



Ensiling Compatibilities of Grass and Legume Forages in Northern Guinea Savannah of Nigeria

¹Abubakar, S. A., ¹Amodu, J.T., ²Abdurrahaman, S.L., ³Sani, S.S., ¹Hassan, M.R. and ¹Isiyaku, Y.M.

¹National Animal Production Research Institute, ABU Zaria.

²Department of Animal Science, Federal University Dutse, Jigawa.

³Institute of Agriculture Research, ABU Zaria.

Abstract

This experiment was conducted over two (2016 and 2017) Cropping Seasons to investigate grass-legume ensiling compatibilities, at National Animal Production Research Institute (NAPRI) Shika. Field grown forages were harvested at 90 days post planting and ensiled for 21 days at a ratio of 70:30 in a 2 x 3 factorial arrangement laid in a Complete Randomized Design to give six treatments; T1: sole Elephant grass (SE), T2: sole maize (SM), T3: maize/lablab (ML), T4: maize/mucuna (MM), T5: Elephant grass/lablab (EL) and T6: Elephant grass/mucuna (EM), replicated three times. Results showed that the pH value of the compounded silages were moderate to fair, ranging from 3.87 for EL mixed silage to 5.99 dark green putrid silage produced by ML mixed silage. The result showed that effect of legumes in mixed grass-legumes silage significantly ($P < 0.05$) affected chemical compositions of the compounded silages. The CP content ranged from 9.0% in SM silage to 15.36% in ML prepared silage. The study shows that silage compounded from maize/lablab produced dark green silage with high crude protein (15.36%), ash (19.59%), calcium (0.31%), magnesium (0.33%) and sodium (2.13%). Fiber fraction was significantly different ($P < 0.05$) among the compounded silages. Highest ADF (44.50%), NDF (58.90%) and CNLS (39.30%) were recorded in SE silage. However, SM recorded higher HC (17.89%). ADL content was similar across all the treatments. It can also be concluded from this trial that for higher crude protein and minerals composition, silages should be compounded using Maize/Lablab harvested at 90 days post planting. Elephant grass and Mucuna legume produced good silage but cannot replace Maize and Lablab silage in terms of quality.

Keywords: Maize, Elephant grass, Mucuna, Lablab, silage.

Introduction

Silage production is one of the forage conservation methods practiced in intensive livestock production systems. While it is not a common practice among livestock producers in Nigeria, silage is a viable option for preservation of surplus forage during seasons when yield and nutritional value are optimal. Legume as an important source of protein is very difficult to ensile due to the high buffering capacity and low concentrations of easily soluble sugars. In mixture with grasses their fermentable characteristics are improved so that silage of adequate quality can be obtained. Also, different grass species have different ensiling abilities depending on the water Soluble Carbohydrate (WSC) and buffering capacity.

Pasture and forage crops remain the primary source of feed for different categories of livestock in Nigeria. There is an acute shortage of forage materials, especially green nutritious fodder crops, which is the major cause of low productivity in livestock keeping. In view of the constraints to fodder production and in order to overcome the gap between demand and supply, emphasis needs to be given on several steps for augmenting fodder production. Under the tropical pattern of pasture production in the Savannah, sustainable supply of feeds can be achieved through judicious choice of suitable plant species, soil fertility and management (Kallah, 1990). Sown improved tropical pasture grasses and legumes are capable of

producing much higher yield of quality herbage than the native or natural grazing land.

Maize (*Zea mays*) is the third most important crop in the world (Bilal *et al.*, 2008), it is usually grown in all continents of the world and many countries making it available for livestock feeding. Forage maize provide high quality yield of palatable forage, high dry matter yield, low buffering capacity and high concentration of water-soluble carbohydrates (Griffith *et al.*, 2004). Elephant grass (*Pennisetum purpureum*) is another forage crop considered an important forage in animal production due to the high growth rate, draught tolerance, high biomass yield, ease of propagation and broad ecological adaptation (Trisha, 2010) and can provide average crude protein content of 9% and fresh weight close to 40 tons per hectare (Lellesi, 2000; Trisha, 2010).

