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EVALUATION OF MAIWA MILLET (*Pennisetum gluacum l.*) ENSILED WITH TRAILING TROPICAL LEGUMES

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ABSTRACT

A study was conducted toevaluate theeffect of stage of maturity at harvest of *Maiwa* millet (*Pennisetum glaucum*) and three legumespecies for ensilage and to determine optimum level of legume inclusion for better millet-basedsilage. The *Maiwa* millet and legumes (*Lablab purpureus, Mucuna pruriens and Centrosema pascuorum*) were harvested at 60, 70, 80 and 90days post planting and chopped to 1cm length separately. The chopped *Maiwa* millet forage was mixed with each of the legumes at 0, 10, 20, 30, 40, 50 and 60% and ensiled for 21 days. Results of physical characteristics of silage made from harvested forage at 70 and 80 days post planting produced better silagewith yellowish green colour and very sweet aroma. At 60 days post-planting, silage made was putrid. Silages made from the inclusion of 30 to 40 percent legumes were yellowish green in colour and had very sweet aroma. Combinations of millet-lablab and millet-centro resulted in better silages compared to combinations with millet-mucuna. The silages prepared were moderate to fair with pH ranging from 4.4 to 5.1. Age of ensiled material had significant effect on the quality of silage ($P<0.0001$). The proximate composition of silages showed significant variations ($P<0.0001$) with millet-centro mixtures having the highest values in crude protein, crude fibre and ether extract. Dry matter content was also significantly different ($P<0.0001$) with silage made from sole millet having the lowest value (94.21%). Stage of maturity influenced the dry matter content of the silages produced, higher values were obtained at 80 and 90days post planting. Highest CP content was recorded at 70days post planting (11.7%) and least at 90 days post planting (9.71%). Highest crude fibres were obtained at 70 and 80 days post planting. Ca, Mg and Zinc nutrient level were significantly different ($P<0.05$) at stage of growth of the forage materials used for compounding the silages only. P differed significantly ($P = 0.023$) at different stages of growth and also between compounded silages ($P = 0.001$). The study showed that silage compounded at 70 and 80 days post planting, 30 to 40% level of inclusion of *Lablab* or Centro produced better silages**.**

INTRODUCTION

Increasing trends of intensification of livestock production in Nigeria suggest the need for development of feed conservation strategies which will allow for stock-piling fodders during the period of abundant supply for later use in the dry season. This will redistribute the feed supply over the year to meet the requirements of livestock resources (Muhammad *et al.*, 2009). Silage production is one of the forage conservation methods practiced in intensive livestock production systems. While it is not a common practice among the livestock producers in Nigeria, silage is a viable option for preservation of surplus forage during the growing season when yield and nutritional values are optimal (Kallah *et al.*, 1997).

Year-round supply of sufficient quantity and quality of feed is a goal sought for in a profitable livestock production enterprise. Manipulation of forage species selection,

production technique and fodder conservation practices could be effectively utilized to bridge the gap in feed supply during the dry season. According to Koon (1993) silage can be used at any time when required especially during the period of shortage.

Maiwa is one of the three types of pearl millet (*Pennisetum glaucum L.*) produced in Nigeria while the others are *Dauro* and *Gero*. It is a cereal crop that is drought-tolerant and well-adapted to the dry tropics of Africa and Asia (FAO, 1981). This late maturing cereal had been used for livestock production systems over wide areas of the tropics and subtropics as a forage crop with promising results (Bishnai *et al.*, 1993). The potential exists for use as forage crop to augment the aggregate feed supply situation for ruminants.

The establishment and maintenance of grass/legumes pastures for feeding of livestock is an old practice in grazing systems. Similarly, the use of legume additions to improve the ensiling quality of cereals as conserved fodder had been explored by number of workers (e.g., Titterton and Maasdorp, 1997 and Muhammad *et al.*, 2009). The addition of legumes to grass forage at feeding increases productivity, profitability and also ensures long term sustainability of livestock production systems in the tropics (Charmley, 2000).

