ISSN:2321-1156

International Journal of Innovative Research in Technology & Science(IJIRTS)

SILAGE CHARACTERISTICS AND VOLUNTARY INTAKE OF ENSILED MAIZE RESIDUE- BROWSE PLANTS MIXTURES FED RED SOKOTO GOATS AS DRY SEASON FEEDSTUFFS IN KWARA STATE, NIGERIA

[1*]Ogunbosoye D.O, [2]Odedire J.A and [3]Akinfemi A.

[1]Department of Animal Production, Fisheries and Aquaculture, Kwara State University, Malete, Nigeria,

[2]Department of Animal Sciences, Obafemi Awolowo University, Ile-Ife, Nigeria,

[3]Department of Agric. Technology, Yaba College of Technology, P.M.B 2011, Yaba Lagos, Nigeria

*Corresponding author: olufunflory@ymail.com, Tel: +234-8038262722

Abstract

The work was carried out to evaluate the fermentation characteristics and voluntary intake of silages made directly from the mixture of Parkia biglobosa (PB), Gliricidia sepium (GS), Ficus polita (FP), Prosopis africana (PA) and maize residue (MR). Twenty growing red Sokoto goats were allocated to the silages for acceptability study in four replicates in a completely randomized design. The maize residue was cut immediately after harvesting the cobs green and the material was ensiled with four browse trees in equal proportion. After 45 days of ensiling period, silage samples were opened and analyzed for chemical composition and fermentative characteristics. Crude protein (CP) ranged from 4.3 % (MR) to 18.18 % (GS). Neutral detergent fiber (NDF) varied between 60.5 % and 65.76 % in Parkia-maize residue and maize residue silages respectively. The silages pH ranged between 4.2 and 4.8 with varying levels of yellowish-green colour and sour to vinegar aroma. The taste was pleasant to nice. The silages broke slowly when touched and remain in-destructible. The silages were accepted by red Sokoto goats in the following order: maize residue> Parkia > Ficus spp > Gliricidia while ensiled Prosopis was rejected. Silages from the browse trees mixed with maize residue could be considered a better feed resource for ruminant animals for their high crude protein content and good quality silages against dry season feeding.

Key Words: Ensiled, Browse Trees, Acceptability Study, Fermentation Characteristics

INTRODUCTION

Livestock are important parts of the farming system in Nigeria, particularly for subsistence and commercial farmers. There is a need to improve food security and family income by improving livestock production. Goats for example play a very prominent role in the livelihood of rural populace. Apart from serving as a source of protein, it also provides income for meeting urgent household needs. However, a shortage of affordable feeds of adequate quality and quantity particularly during the dry season is a major setback at improving production. (Ogunbosoye and Babayemi, 2010)

Ruminant animals in the tropics are basically raised on native pastures which are naturally poor in nutritive value and digestibility (Ogunbosoye and Babayemi, 2012). The native grasses mature rapidly and hence the need for feed conservation in the form of silage. Proper nutrition is essential for the health and productivity of all animals and is the basis of successful production systems. A well planned and executed preventive health program cannot overcome problems that are created by poor nutrition. No amount of reproductive technologies can overcome nutritional limitations of reproduction. Therefore, nutrition of any livestock is of paramount importance for successful production. Nutrients have to be supplied to animals in adequate amounts and in forms that the animals will consume.

The preservation of excess pasture during surplus in the form of silage is indispensable, and this allows mitigating the feed deficit that could be encountered during the critical periods. The quality of the silage is, however, dependent on the quality of the crop at ensiling, type of fermentation, rate of pH decrease, moisture content of the crop and anaerobic conditions (Meeske et al., 2000). Silage making in the tropics is paramount if there will be all year round availability of forages for livestock. In the wet season, there is abundance of grass while it becomes scarce in the dry season. Good silage usually preserve well of the original colour of the pasture or any forage (t'Mannetje, 1999). Researchers had been focusing on the conservation of grasses into silage (Du Ponte et al., 1998, t'Mannetje, 1999, van Niekerk et al., 2007) but there is dearth of information on the use of browse plants as silage.

