

# EVALUATION OF THE NUTRIENTS CONTENTS OF SELECTED PRESERVED FORAGES IN THE DERIVED SAVANNA ZONE

B.I. UMOH; A.C. OKONKWO; B.I. OKON; AND F.W. EKONG

*Department of Animal Science, University of Uyo, Uyo. Akwa Ibom State, Nigeria.*

Received 23 January, 1995; Accepted 25 October, 1996

## ABSTRACT

This study was conducted to evaluate the nutrient contents of selected forages based on methods of preservation. Forages used in the study were *Andropogon tectorum*, *Cenchrus ciliaris*, *Panicum maximum* and *Imperata cylindrica*. Representative samples collected from each experimental zone were preserved in the laboratory with different methods. The samples were analyzed for their proximate chemical contents. Baled hay and ensilage forages were selected to be suitable methods of conservation of forage for dry season feeding based on proximate composition of the feed. *Panicum maximum* and *Cenchrus ciliaris* were also found to be very rich in CP (9.0 and 9.2) respectively when conserved. Seasonal variation, method of forage conservation and stage of maturity were suggested to be major factors that affect DM and nutrient contents of forages.

**Key words:** Nutrients, forage, conservation.

## INTRODUCTION

Shortages of feed during the dry season, and sometimes during the wet season, put a constraint to livestock production in almost every production system in Nigeria. Where feeds are found in abundance, they may be low in nutritive value which may manifest themselves in form of nutritional deficiencies when fed to animals. Increasing livestock production depends to a large extent on the availability of suitable feed resources. Forages in various conservation methods play a significant role in the nutrition of ruminant animals in general.

The derived savanna zone of Nigeria covers an area of about 95,000m square. Ogoja and parts of Obudu are the only derived savanna zone in Cross River State. Other patches of derived savanna zone in Nigeria are noticeable

South of Abeokuta, Ibadan, Ile-Ife, Onitsha, Enugu and extends as far as Ilorin, Kebba and Oturkpo (Loosli, *et al.*, 1974). The need for adequate forage conservation for ruminant livestock is important particularly for dry season use. Forage is the cheapest food for ruminant when conserved as hay or silage with a relative cheaper cost than most other feeding stuff (Sastry and Thomas, 1981). Ruminants will consume and utilize a wide variety of forage in different forms. Factors that influence forage attributes particularly in livestock nutrition have been widely studied (Oyenuga and Olubajo, 1966; Corbett *et al.*, 1963). Some of these factors include stage of growth of the forage, season of harvest and method of preservation. Increased animal production in the savanna zone depends on the improvement in the method of preservation of the quality and quantity of forage produced.

The purpose of this study was to assess and compare the nutrient contents of forages conserved under different conservation methods.

## MATERIALS AND METHODS

Selected species of forage, *Imperata cylindrica*, *Panicum maximum*, *Cenchrus ciliaris* and *Andropogon tectorum* were randomly collected for the study. Forage species selected were native to the derived savanna zone, and were collected from Okuku and the surrounding in the Cross River State. The area is located at an altitude (117.38m) above sea level at Latitude 06°40' and longitude 08°48'E. Representative samples of forage type were collected according to procedures of Jones *et al.*, (1971). Samples were washed in distilled water to avoid contamination from accumulated dust and soil. They were air-dried under the shade and later oven-dried overnight at about 75°C. Samples

were then stored in plastic bags and preserved for further analysis.

#### Baled hay preparation

A total of 20kg of each of the experimental forages (succulent parts, leaves and young stem) was harvested and sundried to reduce moisture content of the mass to 15%. The total moisture content of each mass was measured using proximate method of analysis. Each mass was neatly compressed using hay bale machine and tied with ropes at three points into rectangular bale and stored on raised platforms. Eight hay bales were prepared using the same procedure. The preserved forages (bales) were allowed to remain under this condition for two months.

#### Silage preparation

A similar quantity of each of the above forage was harvested, chopped and wilted for 6 hours for the study, the chopped material was mixed homogeneously, and 3kg was randomly sampled from each mass in a 200ml beaker lined with polythene sheets in the laboratory. Each of the chopped forages was filled rapidly into eight beakers and compressed by hand and later sealed using the surplus lined polythene sheets. Equivalent quantity of unwilted portion of each of the same forage was ensiled using similar method.

Eight similar beakers (two replicates per treatment) were also used to conserve hay of different species. The ensiled materials was carefully compressed to exclude air pockets thus ensuring that no oxygen was entrapped within the mass. The ensiled masses in both cases were allowed a period of 21 days during which time fermentation processes was expected to have completed (Heath *et al.*, 1985).

