg)	40.11 <sup>b</sup>	50.18 <sup>ab</sup>	54.21 <sup>ab</sup>	57.19 <sup>a</sup>	3.54*
Daily feed intake (g/day)	445.69 <sup>c</sup>	557.58 <sup>b</sup>	602.29 <sup>ab</sup>	635.48 <sup>a</sup>	39.5*
Feed Conversion ratio	18.31 <sup>c</sup>	17.73 <sup>c</sup>	15.88 <sup>b</sup>	10.47 <sup>a</sup>	2.00*

<sup>a b c</sup>: Means with different superscript within a row differed significantly ( $P<0.05$ ). SEM: Standard error of mean, \* Significant at 5%

**Cost analysis of feeding *Brachiaria ruziziensis* and Concentrate ratios in a Total mixed ration to Yankasa rams.**

There was an increase ( $P<0.05$ ) in the cost of feed with increase in the ratio of concentrate in the total mixed ration (TMR), 90:10 mixture

had (₦42.58), which increase to (₦52.46) at 60:40 ratio. The increase in the cost is as a result of increase in the level of concentrate which was made from agro-industrial by-products which are known to be expensive. The cost of feeding differs ( $P<0.05$ ) significantly across the treatments where 60:40 ratio recorded the highest value (₦3005) and 90:10 ratio recorded the least (₦1707.8). The progressive increase in TMR intake has to do with the palatability of the TMR at 60:40 ratio hence with increase in the cost of feed consumed. Total expenditure differs ( $P<0.05$ ) significantly across the treatments where animals on 60:40 ratio incurred the highest (₦12612.3) expenditure as a result of the quantity and cost of concentrate inclusion in the ration, the cost of production increases across the treatments as the cost of concentrate increases and vice versa. The revenue generated was highest with animals fed 60:40 ratio (₦17500) was recovered and the least value was on 90:10 ratio (₦10444.7) and (₦11125) respectively. High quality feed is associated with increase in intake and performance and weight gain by the animals fed 60:40 ratios. Gross margin at the end of keeping the animals also differ ( $P<0.05$ ) significantly

across the treatments where animals on 60:40 ratio gave the highest (₦4887.7) and the least (₦680) with animals on 90:10 ratio. This can also be attributed to the quantity concentrate inclusion and weight gain by the animals fed 60:40 ratio. (Yashim *et al.*, 2014) reported that the Cost of feeding and cost of feed per kg gain were influenced by feeding regime. This agrees with earlier findings that increased feeding frequency has a negative impact on cost of feeding, as greater feeding frequencies have been shown to result in increased cost of feeding ruminants (Komwihangilo and Mlela. 2012). Also, restricted feed intake has been reported to increase nutrient digestibility and decreased methane loss resulting to better weight gain (Tovar-Luna *et al.* 2007). Bello *et al.*, (2016) reported a similar total revenue of (₦7565.40), and Net farm income (₦2005.42). Gross margin followed similar trend as was observed for total revenue and net farm in-come in which highest values were recorded for supplemented treatment group (₦3272.42). When he fed dried poultry droppings as supplement to rams as profitable and it is similar with the findings of this study.

**Table 4: Cost analysis of feeding *Brachiaria ruziziensis* and Concentrate mixtures ratios on yankasa rams under small holder system**

Parameters	B.ruziziensis : Concentrate ratio				SEM
	90:10:00	80:20:00	70:30:00	60:40:00	
Cost of rams (₦/ram)	8500 <sup>d</sup>	9750 <sup>a</sup>	9250 <sup>c</sup>	9375 <sup>b</sup>	193.48*
Cost of feed / kg	42.58 <sup>d</sup>	45.87 <sup>c</sup>	49.17 <sup>b</sup>	52.46 <sup>a</sup>	4.94*
Cost of feed (₦/kg) consumed	18.98 <sup>d</sup>	25.57 <sup>c</sup>	29.61 <sup>b</sup>	33.34 <sup>a</sup>	0.89*
Total cost of feed consumed (₦)	1707.8 <sup>d</sup>	2301.9 <sup>c</sup>	2665.2 <sup>b</sup>	3000.5 <sup>a</sup>	80.84*
Total cost of Fattening ram (₦)	10444.7 <sup>d</sup>	12288.8 <sup>b</sup>	12152.0 <sup>c</sup>	12612.3 <sup>a</sup>	213.56*
Total revenue ((₦)	11125 <sup>d</sup>	13500 <sup>c</sup>	15000 <sup>b</sup>	17500 <sup>a</sup>	172.11*
Gross Margin (₦)	680 <sup>d</sup>	1211.2 <sup>c</sup>	2848 <sup>b</sup>	4887.7 <sup>a</sup>	143.74*

<sup>a, b, c</sup>: Means with different superscript within a row differed significantly ( $P<0.05$ ). SEM: standard error of means, \* Significant at 5%, Cost of fattening = Total cost of production, Total revenue = Cost of production – sales, Gross margin = profit.