Indigenous browse species are useful sources of animal feeds as these plants remain green during the dry season and provide vegetation with better nutritive value than other annual grass and herbaceous species that become withered. Tree leaves can be rich in crude protein (CP), minerals and digestible nutrients when compared to grass (Aberra et al., 2011). These indigenous multipurpose trees are well adapted and distributed throughout all the ecological zones of Nigeria (Anele et al., 2008). Naturally, indigenous trees have a potential to prevent desertification, mitigating the effects of drought, allowing soil fixation, could enhance the restoration of the vegetation and the recuperation of rangeland. Some of these indigenous MPT species are easily established, have exhibited rapid re-growth after been lopped and with the ability to remain productive under repeated cutting at frequent intervals (Anele et al., 2009).

Maize residue is a left over after the green harvest of maize cobs from the whole maize plant. Moro local Government area is well known for cereal cultivation with maize accounting for greater percentage. Maize residue, if not immediately consumed by ruminant animals, often constitutes a nuisance to the farmers, particularly in the next cropping season.

Voluntary feed intake is an important factor of newly introduced feed in animal feeding. This gives an impression the animal has towards the feed at first introduction without exercising any force. It is a short period of estimating feed value of a newly introduced feed to animals (Babayemi, 2007). Therefore the objective of this study is to evaluate the quality of maize residue-browse plants silage and its voluntary intake by the ruminant animals with a view of mitigating feed scarcity during critical period of the year.

MATERIALS AND METHODS

Study location

The experiment was carried out at the Goat Unit of the Teaching and Research Farm, Kwara State University Malete, Nigeria. The site is located within the southern guinea savannah ecological zone. The annual rainfall is about 1500 mm and occurs from April to November with the dry season between December and March.

Collection of Maize residues and Browse plants

The maize residues were collected from the farm at the Teaching and Research Farm of the College of Agriculture, immediately after harvesting the green maize cobs. The browse plants used were all collected at highway interception of the Shao-Malete route. The forages were collected in October 2014.

Silage preparation

The collected maize residue and browse plants (*Parkia biglobosa*, *Prosopis africana*, *Ficus polita* and *Gliricidia sepium*) were chopped into 2-3 cm to allow for consolidation. The chopped maize residue and browse plants were mixed thoroughly in equal proportions (50-50) for each treatment. A mixture of molasses-water was prepared in ratio 1-3 and sprinkled evenly on the chopped materials and each was ensiled in the polythene bag. The bags were stacked on each other with the heavy metal discs on them to remove as much air as possible before being taped to prevent air from getting into the material and ensiled for 45 days.

Voluntary intake study

Sixteen growing red Sokoto goats were used to evaluate free choice intake of the silages made from the maize residue and browse plants. The animals averagely weighing 12 kg were grouped into four pens capable of housing ten goats each. The pens were cleaned with disinfectant before the animals moved in. They were randomly allotted to the five groups feeds in a completely randomized design. The diets were labeled 1, 2, 3, 4 and 5 (Maize residue with *Parkia biglobosa*, *Gliricidia sepium*, *Ficus polita*, *Prosopis africana* and maize residue only) respectively and each group of animals having 10kg each of all the silages in the wooden feeders. The goats were adapted for 7 days prior to the commencement of the actual data collection. Fresh feed and water were constantly provided between the hours of 8.00 a.m and 12.00 noon daily after which the animals were released for grazing. The consumption was measured daily by computing the difference between the quantity of feed offered and remnants for each day.

Coefficient of preference (COP) was calculated as the ratio of individual silage intake and the average intake of the silages. COP of silage less than unity is not accepted but greater than one is considered acceptable (Ogunbosoye, 2012)

Chemical composition analysis

After 45 days of incubation a sample was taken from each treatment silo for analysis. The samples were analyzed for pH and oven dried. The samples were ground through a 3 mm screen, a Willy hammer mill and analyzed for DM, CP, EE, ash (AOAC 2000). NDF was determined according to the procedure of Van Soest (1991).

