

Full Length Research Paper

Silage quality, dry matter intake and digestibility by West African dwarf sheep of Guinea grass (*Panicum maximum* cv Ntchisi) harvested at 4 and 12 week regrowths

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An all year round pasture is not always guaranteed in the tropics especially in Nigeria as half of the period is a dry season. In order to circumvent the pasture scarcity during drought, silage making is paramount. In this vein, nutritive value of silage made from Guinea grass (GG) frequently harvested at 4 and 12 week regrowth was assessed by West African dwarf (WAD) sheep. Four weeks GG (4WGG) and 12 weeks GG (12WGG) were mixed to make treatments: 12 week GG (12WGG), 4 week GG (4WGG), 25% 4WGG + 75% 12WGG, 50% 4WGG + 50% 12WGG and 75% 4WGG + 25% 12WGG. Grass mixtures were subjected to silage for 42 days. Quality and chemical composition of the silage was assessed. Silage was also fed to WAD sheep to determine the dry matter intake (DMI) and dry matter digestibility (DMD). Crude protein for 4WGG was 17.5% higher than that of 12WGG. Silage colour was normal except for 12WGG that showed light yellow. The pH value and temperature ranged from 4.2 - 5 and 25 - 27.5°C, respectively. Pleasant and firm textures of the silages were observed irrespective of the age of the grass and the ratio of mixtures. The DMI significantly ranged from 617.2 g in 4WGG to 759.1 g in 50% 4WGG + 50% 12WGG. Variation occurred in DMD among the sheep ranged from 61.8 in 12WGG to 73.5 in 75% 4WGG + 25% 12WGG. Results showed that silage quality was better and that dry matter intake and digestibility were low by the sheep fed 4 or 12 week grass regrowth but the animals performed well at different combinations of grasses, suggesting an effective utilization of both young and fibrous grasses.

Key words: Silage quality, chemical composition, intake and digestibility, Sheep, Guinea grass

INTRODUCTION

One of the major physiological disorders of grazing cattle in the early wet season is bloat. In the early wet season, grasses are just coming up, being tender and with a lot of water in it could result to distention of the stomach, orchestrated by gas accumulation. Also, ruminants benefit little from over matured grass due to lignification. In the light of this there is need to adequately cater for all stages of pasture growth in order to meet the normal feed requirements of ruminants. Babayemi and Bamikole (2006a) reported that feeding grass after anthesis may be a sign that lignifications have occurred and might not be beneficial to livestock consuming it. Ajayi et al. (2008) reported that if grass of any age is effectively managed, it can strategically be exploited to ameliorate forage scarcity in the off season. Babayemi and Igbekoyi (2008) des-

cribed that silage production in the tropics is a sustainable means of supplementing feed for ruminants in the dry season. Young grass of about four and twelve weeks of growth are two extremes often not grazed or 'cut and carry' in Nigeria. The reason may be the anticipation that it could impart little or no benefit to livestock.

Young pastures are high in crude protein, low in fibre but very low in dry matter (Bamikole et al., 2004). On the other hand, older grasses are low in crude protein but high in fibre and dry matter (Babayemi and Bamikole, 2006b). Ensiling is a potent general method for forage preservation and also a form of treatment to occasionally salvage the under utilized pastures for better acceptability and degradability. Young pastures may be low in fermentable carbohydrates or water soluble carbohydrates and

have a high buffering capacity, making them practically difficult to ensile without injecting additives (Salawu et al. 2001; Ohba et al. 2004). On the other hand, older grasses are high in energy and probably a suitable material for silage processing because of its possible high water soluble carbohydrates and low buffering capacity (McDonald et al. 1991; Nishino et al. 2003). The present study was designed to evaluate the nutritive value of ensiling the mixture of young and over matured Guinea grass.

MATERIALS AND METHODS

The experiment was carried out at the Teaching and Research Farm of the University of Ibadan in June 2008. The location was 7°27'N and 3°45'E at an altitude of 200-300 m above sea level. The average annual rainfall was about 1250 mm with a mean temperature of 25 - 29°C.