Silage making enables conservation of surplus feed during the growing season when hay making is obstructed by muck conditions as reported by Kallah *et al*. (1997). Ashbell *et al.* (1997) reported that it is possible to grow wheat along with annual legumes such as lablab or cowpea and ensile them together. This study was therefore designed to evaluate forage yield and quality of maiwa millet (*P. glaucum L*.) ensiled with the trailing, annual legumes lablab (*Lablab purpureus*), mucuna (*Mucuna pruriens*) andcentro (*Centrosema pascourum).*

MATERIALS AND METHODS

The experiment was conducted at the National Animal Production Research Institute (NAPRI), Shika. Shika is located on Latitude $11^{0}12'$N, longitude $07^{o}33'$E with an altitude of 66m above sea level). Shika is located 22km North-West of Zaria in the Northern Guinea Savannah agro-ecological zone of Nigeria (Ovimaps, 2012).

Experimental Procedure

Pasture Establishment

The experimental plot was cleared, ploughed and harrowed twice in the month of July, 2009. Prior to planting, soil samples were collected from 0-15 and 15-30cm horizon, kept in well-labelled polythene bags and later analysed in the Soil Science Laboratory, Ahmadu Bello University, Samaru, Zaria for physio-chemical properties (Table 1). Plots were laid in Randomized Complete Block Design with each plot measuring 6m x 4m. A space of two (2) metres wide gaps were provided between each block. The *Maiwa* millet and four tropical legumes were sown on separate plots on well prepared seed bed. The test legumes were *lablab, mucuna* (velvet bean) and *centro*. The *Maiwa* millet was planted at the seed rate of 4-5kg/ha while the legumes seed rate was 15kg/ha. All the seeds were planted with a spacing of 25cm within rows which were drilled at 75cm apart. Sowing was carried out on 30^{th} July, 2009. The plots were weeded out at3 and 6 weeks post-planting. Fertilizer wasapplied after every weeding; super phosphate for the legumes ($30kgP_20_5$ ha^{-1}) and 150kg ha^{-1} NPK15:15:15 for the millet.

Pasture Sampling and Silage Preparation

Field samplings for forage yield components were carried out at 60, 70, 80 and 90 days post planting. Forage enclosed within the quadrat size of 0.6m by 0.6m was cut at 5cm above ground and fresh weight was determined. Forage samples harvested at 60, 70, 80 and 90 days post planting were chopped separately to 1cm length. Thereafter, silages of the *Maiwa*

millet/legume forage mixtures were prepared with each of the legumes at inclusion levels 0, 10, 20, 30, 40, 50 and 60%. Each of the prepared mixture was tightly packed (about 300g net weight of the chopped material) in glass jars equipped with lids. The mouths of the jars were greased and then tightly sealed with screw covers to provide anaerobic conditions that will promote fermentation. The jars were kept at room temperature (26^0C) for an incubation period of 21 days.

Following the 21 days' fermentation period, the contents of the jars were visually examined by three independent scorers and scored for colour and aroma. Each jar was opened and forceps were used to fetch samples from the middle of the jars and the contents scored for colour on a subjective score of 1– 5 by the same three independent scorers. The pH in water was determined using digital pH metre.

Chemical Analysis

Sub-samples of the silages were oven dried at 60^0C for 48hrs and the dry matter was determined. They were ground to pass through 1mm sieve using "Tecatoscycbtee" 1093 Sample Mill. Proximate analyses of samples were carried out to determine nitrogen (N), crude fibre (CF), ether extract (EE) and ash contents according to AOAC (1999). Ash was obtained by ashing the samples in gallon lamp mupple funnel at 600^0C for 30 minutes. Phosphorus content was determined by perchloric acid digestion (wet oxidation method). Calcium, magnesium and zinc levels were read using Atomic Absorption Spectrometer Shimadzo AA-650 model and Lomb (AOAC, 1999).

Data Analysis

Data collected were stored in Microsoft Excel and later subjected to the General Linear Model proceduresof the Systems Analytical Statistics package (SAS 1999 - 2000) package andthe Duncan's Multiple Range Test was used to separate the means.

RESULTS

Table 1 presents the soil chemical and physical properties of the experimental site. Values obtained for clay fraction increase with increase in soil depth, while silt and sand decrease with increase in soil depth. The textural class was sandy loam for 0 to 15cm and sandy clay loam for 15 to 30cm. The chemical components examined include pH in water, exchangeable cationsNa, K, Ca, Mg, total N, available P, organic carbon and cations exchange capacity. The record showed that the value obtained for potassium was similar in both horizons while available phosphorus increases with increased in soil depth.