Legumes are considered as superior animal feeds to grasses because of higher voluntary intake of digested nutrients (Goering *et al.*, 1991; Thomson *et al.*, 1999). The search for forage legumes as dry season feeds for ruminant animals is a continuous one. Great interest is often attached to those forage legumes referred to as dual purpose in a crop livestock farming system. However, the available research reports are on the potential use of some indigenous and exotic non dual purpose legumes (Larbi *et al.*, 1996). Lablab (*Lablab purpureus*) is a sweet fodder legume that combines a great number of qualities that can be used successfully under various conditions. It is palatable and possesses the ability to out yield other crops especially during the dry season and serves as cover crops (Murphy and Colucci, 1999). Mucuna (*Mucuna pruriens*) is an underutilized tropical legume (Iyayi and Egharevebe, 1998) and is regarded as a good cover crop. Mucuna forage has not been fully incorporated into the ruminant dry season feeding strategy.

The constraints posed by long time dry season in the Northern part of Nigeria causes a serious limitation to grazing and pasture production. The dry season therefore, predisposes ruminants feed with standing hay and low protein roughages to consistent weight lost and low milk production. (Babayomi and Bamikole, 2006). About 80 – 90% of tropical livestock depend on poor quality and low yielding grasses. The most highly productive grasses and legumes have been over grazed and readily available to sustain ruminants throughout the year (Muhammad *et al.*, 2009). Therefore, studies to compare highly productive grasses such as Maize, Elephant grass and other dual purpose legumes like Lablab and Mucuna have become necessary.

Elephant grass (*Pennisetum purperium*) is the most popular perennial fodder recommended for small holder crop livestock farming system, most especially in Kenya where 80% of the Nation milk is produced through ruminant animals and is of high nutritive value for dairy cattle particularly when supplemented with high quality feed such as legumes forage (Nyambati *et al.*, 2010). Elephant grass produces greater dry matter yield than the other tropical grasses. (Skerman and Riveros, 1990). Furthermore, record dry matter yield of 5-15t/ha and exceptional high dry matter yield up to 85t/ha have been reported when high rates of Nitrogen Fertilizer were applied to Napier grass (Skerman and Riveros, 1990).

The shortage of quality feed for ruminant animals can be overcome through cultivation of forage crops with better nutritional value than existing natural feed resources by the establishment of leguminous forage. High yielding leguminous fodder such as Lablab and Mucuna found to provide adequate dry season supplementation and improve the productivity of ruminant and serve as cover crops. (Abubakar, 2012). Despite the importance of these leguminous fodders, there is scarcity of information in comparing

their yield component and dry matter yield. Therefore, it is necessary to carry out agronomic evaluation of these two grasses (maize and elephant grass) and the legumes (lablab and mucuna) on growth parameters, yield and profit margin in two seasons. The objective of this study was to investigate silage quality of two grasses and over two seasons.

Materials and Methods

Description of Experimental Site

The study was carried out at the Experimental Field of Feeds and Nutrition Research Programme (FNRP), National Animal Production Research Institute, Shika. Shika is located on Latitudes 11° 12' N Longitude 07° 33' E and an altitude of 66 m above sea level in the Northern Guinea Savannah of Nigeria (Ovimaps, 2016). Wet season starts from April to early – May and ends in late - September to early - October.

Silage making procedure

The silage making procedure was carried out at Feeds and Nutrition Experimental Site. Forage materials were cut using cutlass when the grasses and legumes are at 90 days post planting (Abubakar, 2012) and chopped to 2-3 cm length. The forage materials were prepared by allowing the forage to wilt for 5 hours. The forage materials were weighed before mixing of the grasses with legumes at the ratio of 70:30 proportions and ensiled in a plastic stack silos. Silos were filled with the chopped samples and compressed to give six treatments.