Preparation of grass for silage

Guinea grass was obtained from an existing pasture established in 2003. A portion of the pasture was marked out and then divided into two blocks of 30 x 30 m each. Each of the blocks, one for 4 week and the other for 12 week old grasses was further sub-divided into 5 plots as replicates in a randomized complete block design. The plots were rouged to remove obnoxious weeds. In order to achieve 4 or 12 week old grass, the whole plots were cut back at 10 cm above the ground, such that the 4 week old grass plots were cut back when that of 12 week old plots were 8 weeks growing. When the grasses were respectively 4 and 12 weeks old, they were totally harvested leaving the edge rows uncut. The harvested grasses were weighed in order to determine the expected amount for the making of silage. Representative samples of known weights were taken for dry matter analysis by drying in the oven for 48 h at 65°C until a constant weight was obtained. The harvested samples were wilted for two hours in order to reduce the moisture content. There were five treatments comprised mixtures of the Guinea grass (GG):

- Treatment A: 12 week GG (12WGG)
- Treatment B: 4 week GG (4WGG)
- Treatment C: 25% 4WGG + 75% 12WGG
- Treatment D: 50% 4WGG + 50% 12WGG
- Treatment E: 75% 4WGG + 25% 12WGG

Grass was chopped into 2-3 cm lengths for ease of compaction and consolidation for silage. The grass weighing 60 kg in five replicates for the different treatments were filled in a 65 kg capacity plastic. The plastic was lined internally by polythene sheets. Each layer of the grass was compacted manually to displace the air until the containers were filled. The final compaction was made after which the polythene sheet was wrapped over the material. Sand bag of 40 kg weight was later rolled on the filled material and was left for 47 days for fermentation.

Determination of silage quality

After 47 days, the fermentation was terminated and the silage was opened for silage quality. The assessed quality characteristics were colour, smell, texture, taste, pH and temperature according to Babayemi and Igbekoyi (2008). Immediately the silage was opened, a laboratory thermometer was inserted to determine the temperature. Sub-samples from different points and depths were later taken

and mixed together for dry matter determination by oven drying at 65°C until a constant weight was achieved. The samples were later milled and stored in an air-tight container until ready for chemical analysis. The pH of sub-sampled silage was done by heating 100 g in a beaker containing 100 ml of distilled water for 5 min at 60°C. The supernatant liquid was decanted, cooled at room temperature and pH meter was used to determine the level of the pH. Colour assessment was ascertained using visual observation with the aids of colour charts. The odour or smell of the silage was relatively assessed as to whether nice or pleasant or fruity. A taste panel of seven people was set up for taste assessment by training them on how to use tongue to detect the taste by comparing it with what they are accustomed to. A variety of taste-like substances such as wine, vinegar, fruits etc were provided for their options. Structure of the silage was also determined whether it is separable or visible or collapsible.

Silage intake and dry matter digestibility

Fifteen male sheep weighing 21-23 kg of 10-12 months old were obtained from the flock at the Teaching and Research Farm, University of Ibadan, Nigeria. In a completely randomized design using three triplicates, the rams were allotted to different metabolic cages specially made for a separate collection of urine and faeces. The sheep were fed 5% of their body weights with the silage. Feed intake was determined on the following day by weighing the remnants and subtracting it from the feed served. Representative sample from the orts was obtained for dry matter and nutrient analysis. Fresh water was supplied daily. Sheep were adapted to the cages for 14 days and another 7 days were used for the collection of data. In the morning, before animals were fed, the faecal output was evacuated and weighed. About 10% of each day's collection of faeces from each animal was taken to the laboratory for oven drying at 65°C for dry matter determination. The oven-dried faeces were later bulked, milled and stored in an air-tight container pending the chemical analysis.

Chemical and statistical analysis

Crude protein, crude fibre, ether extract and ash contents of the silage were carried out in triplicates as described by AOAC (1990) and the amount of CP was calculated ($N \times 6.25$). The fibre components including neutral detergent fibre, acid detergent fibre and acid detergent lignin were determined according to Van Soest et al. (1991). Data were analyzed using analysis of variance by following the procedure of SAS (SAS, 2002). The model for the analysis was:

$$Y_i = \mu + A_i + \epsilon_i$$

Where Y_i is the studied parameters, A_i is the effect of grass mixtures on silage production, and ϵ_i is the residual error.