Physical Characteristics of Silage

Table 2 shows characteristics of silages produced in respect of forage stage of maturity, legume level and species of legume incorporated. Stage of maturity influenced the pH values of the compounded silages. The difference was significant ($P < 0.05$) with the lowest pH obtained at 90 days post planting (4.4).Irrespective of the legume species used in silage making, at 70 and 80 days post planting, silages made within this period were better with acidic pH, yellowish green colour and very sweet aroma while at 60 days post-planting silage made was putrid with a dark green colour. It was observed that delayed harvest at 90 days post-planting produced pleasant silage with light brown colour.

Better silages were made from the inclusion of 30 to 40% legumes, which resulted in silages with yellowish green and very sweet aroma scores. Lower levels of inclusion (0 and 10%) produced silages with pleasant smell but with colours from light brown to pale yellow colour. Higher levels of inclusion gave silages with putrid aroma and dark green colour. Level of legume inclusion also affected the pH values of the silages. There was significant difference ($P < 0.05$) with lower values obtained from 0 to 30% level of legume inclusion.

Table 1: The Soil Chemical and Physical Properties of the Experimental Site.

	0 – 15 cm	15-30cm
Physical Properties (%)		
Clay	18	28
Silt	28	22
Sand	54	50
Texture	Sandy loam	Sandy clay loam
Chemical Properties		
pH (H_2O)	6.60	6.30
Exchange cations (meg/100g soil)		
Na (ppm)	0.25	0.18
K (ppm)	1.28	1.28
Ca(ppm)	4.20	3.60
Mg (ppm)	0.82	0.46
Total N (%)	0.18	0.11
Available P(ppm)	3.50	7.00
Organic carbon (%)	1.04	0.88
C.E.C (Meg/100g soil)	8.40	7.80

Table 2: Colour, aroma and pH value of silage at different dates of harvest, levels of legume inclusion and forage mixture

	Colour	Aroma	pH
Stage of maturity (days, pp):			
60	Dark green	Putrid	5.1^a
70	Yellowish green	Very sweet	4.6^b
80	Yellowish green	Very sweet	4.5^c
90	Light brown	Pleasant	4.4^d
SEM			**0.06**
Legume inclusion level (%):			
0	Light brown	Pleasant sweet	4.3^c
10	Pale yellow	Pleasant sweet	4.3^c
20	Pale yellow	Sweet	4.4^c
30	Yellowish green	Very sweet	4.4^c
40	Yellowish green	Very sweet	4.5^c
50	Dark green	Putrid	4.7^b
60	Dark green	Putrid	5.6^a
SEM			**0.06**
Foragemixture:			
Millet/Mucuna	Dark green	Putrid	4.7^a
Millet/Lablab	Yellowish green	Very sweet	4.5^b
Millet/Centro	Yellowish green	Very sweet	4.5^b
Millet	Light brown	Pleasant	4.3^c
SEM			**0.06**

Score: 1 = Dark brown (Putrid aroma), 2 = Light brown (Pleasant), 3 = Pale yellow (Sweet), 4 = Yellowish green (Very sweet)

Combinations of millet/lablab and millet/centro resulted in better silages (yellowish green and very sweet aroma) comparedto millet/mucuna combinations. Mixture of millet mucuna and maiwa alone were both dark to light brown in colour and putrid or pleasant, respectively. The silages prepared with legume inclusion were fair with pH varying from 4.3 to 4.7.

Proximate Composition and Mineral Content of Silages

The result in Table 3 shows the effect of including trailing tropical legumes on nutrient composition of silage made from *Maiwa*millet. Differences in dry matter content of the silage from the different legume species and nutrient components were statistically significant ($P<0.05$) among the treatments evaluated. Sole millet resulted in lower contents of CP, CF and EE with higher values recorded from Millet/Centro silages. Variations due to legume incorporation were 9.0 – 10.7% CP, 29.9- 35.1% CF and 2.7 – 9.7% EE.

There were significant differences ($P < 0.05$) in the P content of silages; no statistical difference ($P > 0.05$) in contents of Ca, Mg and Zn. Millet/mucuna mixtures had higher contents of P and Cadue to the legume additions than other mixtures. The least phosphorus level was recorded in millet/centromixtures, while sole millet silage had the least calcium content.Magnesium content was not significantlydifferent ($P>0.05$) across treatments. Millet/mucuna silage had the least magnesium concentration. The level of zinc in the silages was not significantly different ($P>0.05$) across the treatments.

