

Proximate and Fiber Composition of *Panicum maximum* and *Centrosema molle* Silage as Affected by Different Proportions and Ensiling Periods

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ABSTRACT

This study was carried out to determine the physical characteristics, proximate and fiber composition of *Panicum maximum* and *Centrosema molle* silage as affected by different proportions and ensiling periods. The experiment was a 3x3 factorial arrangement which comprised of three (3) forage proportions (100% G, 50 G: 50 L% and 75 G: 25 L%) and three (3) storage durations (30, 60 and 90 days) with four replicate.

Results showed that physical characteristics, proximate and fiber composition of *P. maximum* and *C. molle* silage were affected ($p < 0.05$) by forage proportions and storage duration. Silage stored for 60 days had the highest (24.75) value for odor while the silage stored for 30 days was less moldy and silage made from 50 G: 50 L forage proportion recorded the highest crude protein (CP), dry matter (DM), ether extract (EE), and ash contents (11.52%, 93.92%, 5.67%, and 4.58%), respectively. An equal proportion of forage ensiled for 30 days recorded the highest CP and DM content (13.85% and 97.50%). Also, results of this research showed that 100% *P. maximum* silage had the highest ($p < 0.05$) values (68.33% and 47.00%) for neutral detergent fiber (NDF) and acid detergent fiber (ADF), respectively, and NDF values ranged from 59.5% in silage stored for 90 days to 67.8% in silage stored for 30 days. The pure grass ensiled for 30 days had the highest value (72.50%) for NDF. On the other hand, the least values (38.5% and 5.0%) for ADF and ADL were recorded from silage made from 50 G: 50 L forage proportion and stored for 90 days.

It is therefore concluded that the silage made from equal proportion of the two species appeared best in terms of CP content and the silage stored for 30 days had the highest CP content and it is

recommended for ruminant feed supplement during the dry season.

(Keywords: *Panicum maximum*, *Centrosema molle*, forage proportion and ensiling periods)

INTRODUCTION

Ruminants in the tropics are raised predominantly on grasses which are inherently poor in digestibility, nutritive value, and unavailable in the off season (Babayemi, 2009). The shortage of good quality forage needed to sustain livestock growth especially during the dry season has been a perennial problem in Nigeria. The native pastures deteriorate rapidly especially in the dry season, hence the need for conservation in form of silage which is not weather dependent like hay, during the rainy season when they are in abundant supply and high in nutritive value.

Legumes and grasses can be conserved when they are high in nutritive value into silages for future use (Black *et al.*, 1995). The fodder availability is constrained during the dry season by extreme weather condition (Sarwar *et al.*, 2003). The increasing gap between fodder availability and the demand in the tropical region calls for the preservation of fodder crops when abundantly available.

Forage conservation is a valuable pasture management strategy and ruminant animals are primarily forage consumers. A major challenge to livestock producers is inadequate quantity of quality feeds throughout the year. Forage grows rapidly during the wet season, become fibrous, coarse and low in nutrients as the season advanced towards the dry period; this is because tropical grasses grow and mature under a high

temperature regime. High temperature stimulates growth and ageing of grasses with a consequent fall in intake and digestibility by ruminant animals, which eventually hamper development of the animal.

In order to solve the limitations of feeds for ruminants especially during dry season, there is a need for developing the feed conservation strategy during the period of abundant supply (rainy season) so as to redistribute the feed supply over the year to meet the requirements of livestock resources (Moran, 2005). Forage conservation basically aims to produce at low cost, a stable product suitable for ruminant animal feeding with minimum loss of nutritive value. It also bridges the gap between the feed requirement of the animals and the production of the forages. In a good season it allows excess forage to be removed from a paddock so that high quality re-growth is available for grazing, rather than letting old, rank forage accumulate while in a bad season or during seasonal shortages, the conserved feed can be fed to maintain milk production or as longer term emergency feed. Hay and silage are the main methods of conserving forage (Moran, 2005).

The semi-arid and sub-humid zones have seasonal patterns of rainfall yet hosting over 90% of the cattle and 70% of sheep and goats population (RIMS, 1992). There is sporadic year round shortage in the supply of pasture both in quality and quantity despite the abundant supply of feeds during the late rainy season. Furthermore, there are increasing indices towards intensification of livestock, for example, in Nigeria (Muhammed *et al.*, 2007). A foremost contest to ruminant livestock producers in semi-arid zone of West Africa is ensuring supply of sufficient quantities of quality feed through out the year.

One of the conventional approaches is silage as a feed conservation strategy in which feed is conserved during period of abundant supply so as to redistribute the supply over the year to meet the requirements of livestock resource. One of the major advantages of silage is that surplus forage can be conserved during the growing season at a time when hay making is mired by humid condition.