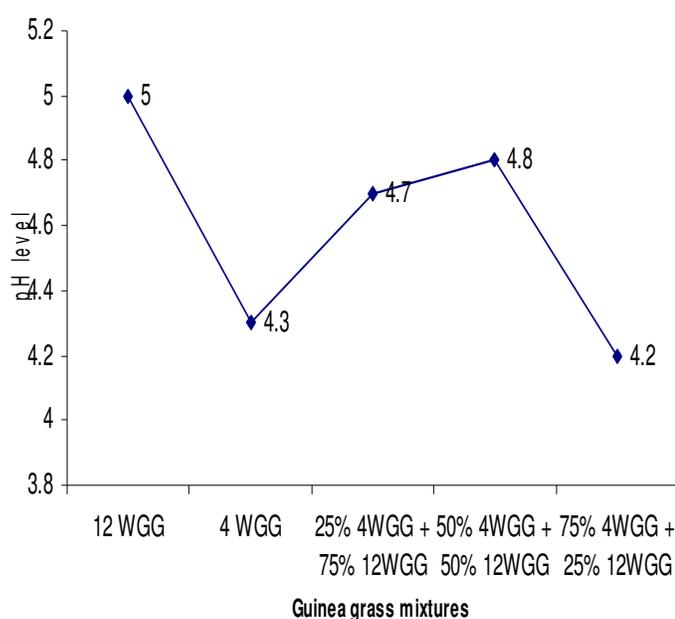
The significant means were separated by the use of Duncan (1955) multiple range F-test.

RESULTS AND DISCUSSION

Chemical composition of the four week harvested grass (FWHG) and that of twelve (TWHG) are presented in Table 1. Crude protein content in FWHG was evidently higher than that of TWHG as the former was 17.5% higher than the latter. On the other hand, the FWHG was lower especially in ADL than that of TWHG. The present result was expected as age of forage had been reported

Table 1. Chemical composition (g/100 g DM) of 4 and 12 week Guinea grass (GG).

Parameter	Guinea grass treatments	
	4 weeks GG	12 weeks GG
Crude protein	7.4	5.2
Crude fibre	23.5	29.1
Ether extract	7.1	8.0
Ash	10.8	11.4
Neutral detergent fibre	40.3	53.6
Acid detergent fibre	26.2	34.9
Acid detergent lignin	7.6	9.8

**Figure 1.** Effects of 4 and 12 week Guinea grass (WGG) on pH of silage.

to always contribute a significant role in the nutrient composition (Ajayi et al., 2007). Tropical forages are characterized by fast lignification and low protein contents as they advance in age (Bamikole et al., 2004; Babayemi et al., 2006; Ajayi et al., 2008; Fajemilehin et al., 2008; Odedire and Babayemi, 2008). Fajemilehin et al. (2008) reported that the highest crude protein content was obtained from 4 week old grass among those of 6, 8 and 12 week old. However, relatively low ADL as obtained for TWHG in the present study may be desirable as cheaper source of energy since most tropical ruminants derive their energy from grass and other forages as practiced by peri-urban ruminant production in Nigeria (Daodu and Babayemi, 2008).

Silage making in the tropics is paramount if there will be all year round availability of forage for livestock. In the

wet season, there is abundance of grass while it becomes scarce in the dry season. The quality of the ensiled Guinea grass pertaining to age of cut and the different mixtures as reflected in terms of colour, taste, texture odour and temperature are shown in Table 2. Also presented in Figure 1 is the pH of the silages. Colour of the silages ranged from olive-yellow in TWHG to olive-green in FWHG and their mixtures. Differences were not observed in the smell of the silage as all the silages were characterized by pleasant. The only exception for the smell was the silage that combined equal amount of FWHG and TWHG (1:1) by exhibiting pleasant-fruity smell. Kung and Shaver (2002) reported that pleasant smell is accepted for a good or well made silage.