Table 3: Proximate composition andmineral content of silage made from Maiwamillet ensiled with different legume species.

		Forage species			
		Millet	Millet/Mucuna	Millet/Lablab	Millet/Centro
Proximate (%)	**DM**	$94.2^{c}\pm0.59$	$95.0^{a}\pm0.09$	$95.0^{a}\pm 0.82$	$94.5^{b}\pm1.38$
	CP	$9.0^{c}\pm0.28$	$10.5^{ab}\pm 0.22$	$10.4^{b}\pm 0.19$	$10.7^{a}\pm 0.23$
	CF	$29.9^{c}\pm3.95$	$33.5^{b}\pm1.21$	$33.4^{b}\pm1.02$	$35.1^{a}\pm1.31$
	EE	$2.7^{c}\pm0.81$	$6.0^{b}\pm0.31$	$2.8^{c}\pm0.79$	$9.7^{a}\pm0.89$
Mineral (ppm)	**P**	$94.5^{ab}\pm24.77$	$109.0^{a}\pm9.95$	$79.2^{b}\pm7.09$	$73.1^{b}\pm6.34$
	Ca	$17.3^{a}\pm4.53$	$25.5^{a}\pm2.54$	$22.3^{a}\pm1.98$	$23.7^{a}\pm1.83$
	Mg	$81.3^{a}\pm72.92$	$53.9^{a}\pm18.04$	$77.3^{a}\pm22.26$	$68.8^{a}\pm23.24$
	Zn	$21.5^{a}\pm19.48$	$20.3^{a}\pm6.13$	$19.3^{a}\pm6.16$	$23.3^{a}\pm7.00$

a, b, c, Means with different superscripts along columns differ significantly at ($P < 0.05$)
DM = Dry Matter, CP = Crude Protein, CF = Crude Fibre, EE = Ether Extract, P = Potasium, Ca = Calcium, Mg = Magnesium and Zn = Zinc.

Effect of Stage of growth on Nutrient Content of *Maiwa*Millet Silage

Table 4 shows the effect of growth stages on silage nutrient, and mineral content. Dry matter content was significantly affected bythe stages of growth of the mixtures. The DM values ranged from 94.4%, in silages compounded with forage harvested at 70 days post planting, to95% in silages of 90 days post planting. The result of the CP contents at different stages of growth differ significantly ($P<0.05$). The highest CP content was recorded at 70 days post planting (11.7%) and least CP with forage mixtures at 90 days post planting.Crude fibre was highest at 70 and 80 days post planting. The least CF was recorded at 60 days post planting stage of growth. Growth stages had significant ($P <0.05$) effect on ether extract contents. The

ether extract contents increased with maturity of the plants, with the least value obtained in forage harvested at 60 days post planting (1%) and the highest value in forage harvested at 90 days post planting (9%).

Table 4: Effect of Stage of growth on Nutrient Content of Maiwamillet silage

		Age of ensiled material post planting (days)			
		60	70	80	90
Proximate (%)	**DM**	$94.8^{b}\pm0.17$	$94.4^{c}\pm0.16$	$94.9^{ab}\pm0.9$	$95.0^{a}\pm0.09$
	CP	$10.5^{b}\pm0.17$	$11.7^{a}\pm0.25$	$9.9^{c}\pm0.15$	$9.7^{d}\pm0.22$
	CF	$21.2^{c}\pm0.45$	$39.5^{a}\pm0.75$	$39.5^{a}\pm0.57$	$34.9^{b}\pm0.61$
	EE	$1.0^{d}\pm0.04$	$5.8^{c}\pm0.30$	$8.1^{b}\pm1.32$	$9.0^{a}\pm0.68$
Mineral (ppm)	**P**	$67.6^{c}\pm2.71$	$81.5^{bc}\pm8.01$	$105.2^{a}\pm15.05$	$95.68^{ab}\pm6.03$
	Ca	$14.5^{b}\pm0.84$	$22.5^{a}\pm1.32$	$29.1^{a}\pm2.86$	$27.9^{a}\pm2.39$
	Mg	$242.11^{a}\pm17.63$	$7.37^{b}\pm0.70$	$9.7^{b}\pm1.01$	$8.1^{b}\pm1.00$
	Zn	$72.4^{a}\pm2.64$	$1.9^{b}\pm0.21$	$3.0^{b}\pm0.27$	$6.0^{b}\pm2.60$

$^{a, b, c}$ Means with different superscripts along columns differ significantly at ($P < 0.05$)
DM = Dry Matter, CP = Crude Protein, CF = Crude Fibre, EE = Ether Extract, P = Pottasium, Ca = Calcium, Mg = Magnesium and Zn = Zinc.

