ISSN 0189-0514
J. Anim. Prod. Res. (2018) 30(1):72-78

National Animal Production Research Institute
Ahmadu Bello University
P.M.B 1096, Shika-Zaria,
Kaduna State, Nigeria.
Email:japr@napri.gov.ng Url:journals.napri.gov.ng

NUTRITIONAL VALUE OF FIVE TROPICAL LEGUMES HAY HARVESTED AT DIFFERENT STAGES OF GROWTH IN THE SUB-HUMID ZONE OF NIGERIA

***[1]Abubakar S. A., [2]Sani S. S., [3]Abdu S. B., [3]Hassan M. R. and [4]Abdulrahman S. L.**
[1]National Animal Production Research Institute, P.M.B. 1096, Ahmadu Bello University Zaria, Nigeria.
[2]Institute for Agricultural Research, P.M.B. 1044, Ahmadu Bello University Zaria, Nigeria.
[3]Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria.
[4]Department of Animal Science, Federal University Dutse, PMB 7156 Dutse, Jigawa State-Nigeria
*Corresponding Author: sababubakar2@gmail.com *mamanamirah@yahoo.com*

ABSTRACT

An experiment was conducted to investigate the nutrient composition, mineral contents and cell wall fractions of some selected tropical legumes harvested at 60, 70, 80 and 90 days after sowing (DAS). The legumes are Mucuna pruriens, Centrosema pascourum, Alysicarpus vaginalis, Lablab purpureus and Vigna unguiculata. The nutrient concentration in all the forages varies with the stages of harvest. There was no significant (P > 0.05) variation in chemical composition of all the legumes studied except for the percentage EE that was highest (1.02%) in Centrosema pascourum and lowest (0.78%) in Alysicarpus vaginalis. The mineral constituent also showed no significant (P>0.05) difference in all the legumes understudied except for Phosphorus which was highest in Mucuna pruriens (0.477 ppm) and lowest (0.062 ppm) in A. vaginalis. Legumes harvested at earlier stage may assume high quality material but this study will serve as a guide on squality of hay material to be conserved by stockowners for dry season feeding. It is advocated that stockmen should give more research attention to such legumes hay conservation practice.

Key words: Hay, stages of growth, sub-humid Nigeria, tropical legumes.

INTRODUCTION

Ruminant livestock in most part of the tropics graze mainly on naturally growing forages, which are poor in quality (Awad and Elhadi, 2010). Nutrient imbalances in level of energy, protein and mineral have been held responsible for low forage productivity and reproductive problems (McDowell *et al.*, 1993). Availability of nutrient in forages is dependent upon the interaction of a number of factors including soil, plants specie, stage of maturity, pasture management and climatic condition.

Legume forage species have various advantages over grass forage species; adaptability to soil that is low in nitrogen due to their ability to fix atmospheric nitrogen into usable forms, high levels of crude protein contents and ability to provide nitrogen associated grass species (Agishi, 1984). They also have higher level of calcium, phosphorus, potassium, magnesium and zinc (Agishi, 1984; McDowell *et al.*, 1993; Kallah, 2000). Therefore, forage legumes contribute to sustainable agricultural production by enhancing soil fertility, which in turn leads to increased crop production and quality of animal feeds. Legume roughage hays are nitrogenous (convertible to protein) feed supplements included in the diet of ruminant animals to alleviate nutritional deficiencies, and to increase production (Tarawali, 1994). These include cowpea, soya beans, stylo and groundnut hays. They contain over 10% crude protein, and about 0.9% calcium and a reasonable amount of carotene (Skerman,

1988). Legumes hay is generally expensive source of protein during the dry season, they are delicate to produce and can easily be lost to dry weather (Amodu and Abubakar, 2004).

The objective of this study was to assess five different legume species (*Mucuna pruriens, Centrosema pascourum, Alysicarpus vaginalis, Lablab purpureus* and *Vigna unguiculata*) at different stages of harvest (60 DAS, 70 DAS, 80 DAS and 90 DAS) for nutritive value in sub-humid zone of Northern Nigeria.

MATERIALS AND METHODS

Site characteristics

The study was conducted at the Feeds and Nutrition Research Programme established pasture plots of the National Animal Production Research Institute, Shika, Zaria, Kaduna State. Shika is located at (11°12′ N, 7°33′E; with an elevation 610 m) in the sub-humid zone of Nigeria. In this location wet season starts from early May and ends in late September to early October. Long-term annual rainfall ranges from 1110 - 1580mm with a maximum temperature of 30^0c and relative humidity of approximately 70% (IAR, 2012).