Experimental Design and Treatments

The experiment was a 2 x 3 factorial arrangement laid out in a randomized complete block design. The two factors were grasses with two levels (Maize and Elephant grass) and legumes with three levels (no legume, Lablab and Mucuna). The six treatment combinations were replicated three times (r = 3). The treatment combinations for this experiment were as follows:

Silage 1 = sole elephant grass (SE) (100:0)

Silage 2 = sole maize (SM) (100:0)

Silage 3 = maize: lablab (ML) (70:30)

Silage 4 = maize: mucuna (MM) (70:30)

Silage 5 = elephant grass: lablab (EL) (70:30)

Silage 6 = elephant grass: mucuna (EM) (70:30)

Proximate Analysis

Silages were made on the same day and stored at room temperature of 27°C for 21 days to allow complete fermentation, after which samples of silage were collected for physical characteristics (colour, aroma and texture) analysis. The samples were visually examined and rated by three independent scorers as described by Olusola, (2011) and Abubakar *et al.* (2015). The pH of the silage was measured using digital pH meter. Composite sample (450 g) was obtained by selecting materials (150 g) from the top, middle and bottom of the stack silo and then bulked immediately and mixed thoroughly before storing in the refrigerator for proximate analysis as described by AOAC (2005). Mineral contents such as Sodium, Calcium, Potassium, Magnesium and Phosphorus were determined in line with earlier reports of AOAC (2005) methods using the atomic absorption spectrophotometer. Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF), Hemicellulose (HC), Cellulose and Acid Detergent Lignin (ADL) were determined by the method of Van Soest *et al.* (1991).

Statistical analysis

The data collected were subjected to Analysis of Variance using the General Linear Model Procedure of SAS (2005). Significant (P<0.05) differences among treatment means were compared using the Duncan's Multiple Range Test as applicable using the SAS package.

The model for the Experiment

$$Y_{ijk} = \mu + G_i + L_j + (GL)_{ij} + E_{ijk}$$

Where Y_{ijk} = individual observation based on the ijk classification.

μ = grand mean
 G_i = effect of grass
 L_j = effect of legume
 $(GL)_{ij}$ = interaction effect of grass i and legume
 E_{ijk} = random error term with mean 0 and variance σ^2

Results and Discussion

Physical characteristic assessment of sole and mixed forage species silages

Table 1 shows Physical characteristics of silage. Well fermented silage must be palatable and not poisonous to the animals. This depends on the good quality possessed by the silage.

It is generally believed that leguminous forages must have buffered capacity which will result in relatively high value in silages made from such materials (Uchide and Kitamine, 1987).

The pH values of EL, SE, MM and EM that ranged from 3.87 - 4.97 produced compounded silages that are of good quality. This study agreed with report of Mannelje (1999), Kaiser (2004), Kungo (2001) and Amodu (2001) that good quality silage must have a pH between 4.0 – 4.5. Tropentag (2011) carried out findings of Elephant grass ensiled with different levels of cassava peels and recorded the pH range of 3.75 - 4.70 that is within acceptable range for good silage in the tropics.

However, silages compounded from sole maize and maize lablab mixtures produced highest pH values of 5.35 and 5.55, dark green colour in appearance with firm texture and pleasant aroma. The discrepancies observed in the pH of the sole and mixed forage species might be as a result of oxidation in the type of grass or legume and chemical composition of the forage species.

The pH of the sole maize silage in this study did not fall within the recommended range of 3.7 – 4.2 as stated by Kaiser and Blackwood (2004), King and Shower (2001) and Amodu *et al.* (2020), for maize silage. Moreover, the

result of the pH value in this study agreed with report of Abubakar *et al.*, (2015) who compounded millet and five legumes with resultant silage of pH value from 4.3 to 5.6. Also, lower than results obtained by Muhammad *et al* 2008 and 2009 which recorded 5.3 – 5.7 of pH value of silage made from grasses (*Andropogon gayanus*) and fortified with different legumes (*Lablab and Mucuna*). Moreover, sole elephant grass and its mixtures with elephant grass silage reduced pH level in the compounded silages.

Temperature is another essential factor that affects silage quality and colour (McDonald *et al.*, 1995). The authors in their study on silage physical characteristics, the temperature ranged from 29°C – 30°C and concluded that temperature above 30°C will result in dark silage due to caramelization of sugar in the forage. The result obtained is in agreement with the recorded temperature of 30°C.

The proximate and mineral composition of sole grass (maize/elephant grass) and mixed silage forage legumes (*lablab/mucuna*) species

Table 2 shows the proximate and mineral composition of sole and mixed silage forage species. The dry matter evaluated for the compounded silage range from 93.14% - 95.16%, and all were statistically similar ($P>0.05$). These results agreed with value of DM obtained by Abubakar *et al.* (2015) when the compounded silage of millet with three different trailing tropical legumes (*lablab, mucuna* and *centro*). Dry matter value was lower than that reported by Ahmed *et al.* (2015) in their experiment of *Pennisetum typhoides* fortified with different levels of lablab mixed silages.