Effect of level of Legume Inclusion onMaiwa Millet Silage Nutrient Composition

Table 5 showsthe dry matter content of silages made from various levels of tropical legumes included in *Maiwa* millet. Dry matter obtained varied from 94.2 – 95.1%. Crude protein content increased with level of legume added. Crude protein was highest ($P < 0.0001$) at 60% legumes inclusion in *Maiwa millet* silage. The control (0%) had the least CP content. Crude fibre content (CF) varied at different levels of legume incorporated ($P<0.0001$). Higher CF was derived from 30% inclusionwhile the least value was obtained from the sole *Maiwa* millet silage. Increase in the level of legumes resulted in increase of the crude fibre content of the silages. Increase in the level of legume incorporation in the silage also resulted in increased EE values. Ether extract was highest at 60% level of legumes inclusion with the least obtained in sole millet silage. The levels of minerals (P, Ca, Mg and Zn) recorded no significant change ($P > 0.05$) as levels of legumes increased in the mixtures.

DISCUSSION

Choice of the legumes specie for inclusion in grass silage will depend on its concentration, nutrients and yield per unit area (Muhammad *et al.*, 2008). Mixtures of cereal and legumes are particularly suitable for ensilages.This way the deficiency of protein in cereal crop and low level of carbohydrate in legumes are overcome (Moyo, 1996; Ngongoni *et al*., 2007 and Muhammad *et al*., 2009).

Silage Physical Characteristics

Values were reported by different authors but the recommended pH is 4.2. The pH values obtained were moderate indicating that satisfactory silages were produced. The pH (4.3 to 5.6) values obtained in the represent study are similar to data reported by Titterton *et al.* (2002) and lower than that reported by Muhammad *et al.* (2008, 2009) who recorded (5.3–5.7). Tjandraatmadja *et al*. (1993) recommended pH 4.2 for tropical silages. There was slight increase in pH as the level of inclusion of legumes increased indicating that increase in legumes results in pH shift from acidic approaching neutral. At lower levels of inclusion, the colour produced indicated good silage with acceptable aroma, but at higher levels of legume

Table 5: Effect of Level of Legume Inclusion on Nutrient Composition of *Maiwa* Millet Silage

Level of inclusion	Proximate (%)				Mineral (ppm)			
	DM	**CP**	**CF**	**EE**	**P**	**Ca**	**Mg**	**Zn**
0	94.2^{d}±0.11	9.0^{f}±0.28	29.9^{f}±3.93	2.7^{e}±0.81	94.5^{a}±24.77	17.25^{a}±4.5	81.3^{a}±72.92	21.6^{a}±19.4
10	94.8^{b}±0.06	9.6^{e}±0.18	34.3^{c}± .39	5.2^{d}±1.09	72.6^{a}±7.22	24.1^{a}±3.52	64.6^{a}±30.24	22.9^{a}± .02
20	95.1^{a}±0.06	10.0^{d}±0.23	32.6^{d}± .78	5.2^{d}±1.10	90.9^{a}±13.36	22.1^{a}±1.69	63.0^{a}±30.51	19.7^{a}±8.86
30	94.7^{bc}±0.06	10.4^{c}±0.21	35.6^{a}±1.99	5.2^{d}±0.99	83.4^{a}±12.41	25.0^{a}±2.21	71.3^{a}±38.87	19.2^{a}±8.41
40	94.9^{ab}±0.06	10.9^{ab}±0.33	32.1^{e}± .68	6.6^{c}±1.20	100.5^{a}±15.31	22.3^{a}±3.46	74.2^{a}±34.28	19.2^{a}±8.72
50	94.7^{bc}±0.06	10.5^{ab}±0.34	35.0^{b}± .60	7.2^{b}±1.24	85.7^{a}±12.10	23.6^{a}±3.63	70.9^{a}±32.42	21.6^{a}±9.66
60	94.5^{c}±0.06	11.5^{a}±0.28	34.5^{c}± .59	7.7^{a}±1.27	89.6^{a}±11.04	25.7^{a}±3.48	57.5^{a}±27.72	23.4^{a}±11.2

a,b,c Means with different superscripts along columns differ significantly at ($P<0.05$)
DM = Dry Matter, CP = Crude Protein, CF = Crude Fibre, EE = Ether Extract, P = Pottasium, Ca = Calcium, Mg = Magnesium and Zn = Zinc.

inclusion and stage of growth, the silages produced were dark brown in colour and were putrid.