Sampling

This investigation was carried out with five (5) forage legumes hay samples; *Mucuna pruriens, Centrosema pascourum, Alysicarpus vaginalis, Lablab purpureus* and *Vigna unguiculata* all collected from the established experimental plots. Sampling of forage samples was carried out at 60, 70, 80 and 90 days after sowing. Forage materials within $1m^2$ quadrat were harvested using sickles and thereafter subjected to drying under the shade for 48 hours. Samples were oven-dried and later ground to pass through 1.0mm sieve for chemical analysis.

Chemical and Statistical Analysis

Proximate analysis was carried out to determine Nitrogen (N) Crude Fibre (CF), Ether Extract (EE), Nitrogen Free Extract (NFE) and Ash content according to AOAC, (2000). Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF), Hemicellulose (HC) was determined by the method of Van-Soest *et al.* (1991). Mineral contents such as Calcium, Magnesium, Phosphorus and Zinc were determined by the method of AOAC, (2000). Data collected were subjected to analysis of variance and significant means were compared using Duncan's Multiple Range Test (DMRT) using SAS package (2005).

RESULTS

The chemical compositions of five tropical legumes hay investigated are presented in Table 1. The % DM were above 92% in all the forage legumes hay harvested at 60, 70, 80 and 90 DAS respectively. The percentage CP, EE, CF, ASH and NFE varied with age of maturity in all the five (5) forage legumes hay. At 60 DAS, *mucuna* produced the highest NDF and ADF of 64.28 and 45.31, respectively, but the least HC content of 10%.

The mineral contents of the five forage legumes hay are presented in Table 2. The lowest and the highest content of calcium were produced at 80 DAS (60.0 ppm) and 60 DAS (140.5 ppm), respectively. The phosphorus contents of all the five forage legume hays were similar, irrespective of stage of harvest.

The chemical composition and fiber fraction of five tropical legumes hay are presented in Table 3. There were no significant ($P>0.05$) differences in percentage DM, CP, CF, Ash, NFE and HC for all the legumes harvested at 60, 70, 80 and 90 DAS. The percentage EE, NDF and ADF showed a significant ($P<0.05$) difference. The highest value of 1.02 % EE was found in *Centrosema* and lowest value of 0.78% EE was in *A. vaginalis*. The % NDF was highest (62.41%) in *Centrosema* and lowest (52.54%) in *V. unguiculata*, which also had lowest (29.06%) ADF. The % ADF was highest (43.51%) in *lablab*.

The mineral contents of five forage legumes hay are presented in Table 4. There was no significant ($P>0.05$) difference in Ca, Mg and Zn in all the legumes studied. The P content of the legumes showed significant ($P<0.05$) variations with minimum value of 0.05ppm and

maximum value of 0.90ppm. The highest P content of 0.477ppm was observed in Mucuna and lowest 0.062ppm was recorded in A. *vaginalis.*

Table 1: Chemical composition of five selected tropical legumes hay at different days of harvest

		Components (%)								
DAS	**Tropical legumes hay**	**DM**	**CP**	**CF**	**EE**	**ASH**	**NFE**	**NDF**	**ADF**	**HC**
60	*M. pruriens*	95.42	13.56	23.42	1.08	11.21	50.73	64.28	45.31	10.17
	C. pascourum	95.11	17.00	22.76	0.96	8.84	50.44	62.45	38.89	23.56
	A. vaginalis	94.88	15.44	23.08	0.87	8.57	50.04	54 53	39.57	14.96
	L. purpureus	94.18	14.81	23.57	0.91	11.96	48.75	61.59	44.03	17.56
	V. unguiculata	95.48	15.50	23.66	1.02	12.12	47.70	52.66	27.76	24.90
70	*M. pruriens*	94.33	12.88	26.45	0.97	15.91	44.67	55.07	35.67	19.40
	C. pascourum	95.56	8.81	25.4	1.06	13.00	51.73	62.44	39.37	23.07
	A. vaginalis	93.99	9.38	26.36	0.69	11.02	52.55	57.07	32.76	24.31
	L. purpureus	92.98	17.75	25.69	0.78	10.19	45.59	61.89	38.61	23.28
	V. unguiculata	94.18	14.19	25.46	0.59	10.91	48.85	52.80	28.53	24.27
80	*M. pruriens*	95.89	9.88	21.80	0.89	9.92	57.51	56.10	34.13	21.97
	C. pascourum	95.72	10.88	24.42	0.93	9.44	54.33	65.06	43.79	21.27
	A. vaginalis	95.28	9.13	20.00	0.88	11.88	58.11	58.40	36.35	22.05
	L. purpureus	94.77	9.75	26.41	0.87	8.49	54.48	60.78	46.51	14.27
	V. unguiculata	93.97	11.87	24.81	0.76	8.33	54.23	57.08	24.68	32.40
90	*M. pruriens*	96.01	13.18	26.98	1.02	12.28	46.51	47.41	34.06	13.35
	C. pascourum	94.88	15.94	24.37	1.12	12.17	46.40	59.70	41.48	18.22
	L. purpureus	96.05	9.56	26.09	0.76	9.24	54.25	56.74	44.87	11.87
	V. unguiculata	95.57	14.56	26.01	1.11	10.43	47.89	47.63	35.27	12.36

DAS = Days after sowing, DM = Dry matter, CP = Crude protein, CF = Crude fibre, EE = Ether extract, NFE = Nitrogen free extract, NDF = Neutral detergent fibre, ADF = Acid detergent fibre and HC = Hemicellulose.