The contribution of legumes to improving the ensiling quality had been noted (Sibanda *et al.*, 1997; Titterton and Maasdorp, 1997). Bath *et al.* (1985) defined silage as a material produced by

controlled fermentation of crops of high moisture content which involves natural fermentation, which produces lactic and other acids, which 'pickle' or preserve the forage. This fermentation takes place only under anaerobic (oxygen-free) conditions, so the forage must be packed to remove air and sealed to keep air out. Silage will generally keep while it remains sealed and anaerobic (Moran, 2005).

MATERIALS AND METHODS

The silage making and the chemical analysis were carried out at the Laboratory of Department of Pasture and Range Management, College of Animal Science and Livestock Production, Federal University of Agriculture, Abeokuta, Nigeria. The study was carried out using a 3 x 3 factorial design comprising three (3) mixing proportions (*P. maximum* 100%, 75% of *P. maximum* : 25% of *C. molle* and 50% of *P. maximum* : 50% of *C. molle*) and three (3) ensiling periods (30, 60, and 90 days) and which was replicated four (4) times.

Physical characteristics (odor, moldiness and color) were determined and ranked according to Bates (1998a) ranking Proximate composition (dry matter, crude protein, ether extract and ash) were determined according to A.O.A.C. (1995) while non-fiber carbohydrate was calculated as $NFC = 100 - (CP + Ash + EE + NDF)$. Fiber fraction (neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined with the procedure of Van soest *et al.*, (1991). Cellulose content was taken as the difference between ADF and ADL while hemicellulose content was calculated as the difference between NDF and ADF.

Data collected were subjected to Two-Way Analysis of Variance and the treatment means were separated using Duncan's Multiple Range Test using SAS (1999) package.

RESULTS AND DISCUSSION

There were significant ($p < 0.05$) differences in the effect of forage proportion and ensiling period on the proximate composition of *P. maximum* and *C. molle* silage (Table 1). The highest value (93.92%) for DM was observed in 50:50% forage proportion and the lowest value (91.83%) in whole *P. maximum*. Contents of CP, EE and Ash

were significantly ($p < 0.05$) higher in 50:50% forage proportion than other proportions. The values for other proportions were similar. NFC value ranged from 13.61% in whole *P. maximum* to 21.66% in 75:25% forage proportion. Increased in level of legumes in the silages resulted to increases in the CP and EE with corresponding decline in NDF, ADF and Hemicellulose in all the treatments examined. This suggests that inclusion of 50% legume improves the ensiling quality of grass at full bloom stage of maturity.

The CP content of the silage produced from mixtures of grass and legume was above the CP critical level of 8% (Norton, 1994) accepted for ruminant performance. The CP recorded for the silages were well above the threshold of 60g/kg required by rumen microbes to build their protein body, below this threshold, intake of forages by ruminants and rumen microbial activity would be adversely affected (Van Soest, 1994). The CP of the silages in this study was higher than the critical value of 70g/kg recommended for small ruminants (NRC, 1981). The silages will also be adequate in providing high quality protein supplement for non-lactating ruminants during the dry season. The CP content of silage in this study fell within the range of 6.54 – 15.15% reported by Ukanwoko and Igwe (2012) and also fell within that reported by Anele *et al.* (2011) for grass and legume silage but higher than that reported by Babayemi (2009) for *P. maximum* alone, which

might be as a result of the nutrient composition of the original forage.

The DM and CP values of the silage were highest at 30 days storage duration. The values declined as ensiling periods increased. CP values were above 8% for all treatments. EE, Ash and NFC contents increased with longer period of ensiling (Table 1).

The DM content declined as the ensiling period progressed. The decrease could be explained by a moderate fall in reducing sugar which is similar to Henk and Linden (1992) and Stokes and Chen (1994) findings for sweet sorghum and corn silage, respectively.

This reduction was ascribed to the continued maintenance requirement of the microbial population in the silage. In addition, CP content also decreased with increase in the ensiling duration from 30 to 90 days after ensiling. The reduction in the CP content of the silage recorded in this study agreed with the report of Akinola (2008) and Jolaosho *et al.* (2013) when guinea grass, cassava peel, brewery and pineapple wastes were ensiled at different proportion. Meanwhile, the CP content of silages in this study as influenced by ensiling duration are higher than 7% being level considered minimal requirements for ruminant animals according to Van Soest (1994).

Table 1: Effect of Forage Proportion and Storage Duration on Proximate Composition (%) of *P. maximum* and *C. molle* Silage.