Nutritional Composition of the Silages

Crude protein (CP) content of the prepared silage was fair (9 – 10.7), this agreed with results reported byMoyo (1996); Kallah *et al.* (1997), Griffith and Burn (2004) and Ngongoni *et al.* (2007) that showed high CP contents of the silages made from forage cut at early growth stages. Silages prepared with Centro had higher CP, CF and EE values. This result agreed with Muhammad *et al*. (2008) who observed the use of legumes (Stylo and Centro) in the improvement of silage quality of Columbus grass. This perhaps suggests that Centro is higher in some component of nutritive value relative to Lablab and Mucuna. Conversely, inherent differences in nutrient composition between and within plant species may be the reason for the observed differences (McDowell *et al*. 1999).

Increase in the level of legumes incorporated in the silages resulted in increased percent crude protein and Ether extract with corresponding decline in crude fibre. Crude protein values realized for the sole *Maiwa*millet silage compared well with the report by Kallah *et al.* (1997) and Muhammad *et al.* (2008) but higher for sole sorghum and lower for sole maize silage (Ngongoni *et al*., 2008). This suggests that inclusion of tropical legumes improved the ensiling quality of *Maiwa*millet silage as earlier reported byAzim *et al.*, (2000), Mthiogene *et al.* (2001), Muhammad *et al*. (2008, 2009).

The CP content of silages in respect of legume additions ranged from 9.6% to 11.7%, which were lower than valuesfor Columbus grass ensiled with Groundnut, Lablab and Centro as reported by Muhammad *et al*. (2008) but higher for Gamba grass ensiled with these legumes (see Muhammad *et al*., 2009). The range in CP value is in agreement with the report of Amodu (2004) who observed that addition of Lablab improved the nutritive value of millet based silages (10.2 – 11.8% CP).

According to Whiteman (1980) a finishing beef steer of 300 to 500 kg live weight requires 11% CP, whereas a 550 kg dairy cow producing 20 kg milk/day will require 15-16% CP. Thus, crude protein concentration of the compounded silage may meet beef requirements but deficient for dairy production.

Mineral Composition

The mineral concentrations determined were lower than the values reported by Amodu (2004) for pearl millet in the sole millet silage. The highest phosphorus level weigh 120 gkg/ha and calcium 30 gkg/ha. Apart from the phosphorus, all other minerals in the compounded silages were below recommended levels forruminant animals although it is in agreement with that of Kaiser and Pitzz (2004) who reported low values in mineral contents for silages prepared for dairy cows.

Calcium which is very important in the nutrition of dairy cattle was inadequate and the phosphorus level was higher than that of calcium.The mineral composition of the silages experimented in this study was adequate for P and Mg but inadequate for Ca and Zn relative to the recommendation of Mc Dowell (1985) for ruminant production in warm climate. Therefore feeding of these silages may require calcium and zinc supplementation.

Effect of stage of growth on silage quality

The growth stage to harvest cereals for silage is a compromise between forage quality and yield. Protein content falls while dry matter yield increases with advancing crop maturity (Griffiths and Burns, 2004). The soft dough stage (80 days post planting) produces forage of 15,340 kg ha^{-1} with yellowish green colour and sweet aroma. The silage had moderate pH value, good CP, CF, EE, P and Ca content. This result is in agreement with result of Black *et al*. (1980), Kallah *et al.* (1997), Ngongoni *et al*. (2007) and Titterton *et al.* (2002). Yield and quality of forage have been found to depend on age of plant at harvest. Leshem *et al*. (2000) studied the effects of three sowing dates on DM yield which were harvested simultaneously. The younger plants resulted in lower DM yield buthigher nutritional value.