Table 2: Mineral composition of five selected tropical legumes hay at different days of harvest

		Minerals in (ppm).			
DAS	**Tropical Legumes hay**	**Ca**	**P**	**Mg**	**Zn**
60	*Mucuna pruriens*	106.67	0.08	100	99.26
	Centrosema pascourum	86.67	0.08	100	74.82
	Alysicarpus vaginalis	133.33	0.06	400	74.82
	Lablab purpureus	126.67	0.06	400	127.4
	Vigna unguiculata	140.5	0.08	220	84.8
70	*Mucuna pruriens*	93.33	0.86	200	94.07
	Centrosema pascourum	86.67	0.05	200	48.89
	Alysicarpus vaginalis	100	0.07	100	130.37
	Lablab purpureus	86.67	0.07	200	77.04
	Vigna unguiculata	113.33	0.08	200	47.41
80	*Mucuna pruriens*	120	0.07	200	59.26
	Centrosema pascourum	80	0.06	300	54.82
	Alysicarpus vaginalis	73.33	0.06	100	68.89
	Lablab purpureus	100	0.07	100	70.37
	Vigna unguiculata	60	0.06	100	60.74
90	*Mucuna pruriens*	73.33	0.9*	300	78.52
	Centrosema pascourum	100	0.07	100	66.67
	Alysicarpus vaginalis	140	0.06	100	85.19
	Lablab purpureus	80	0.07	200	68.15
	Vigna unguiculata	73.33	0.06	200	74.82

DAS = Days after sowing, ppm = Part per million, Ca = Calcium, P = Phosphorus, Mg = Magnesium, Zn = Zinc.

Table 3: Chemical composition and fiber fraction of five tropical legumes hay

Nutrients %	*Mucuna pruriens*	*Centrosema pascuorum*	*Alysicarpus vaginalis*	*Lablab purpureus*	*Vigna unguiculata*	SEM (±)	LS	Min. - Max.
DM	95.41	95.31	94.61	94.50	94.8	0.57	NS	92.98-96.05
CP	12.38	13.16	11.05	12.97	14.03	1.98	NS	8.81-17.75
CF	24.66	24.24	23.67	25.44	24.99	1.28	NS	20.0-26.89
EE	0.99^{ab}	1.02^{a}	0.78^{b}	0.83^{ab}	0.87^{ab}	0.11	*	0.59-1.12
Ash	12.33	10.86	10.34	9.97	10.45	1.32	NS	8.33-15.91
NFE	49.64	50.73	54.14	50.79	49.67	2.99	NS	43.79-58.11
NDF	55.72^{bc}	62.41^{a}	58.28^{abc}	60.25^{ab}	52.54^{c}	3.67	*	47.41-65.06
ADF	39.49^{a}	40.88^{a}	37.92^{a}	43.51^{a}	29.06^{b}	4.98	*	24.68-54.11
HC	16.22	21.53	20.36	16.75	23.48	4.03	NS	10.17-32.40

*Means with the same superscripts in the same row are not significantly (P>0.05) different.
DM = Dry matter, CP = Crude protein, CF = Crude fibre, EE = Ether extract, NFE = Nitrogen free extract, NDF = Neutral detergent fibre, ADF = Acid detergent fibre, HC = Hemicellulose, SEM = Standard error of the mean and NS = Non significant.

Table 4: Mineral contents and five forage tropical legumes hay

Mineral contents (ppm)	*Mucuna pruriens*	*Centrosema pascuorum*	*Alysicarpus vaginalis*	*Lablab purpureus*	*Vigna unguiculata*	SEM (±)	LS	Min. - Max.
Ca	98.34	88.34	111.67	98.34	96.79	16.59	NS	60.0-140.50
P	0.477^{a}	0.065^{b}	0.062^{b}	0.068^{b}	0.07^{b}	0.17	*	0.05-0.90
Mg	200.0	175.0	175.0	225.0	180.0	71.92	NS	100.0-400.0
Zn	82.78	61.30	89.82	85.74	66.94	15.84	NS	47.41-130.37

*means with the same superscripts along the row are not significantly (P>0.05) different. NS- not significant
ppm = Part per million, Ca = Calcium, P = Phosphorus, Mg = Magnesium, Zn = Zinc.