Samples collected from fresh and preserved forages were analysed for DM, CP, CF, EE, NFE, were measured, A. O. A. C., (1980), energy was calculated. Samples were also analyzed for calcium (Ca) and phosphorus (P) while  $p^H$  of each samples was measured using a  $p^H$  meter (meter-orion Research-model 601A/ digital lonilyzer). All data collected were analysed by the procedure of General

Linear Model, (Least Squares) using SAS/STAT Procedures for Personal Computers (SAS, 1986). Significant means were separated using Duncan's New Multiple range Test (Steel and Torrie, 1960).

## RESULTS AND DISCUSSION

Details of ingredient composition of the preserved forages are presented in Table 1. There was variation in the percentage of DM among the species.

*Andropogon tectorum* and *Imperata cylindrica* were higher ( $P < 0.05$ ) compared with others. CP percentage was similar and higher ( $P < 0.05$ ) for *Cenchrus ciliaris* and *Panicum maximum*, intermediate for *Imperata cylindrica* and significantly lower for *Andropogon tectorum* and *Panicum maximum* and lower but similar for *Cenchrus ciliaris* and *Imperata cylindrica*, while EE was higher ( $P$ ) for *Panicum maximum* and *Imperata cylindrica* and significantly lower for *Andropogon tectorum* and *Cenchrus ciliaris*. NFE percentage was similar and intermediate (55.2 and 55.6) for both *Andropogon tectorum* and *Cenchrus cylindrica* respectively, lowest (52.6) for *Panicum maximum* but similar but higher for *Panicum maximum*. Energy (KJ/g) value was higher for *Panicum maximum* and lower and similar for *Andropogon tectorum*, *Cenchrus ciliaris* and *Imperata cylindrica*. Calcium and phosphorus contents of the forage were not different ( $P > 0.05$ ) among the species.

#### Influence of preservation methods on nutrient content.

The Dm content varies with methods of preservation. The loose and baled hay indicated higher ( $P < 0.05$ ) DM content (87.7 and 86.1%) respectively than the wilted silage 59.9% which was intermediate, while DM content of unwilted was lowest (30.7%). Hay generally was observed to contain more DM than the silage processed forage. DM content of wilted silage was intermediate (59.9%) but higher than DM value for unwilted hay which was the lowest (30.7%). Wilting tended to affect DM of the forage. The present study corroborates with findings of McDonald *et al.*, (1987) who observed DM losses as high as 6%

NUTRIENT CONTENTS OF PRESERVED FORAGE

TABLE 1: LEAST SQUARE MEANS ( $\pm$ S.E.) OF NUTRIENTS OF SELECTED FORAGES.

Chemical Components		Species of forages preserved			
		<i>Andropogon tectorum</i>	<i>Cenchrus ciliaris</i>	<i>Panicum Maximum</i>	<i>Imperata cylindrica</i>
Dry matter	%	69.1 $\pm$ 8.3 <sup>a</sup>	63.0 $\pm$ 9.4 <sup>b</sup>	61.2 $\pm$ 9.8 <sup>b</sup>	70.6 $\pm$ 7.8 <sup>a</sup>
Crude protein	%	4.9 $\pm$ 0.5 <sup>a</sup>	9.2 $\pm$ 0.8 <sup>a</sup>	9.0 $\pm$ 0.7 <sup>a</sup>	7.2 $\pm$ 0.6 <sup>b</sup>
Crude fibre	%	35.1 $\pm$ 3.9 <sup>a</sup>	30.7 $\pm$ 0.9 <sup>a</sup>	32.7 $\pm$ 0.4 <sup>a</sup>	30.0 $\pm$ 0.6 <sup>b</sup>
Ether Extract	%	2.3 $\pm$ 0.1 <sup>b</sup>	2.6 $\pm$ 0.1 <sup>b</sup>	4.0 $\pm$ 0.6 <sup>c</sup>	3.6 $\pm$ 0.5 <sup>b</sup>
N.F.E.	%	55.2 $\pm$ 0.5 <sup>b</sup>	55.6 $\pm$ 0.9 <sup>b</sup>	52.6 $\pm$ 0.8 <sup>c</sup>	57.4 $\pm$ 0.8 <sup>a</sup>
Energy (Kj/g)	%	18.5 $\pm$ 0.0 <sup>b</sup>	18.9 $\pm$ 0.1 <sup>b</sup>	19.9 $\pm$ 0.2 <sup>a</sup>	19.9 $\pm$ 0.1 <sup>b</sup>
Calcium	%	0.4 $\pm$ 0.1	0.4 $\pm$ 0.1	0.5 $\pm$ 0.1	0.4 $\pm$ 0.1
Phosphorus	%	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0	0.1 $\pm$ 0.0	0.2 $\pm$ 0.3

a,b,c, Means in the same row with different superscripts are different ( $P < 0.05$ ).