Crude protein (CP) of the silage examined showed significant ($P< 0.05$) variation. The range of the crude protein content was from 9.90 - 15.36%. Highest CP was obtained from treatment of maize-lablab compounded silage (15.36%). Among the compounded silages, maize-lablab mixed silage was

significantly ($P < 0.05$) higher in CP, Ash, Ca, P, K, Mg and Na than the other forage silage mixtures. However, sole maize silage recorded the least CP, Ca, K and Na in contrast with other silage mixtures. On the other hand, Elephant grass-mucuna mixed silage recorded significantly ($P < 0.05$) higher EE (13.09%) compared to SE (3.22%) that was having lowest ether extract. However, all the compounded forage mixed silages were statistically at par ($P > 0.05$) in terms of CF.

The result of the CP content was within a range recorded by Ahmed *et al.* (2015) in an experiment with *Pennisetum typhoides* fortified with different levels of lablab forages. However, the result obtained was higher than Abubakar *et al.* (2015) and Muhammad *et al.* (2009) in an experiment carried out to see the effect of millet mixed silage with trailing tropical legumes (*lablab*, *mucuna* and *centro*) and ensiling quality of Gamba fortified with tropical legumes (*stylo*, *groundnut* and *lablab*) respectively.

Highest CF was recorded with sole Elephant grass silage (37.60%) while the least CF was found in sole maize silage of 29.44%. The CF content result was higher than the result obtained by Akpensuwen *et al.* (2016) in an experiment of assessment of maize varieties silage SHIMAZ and WASAI for silage. The result agreed with Muhammad *et al.* (2008) in a trial on use of legumes in improvement of silage quality of Columbus grass and also with result of Abubakar *et al.* (2015) in their study on mixed millet and trailing tropical legumes silage.

In this study, there was a significant difference ($P < 0.05$) in ether-extract content of the resultant silages. Elephant grass-Mucuna contained the highest ether extract (13.04%), while sole elephant grass had the least. This result was slightly (EE 6.6 - 19.4%) below that of Muhammad *et al.* (2008) in their experiment carried out on use of legume to improve silage quality of Columbus grass. However, Abubakar *et al.* (2015) recorded lower amount of ether

extract (2.7—6.0%) in their experiment of millet mixed with tropical legumes silage.

The Ash and minerals (Ca, P, K, Ma, and Na) were statistically different ($P < 0.05$) among the compounded silages. Highest Ash content was recorded in maize-lablab (19.59%) and maize-mucuna (5.17%) recorded the least ash content.

Mineral composition of mixed grass-legumes silages

There were significant differences ($P < 0.05$) in the mineral composition of the different compounded silage mixtures. Highest ash, calcium (0.31) phosphorus (0.28), potassium (4.11), magnesium (0.33) and sodium (2.13) were recorded in maize-lablab mixed silage and the least of calcium content was observed in sole maize silage. Furthermore, least phosphorus, potassium and sodium were recorded in maize-mucuna mixed silage and sole maize silage recorded least potassium and sodium content. The result obtained in mineral content was higher than that reported by Abubakar *et al.* (2015) in their study on mineral composition of mixed millet with tropical trailing legumes silage. Amodu *et al.* (2020) recorded higher macro minerals content in his finding of ensiled WASAI and SHIMAZ silage when compared to the result recorded in this experiment. The experiment result agreed with those of Aganga *et al.* (2005) in their experiment on stage of harvest of Napier grass harvested at 75 cm height and ensiled for macro elements nutrient assessment.