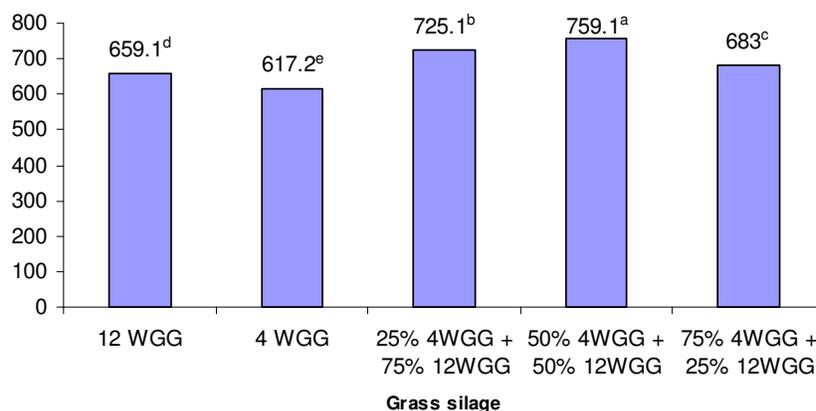
Good silage usually preserve well of the original colour of the pasture or any forage (t'Mannetje, 1999). The olive green and other different yellow colours obtained in the present study were in order. The olive green colour was closed to the original colour of the grass, which was an indication of good quality silage that was well preserved (Oduguwa et al., 2007). Also the different yellow colour was in accordance with the report of Kung and Shaver (2002) that when a green plant material that is ensiled produces yellow colour, it can be classified as well made silage. The yellow colour produced by TWHG silage might be due to the advanced age of the grass. The temperature of all the present silages was below 28°C and indicated well preserved silage. Temperature is one of the essential factors affecting silage colour. The lower the temperature during ensilage, probably the less will be the colour change. If the temperature obtained for the present silages was above 30°C, the grass silage would have become dark yellow or closer to brown due to caramelization of sugars in the forage (McDonald et al. 1995). The texture for the present silage was firm, which was expected to be the best texture of good silage (Kung and Shaver, 2002).

Presented in Figure 1 is the pH of the silage. The pH value in the present result was within the range of 4.5-5.5 classified to be pH for good silage (Meneses et al. 2007). Generally pH is one of the simplest and quickest ways of evaluating silage quality. However pH may be influenced by the moisture content and the buffering capacity of the original materials. Silage that has been properly fermented will have a much lower pH (be more acidic) than the original forage. Kung and Shaver (2002) in their interpretation of silage analysis stated that a good quality grass and legume silage-pH values in the tropics ranges between 4.3 and 4.7.

Crude protein, CF, EE, NDF, ADF and ADL of the ensiled grass are in Table 3. The increasing proportion of 4WGG in the grass silage mixture increased the CP content while the mixture with 12WGG reduced the crude fibre and fibre fraction contents. Silage effect was not evident in CP and fibre contents as the composition was not different from the control (Table 1). The objective of the present study was not either to increase the crude protein

Table 2. Colour, smell, taste, structure and temperature (°C) of ensiled four and twelve week Guinea grass (WGG)

Ensiled Guinea grass	Silage quality			
	Colour	Smell	Texture	Temperature (°C)
12 WGG	Light-yellow	Pleasant	Firm	27.5
4 WGG	Olive-green	Pleasant	Firm	26.5
25% 4WGG + 75% 12WGG	Olive-yellow	Pleasant	Firm	25.0
50% 4WGG + 50% 12WGG	Olive-yellow	Pleasant-fruity	Firm	26.0
75% 4WGG + 25% 12WGG	Olive-yellow	Pleasant	Firm	26.0

**Figure 2.** Effects of 4 and 12 week Guinea grass(WGG) on dry matter intake (g) of grass silage by sheep.**Table 3.** Chemical composition (g/100 g DM) of ensiled 4 and 12 week Guinea grass (WGG) mixtures.