Fermentative characteristics

Silage samples were also examined for colour, smell, texture, taste, odour and pH (Chiba et al., 2005).

Statistical analysis

The data obtained were subjected to analysis of variance (ANOVA) techniques using General Linear model procedures of SAS (1994) in a completely randomized design. Treatments means were separated using Duncan Multiple range test of the same package.

RESULTS AND DISCUSSION

Chemical composition of materials before and after ensiling

The chemical composition of the fresh plant materials before they were ensiled is presented in Table 1. There were variations in the nutritional composition of the materials used for the silage. The results revealed that maize residue had the highest dry matter, crude fibre and NDF values but lowest CP. The CP was highest in *Gliricidia sepium* (18.61%) but having lowest contents of NDF (44.84%) and EE (3.25%). There are many factors that could interact together to have cumulative effects on nutritional composition of any plant material such as the age, time of harvest and even plant species (Bamikole et al., 2004). Presented in Table 2 is the chemical composition of silages produced from different browse trees in equal proportion with maize crop residues. It was observed that there was decreased in both CP and NDF contents of the silage materials. The same trends were observed as in Table 1 regarding their nutrients composition. This suggests that the output of silage depends on the materials being ensiled. Jianxin and Jun, (2002) reported the same result. Therefore, in silage making adequate attention must be drawn into the quality of materials to be ensiled so as to have good feeds for the animals. Meanwhile, the nutrient composition of the ensile materials in this study was in corroboration with the work carried out by Phiri et al (2007) using *Leucaena leucoephala* and *Acacia boliviana.* The CP contents of maize residues-browse trees silages (12.62 to 18.81 % DM) were above the minimum required for growth (11.3 % DM) in ruminant animals (ARC, 1984). The lowest CP content of maize residue in this study was expected as it has reached its maturity stage before ensiling. The NDF content of the silages ranged from 43.3% to 65.76% this was within the acceptable levels of 60% to 65% recommended for optimum ruminant animals' performance (Messiner et al., 1991 and Mahanna, 1994).)

Table 1: %Chemical composition of the silage materials

Plant materials	DM	CP	CF	EE	Ash	NDF
Ficus polita (FP)	33.05	14.24	24.23	3.86	7.84	54.82
Parkia biglobosa (PB)	34.26	15.90	29.33	3.95	8.25	61.31
Prosopis africana (PA)	33.14	16.62	17.55	4.02	7.15	52.07
Gliricidia sepium (GS)	31.94	18.61	16.20	3.25	9.14	44.84
Maize residue (MR)	39.48	5.5	40.00	3.45	8.23	66.80

Table 2: Chemical composition of the silages (g/kg DM)

Parameters	Treatments				
	1	2	3	4	5
	50%PB	50%GS	50%FP	50%PA	100% MR
Dry matter (DM)	30.51	30.20	31.00	30.90	33.91
Crude protein (CP)	17.40	18.81	12.62	14.22	4.30
Crude fibre (CF)	22.34	14.40	21.00	16.05	35.45
Ether extract (EE)	3.01	3.30	3.60	3.45	3.20
Ash	9.20	10.30	8.34	8.56	9.64
Neutral Detergent Fibre (NDF)	60.5	43.23	53.87	50.43	65.76

Table 3: Fermentative characteristics of ensiled maize residue- browse plants species mixtures

Parameters	Treatments				
	1	2	3	4	5
	50%PB	50%GS	50%FP	50%PA	100% MR
Colour	Yellowish green	Olive-green	Yellow-green	Light-yellow	Pale Yellow
Smell	Sweet sour	Nice	Pleasant	Pleasant	Pleasant
Taste	Sour	Vinegar	sour	Vinegar	Sour
Touch	Breaks slowly	Separable	Visible	Separable	Break slowly
pH	4.7	4.8	4.7	4.8	4.2