Fibre fraction of sole and mixed forage silage

Table 3 shows fibre fractions of sole and mixed silage. The fibre fractions of the resultant silages differed significantly ($P < 0.05$) except for ADL. Sole elephant grass record significantly ($P < 0.05$) higher ADF (44.50), NDF (58.90) and CNLS (39.30%). Among the treatments examined, MM sole, (17.89%) was found to contain significantly higher HC ($P < 0.05$) compared to other treatments. Sole maize silage recorded the least ADF (33.47%), CNLS (29.09%) and ADL (4.18%). However,

among the compounded forage silages of maize-mucuna (47.84%) had the least NDF content. HC was found to be lowest in maize-mucuna (10.17%) produced silage. ADL in the compounded silages varied from 4.18—5.76%, highest concentration of ADL was recorded at EL (5.96%) and least with SM (4.18%). The result of NDF obtained agreed with those of Ahmad *et al.* (2015) in their experiment on *Pennisetum typhoides* fortified with different levels of lablab. Muhammad *et al.* (2009) recorded higher NDF, ADF and HC in their experiment carried out to investigate effect of ensiling Gamba grass fortified with tropical legumes (lablab and stylo) at 20% and 40% inclusion level of legumes, compared to results obtained in this experiment.

The results obtained were in agreement with those of Aganga *et al.* (2005) with respect to NDF, ADF. However, slightly higher ADL when compared with that of Aganga (2005) in their experiment on addition of additive to Napier grass silage and ensiled at 75 cm cutting height.

Conclusion and recommendation

It can be concluded from the result of this study that Maize and Lablab silage mixtures produced better quality silages.

Recommendations

Livestock farmer should adopt feeding of maize lablab silage mixture for better quality feed.

References

- Abubakar, S.A. (2012). Evolution of Ensiling Quality of Maiwa Millet Using Four Tropical legumes. MSc Thesis Submitted to the Department of Animal Science, Bayero University Kano pp 36-40.
- Abubakar, S.A., Muhammad, I.R., Sani, S.S., Amodu, J.T., Muhammad, R.H. and Akpeswen, T.T. (2015). Evaluation of maiwa millet (*Pennisetum gluacum*) ensiled with trailing tropical legumes *Journal Animal Production Research*: 27:184-194 <http://journalnapri.gov.ng>.
- Aganga, A.A., Omphile, U.J., Thema, J. and Batshotlhi, J.C. (2005). Chemical composition of Napier grass silage with Additives. *Journal of Biological Sciences* 5(4). ISSN 1727-3048.
- Ahmed, M.Y., Abdurrahman, S.L. and Muhammed, I.R. (2015). Nutritional quality of pearl millet silage fortified with graded levels of lablab forage proceedings of 40th Annual conference Zaria 2015. Edited by I.A. Adeyinka, M. Kabir S.B., Abdu, G.I. Erakpotobor, M.R. Hassan and A.O. Iyiola – Tunji, held at NAPRI/Ahmadu Bello University Zaria 559-562.
- Amodu, J.T., Akpensuen, T.J., Dung, D.D., Tanko, R.J., Musa, A., Abubakar, S.A., Hassan, M.R., Jegede, J.O. and Sani, I. (2020). Evaluation of Maize Accessions for Nutrients Composition, Forage and Silage yields critical Overview. *Research and Development in Agricultural Science* 3:59-75.
- Amodu, J.T., Kallah, M.S., Orifade, O.S. and Omokanye, A.T. (2001). The effect of harvesting at different growth stages on yield and quality of three late maturity pearl millet accessions in Northern Nigeria *Tropical Grassland* 5: 175-179.
- AOAC, (2005). Official Method of Analysis International, 24th Edition. Association of Official Analytical Chemists, 24th edition Washington, DC, USA. pp200-210.
- Babayemi, O.J. and Bamikole, M.A. (2006). Effect of Supplementary Value of *Tephrosia candida* and its mixture with guinea grass on in-vitro fermentation changes as feed for ruminants in Nigeria. *Pakistan Journal of Nutrition*. 5 (1): 14-18.
- Bilal, M. Q. (2009). Effect of molasses and corn of silage additives on the characteristics of Mott dwarf elephant grass silage at different fermentation periods. *Pakistan Veterinary Journal*. 29(1):19-23.
- Goering, H.K., Waldo, D.R., Tyrell, H.F., Thomson, D.J. (1991). Composition of Formaldehyde and Formic Acid Treated Alfaalfa and Orchard Grass Silages Harvested at Two Maturities and their Effects on Intake and Growth by Holstein Heifers. *Journal of Animal Science*. 69:463-464
- Griffiths, N.W., Micken, F.L. and Kaiser, A.G. (2004). Crops and by-products for silage. In: Kaiser, A.G., Piltz, J., Burns, N.M. and Griffiths, N.W. (Eds). Top Fodder Successful Silage Production manual. Published by Weyga-Weyga Agricultural Institute. NSW, DPI, Australia. Pp 112-114.
- Iyayi, E.A and Eghareu, B.J (1988) Biochemical evaluation of seeds of an underutilize legume (Macuna Utils) Nigeria *Journal of animal production* (1) 25: 40-45.
- Kaiser, A.G and Piltz (2004). Feed testing Assessing silage quality. In: Kaiser A.G. Piltz, J., Burns,