TABLE 2: LEAST SQUARES MEANS OF NUTRIENTS AS AFFECTED BY PRESERVATION METHODS

Chemical Composition		Bale Hay	Loose Hay	Conservation Methods	
				Wilted silage	Unwilted silage
Dry matter	%	86.1 $\pm$ 0.0 <sup>a</sup>	87.3 $\pm$ 0.61	59.9 $\pm$ 3.6 <sup>b</sup>	30.7 $\pm$ 1.0 <sup>c</sup>
Crude protein	%	7.5 $\pm$ 1.0 <sup>a</sup>	6.1 $\pm$ 0.6 <sup>b</sup>	6.6 $\pm$ 0.5 <sup>c</sup>	10.2 $\pm$ 0.8 <sup>a</sup>
Crude fibre	%	32.4 $\pm$ 0.8 <sup>a</sup>	33.0 $\pm$ 1.0 <sup>a</sup>	31.3 $\pm$ 0.8 <sup>b</sup>	31.0 $\pm$ 0.8 <sup>b</sup>
Ether extract	%	2.4 $\pm$ 0.1 <sup>b</sup>	2.2 $\pm$ 0.1 <sup>b</sup>	3.8 $\pm$ 0.5 <sup>a</sup>	4.0 $\pm$ 0.5 <sup>a</sup>
N.F.E.	%	55.4 $\pm$ 1.0 <sup>a</sup>	56.7 $\pm$ 0.5 <sup>a</sup>	56.4 $\pm$ 1.0 <sup>a</sup>	52.0 $\pm$ 0.6 <sup>b</sup>
Energy (Kj/g)	%	18.7 $\pm$ 0.1 <sup>b</sup>	18.6 $\pm$ 0.1 <sup>b</sup>	19.9 $\pm$ 0.2 <sup>a</sup>	19.2 $\pm$ 0.2 <sup>a</sup>
Calcium g	%	0.5 $\pm$ 0.1 <sup>b</sup>	0.6 $\pm$ 0.1 <sup>b</sup>	0.2 $\pm$ 0.0 <sup>a</sup>	0.03 $\pm$ 0.0 <sup>a</sup>
Phosphorus g	%	0.03 $\pm$ 0.0 <sup>b</sup>	0.01 $\pm$ 0.0 <sup>b</sup>	0.03 $\pm$ 0.0 <sup>b</sup>	0.2 $\pm$ 0.1 <sup>a</sup>

a,b,c, Means in the same row with the same superscript are not different ( $P < 0.05$ ).

after 5 days and 10% after 108 days wilting in the field. They further mentioned that wilting is associated with low butyric acid concentrations and reduction in DM and Nitrogen losses.

Dry matter contents ranging from 80 - 95% have been reported for hay (Egten and Reeves, 1978) and silage have been shown to have a lower value of 28 - 58% (Obioha and Ndukwe, 1976).

Moisture contents calculated for hays (baled and loose hays) were found to be 13.9% and 12.9% respectively, while those of the wilted and unwilted silages comparatively increased ( $P < 0.05$ ) to 41% and 69.4% respectively. The moisture content recorded for hays have been reported by (Church and Pond, 1988) to be satisfactory in maintaining the storage quality of the feedstuff.

Percent EE was similar for wilted and unwilted hays and higher for both silages compared with baled and loose hays. This increase in EE in the silages is indicative of a high production of organic acids during fermentation by microbial organisms. Most of

the acids produced include acetic, propionic butyric and aleric at varying proportions. The  $p^H$  of the ensiled materials recorded were 4.9 and 4.7 for unwilted and wilted ensiled materials respectively. The  $p^H$  of silage prepared from forage materials has been reported to be higher than 4.2 which is said to be standard  $p^H$  for tropical silage are to store well, a  $p^H$  range of 3.8-5.0 must be maintained. Heat *et al.*, (1985) reported on  $p^H$  range corroborates this claim for proper  $p^H$  to stabilise ensiled mass. The reason for this high pH in silage is due to the fact that no additive was added to the ensiled mass and a pH of 4.8 or higher have been reported to be one of the characteristics exhibited by silage made without any form of additive (Catachpoole, 1968).

CP percentage was low for forage preserved as loose and wilted ensiled material compared with other forages preserved using other methods. Highest crude protein percentage was recorded for forages preserved as baled hay and unwilted ensiled materials. The considerable reduction in the nutrient

content of tropical forages, especially in CP content as a result of extended exposure to adverse weather condition before hay making has been recognised. The CP of hay has been reported to be within the range 2.8 - 11.0% from different conserve forage during the dry season, (Heat *et al.*, 1985), and the data conform with the values obtained in this study. Percent CP concentration in hay has been reported to depend chiefly upon species, stage of maturity and nitrogen fertilization levels for grass and leaf contents (Bula *et al.*, 1981).