Parameter	Treatment				
	4 WGG	12 WGG	25%4WGG + 75%12WGG	50%4WGG + 50%12WGG	75%4WGG + 25%12WGG
Crude protein	7.2	5.0	4.9	5.3	6.2
Crude fibre	20.8	26.5	23.1	22.5	20.3
Ether extract	7.32	8.1	7.9	7.3	7.6
Ash	11.1	11.6	10.4	11.7	10.3
Neutral detergent fibre	36.3	47.8	41.2	40.4	38.5
Acid detergent fibre	21.2	25.9	23.1	21.5	24.0
Acid detergent lignin	7.6	8.5	7.4	8.7	7.7

or to reduce fibre contents but to make forage available at all times. The crude protein value (4.9-7.2 g/100 g) for the present study was lower than the critical value of 7.7% or 70 g/kg recommended for small ruminants (NRC, 1981) and also lower than the minimum protein requirement of 10-12% recommended by ARC (1985) for ruminants. The low amount of protein in the present study showed that it is limiting in grass and therefore suggests a supplementation with richer protein sources. Grass silage in Nigeria can be fortified with energy or protein sources by ensiling with cassava leaf, browse pods and

industrial by-products. Oluwadamilare (1997) reported 31.9% CP for cassava/Guinea grass mixtures. In order to enhance the CP supplementation for WAD goats, Igbekoyi (2008) ensiled Guinea grass with *Albizia saman* pods to obtain 14-18% CP.

Dry matter intake of silage by sheep is in Figure 2. Dry matter intake (DMI, g) by sheep varied from 617.2 in 4WGG to 759.1 in 1:1 4WGG + 12WGG silages. Statistical analysis showed that there were significant variations in the treatment means. The least DMI from 4WGG and 12WGG were expected. The 4WGG silage was low

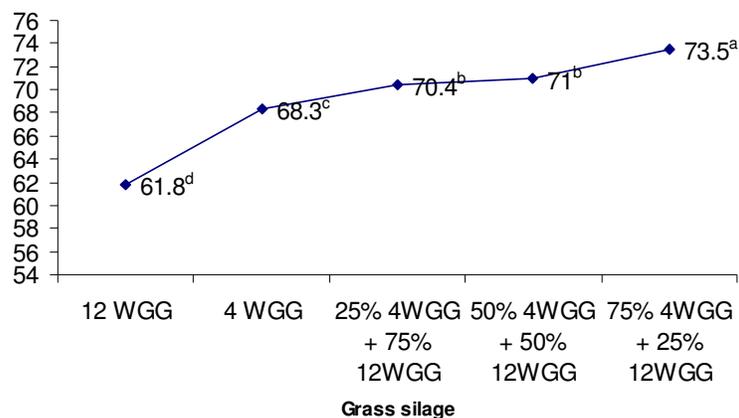


Figure 3. Effects of 4 and 12 week Guinea grass (WGG) on dry matter digestibility (%) of ensiled grass by sheep.

in dry matter and in fibre fractions while that of 12WGG was in the opposite. Inclusion of 4WGG at an increasing rate increased the DMI and later dropped after ratio 1:1 inclusions.

Dry matter digestibility of ensiled grasses is in Figure 3. Dry matter digestibility (DMD) of the ensiled grass ranged from the least (61.8%) in 12WGG to the highest (73.5%) in 75% mixture inclusion of 5WGG. There were significant differences in the DMD by sheep for silages. The age at which grass was harvested had significant effect such that the DMD of 12WGG was apparently lower than that of 4WGG. The different proportion of the mixtures of the grass significantly enhanced DMD by sheep. The least DMD in 12WGG may be attributed to the high fibre content. Percentage fibre composition is a function of cutting intervals of Guinea grass and may therefore have consequence effects on DMD. Bamikole et al. (2004) reported an apparent effects of the age at which grass was cut and observed a decrease on dry matter degradability with increasing age. Odedire (2006) noted a rapid decline in the DM intake and DM digestibility of eight week old *Andropogon gayanus* fed WAD goats than those on 4 and 6 weeks old. In order to obtain a better nutritive value of Guinea grass, Ajayi (2008) reported that such grass should not be older than 6 weeks before it is harvested.

Conclusion

Result indicates that four and twelve regrowth of Guinea grass are poor in nutrition, being interchangeably low in protein and high in fibre. Silage of the mixtures did not alter the chemical composition but increased the dry matter intake and dry matter digestibility by sheep.

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