H. M. and Griffiths N.W. (eds). Top fodder successful silage production manual published by wagga - wagga Agricultural Institute NSW, Department Primary Industry, Australia. 311-331.

Kallah, M.S., (1990). Forage Resource Nigeria Workshop. In: Range land Pasture Development and Management at Abuja in Nigeria. 17- 22 September 1990 pp. 11-15.

Kung, L., and Shaver, R.D. (2001). Interpretation and use of silage fermentation analysis/reports focus on silage, 3(3). University Of Wisconsin, College of Agriculture and Life Science.

Lehasi, J. K. (2000). Manure Management in the Kenya Highland: Collection, Storage and Utilization to enhance fertilizer quantity and quality. PhD Thesis. Coventry University UK. Pp.45.

Mannetje, L.I. (1999). Tropical grasslands STOAS, Wageningen, Netherlands, 26.

Mc Donald, P., Edward, R.A. and Green halgh J.F.D. (1995). Animal Nutrition 5th edition Longman Scientific and Technical England.

Muhammad, I. R, Abdu, M. I., Iyeghe-Erakpotobor, G.T. and Suleiman, K. A. (2009). Ensiling Quality of Gamba Fortified Tropical Legumes and its Preference to Rabbits. *Journal of Applied Sciences*, 4 (1): 20-25.

Muhammad, I.R., Mohammed, B., Mustapha, M.Y., Ahmad, Abdurrahman, L.S. (2008). Use of legumes in the improvement of silage quality of Columbus grass (*Sorghum almum*). *Medwell online Research Journal Animal Science* 2(4):102 – 112, ISSN 1993-5269.

Murphy, A. M., Colucci, P. E., (1999). A tropical forage solution to poor quality ruminant diets: A review of Lablab purpureus. *Livest. Res. Rural Dev.*, 11 (2): 112.

Nyambati, E.M, Muyekho, F.N., Onginjo, E. and Lusweti, C.M. (2010). Production, Characterization and Nutritional Quality of Napier Grass (*Pennisetum purpureum* Schum.) cultivars in Western Kenya. *African Journal of Plant Science*, 4 (12):496-502.

Olusola, O. (2011) Intake and digestibility of elephant grass ensiled with cassava peels by Red Sokoto goats. Tropentag 2011 University of Bonn Conference on International Research on Food Security National Research Management and Rural Development. Held on October 5th 2011).

Ovimaps,(2016). Ovi location map; Ovi Earth Imagery Data. Retrieved on November 4- 2019.

Skerman, P.J and Riveros, F., (1990).Tropical Grasses. FAO, Rome.

Thomson,D.J.Wald,P.R., Geering, H.I.L and Tyrrel (1991).Voluntary Intake,Growth Rate and Tissue Retention by Holstein Steens Fed Formalhde and fmic Acid Treated Lucerned orchard grass-silage *Journal Animal Science* 69:4644-4658.

Trisha-Collins, P. (2010). Is there an alternative to Napier grass? Matching Genetic Resources to meet the Demands of Smallholder farmers. Report of World Food Prize Foundation (2010). Burloug Ruen International Livestock Research Institute Addis Ababa, Ethiopia W 23: pp 4.

Uchide S and Kitamine V. (1987). Silage Making from Tropical Pasture Plants Grown in south western Islands of Japan. *Effects of Various Treatments of Ensiling Quality of Rhody Grass and Napier Grass Silages Journal of Japanese Society of Grassland Science* 32: 369 – 374.