Effect of level of inclusion of tropical legumes

It is generally believed that leguminous forages have high buffering capacity which would result in relatively high pH value in silages made from such materials (Uchide and Kitemine, 1987). Legumes are considered superior animal feeds than grasses because of a higher voluntary intake (Thomson *et al.*, 1991). To take advantage of high crude protein concentration, combination of grasses (Millet) and legumes can be ensiled in combination. Increase in level of tropical legumes inclusion in the millet silages resulted in increase in CP, EE and pH levels. The increasing trend observed in CP, EE and pH was in agreement with previous findings in the savannah (Titterton, 1997; Azim *et al*., 2000; Ngongoni, 2008; Mugweni, 2009 and Muhammad, 2009). However, as the level of legume inclusion increased, there was decrease in magnesium content.

Forty percent (40%) legumes inclusion level in the forage ensiled produced silages with yellow greenish colour that has sweet aroma with moderate pH value similar to report byTjandraatmadja *et al.* (1993) and Muhammad *et al. (*2009).

CONCLUSION

The results obtained in this study revealed that harvesting of *Maiwa*millet and lablab at 70 days post planting produces better silage, with moderate pH value. The level of tropical legumes inclusion at 40% gives better quality silage. Lablab combines better with *Maiwa*millet for good quality silage.

RECOMMENDATION

Further investigations should be carried out to include feeding trials.

REFERENCES

Amodu, J.T. and Abubakar, S.A. (2004). Forage Conservation Practices.In: Jerome O. Gefu and Joshua T. Amodueds. Forage Production and Management in Nigeria. A training manual edited by NAPRI, ABU Zaria Nigeria pp. 60 – 65.

Anonymous (1981). FAO Production Yearbook.Volume 38 FAO, Rome, Italy, 296p.

AOAC (Association of official Analytical Chemists), (1984), Official methods of analysis of the Association of Afficial Analytical chemists. Washington D.C. U.S.A. :1094pp.

Ashbell G. Inleinberg, G. and Isey Y. (1997). (Intercessions between Intheer and Vetal during Co-ensiling CinTebrow) Meshel Habahar Velachehev in 272 P. 20-22 Maha.

Azim, A., A. G. Khan, M.A Nadeem., D. Mohammad. (2000). Influence of maize and cowpea intercropping on fodder production and characteristic of silage. Asian Australian Journal of Animal Science, 4(3): 781-784

Azim, A., Khan, A.G., Nadeem, M.A. and Muhammad, D. (2000). Influence of Maize and Cowpea Intercropping on Fodder Production and Characteristics of Silage. *Asian Australas. J. Anim. Sci.*13(6):781-784. DOI: http://dx.doi.org/10.5713/ajas.2000.781

Bishnai, U.K., G.M. Oka and A.L. Fearon (1993). Quantity and quality of forage silage of pearl millet in comparison to Sudan grain and forage sorghum harvested at different growth stages. Journal of Tropical Agriculture (Trinidad) 70: 98-102

Black, J.R., Ely, L.O., Mccullough, M.E., Sudweeks, E.M. (1980). Effect of stage of maturity and silage additives upon the yield and gross and digestible energy in Sorghum Silage; Journal of Animal Science. 50:617-624

Charmley, E. (2000). Toward improved silage quality.A review cent. J. Anim/Sci., 18:157-168.

Griffiths, N.W. and Burns, H. M. (2004). Silage from Pasture and Forage Crops. In: Kaiser, A. G., Piltz, J. Burns H.M. and Griffiths, N.W. (eds) Top fodder Successful Silage Production Manual. Published by Waggawagga Agricultural Institute NSW, Department Primary Industry, Australia, Pp. 75.

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 WaggaWagga Agricultural Institute NSW, Department Primary Industry, Australia pp. 311 – 331.

Kallah, M.S.; Baba, M.; Alawa, J.P.; Mohammed, I. R. andTanko, R.J. (1997). Ensiling Quality of Columbus grass (*Sorghum almum*) grass in Northern Nigeria, *Animal Feed Science and Technology 68:153-163.*

Koon, L.L. (1993) Production of Silurian Silage from Fodder Grass Species for Dry Season Feeding Strategies for Suitable Forage Based Livestock Production in South East, ASIR, Proceedings of the Third Meeting of the Regional Working Group on Grazing and Fed Resources of South East Asia. 31 January – 6 February 1993, Knon rein Thailand Pp 101.