Fermentation characteristics of the silages

The fermentation characteristics of silages were depicted in table 3. These were colour, smell, taste and structure of silages and pH made from parkia, gliricidia, ficus, prosopis and maize residues mixtures. The different yellow colour obtained in this study was expected as this is the colour of good silage. The yellowish green was similar to the original colour of the maize stover and browse tree mixtures before ensiling. Babayemi and Igbekoyi, 2008 and Oduguwa et al., 2007 observed that good silage usually assumes the original colour of the ensiled materials. The observed smell was good and it was actually a typical smell of lactic acid bacteria. This suggests that the maize stover-browse trees silage mixtures produced was well conserved. The sour/vinegar tastes indicates that the quality of the silages was good (Chiba et al., 2005). The pH value of the silage mixtures was desirable and within the range of 4.2-4.8. This was classified to be pH for good silage by Menenses et al. (2007). Structure of the silages was firm and indestructible when squeezing tightly in the hand, implying that there were no viscous or slimy appearances of the material an indication that the silages were well conserved.

Voluntary intake

Table 4 depicted the average daily voluntary dry matter intake and coefficient of preference (COP) of all the silages made from the mixtures of trees and maize residues. There were significant variations in the intake form day 1 to day 7 of the study. Parkia- maize residue mixture and maize residue silages attracted more to the animals from the on-set and this continued till the time the experiment was terminated. Ficus spp was then accepted on the 3rd day and it continued till the end. On the other hand, Gliricidia-maize residue silage was not accepted by goat until the 6th and 7th day. Meanwhile, all through the experiment, Prosopis-maize residue silage was out rightly rejected. The reason for this preference attitude expressed by the goats could be attributed to the fact that goats browse naturally on any ficus species, parkia and maize plants but will not show any willingness to consume Prosopis africana despite its high protein content. Poor acceptability of Gliricidia may be due to the presence of coumarine inherent in it. This anti-nutritional factor makes the trees leaves bitter and so could derive animals away from consuming it. The presence of some photochemical in tree legumes may be one of the reasons Prosopis-maize residue silage was refused by goats. Makkar, 2003; Ben Salem et al., 2005 observed that most tropical browse species used as animal feed contain substantial amounts of phenolic compounds, mainly tannins. The existence of these compounds in the feed could reduce nutrient value and digestibility, as tannins bind to feed proteins thereby making them unavailable to ruminal micro-organisms. Silanikove et al., (1996) also discovered that there is inverse relationship between high condensed tannins (CT) level in forages and their palatability, voluntary intake, digestibility and N retention in ruminants. Although the tannins level of these tree plants was not determined in this present study, but it was reported that the presence of CT at dietary concentrations below appropriately100 g/kg DM in the diet may increase the performance of the ruminant animals (Waghorn et al., 1999). A nonchalant attitude to Gliricidia by goats has been suggested (Babayemi 2007), and may not willingly relish it even on free range.

Based on the results of this study, it could therefore be concluded that browse trees with maize left offer could be fermented and conserved as excellent feed for ruminant animals. Hence, ameliorating feed problem that is often associated with ruminant production during the dry season. This is demonstrated in the acceptability of the silages produced by the animals and could serve as a means of supplying high nutritious feedstuff all the year round.

Table 4: Mean Voluntary intake (kg DM) and coefficient of preference (COP) of maize residue - browse plant silages by red Sokoto goats

	Voluntary feed intake													
	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7	
Silages	MFI	COP	MFI	COP	MFI	COP	MFI	COP	MFI	COP	MFI	COP	MFI	COP
MR-PB	2.1a	1.5a	2.1a	1.6a	1.9a	1.3b	2.0a	1.4a	2.0a	1.5a	1.8a	1.3a	2.0a	1.3a
MR-GS	0.7b	0.5b	0.7c	0.5c	0.6c	0.4c	0.7b	0.5b	1.2b	0.9b	1.2ab	0.8ab	1.4ab	0.9ab
MR-FP	2.0a	1.4a	1.7b	1.2b	2.0b	1.5ab	1.9a	1.4a	1.5ab	1.1ab	1.7a	1.2a	1.6a	1.3a
MR-PA	0.2b	0.1b	0.3d	0.2d	0.5c	0.3c	0.5b	0.4b	0.6c	0.4c	0.7b	0.5b	0.8b	0.5b
MR	2.1a	1.5a	2.0a	1.5a	2.5a	1.7a	1.9a	1.3a	1.5ab	1.1ab	1.6a	1.2a	1.6a	1.1a

abc = Means within the column with the same letters are not significantly different (p>0.05), MFI=Mean feed intake