Percentage NFE was similar for baled hay, loosely packed hay and wilted ensiled materials but significantly higher than the unwilted silage. Calcium was significantly higher for loose hay than wilted and unwilted silages but similar to baled hay. Percentage phosphorus was higher for unwilted silage than for any other preservation methods. Total amount of phosphorus in other conservation methods was similar. Baled hay and unwilted ensiled materials may be recommended as methods feeds could be preserved during the dry season for animals. There were marked reductions in the DM, CP, CF, Calcium and phosphorus when the forage materials were ensiled for this study. This observation agrees with report of Watson and Nash (1960) who observed a reduction in the overall nutrients of the ensiled material as a result of losses in the silo as fermentation requires energy. Their report also showed that the low quality of silage produced accounts in part for the sugar contents of the derived savanna forage. The present study is in a variance with their report in respect of energy. The ensiled forages both wilted and unwilted were higher in energy content than baled hay and loose hay. (McWilliams and Duckworth, 1949) observed that unwilted tropical forage species often fail to settle or settle only and slightly during ensilage and Vera Cruz (1967) reported extensive spoilage due to aerobic decomposition during storage.

#### REFERENCES

A.O.A.C. (1980). Official Methods of Analysis (13th ed.) Association of Official Analytical

Chemists, Washington, D.C.

BOGDAN, A. O. (1977). Tropical pasture and fodder crops, New York, Longman Inc. pp. 68 - 73.

BULA, R. J., LECHTENBERGE, V.L. and HOLT, D. A. (1981). Potential of the world forage for ruminant animal Production, pp. 601 - 633.

CATCHPOOLE, V. R. (1968). Effects of season, maturity and rate of nitrogen fertilizer on ensilage of *Seteria sphaecelata*, *Aust. J. Expt. Agric. Anim. Husb.* 8.

CHURCH, O. C. and POND, W. G. (1988). Basic Animal Nutrition and feeding, 3rd (ed.), pp. 328 - 339, USA, John Wiley and Sons.

CORBETT, J. L. LANGLANDS, J. P. and REID, G.W. (1963). Effects of season on growth and digestibility of herbage on intake of grazing dairy cows. *Anim. Prod.* 5: 119 - 129.

EGTEN, W.M and REEVES, P.M. (1978). Dairy cattle feeding and management, pp. 108 - 109, U.S.A. Longman Inc. Ltd.

HEATH, M. E. BARNES, R.F. and METCALFE, D.S.(1985). Forages, The Science of grassland Agriculture, 4th ed., U.S.A Iowa State University Press. pp. 517 - 527.

ILCA (1987). International livestock centre for Africa. Annual report, p. 31.

JONES JR., LARGE, R.L., PJEIDERER, D. B. and KLOSKY, H, S. (1971). How to properly sample for a plant analysis. *Crop soils* 23: 15 - 18.

LOOSLI, J. K., OYENUGA, V. A. and BABATUNDE, G. M. (1974). Animal Production in the Tropics. Proceedings of the International Symposium on Animal Production in the Tropics. Nigeria Caxton Press. pp. 157 - 159.

McDONALD, P. EDWARDS, R. A. and GREENHALGH, J. F. D. (1987). Animal

- Nutrition, 4th ed., New York, Longman Inc. pp. 405 - 429.
- O BIOHA, F. C. and NDUKWE, N. (1976). Changes in Yield chemical composition of standing and conserved forages during the dry season in Eastern central Nigeria. *Nig. J. Anim. Prod.* 3: 105 - 116.
- OYENUGA, V. A. and OLUBAJO, F. O. (1966). Productivity and Nutritive value of Tropical pastures at Ibadan. Proc. Intl, Grassld. Congr. pp. 963 - 969.
- OYENUGA, V. A. and HILL, D. H. (1966). Influence of fertilizer application on the yield efficiency and ash constituents of meadow hay. *Nig. Agric. J.* 3: 6 - 14.
- SAS, (1986). SAS/STST Guide for personal computers, version 6 edition, SAS Institute Inc., SAS circle, Carey, NC, 183pp.
- SASTRY, N. S. F. and THOMAS, C. K. (1981). Farm Animal Managment, 4th ed., New Delhi, Vikas Publ. pp. 152 - 160.
- STEEL, R. G. D. and TORRIE, J. H. (1960). Principles and Procedures of Statistics, pp. 107 - 111. McGraw-Hill Books Company Inc.
- WATSON, S. J. and NASH, M. J. (1960). The conservation of grass and forage cropd. London, pp. 120 - 122.
- McWILLIAMS, A. P. and DUCKWORTH, J. (1949). The preservation of elephant grass silage and its feeding value for *Tropical dairy cattle*, *Tropical Agric. (Trin.)* 26: 16 - 23.
- VERA CRUZ, N. C. (1967). Making grass silage, *Phil. Agric.* 35: 266 - 271.