Nig. J. Anim. Prod. 2019, 46(5):155 - 162
©Nigerian Society for Animal Production
Nigerian Journal of Animal Production

Assessment of ensiled Pearl millet stover with or without legumes stover for quality and acceptability by West African dwarf goat

*Amuda, A. J.** Falola, O. O. and *Tukura, D. M.
**Department of Animal Production and Health,*
Federal University, Wukari, Taraba State.
***Federal College of Animal Health and Production Technology,*
Ibadan, Nigeria.
Corresponding author: aademolajoseph@gmail.com; +2348039288427

Abstract

This study was conducted to evaluate ensiled millet stover with or without legumes stover for quality and acceptability by West African dwarf goats. The materials (millet stover and legumes stover) were ensiled for 90 days in bag silo. There were five silage treatments: A (100% Pearl Millet stover only), B (80% Pearl Millet stover + 20% Groundnut stover), C (80% Pearl Millet stover + 20% Bambaranut stover), D (80% Pearl Millet stover + 20% Soybean stover), E (80% Pearl Millet stover + 20% Cajan cajanus stover) with four replicates each. Acceptability studies was done using eight (8) female West African dwarf goats of average weight of 8-12kg. Results of physical characteristics of ensiled pearl millet stover with or without legumes produced good quality silages with greenish yellow colour, firm texture and good aroma (fruity and pleasant). Coefficient of preference (CoP) indicates that 100% ensiled pearl millet stover was highly preferred, followed by ensiled pearl millet stover with bambaranut stover by WAD goats with CoP values of 1.08 and 1.02, respectively. However, daily mean consumption (g/day) suggested that with time the goats would get use to other silage types. The CP contents of the silage types ranged significantly (P<0.05) from A silage (11.50%) to D silage (14.08%). The pH, temperature, moisture and DM values were similar (P>0.05) across the treatments. The silage pH and temperature (^{0}C) values however, ranged from 3.70 to 3.83 and 25.75 to 26.75^{o}C, respectively. Moisture content ranged from A silage (63.90%) to E silage (67.28%) and dry matter (DM) from E silage (32.71%) to A silage (36.60%). It was observed that all the silage types preserved well and legumes stover improved CP content of ensiled millet stover significantly. Therefore, the various silage from this study could be used for feeding ruminants, since CP contents were above 7% threshold recommended for ruminants.

Keywords: Pearl Millet stover, legumes stover, acceptability, dwarf goat, crude protein.

Introduction

Inadequate quantity and quality of forages all year- round coupled with high cost of conventional feedstuff especially during the dry season has necessitated the use of crop residues in ruminants feed production. Furthermore, increasing trends of livestock production in Nigeria suggests 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 practised 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. 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 utilised to bridge the gap in feed supply during the dry season. Sorghum (Kalton, 1988) and pearl millet (de Andrade and deAndrade 1982) are excellent for producing silage, particularly in regions with dry spells during the rainy season, pearl millet can produce higher silage yields with higher protein than sorghum. Silage can be used at any time when required especially during the period of shortage and dry season. Pearl millet like other cereal crops is cultivated on large scale-farming in north–central and north–east Nigeria. Preliminary studies indicate that pearl millet forage is more succulent and has higher crude protein (CP) than sorghum or maize with other chemical constituents being comparable (Kichel *et al.,* 1993). Ensiling cereal stover with legumes stover will improve nutritional quality and feed value of the materials ensiled especially the crude protein contents. This will reduce the cost of feeding protein concentrate as supplement in dry season period. As a feedstuff, it is mainly grown to produce hay, silage, green-chop, pasture and stand over feed grazed directly (FAO, 2009). Pearl millet stover is the part of the plant that remains after grain harvest and is a fibrous by-product with a low nutritive value. However, dual purpose (grain and forage) varieties with higher forage quality are being developed in South and West Asia (Alexander *et al.,* 2007). Silage can be made from the stover after the main crop has been harvested (Stewart, 2011). Most these stovers are left wasted on the field but if ensiled could be used for dry season feeding in ruminant animals production. The study was carried out to determine the effect of ensiling pearl millet stover with or without legumes stover on silage physical characteristics, crude protein content and acceptability of ensiled pearl millet stover by West African dwarf goats.

Materials and methods

Experimental site

The study was carried out in Teaching and Research Farm, Federal University Wukari, Taraba State.