REFERENCES

[1]. Aberra, M, Workinesh, T and Tegene, N. Effects of feeding *Moringa stenopetala* leaf meal on nutrient intake and growth performance of Rhode Island Red chicks under tropical climate. Tropical and Subtroplcal. Agroecosystem, (2011), 14:485-492.

[2]. Anele, U.Y., Arigbede, O.M., Südekum, K.H., Oni, A.O., Jolaosho, A. O., Olanite, J.A. Adeosun, A.I., Dele, P.A., Ike, K.A. and Akinola, O.B. Seasonal chemical composition, in vitro fermentation and in sacco dry matter degradation of four indigenous multipurpose tree species in Nigeria. Animal Feed Science Technology.(2009), 154:47-57.

[3]. Anele, U.Y., Arigbede, O.M. Olanite, J.A. Adekunle, I.O., Jolaosho, A.O., Onifade O.S. and Oni, A.O. Early growth and seasonal chemical composition of three indigenous multipurpose tree species (MPT); *Moringa oleifera*, *Millettia griffoniana* and *Pterocarpus santalinoides* in Abeokuta, Nigeria Agroforestry System. (2008). 73, 89–98.

[4]. AOAC. Association of Official Analytical Chemist. Official Methods of Analysis. (15th Ed) 2000. Washinting DC, USA.

[5]. ARC (Agricultural Research Council). The Nutrient Requirements of Livestock. Commonwealth Agricultural Bureaux, (1984). Slough, England.

[6]. Babayemi, O.J. *In vitro* fermentation characteristics and acceptability by West African dwarf goats of some dry season forages**.** African Journal of Biotechnology. (2007), 6 (10), pp. 1260-1265.

[7]. Babayemi, O.J. and. Bamikole M.A.Supplementary value of Tephrosia bracteolata, *Tephrosia candida*, *Leucaena* and *Gliricidia sepium* hay for West African dwarf goats kept on range. Journal of. Central European. Agriculture, (2006), 7(2): 323.

[8]. Babayemi, O.J. and. Igbekoyi. J.A . In (Ed: Eric Tielkes), Competition fort resources in a changing world:New drive for rural development. Conference of the International Research on Food Security, Natural Resource Management and Rural Development, (2008), Tropentag, 7th – 9th October, 2008.

[9]. Bamikole, M.A., Ikhatua, U.J., Arigbede, O.M., Babayemi O.J. and Etela. I.. An Evaluation of the Acceptability as forage of some Nutritive and Anti-nutritive Components and the Dry Matter Degradation Profiles of Five Species of Ficus. Tropical Animal Health and Production, (2004), 36; 157-167.

[10]. Ben Salem, H.S.,. Abidi, S. Makkar H.P.S. and Nefzaoui. A . Wood ash treatment, a cost-effective way to deactivate tannins in Acacia cyanophylla I Lindl. foliage and to improve digestion by Barbarine sheep.

[11]. Animal Feed Science Technology. (2005), 123, 93-108. Chiba, S., Chiba, H. & Yagi, M. A guide for silage making and utilization in the tropical regions. A publication of the Japanese Livestock Technology Association, (2005), pp 29.

[12]. Du Ponte, W. M.,. Souza, E. Campbell M. C. and Fukumoto, K. G. Guinea grass (*Panicum maximum*) silage as an alternate roughage source for subsistent dairy production. http://www hawaii. edu/ansc/Proceed/hl/grass.htm Edition. 2200 Wilson Boulevard, Arlington.Virginia (1998). 22201, USA.