## Conclusion

It is possible to mix *B. ruziense*s forage with Concentrate at 60:40 ratio for better performance in yankasa rams. Feeding a ratio of 60:40 ratio *B. ruziense*s forage and Concentrate gave higher level of feed intake by 28.35%, improve weight gain by 38.92% and resulted in a higher revenue of ₦4887.7.

## Recommendation

It can be recommended that farmers can feed total mixed ration to ruminants with up to 60% of *B. ruziense*s forage and 40% concentrate ratio inclusions for improved performance and productivity.

## References

- Abdel Hameed, A. A., Fedel Elseed, A. M. and Salih, A. M. (2013). Growth Performance and Rumen Fermentation of Lambs Fed Untreated or Urea Treated Groundnut Hull with Different Protein Sources. *Journal of Animal Production Advances*, 3(3): 86–96.
- Abdullahi, S., Nyako, H.D., Malgwi, I.H., Yahya, M.M., Mohammed I.D., Tijani, I., Aminu, I. M., Shehu, I.T. (2016.) Performance of Yankasa Rams Fed Urea Treated Sorghum Chaff as a Basal Diet Supplemented with maize offals in semi - arid environment of Nigeria. 4, (1), 15-21. Available at: [www.researchpublish.com](http://www.researchpublish.com)
- AOAC, (2005). Official Method of Analysis, 17th edition. Association of Analytical Chemists, 24<sup>th</sup> edition Washington, DC. USA. 200-210.
- Alabi, J.B., Yahaya, M.S., and Julius, N. (2010). Effect of Sorrel seed (*Hibiscus sabdariffa*) supplementation on the performance of Yankasa rams fed *Brachiaria decumbens* as basal diets. *Journal of Agriculture and Veterinary Science*. Pp: 7: 12-13.
- Ajayi, F.I., Ogunleke, F.O., Odejide, J.O., Tiamiyu, A.K., and
- Morankinyo, O.A. (2014). Feed Intake and Weight Changes of West African Dwarf Goats Fed Concentrated Diet with Corn cob in varying levels. Proc. 39th Conf. Nig. Soc. For Animal Prod. 16-19 March, 2014. Babcock Univ. Ilishan-Remo, Ogun State, Nigeria. Pp 262-264.
- Bello, A.A. (2016). Economics of feeding sun-dried poultry dropping based diets on growing rams consuming sorghum stover. *Iranian Journal of Applied Animal Science*. 6(3), 595-598.
- Doma, U.D., Adegbola T.A., Bamgbose, A.M. and Umeh, P.A. (1999). Utilization of Cowpea Shell and Maize Cobs in Diet of Rabbit. *Tropical Journal of Animal Science*, 2(1): 27-32.
- Doma, U. D., Mohammed, L. K., and Umeh, A. P. (1999). Observation on the characteristics of small holder sheep and goat management practice in old Bauchi State. *Tropical Journal of Animal Science*, 2: 125–130. (b)
- Duncan D.B. (1955). Multiple range and multiple F-test. *Biomet-ric*. 11:1-42.
- Ferdous, M. R., Khan, M. J., Rashid, M. A. and Kamruzzaman, M. (2011). Effect of different levels of concentrate supplementation on the performance of Black Bengal goat. *Bangladesh Journal of Animal Science*. 40 (1-2): 40-45.
- FAO (1995). Food and Agriculture Organization of United Nations. *Food and Nutrition Series*, No.27.
- Glatzle, A. (1992). Feed Resources in the Sahel. *Animal Research and Development*, 35. 43–58.
- Hassan M. R., Muhammad, I. R., Amodu, J. T., Jokthan, G. E., Abdul, S. B., Adamu, H. Y., Yashim, S. M., Taofik, I., Tamburawa, M.S. and Musa, A. (2016). Growth performance of Red Sokoto bucks fed graded levels of Lablab (*Lablab purpureus* L. Sweet) hay as