Freshly harvested green millet stovers and legumes stovers were collected from Teaching and Research Farm of Federal University Wukari, Taraba state, Nigeria. Harvesting was done in the month of November. Harvested millet stovers and legumes stovers were chopped into 3 – 5cm pieces size (for easy compaction) and wilted under shade for 24 hours on the spread nylon sheet. Four different legumes stovers were used which included groundnut stover, bambaranut stover, soybean stover and cajanus cajan stover. Each legume stover was added at 20% inclusion level of treatment. Five ensiled treatments were produced: A (100% Millet stover only) control, B (80% Pearl Millet Stover+20% Groundnut stover), C (80% Pearl Millet Stover + 20%Bambaranut stover), D (80% Pearl Millet stover + Soybean stover), E (80% Pearl Millet stover + 20% Cajanus cajan stover). All were replicated four times in a completely randomised design. The materials were ensiled in bag silo for a period of 90 days.

Silages were opened after 90 days for silage quality assessment. The temperature of the silage was taken immediately it was opened by inserting a laboratory thermometer inside each sample (silage type) and kept hold for 5 minutes before taken the reading. The physical characteristicts of the silage such as colour, smell and texture were determined using the methods of Bababyemi *et al.* (2009) and Amuda *et al.* (2018). Sub-samples from different points and depths were later taken and mixed for dry matter and moisture content

determination at 110^{0}C. However, the samples for crude protein determination was oven dried at 65^{o}C and milled by 'MG 123' grinder for laboratory analysis.

The pH of the silage was determined by taking 25 g of the ensiled samples from each treatment and were taken to the laboratory, soaked in 100 mLs of distil water in a beakers and allowed for 1 hour agitated for 2 minutes (Babayemi, 2009 and Amuda *et al.,* 2017). pH was read using a pH meter glass electrode was inserted into the beakers containing the samples, and allowed for 10 seconds according to AOAC (2000).

Acceptability study

Experimental animals

Seven West African dwarf (WAD) goats weighing between (8-16kg) were used to evaluate the free choice intake of ensiled millet stover with or without legumes stovers in a cafeteria feed preference study. The five silages (A, B, C, D, E) were introduced on a cafeteria basis to the animals (WAD goat). 1Kg of each silage type was served in five wooden feeders measuring 150cm by 30cm, the position of each feeding trough with the treatments were changed daily to avoid the animals sticking to particular treatment at a particular spot. The goats were allowed to feed for 8 hours daily and for upward of 7 days. The intake was measured by deduction of remnants from the amount of feed offered. The silage preferred was determined using coefficient of preference (CoP) value; provided by Bamikole *et al.,(2004)* as shown below.

Table 1: Physical characteristic of ensiled millet stover with or without legumes stovers

Treatment	Colour	Texture	Odour	Mouldness
A	Greenish yellow	Firm	Fruity	Not mouldy
B	Greenish yellow	Firm	Pleasant	Slightly mouldy
C	Greenish yellow	Firm	Fruity	Not mouldy
D	Greenish yellow	Firm	Pleasant	slightly mouldy
E	Greenish yellow	Firm	Fruity	Not mouldy

A= 100% Millet Stover only, B = 80% Millet Stover + 20% Groundnut Stover
C = 80% Millet Stover + 20% Bambaranut Stover, D = 80% Millet Stover + 20% Soybean Stover, E =80% Millet Stover + 20% Cajanus cajan Stover

Crude protein content, pH, temperature, moisture content and dry matter composition of the silages are presented in Table 2. The CP contents of treatments A, B, C and E were similar except for treatment D (14.08%) was significantly higher ($P<0.05$) compared to treatments E (11.84%) and C (11.95%). The slight increase in CP contents of ensiled pearl millet stover with legumes stover is due to protein contribution from legumes stover. The CP contents obtained in this study were more than 8.0% which according to Norton (2003) should provide ruminal ammonia levels above the minimum required by rumen microorganisms to support optimum growth for maintenance, production and optimum activity. The crude protein and dry matter obtained in this study compared well with those of some tropical grasses and legumes and could be used to replace them in dry season feeding in ruminants. There were no significant differences ($P<0.05$) across the treatments for temperature, pH, moisture and dry matter contents. Temperature is one of the essential factors affecting silage colour and quality. The temperature of fermenting forage varying from 27 – 38^{0}C was presumed to produce excellent silage (Muck, 1996). The temperature range of 25.75 to 26.75^{0}C of millet stover and legumes stover silages was within 25 – 27.5^{0}C obtained by Babayemi (2009) in

silage of Guinea grass fed to WAD sheep. The lower the temperature during ensilage, probably the less will be the colour change (Adesogan and Newman, 2010). Furthermore, in this study, the range values (25.75 – 26.75^{0}C) obtained during fermentation period (90 days) was in agreement with the temperature of 26.5^{0}C reported by Menesses *et al*. (2007) for artichoke by-product ensiled for 50 days.