Van soest, P.J., Robertson, J.B. and Lewis, B.A. (1991). Method for dietary fiber, neutral detergent fiber and non-starch polysaccharides in relation to animal nutrition. *Journal of Dairy Science* 74: 3583 – 3597.

Table 1: Physical characteristics of silage produced from sole and mixed forage species

Parameters	SM	SE	MM	ML	EL	EM
Colour	Dark green	Light green	Light green	Dark green	Yellowish green	Yellowish green
Texture	Firm	Firm	Firm	Firm	Firm	Firm
Aroma	Pleasant	Sweet	Sweet	Pleasant	Sweet	Sweet
pH	5.35	4.13	4.33	5.55	3.87	4.97
Temperature	29 ⁰ C	30 ⁰ C	30 ⁰ C	29 ⁰ C	30 ⁰ C	30 ⁰ C

ML= Maize lablab, MM=Maize Mucuna, EL= Elephant grass lablab, EM= Elephant grass Mucuna, SM= sole maize silage, SL= sole Elephant grass silage, SEM= standard error of mean

Table 2: Proximate and mineral composition of Grass Legumes Silages Mixtures

Parameters(%)	SM	ML	MM	SE	EM	EL	SEM
Dry matter	94.63	94.96	93.14	95.16	94.05	94.99	0.71 NS
Crude protein	9.90 ^c	15.36 ^a	10.17 ^b	10.92 ^b	10.31 ^b	11.02 ^b	1.72 *
Crude fibre	29.44	37.32	26.21	37.6	33.62	30.65	5.88 NS
Ether extract	4.94 ^b	8.27 ^a	7.20 ^a	3.22 ^b	13.04 ^a	11.03 ^a	3.89 *
Ash	8.21 ^{bc}	19.59 ^a	5.17 ^c	14.58 ^{ab}	12.33 ^b	11.47 ^{bc}	2.11 *
Calcium	0.18 ^c	0.31 ^a	0.29 ^a	0.22 ^{bc}	0.30 ^a	0.26 ^{ab}	0.12*
Phosphorus	0.25 ^b	0.28 ^a	0.21 ^c	0.23 ^c	0.30 ^a	0.40 ^a	0.07 *
Potassium	1.68 ^c	4.11 ^a	1.31 ^c	2.95 ^c	2.76 ^b	2.52 ^b	0.26 *
Magnesium	0.23 ^{ab}	0.33 ^a	0.19 ^{ab}	0.19 ^{ab}	0.23 ^{ab}	0.18 ^b	0.44*
Sodium	0.75 ^c	2.13 ^a	0.75 ^c	1.69 ^b	1.60 ^b	1.48 ^b	0.13*

a, b, c, Means with different superscripts along rows differed significantly at (P <0.05) ML= Maize lablab, MM=Maize Mucuna, EL= Elephant grass lablab, EM= Elephant grass Mucuna, SM= sole maize silage, SL= sole Elephant grass silage, SEM= standard error of mean

Table 3: Fibre fraction of sole and mixed forage species.

Parameters (%)	SM	SE	ML	MM	EL	EM	SEM
ADL	4.18	5.20	4.47	5.54	5.76	5.63	1.59
ADF	33.47 ^b	44.50 ^a	34.90 ^{ab}	37.66 ^{ab}	38.32 ^{ab}	38.05 ^{ab}	4.94
NDF	51.16 ^{ab}	58.96 ^a	52.36 ^{ab}	47.84 ^b	49.20 ^{ab}	54.45 ^{ab}	5.14
HC	17.89 ^a	14.46 ^{ab}	17.40 ^a	10.17 ^b	10.88 ^b	17.26 ^a	3.11
CNLS	29.09 ^b	39.30 ^a	27.09 ^b	32.42 ^{ab}	32.26 ^{ab}	32.18 ^{ab}	4.43

a,b,c, Means with different superscripts along rows differed significantly at (P<0.05) ADF= Acid Detergent Fibre, ADL=Acid Detergent Lignin, NDF= Neutral Detergent Fibre, HC= Hemicellulose, CNLS=Cellulose Nitrogen ML= Maize lablab, MM=Maize Mucuna, EL= Elephant grass lablab, EM= Elephant grass Mucuna, SM= Sole Maize Silage, SL= Sole Elephant Grass Silage, SEM= Standard Error Of Mean