[13]. Jianxin, L. and. Jun, GEnsiling crop residues. In (Eds. Tingshuang, G., Sanchez, M. D. and Yu, G. P.) Animal Production Based on Crop Residues – Chinese Experiences. FAO Animal Health and Production Paper, (2002). 149, ISSN 0254-6019, Chapter 4.

[14]. Mahanna, W. Proper management ensures high quality silage grains. Feedstuff . (1994), 10: 12.

[15]. Makkar, H.P.S.. Effects of fate of tannins in ruminant animals, adaptation to tannins and strategies to overcome detrimental effects of feeding tannin-rich feeds. Small Ruminant Research. (2003), 49, 241-256.

[16]. Meeske, R., Cruywagen, C.W., Van der Merwe., G.D and Greyling. J.F. The effect of adding a lactic acid bacterial inoculant to big round-bale oat silage on intake, milk production and milk composition of Jersey cows. South African Journal of Animal Science. (2000). 30: 80-81

[17]. Menesses, M. D., Megias, J., Madrid, A., Martinez-Teruel, F., Hemandez, J. and Oliva, J. Evaluation of the phytosanitary, fermentative and nutritive characteristics of the silage made from crude artichoke (*Cynarascolymus* L.) by-products feeding for ruminants. Small Ruminant Research, (2007). 70: 292-296.North Carolina, USA.

[18]. Meissner, H.H., Viljoen, M.D and Van Nierkeki, W.A. Intake and digestibility by sheep of Anthephora, Panicum, Rhode and Smuts finger grass pastures: Proceeding of the IVth International Rangeland Congress, September1991. Montipellier, France, (1991). pp 648-649.

[19]. Oduguwa, B.O., Jolaosho A.O and. Ayankoso, M.T. Effect of ensiled on physical properties, chemical composition and mineral contents of guinea grass and cassava tops silage. Nigerian

Journal of Animal Production, (2007). 34:100-106.

[20]. Ogunbosoye D.O and Babayemi O.J.. Potential values of some non leguminous browse plants as dry season feed for ruminants in Nigeria. African Journal of Biotechnology, (2010) 9 (18): 2720-2726.

[21]. Ogunbosoye D.O and Babayemi O.J (2012). Assessment of the potential value of twelve browse legume trees using in vitro gas and coefficient of preference techniques. African Journal of Livestock Extension vol. 10, pp 1-9.

[22]. Phiri1 M.S., Ngongoni1, N.T., Maasdorp, B. V., Titterton1, M., Mupangwa J. F. and Sebata. AEnsiling characteristics and feeding value of silage made from browse tree legume-maize mixtures Tropical and Subtropical Agroecosystems, . (2007). 7: 149 – 156.

[23]. SAS (Statistical Analysis Systems) Institute inc. (1994). SAS Guide for personal computers. Cary,Silanikove, N., Gilboa, N., Perevolotsky A. and Nitsan. Z. Goats fed tannin-containing leaves do not exhibit toxic syndromes. Small Rumininant Research. (1996). 21: 195-201.

[24]. Mannetje L.T. Introduction to the conference on silage making in the tropics in Mannetje (Ed).silage making in the tropics with particular emphasis on small holders. FAO. Plant production and protection. (1999). Paper, 161.

[25]. van Niekerk, W.A., Abubeker Hassen., Bechaz F.M and Coertze R.J. Fermentative attributes of wilted *vs*. unwilted *Digitaria eriantha* silage treated with or without molasses at ensiling South African Journal of Animal Science, (2007). 37: 4, 261-268.

[26]. Van Soest, P.J., Robertson J.B and. Lewis, B.A Methods for dietary fibre, neutral detergent fiber and non-starch polysaccharides in relation to animal nutrition. Journal of Dairy Science, (1991). 74: 3583-3597.

[27]. Waghorn, G.C., Reed, J.D. and Ndlovu. L.R. Condensed tannins and herbivore nutrition. Proceeding of the XVIII International Grassland Congress. (1999). 3, Calgary.