Generally, pH is one of the simplest and quickest ways of evaluating silage quality. The lower the pH, the better preserved and more stable is the silage (Seglar 2003). However pH may be influenced by the moisture content and the buffering capacity of the original materials. Silage can be classified as good quality depending on its physical characteristics like taste, smell, and colour but more precisely by measuring the pH in the pit. (Chaudhary *et al.,*2012). A pH of 3.5 to 4.2 indicates excellent fresh acidic/sweetish silage, 4.2 to 4.5 for good acidic, 4.5 to 5.0 fair less acidic and above 5.0 for poor pungent/rancid smelling silage (Susan *et al*., 2009). Low pH values obtained for all the silages indicated that lactic acid producing bacteria dominated the fermentation phase. Thus, the silage was well-preserved and stable. Moisture content of the crop at harvest is the most important factor in determining silage quality. If the moisture is too high, the crop will not ensile properly. A moisture level of 60-75% will allow for optimum fermentation (Susan et al., 2009). Similarly, a lower or higher DM content may result in poor silage quality. The DM content affects directly the microbial activity and effluent losses (McDonald, 1991). A low DM content also results in nutrient losses (DM, water soluble carbohydrates and protein) during ensiling (leachates) (McDonald, 2002). A DM content of less than 30% increases the risk of bacterial and fungal spoilage (Johansson, 2011). Furthermore, DM content above 45% difficult the process of forage packing, resulting in high porosity, which may cause losses by the development of aerobic microorganisims resulting in mould silage (Pitt *et al*., 1991). The moisture and DM contents of the silages in the study were similar to the values reported by Amuda *et al.* (2018), but lower than those reported by Binuomote and Babayemi (2010).

Table 2: Crude protein, temperature, pH, moisture and dry matter of ensiled millet stover with or without legumes stover

Parameters	Treatments					
	A	B	C	D	E	SEM
Crude protein	11.50^b	13.00^{ab}	11.95^b	14.08^a	11.84^b	1.52
Temperature (°C)	26.00	26.75	26.00	26.50	25.75	0.41
pH	3.70	t.82	3.81	3.78	3.83	0.05
Moisture (%)	63.90	65.34	64.55	67.28	67.36	1.58
Dry Matter (%)	36.60	34.64	35.45	32.71	32.64	1.73

^{ab} means on the same row with different superscripts are significantly (P<0.05) different.
A= 100% Millet Stover only, B = 80% Millet Stover + 20% Groundnut Stover
C = 80% Millet Stover + 20% Bambaranut Stover, D = 80% Millet Stover + 20% Soybean Stover, E =80% Millet Stover + 20%Cajanus cajan Stover

Presented in Table 3 is the acceptability of ensiled millet stover with or without millet stover by WAD. The CoP varied from 0.936 to 1.080 and DMI/day ranged from 307.59 to 353.37g. Acceptability or free choice intake of a feed connotes the actual response of an animal to a particular feed and the possible visual effects of the feed to the animal (Bamikole *et al.,*2004). Furthermore, coefficient of preference

(CoP) is a direct measure of acceptability and nutritional capabilities of a feedstuff. In recent times, cafeteria techniques have been used to evaluate the acceptability of some forage (Amuda *et al*., 2018 and Amuda and Nuhu 2019). There are many ways of assessing the nutritive value of feeds for ruminants; the direct intake by the animals is the best method. Acceptability study of a feed is a quick assessment of the physical quality of the feed by the animal. It is one of the *in vivo* trials that reveal the actual reaction of animals to a feed. In this study, the mean dry matter and coefficient of preference (CoP) by goats placed on ensiled pearl millet stover with and without legumes stover are indicated. In this study, based on the CoP values of more than unity, silages A and C were preferred compared to other silage types (B, D and E). In order words, control silage and ensiled pearl millet stover with bambaranut stover with CoP ranging above unity were accepted or preferred while the other silages with CoP values of 0.999, 0.968 and 0.939 each were not accepted. There are number of factors that may influence acceptability of feed by small ruminants. Plant physical structure and chemical composition are the most important factors that influence preference (VanSoest, 1994; Babayemi *et al*., 2009). In studies to predict voluntary intake from silage fermentation characteristics, some authors(Steen *et al*., 1998; Wright *et al*., 2000; and Seglar 2003) found moderate correlation between fermentation acids and voluntary intake. Usually, palatability or acceptability, plant physiology and morphology, feed quality, seasonal variation and availability and forage digestibility are some factors that influenced feed intake by an animal (Hanna,1993). However, the dry matter intake of the WAD goats suggest that with time they will accept the other silage types.