Leshem, Y., Brukental., I. Landaws and Brosh, A. (2000). Forage Crop in Israel. Meshek HabakarVeha Chalau 286, Pp. 27- 31.

McDowell L.R (1985). Nutrient requirement of ruminants in Mcdowell L.R (Eds) Nutrient of Grazing Ruminant in Warm U.K pp. 21-34

McDowell, L.R., Conrad, J.H. Ellis, G.L. and Loosli, J.K. (1999). Minerals for grazing runminants in tropical regions. Bulleting Institute of Food and Agricultural Schience, University of Florida, USA, p.81

Mugweni, B.Z., Titterton M., Maasdorb, B.U., Gendiya. E. (2009). Effect of mixed cereal legumes silages on milk production on lactating Holstein Dairy Cows (R7010).htt://www.journals.elselvierhealth.com/periodicals/anifeearticle/PHSO377840197 816409 4/28/2012.

Moyo, M.T. (1996). Evaluation of the yield, ensiling properties and nutritive value of mixed crops.M.Sc. Thesis, Department of Animal Science, University of Zimbabwe, Harare.

Muhammad, I.R.; Baba, M; Mustapha, A.; Ahmed, M.Y. and Abdul-Rahman, L.S. (2008). Use of legume in the improvement of silage quality of Columbus Grass.Medwell*Research Journal of Animal Sciences* 2 (4): 109-112.

Muhammad, I.R.; Abdu, M.I.; Iyeghe-Erakpotobor, G.T. and Suleiman, K.A. (2009). Ensiling Quality of Gamba Fortified with Tropical Legumes and its Preference by Rabbits. *Research Journal of Applied* Science, 4(1): 20 – 25 . URL: http://www.medwellonline.net.

Mthiogene, D.M.W., I.U. Nawai, M.I.K. Bons (2001). The Nutritional Composition Fermentation characteristic, in Sacco degradation and fungal pathogens dynamics of sugar cane tops ensiled with or without water. Animal Feed Science Technology, 3(4):171-185

Ngongoni, N.T., Mwale M., Mapiye C., Moyo, M.T., Hamudikuwanda, H., and Titterton, M. (2008). Research Note: Inclusion of Lablab in Maize and Sorghum Silage Improves Sheep Performance. Tropical Grasslands. 2: 188 – 192.

Ngongoni, N.T., Mapiye C., Mwale M and Moye M.J. Hamudikuwanda, H. and Titterton. M. (2007). Evaluation of Cereal Legume Inter Cropped Forages for Smallholder Dairy Production in Zimbabwe. Livestock Research for Rural Development 19(9) (In press).

Ovimaps (2012).Ovilocation Map: Oviearth Images. May 4th 2012.

SAS (1999 – 2000). SAS System for Windows, Release 8.02. SAS. Institute, Cary, NC.

Thomson, D.J.; Waldo, P.R.; Goering, H.K .IL and Tyrrel, H.F. (1991). Voluntary Intake, Growth Rate and Tissue Retention by Holstein Steers Fed Formaldehyde and formic Acid Treated alfalfa and Orchard grass – silage. Journal of Animal Science.69(11):4644 – 4659.

Titterton, M., Mhere, O., Maasdorp, B., Ripnist, T., Ashbell, G., Smith, T. and Weinberg (2002). Ensiling of Tropical Forages with Particular Reference to African Livestock Systems. Forage Production and Consumption for dry Season Feeding of Small Holder Dairy Cattle in the Semi Arid Region of Southern Africa. A Paper Presented at the XIII International Silage Congress on 11 – 13 September 2002.

Titterton, M. and Maasdorp, B.V. (1997). Nutritional Improvement of Maize Silage for Dairying: Mixed Crop Silages from Sole and Intercropped Legumes and a Long Season Variety of Maize. 2. Ensilage Animal Feed Science Technology, 69(1)3: 263 - 270.

Tjandraatmadja, M., Macrac, I.C., and Norton B.W. (1993). Digestion by Sheep of Silages Prepared from Mix of Tropical Grasses and Legumes. *Journal of Agricultural Science* Cambridge.Pp 120 – 40.

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 Rhode Grass and Napier Grass Silages. *Journal of Japanese Society of Grassland Science* 32: 369 – 374.