- supplement to maize (*Zea mays*) stover basal diet. *Journal of Animal Production research*, 28(1): 283-298.
- IAR (2017). Institute for Agricultural Research, Ahmadu Bello University, Zaria. Meteorological Data Information of Samaru and its Environs.
- Jayasuriya, M. C. N. (1986). Agro-industrial by-products as ruminants feed. In nuclear and related techniques for improving animals in harsh environments. IAEA, Vienna, Austria.
- NASS, (2011). National Agricultural Sample Survey Census on Nigerian livestock. Ministry of Agriculture and Rural Development.
- National Research Council (2007). *Nutrient Requirements for various classes of sheep and goat, Update 2007*. National Academy Press, Washington, DC.
- Kallah, M. S., Baba, M., Alawa, J. P., Muhammad, I. R. and Tanko, R. J. (1997). Ensiling quality of Columbus grass (*Sorghum almum*) growth in northern Nigeria. *Animal Science and Technology*, 68: 153 – 163.
- Komwihangilo, D.M. and Mlela, J.I. (2012). Social and economic feasibility of using selected indigenous browses as protein supplements for goats in Central Tanzania. *Livestock Research for Rural Development*, 24(108). Retrieved, from <http://www.lrrd.org/lrrd24/7/komw24108.htm> on July 23th, 2013.
- Kibon, A. and Ørskov, E. R. (1993). The use of degradation characteristics of browse plant to predict intake and digestibility of goats. *Animal Production*, 57: 247-251.
- Leng, R.A (1990) Factors affecting the utilization of poor quality forage by ruminants particularly under tropical conditions *Nutritional Research Review* 3:277-303.
- Otchere, E.D., Ahmed H.H., Adenowo, T.K., Kallah, M.S., Bawa, E.L.K., Olurunju, S.A. and Voh. A.A.Jr. (1987). Sheep and Goat Production in the Traditional Fulani Agropastoral Sector. *World Animal Review*, 64:50-55.
- Osinowo, O. A., Abubakar, B. Y., Adewuyi, A. A., Onifade, O. S. and Dennyar, P. O. (1991). Estimates of genetic and phenotypic parameters of birth weight, weaning weight and pre-weaning gain in Yankasa sheep. In *The Proceedings of the 16th Annual Conference of the Nigerian Society for Animal Production*, Usmanu Danfodio University, Sokoto, Nigeria.
- Ovimap, (2015). Ovi location map: Ovi Earth Imagery Data.
- Preston, T.R., and R.A., Leng, (1987). Matching Ruminant production system with Available Resources in the tropics and subtropics. Penambul Books Ltd, Arnidale NSW Australia. Pp 245.
- SAS, (Statistical Analysis Systems). (2002). Procedures Guide. North Carolina, USA: Statistical Analysis Systems Institute, Cary.
- Sani I. (2012). Effect of Different protein supplementation on the performance of Yankasa sheep fed Congo grass (*Brachiaria ruziziensis*). Pp 64-69.
- Schultze-Kraft, R. and Teitzel, J. K. (1992) *Brachiaria ruziziensis* Germain & Evrard. In: ‘t Mannetje, L. and Jones, R.M. (eds) *Plant Resources of South-East Asia No. 4. Forages*. pp. 65–67. (Pudoc Scientific Publishers, Wageningen, the Netherlands).
- Singh, R. J. (2009). *Genetic resources, chromosome engineering and crop improvement: Forage crops*. CRC Press, Florida, U. S. A. Pp 8-12.
- Tovar-Luna, I., Goetsch, A.L., Puchala, R., Sahlu, T., Carstens, G.E., Freetly, H.C. and Johnson, Z.B. (2007). Effects of moderate feed restriction energy expenditure by 2-year-old crossbred boer goats. *Small Ruminant Research* 72:25-32.



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- Van Soest, P. J., Robertson, J. B. and Lewis, B. A (1991). Method for directory Neutral detergent fibre and Non- Starch polysaccharides in relation to Animal Nutrition, *Journal of Dairy Science*, 74: 3583-3597.
- Watson, L. and Dallwitz, M. J. (2008). The grass genera of the world: Descriptions, illustrations, identification and information retrieval; including synonyms, morphology, anatomy, physiology, phytochemistry, cytology, classification, pathogens, world and local distribution and references. *The Grass Genera of the World*. Retrieved from <http://www.tropicalforages.info/key/Forages/Media/Html/glossary.html>. 2011-11-07
- Yashim, S. M., Jokthan, G. E., Lamidi, O. S., Yakubu, R. L. Hassan, M. R., Ibrahim, T. A. and Abdu, S. B. (2014). Performance, nutrient digestibility and nitrogen balance of growing Yankasa rams fed *Digitaria smutsii* hay supplemented with *Ficus sycomorus* leaf meal. *Nigerian Journal for Animal Science*, 16(1): 85-93.