Table 3: Dry matter intake and coefficient preference of WAD goat s fed ensiled millet stover

Silage type	Mean daily consumption of animals (g)/DM	CoP	Ranking
A	353.37	1.080	1
B	328.32	0.999	3
C	335.48	1.022	2
D	317.92	0.968	4
E	307.59	0.936	5

A = 100% Millet Stover only (Control), B = 80% Millet Stover + 20% Groundnut Stover
C = 80% Millet Stover + 20% Bambaranut Stover, D = 80% Millet Stover + 20% Soybean Stover, E =80% Millet Stover + 20%Cajanus cajan Stover

Conclusion

The result obtained from this study indicates that all the silage types preserved well and legumes stover improved CP content of ensiled millet stover significantly. Also, ensiled pearl millet stover with and without legumes stover could be fed to goat especially during the dry season when there is less available forage nutrients. Silage from this study could be used for feeding in ruminants production, since CP contents were above 7% threshold recommended for ruminants.

References

Adesogan, A. T. and Newman,Y. C. 2010. Silage Harvesting, Storing and Feeding. SS-AGR-177/AG180: Forage Management (Florida Forage Handbook). Pp.1-7.

Alexander, G., Khan, A. A., Ravi, D., Hash, C. T. and Blümmel, M. 2007. Morphological, chemical and in vitro stover quality traits to predict the livestock productivity potential of pearl millet stover. International Livestock Research Institute (ILRI), Patancheru 502 324, Andhra Pradesh, India. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru 502 324, Andhra Pradesh, India

Amuda, A. J. and Tanko, N. 2019. Physical Properties of Ensiled Maize and Legumes Stover and Acceptability by West African Dwarf goats. *Nigerian Journal of Animal Science and Technology Vol. 2 (1):36 – 44.*

Amuda, A. J., Okunlola, D. O. and Babayemi, O. J. 2018. QualityCharacteristics and Chemical Composition of Ensiled Maize Stover with or without Additives. I. C Okoli, I. P. Ogbuewu, O. O. Emenaldom and B.O.Esonu (Eds). Proceedings of the 43rd Nigerian Society for Animal Production. 18th – 22nd March, 2010 pp.1243 – 1246.

Amuda, A. J., Falola, O. O. and Babayemi, O. J. 2017. Chemical composition of quality Characteristics of ensiled maize stovers. *Federal University Wukari Trends in Science and Technology Journal vol 2.* (1) pp. 195-198.

A.O.A.C. 2000. The official methods of Analysis. Association of Official Analytical Chemist, 16th Edition ,Washinton D.C.pp.69-88.

Babayemi, O. J. 2009. Silage quality, dry matter intake and digestibility by African dwarf Sheep of Guinea grass (Panicum maximum cv ntchisi) harvested at 4 and 12 week regrowths. *African Journal of Biotechnology vol.* 8: 3988-3989.

Babayemi, O. J., Ekokotu, O. A. and Iyang, A. U. 2009. Evaluation of ensiled cassava peels togeher with Albiza saman pods. Umoh,B.I, Udedibe,A.B.I, Solomon,I.R., Obasi,O.L., Okon, B.I. and Udoh.E.J., (Eds). Proceedings of the 34th Nigerian Society for Animal Conference, pp. 547-550

Bamikole, M. A., Ikhatua, U. J., Ajulo, M. T. and Osuji, A. C. 2004. Feed utillisation potential of west African dwarf goats fed different proportions of Ficusthonningii and Panicum maximum. Proceedings of the 29th Annual conference of Nigeria society of animal production, Vol., 29, pp: 336 -340.

Binuomote, R. T., Igbekoyi, A. J. and Babayemi, O. J. 2010. Chemical Composition and *In Vitro* fermentation characteristics of ensiled cassava (*Manihotesculentus,* Crantz) Top and Guinea grass mixture. Babayemi, O.J., Abu, O.A. and Ewuola, E.O. (Eds). Proceedings of the 35th Nigerian Society for Animal Production. 14 – 17th March, 2010 pp. 566 – 568.

Chaudhary, D. P., Ashwani, K., Sapna, S. Mandhania, P. Srivastava and Kumar R. S. 2012. Maize as Fodder. An alternative approach, Directorate of Maize Research, Pusa Campus, New Delhi - 110 012, Technical Bulletin. Pp. 17 – 32.

de Andrade, J. B. and de Andrade, P. 1982. Produca de silagem do

milheto (*Pennisetum americanum* (L.) K. Schum.). *Boletim de Industria Animal* 392:155–165.