DISCUSSION

The results obtained from this study indicated that stage of harvest had an influence on the nutrient concentration, mineral component and cell wall component of the five tropical forage legumes hay produced. Hay making is the most accepted and cost effective method of forage conservation within majority of farmers in the study area. Forage legumes in particular are used as green manure, cover crops and short term pastures in rotation with cereal crops

(Omokanye, 2001). All the legumes studied; *Mucuna pruriens, Centrosema pascuorum, Alysicarpus vaginalis, Lablab purpureus* and *Vigna unguiculata* can successively be cultivated and harvested as hay at 60, 70, 80 and 90 DAS with a DM above 92.0% and CF higher than 8% in Table 1. The %CP, %CF and %NFE are within the recommendation for good quality hay (Kallah, *et al*. 2000 and Amodu, 2004). The mineral contents varied with age in P concentration, which is an important active element for seed formation. The legume species analysed had nutrient levels indicative of forages of good quality, which varied from 8.81% to 17.75%. These values are within the % CP of most tropical forages (Kallah, *et al.* 2000).

CONCLUSION AND RECOMMENDATION

This study shows that the tropical legumes studied can be harvested at 60, 70, 80 and 90 post planting for high legumes quality hay. However, high crude protein was obtained at 60 and 70 days post planting. The stages of planting did not have any influence in mineral content (Ca, P, Mg and Zn) of all the forage legumes. Further research to include feeding trial should be carried out. The result of the study showed that all the four stages of legumes harvest were acceptable for hay production in terms of nutrient, mineral and cell contents. However, legumes harvested at earlier stage may assume high quality of nutrients but this study serves as a guide on the quality of hay material to be conserved by stockowners for dry season feeding. In terms of % CP, *M. prurieuns, C. pascuorum, A. vaginalis* and *V. unguiculata* should best be harvested at 60 DAS while *L. purpureus* at 70 DAS. It is advocated that stockmen should give more research attention to such legumes hay conservation.

REFERENCES

Agishi E. C. (1984). Mineral content of browse plant. *Annual Report* 1984, NAPRI, ABU Zaria. Pp47-55.

Amodu J. T. and Abubakar, S. A., (2004). Forage conservation practices. Forage Production and Management in Nigeria. *A Training Manual,* National Animal Production Research Institute Shika, Zaria. Nigeria. Pp 60-67

Awad, O. A. and Elhadi, O. A. (2010). Seasonal variability in nutritive value of ruminant diets under open grazing system in the semi-arid rangeland of Sudan (South Darfur State). *Agriculture and Biological Journal of America*, 1(3):243-249.

Kallah, M. S., Muhammad, I. R., Abdullahi, U. S., Olorunju, S. A. S. (2000). Nutrient concentrations of stem segments of lovegrass (*Eragrotis tremula* L.) *Journal of Agricultural and Environment* Volume 1(2):43-52.

Kallah, M. S.; Bale, J. O.; Abdullahi, U. S.; Muhammad, I. R. and Lawal R. (2000). Nutrient composition of native forbes of semi-arid and dry sub-humid savannas of Nigeria. *Animal Feed Science and Technology* 84:137-145.

McDowell, L. R.; Conrad J. H. and Humbry F. G. (1983). Mineral for grazing ruminants in Tropical Regions Bulletin, the U. S. Agency for Literature Development and Carribean Basin Advisoty Group (CBAG), USA 74 pp.

Omokanye, A. T. (2001). Seed production, herbage residue and crude protein content of Centro (*Centrosema pubescens*) in the year of establishment at Shika. *Tropicultura* 19 (4):176-179

SAS (2005). Statistical Analysis Software (CD-ROM), Version 8.1, SAS Institute Inc., Cary, N.C., USA.

Skerman, P. J. (1988). Tropical legumes. FAO plant production and protection series No. 2, 2nd Edition.

Tarawali, S. A. (1994). Evaluation of selected forage legumes for livestock and crop production in the sub-humid zone of Nigeria. *Journal of Agriculture Science 1*23:35-60.

Van Soest, P. J., Robertson, J. B., Lewis, B. A., (1991). Method for dietary fiber, neutral detergent fiber, and Nonstarch polysaccharides in relation to Animal Nutrition. *Journal Dairy Science* 74:3583-3597.

Yashim, S.M., Adamu, A.M., Lakpini, C.A.M., Abdul S. B. (2006). Comparative response of growing rams fed solely on Centrosema pascuorum and Alysicarpus vaginalis. *Pakistan Journal of Nutrition.* Volume, 5(3):261-262.