Factor	DM	CP	EE	ASH	NFC
Forage proportion (%)					
100 G	91.83 ^b	10.23 ^b	3.83 ^b	4.00 ^b	13.61 ^c
50 G:50 L	93.92 ^a	11.55 ^a	5.67 ^a	4.58 ^a	19.53 ^b
75 G:25 L	93.42 ^a	9.01 ^c	3.75 ^b	3.58 ^b	21.66 ^a
SEM	1.08	0.58	0.51	0.33	1.19
Storage duration (days)					
30	96.67 ^a	12.57 ^a	3.17 ^b	2.83 ^c	13.60 ^b
60	93.75 ^b	9.96 ^b	3.83 ^b	4.25 ^b	20.29 ^a
90	88.75 ^c	8.26 ^c	6.25 ^a	5.08 ^a	20.91 ^a
SEM	0.52	0.39	0.43	0.22	1.19

^{a, b, c}: Means in same column for each factor with different superscripts are significantly ($p < 0.05$) different.

SEM = Standard Error of Mean

50:50%= 50% *P. maximum* and 50% *C. molle*

DM = Dry Matter

EE = Ether Extract

G = Grass

100% = Whole *P. maximum*

75:25%= 75% *P. maximum* and 25% *C. molle*

CP = Crude Protein

NFC = Non Fibre Carbohydrate

L = Legume

Table 2: Effect of Forage Proportion and Storage Duration on Fiber Composition (%) of *P. maximum* and *C. molle* Silage.

Factor	NDF	ADF	ADL	HEM	CELL
Forage proportion (%)					
100 G	68.33 ^a	47.00 ^a	8.17	21.33 ^a	38.83
50 G: 50 L	58.67 ^c	45.33 ^b	8.17	13.33 ^c	38.67
75 G: 25 L	62.00 ^b	46.83 ^{ab}	6.83	15.17 ^b	38.50
SEM	1.16	1.44	0.70	0.70	1.12
Storage duration (days)					
30	67.83 ^a	51.83 ^a	10.00 ^a	16.00 ^b	41.83 ^a
60	61.67 ^b	46.50 ^b	7.17 ^b	15.17 ^b	39.33 ^b
90	59.50 ^c	40.83 ^c	6.00 ^b	18.67 ^a	34.83 ^c
SEM	1.28	0.56	0.51	1.17	0.70

^{a, b, c}: Means in same column for each factor with different superscripts are significantly ($p < 0.05$) different.

SEM = Standard Error of Mean

50:50%= 50% *P. maximum* and 50% *C. molle*

DM = Dry Matter

EE = Ether Extract

G = Grass

100% = Whole *P. maximum*

75:25%= 75% *P. maximum* and 25% *C. molle*

CP = Crude Protein

NFC = Non Fibre Carbohydrate

L = Legume

The Ether Extract (EE) content of the silage was higher than that reported by Ukanwoko and Igwe (2012) and Muhammed *et al.* (2009) but fell within the range 3.36 – 9.90% as reported by Jolaosho *et al.* (2013). However, the range of EE of the silages were below 80g/kg level established by NRC (2001) as the limit for which reductions would occur in the DM intake by ruminants. The Ash content of the silage as affected by forage proportion and storage duration were lower than that reported by Shahabodin *et al.* (2014) for silage produced from sweet sorghum. This might be as a result of the soil on which the ensiled forages were grown and the age at which the forages were harvested.

Also, effect of forage proportion and ensiling period on fiber composition of *P. maximum* and *C. molle* silage were significantly ($p < 0.05$) different except for contents of Acid detergent lignin and Cellulose. The NDF, ADF and hemicellulose values were highest in whole *P. maximum* and least in 50:50% forage proportion. The fiber constituents (except hemicellulose) declined with increase in ensiling period. The value for NDF ranged from 59.5% to 67.83% for forage ensiled for 90 days (Table 2). The Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) contents reported in this study for whole *P. maximum* and 50:50% (*P. maximum* 50% and *C. molle* 50%) mixture were higher than the NDF (48.14%, 43.00%) and ADF (34.27%, 31.01%), respectively, reported by Ukanwoko and Igwe, (2012).

The values for ADF and NDF declined from 30 to 90 days. The reduction in the NDF and ADF content of the silage with increase in ensiling duration as observed was in line with the findings of Akinola (2008) which might be attributed to degradation of cell wall by activity of bacterial enzyme (cellulose and hemicellulose) and production of organic acids during fermentation (Yahaya *et al.*, 2001).

CONCLUSION

The importance of silage cannot be overemphasized, apart from providing feed for livestock especially during dry season; it also preserves the nutrient in the forage materials. The use of legume in preparation of grass silage has beneficial advantage to silage quality. This study showed that the duration of ensiling changed the characteristics of the grass – legume silage.

The composite silage made from 50% *P. maximum* and 50% *C. molle* was the best in terms of CP content and with relatively least fiber fraction and silage ensiled for 30 days also had the highest CP value. The CP of the silage being higher than the minimum requirement for maintenance of ruminant animals across the three ensiling duration (30, 60 and 90 days) makes them a good supplement for dry season feeding.

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