Duncan, 1995. Multiple Range F-test.

FAO. 2009. Grassland Index. A searchable catalogue of grass and forage legumes.

Hanna, W. W. 1993. Improving forage quality by breeding. International crop science I. International Crop Science Congress, Ames, Iowa, USA,14–22 July 1992 (Buxton DA, Shibles R, Forsberg RA, Blad BL, Asay KH, Paulsen GM and Wilson RF, eds.). Madison, Wisconsin, USA: Crop Science Society of America. Pp. 671–675.

Kalton, R. R. 1988. Overview of forage sorghums. Pages 1–12 *in* Report of Forty-third Annual Corn and Sorghum Research Conference (Wilkinson W, ed.). American Seed Trade Association Publication 43. Washington, DC, USA: American Seed Trade Association.

Karbo, N. Barnes, P. and Rudat, H. 1993. An evaluation of browse forage preferences by sheep and goat in the Northern savannah zone, Ghana. In: J. Ndikumanaan P. deLeeuw (eds), proceedings of the 2nd African Feed Resource Network (AFRNETA) on sustainable feed production and utilization small holder Livestock enterprises in sub-Saharan African. Harare, Zimbabwe, 107-110.

Kichel, A. N., Miranda, C. H. B. and da Silva, J. M. 1999. Pearl millet (*Pennisetum americanum* L. Leek) as a forage plant. Proceedings of International Pearl Millet Workshop, Planaltina, Brazil, 9–10 June 1999 (FariasNeto AL, Amabile RF, Netto DAM, Yamashita T and Gocho H, eds.) EmbrapaCerrados, Planaltina. Pp. 93–98.

Johansson, S. 2011. Whole-crop maize silage for growing dairy bulls-effects of maturity stage at harvest and feeding strategy. Swedish University, Agricultural Science Department of Animal Envaronment and Health. AZE. Pp.1 – 59.

Kung, L. and Shaver, R. 2002. Interpretation and use of silage fermentation analyses reports. Dept. of animal and food science, University of Delaware Newark, DE 19717. Pp. 1-5.

McDonald, P., Henderson, A. R. and Heron, S. J. E. 1991. The Biochemistry of silage, 2nd Edition, Kingston, U.K., Chakombe Publications. Pp. 340.

McDonald, P., Edwards, R. A., Greenhalgh, J. F. D. 2000. Animal Nutrition.6th Edition. Longman, London and New York: Pp.543.

Menesses, M. D., Megias, J., Madrid, A., Martinez, Teruel, F. Hernandez, J. Oliva 2007. Evaluation of the phytosanitary, Fermentative and nutritive charactistics of the silage made from crude artichoke (*Cynara scolymus* L.) by-product feding for ruminants. *Small Ruminant Research Volume* 70: 292 – 296.

Muck, R. E. 1996. Silage inoculation: In inoculation of Silage and its effects on silage quality, U.S. Dairy Forage Research Centre, Int. Conference with Dairy and Forage industries. Pp. 43–51.

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.

Norton, B.W. 2003. The Nutritive value of tree legumes. In: R.C. Guttering and H.M.Shelton(eds). Forage tree legumes in tropical agriculture. Available from http//www.fanorg/AGP/AGPC/doc/Publicat/Gutt-shel/x5556e0j.htm.

Pitt, R. E., Muck, R. E. and Pickering, N. B. 1991. A model of aerobic fungal growth silage. *Grass and Forage Science, Vol.(46): pp. 301 – 312.*

Seglar, W. J. 2003. Fermentation Analysis and silage quality testing. In Proceedings of the Minnesota Dairy Health Conference, University of Minnesota. Pp. 119 – 135.

Steen, R. W .J., Gordon, F. J., Dawson, L. E. R., Park, R. S., Mayne, C. S., Agnew, R. E., Kilpatrick, D. J. and Porter, M. G. 1998. Factors affecting the intake of grass silage by cattle and prediction of silage intake. *Journal of Animal Science.* 66: 115 – 127.

Stewart, W. M. 2011. Plant Nutrition Today. From Scientific Staff of the International Plant Nutrition Institute (IPNI), Norcross, Georgia.

Van Soest, P. J. 1994. Nutritional Ecology of Ruminats. 2nd Edition. Cornell Universiity Press, USA. Pp. 476.

Wright, D. A., Gordon, F. J., Steen, R. M. I. and Patterson, D. C. 2000. Factors influencing the response intake of silage and animal performance after wilting of grass before ensiling: a review. *Grass for Science*. 55: 1 – 13.

Received: 12th May, 2019
Accepted: 19th December, 2019